REFORM AND EXPERIMENTATION AFTER THE COLD WAR 1989–2001

HISTORY OF ACQUISITION IN THE DEPARTMENT OF DEFENSE
Glen R. Asner, Series Editor

Volume I: Elliott V. Converse III, *Rearming for the Cold War, 1945–1960* (2012)
Volume II: Walter S. Poole, *Adapting to Flexible Response, 1960–1968* (2013)

HISTORY OF ACQUISITION IN THE
DEPARTMENT OF DEFENSE

Volume V

REFORM AND EXPERIMENTATION AFTER THE COLD WAR 1989–2001

Philip L. Shiman
Elliott V. Converse III
Joseph A. Arena

Historical Office
Office of the Secretary of Defense
Washington, D.C. • 2022

Use of ISBN

AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

This is the official U.S. Government edition of this publication and is herein identified to certify its authenticity. Use of 978-0-16-095927-1 is for the U.S. Government Publishing Office editions only. The Superintendent of Documents of the U.S. Government Publishing Office requests that any reprinted edition clearly be labeled a copy of the authentic work with a new ISBN.

Library of Congress Cataloging-in-Publication Data

Names: Shiman, Philip, author. | Converse, Elliott Vanveltner, author. | Arena, Joseph A., 1983– author. | United States. Department of Defense. Historical Office, issuing body.
Title: Reform and experimentation after the Cold War, 1989–2001 / Philip L. Shiman, Elliott V. Converse III, Joseph A. Arena.
Other titles: History of acquisition in the Department of Defense; v. 5.
Description: Washington, D.C.: Historical Office, Office of the Secretary of Defense, 2022. | Series: History of acquisition in the Department of Defense; volume v | Includes bibliographical references and index.
Identifiers: LCCN 2022003931 | ISBN 9780160959271 (cloth)
Subjects: LCSH: United States. Department of Defense—Procurement—History. | United States. Department of Defense—Reorganization—History. | Weapons systems—United States—Case studies. | Research and development contracts, Government—United States—History. | United States—Armed Forces—Procurement—History. | United States—Armed Forces—Weapons systems—History.
Classification: LCC UC263.S455 2022 | DDC 355.62120973—dc23/eng/20220216 | SUDOC D 1.2:H 62/19/V.5
LC record available at https://lccn.loc.gov/2022003931

♾ *The paper used in this publication meets the requirements for permanence established by the American National Standard for Information Sciences "Permanence of Paper for Printed Library Materials" (ANSI Z39.38-1984).*

Contents

LIST OF ILLUSTRATIONS ix
FOREWORD xi
PREFACE xiii
ACKNOWLEDGMENTS xix

I. THE INTERNATIONAL ORDER IN FLUX: FROM THE FALL OF THE BERLIN WALL TO THE 9/11 ATTACKS 1
America's Search for a Post–Cold War Strategy 2
Structuring the Post–Cold War Force 7
Technology and the Search for New Methods of Warfare 14

II. IN PACKARD'S WAKE: THE DEFENSE MANAGEMENT REVIEW, 1989–1990 23
The Quest for Acquisition Reform 23
The Management Review and Report 32
Implementing the Report 37

III. THE FAILURE OF OVERSIGHT AND MANAGEMENT: THE A–12 PROGRAM 53
The New Acquisition Czar 53
The A–12 Fiasco 59
Lessons of the A–12 66
Disciplining the System 71

IV. THE V–22 OSPREY AND THE POLITICS OF THE DEFENSE DRAWDOWN, 1989–1992 85
The Peace Dividend 85
The Fight for the Osprey: Strategy and Tactics 94
The Fight for the Osprey: Cat and Mouse 102
The Fight for the Osprey: Showdown 107

V. ACQUISITION UNDER STRESS: ADAPTING TO WAR AND RETHINKING REFORM, 1990–1993 121
Acquisition for the Persian Gulf War 121
Progress Without Production 131

The "New Approach" to Acquisition 134
Rethinking Acquisition Reform 141

VI. THE CLINTON ADMINISTRATION, CONGRESS, AND ACQUISITION REFORM, 1993–1997 155
Pentagon Acquisition Leadership and Reform Agenda 155
Integrating the Defense and Civilian Industrial Bases 161
Reinventing Government 164
Congress and Reform 168

VII. REFORMERS "REENGINEER" ACQUISITION, 1993–1997 . . . 179
Business Process Reengineering 179
Organizing for Acquisition Reform. 181
Planning Acquisition Reform: Process Action Teams 184
Changing "How We Buy": Integrated Product Teams and Integrated Product and Process Development 186
Changing "What We Buy": Military Specifications and Standards Reform 190
Defense Acquisition Pilot Program 193
The Search for Reform Metrics 194
The JDAM Pilot Program 196
Acquisition Reform Through Clinton's First Term 199

VIII. THE TECHNOLOGY IMPERATIVE 211
The Problem of Technology Transition 212
Advanced Concept Technology Demonstrations. 215
Unmanned Aerial Vehicle ACTDs 223
JAST and the Origins of the F–35 Joint Strike Fighter 233

IX. ACQUISITION AND THE COMPUTER REVOLUTION 251
Defense Department Oversight of Computer Acquisition 252
Difficulties in Hardware and Software Development 262
Command and Control Systems: Requirements 274
Command and Control Systems: Interoperability 281
Simulation-Based Acquisition 284

X. ACQUISITION REFORM, 1997–2001 299
The Fiscal Context of Reform 299
The New Team: Organization and Priorities 303
Reduction of Total Ownership Costs 310
The Section 912 Studies 315
The Rise of Alternative Acquisition Approaches 319
Evolutionary Acquisition Becomes Policy 328

XI. THE AIR FORCE AND ACQUISITION, 1989–2001 345
Acquisition Organization and Management 345
Darleen Druyun and Acquisition Reform 358
The C–17 Globemaster III: A Troubled Program Reverses Course. . . 367

XII. THE ARMY AND ACQUISITION, 1989–2001 391
Organizing for Acquisition 391
Matrix Management 396
Acquisition Reform Organization and Training 399
MILSPEC Reduction and Teaming 402
Continuous Modernization 406
Modernizing Armor 411
"Changing The Way We Change," Force XXI, and the Digitized Battlefield 414
Force XXI Battlefield Command, Brigade and Below 420
Crusader: Acquisition in an Age of Army Transformation 422

XIII. ACQUISITION IN THE NAVY AND MARINE CORPS, 1989–2001 441
Acquisition Organization 441
Reorganizing OPNAV: Integrating the Warfare Communities 447
A–12 Fallout Stimulates Reform: The F/A–18E/F Super Hornet Program . . 451
Navy Acquisition Reform Organization and Initiatives 456
Applying Acquisition Reforms to Aircraft, Ship, and Submarine Programs 459
The Arsenal Ship 468
Acquisition Reform's Mixed Results 472

XIV. RESTRUCTURING THE DEFENSE INDUSTRY, 1989–2001 . . . 491
Decline and Restructuring 491
The Battle Over Industrial Base Policy 497
The Promise and Peril of Dual-Use Technology 503
Merger Mania 510

XV. THE DEFENSE ACQUISITION WORKFORCE, 1989–2001. . . . 525
Defense Acquisition Workforce Improvement Act 525
Implementing DAWIA 529
The Workforce and Acquisition Reform 535
Defining and Downsizing the Acquisition Workforce. 538

XVI. CONCLUSION 551
New Approaches to Developing Innovative Technology 552
Reforming Acquisition Management 554
Innovation in Organizing System Development and Managing Program Costs 556
Reshaping the Relationship between Government and the Defense Industrial Base 558
Increasing the Quality of the Acquisition Workforce 560
Assessing Acquisition in the 1990s: Successes and Shortfalls 561

APPENDIX I: U.S. Forces, FY 1989–FY 2001 565
APPENDIX II: Key Acquisition Officials, 1989–2001 567
LIST OF ABBREVIATIONS. 575
BIBLIOGRAPHY 583
INDEX 617

List of Illustrations

TABLES

1-1:	Base Force and Bottom-Up Review Plans	13
2-1:	Acquisition Categories	42
4-1:	Budget Authority for Future Years Defense Program, FY 1989–FY 1994	86
8-1:	Unmanned Aerial Vehicle Characteristics	230
9-1:	Weapon System Software Size, as of 1999	267
9-2:	Dependence of U.S. Combat Aircraft on Software	267
9-3:	Odds of Successful Program Completion by Software Team Size	273
10-1:	Acquisition Budgets, FY 1993–FY 2001	301
10-2:	Reduction of Total Ownership Cost Pilot Programs	314
14-1:	Top 10 Defense Prime Contractors, FY 1989 and FY 2000	516
15-1:	Acquisition Career Development	530

FIGURES

2-1:	Department of Defense, 1989	24
2-2:	Program Manager's Reporting Chain	30
2-3:	Requirements Generation and Validation: Mission Need Statement	36
2-4:	Acquisition Milestones and Phases, 1991	41
5-1:	Political Atlas of the F–16 Falcon	146
7-1:	OSD Acquisition Organization, May 1994	182
7-2:	Acquisition Milestones and Phases, 1996	189
8-1:	Relationship Between S&T and Acquisition	214
8-2:	RDT&E Budget Categories	214
8-3:	How ACTDs Fit Into the Acquisition Process	217
8-4:	The Tangled Evolution of MR UAV	227
8-5:	Major DARO UAV Programs, April 1994	228
9-1:	Embedded Computers: The Aegis Combat System	254
9-2:	Organization of the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), 1999	261
9-3:	Life-Cycle Mismatch: Integrated Circuits vs. Weapon Systems	266

9-4: The Waterfall Software Development Model 270
9-5: The Basic Spiral Development Model 271
9-6: Evolutionary Acquisition of the Global Command and Control System . . . 279
9-7: Global Command and Control System Development Process 280
10-1: Acquisition Budget Trends, FY 1993–FY 2001 301
10-2: Defense Systems Affordability Council 307
10-3: Life-Cycle Cost Composition for Aircraft 310
10-4: Evolutionary Acquisition vs. Grand Design 320
10-5: Spiral Model for Development in the Department of Defense, 1994 324
10-6: Spiral Development in the Army, ca. 2000 325
10-7: Spiral Development as Applied to the Air Force Expeditionary
Force Experiments 326
10-8: DoD Instruction 5000.02 327
10-9: Average Acquisition Cycle Times for Major Programs 329
10-10: Comparison of 1996 and 2000 Milestones and Phases 333
10-11: Acquisition in the New 5000 Series, 2000–2001 334
11-1: Air Force Acquisition Organization after 1987 347
11-2: Air Force Acquisition Organization after 1992 351
11-3: IWSM Implementation Structure 356
11-4: Air Force Acquisition Reform Logo, 1996 363
12-1: Army Acquisition Reporting Chain, 1986 392
12-2: Army Acquisition Reporting Chain, 1989 394
12-3: 2d Generation FLIR on the M1A2 Abrams Tank 410
12-4: Armored Systems Modernization Family of Vehicles, 1991 412
13-1: Navy Acquisition Budgets, 1985–2001 442
13-2: Navy Secretariat Acquisition Organization, 1989 443
13-3: Navy Acquisition Reporting Chain, 1989 446
13-4: Navy Aircraft Program Reporting Chain, 1990 448
13-5: NAVAIR's Program Management Structure, July 1996 460
14-1: Consolidation in the Defense Industry, 1993–2000 513
15-1: Acquisition Workforce Trends, 1980–2006 542

Foreword

The United States Department of Defense has been among the world's preeminent drivers of technological change since World War II. In collaboration with its federal and private-sector partners, the Defense Department has supported research, development, and the production of new technologies with one main purpose: to provide U.S military forces with superior weapons and equipment to defend the interests of the United States and its allies. The effort to continuously advance the capabilities of weapon systems has been accompanied throughout the decades by a quest to find better methods for making those weapons.

Reform and Experimentation after the Cold War, 1989–2001, captures the history of acquisition during a fertile period for initiatives aimed at enabling the Defense Department to become better at supporting the development and production of new weapon systems. In a context of restrained budgets and optimism for a future free of superpower conflict, defense leaders implemented reforms and experimented with new methods designed to sidestep the hurdles that often led to unacceptable cost increases and schedule delays. The increasing consolidation of responsibility for acquisition oversight and policy in the Office of the Secretary of Defense, combined with pressure from Congress and elsewhere to fully implement the Packard Commission and Goldwater-Nichols reforms of the mid-1980s, gave defense leaders the motivation and influence to carry out several waves of reform over the 12 years of this wide-ranging study. As the authors deftly show, those reforms and experiments met with mixed success. This book shares the histories of those efforts, as well as numerous case studies of major weapon system programs, for future leaders to consider as they continue the pursuit of technological advantage for the U.S. military.

Historians typically rely on troves of well-organized records gathered and archived long after their topic of interest has receded into the past. Dr. Philip L. Shiman, the first author of this volume, did not have that luxury when he began his research in the early 2000s. Instead, for most chapters, he relied to a great extent on published books, articles, and reports, and a large number of unclassified government documents posted to the Internet. Despite these complications, he identified and developed the major themes in defense acquisition during the 1990s. The breadth of his research, the diversity of topics he examined, and the quality of his analysis are impressive.

The list of individuals who helped to shape Dr. Shiman's manuscript includes many accomplished historians, acquisition experts, and former government officials. One scholar deserves special recognition for transforming the draft manuscript into a publishable book: Dr. Elliott V. Converse III, the lead historian for the Defense Acquisition History Project since its inception and author of the first volume in the acquisition history series. At the request of the OSD Historical Office, Dr. Converse assumed responsibility for completing this book, including reorganizing large portions of the manuscript, writing new sections and case studies, gathering photographs, creating tables and charts, compiling appendices, and reviewing and revising each chapter multiple times. Along with Dr. Joseph A. Arena, who wrote several chapter sections and provided insights that significantly improved the volume's characterization of key issues and events, Dr. Converse earned the honor of coauthorship with countless improvements in content and interpretation that transformed a raw manuscript into a book that meets the highest standards of the historical profession.

The final editing and production of the volume provided a unique opportunity for Dr. Converse to team up with Sandra J. Doyle, a highly respected editor of military history books. Ms. Doyle served for 25 years as a senior editor with the Naval History and Heritage Command and has edited several important studies on the Office of the Secretary of Defense since joining the Historical Office in 2014. It was a privilege to witness two experts in prime form moving a major book project through the editing and publication process. The OSD Historical Office is grateful for the skill, dedication, and professionalism of Dr. Converse and Ms. Doyle, and for their numerous contributions to the advance of historical knowledge of the Department of Defense.

Interested government agencies reviewed this volume and cleared it for public release. Although staff and contractors of the OSD Historical Office wrote and prepared the volume for publication, the views contained within it do not represent the official position of the Office of the Secretary of Defense on any subject.

Glen R. Asner
Series Editor

Preface

In the four decades between passage of the National Security Act of 1947 and the beginning of President George H. W. Bush's administration in 1989, the Defense Department's budget totaled $18.3 trillion (in fiscal year 2014 dollars adjusted for inflation). Of this amount, the combined appropriations for research, development, and test and evaluation (RDT&E) and procurement, the two congressional accounts funding weapon acquisition, came to $5.8 trillion, just under 32 percent of the budget during those years. Despite the huge sums spent annually on acquiring weapon systems, in the mid-1980s the Packard Commission concluded that with some exceptions they "take too long and cost too much to produce. Too often, they do not perform as promised or expected." In the 1990s, both President Bush and President William J. "Bill" Clinton made correcting the deficiencies of acquisition programs a high priority. The period's sweeping reforms and experimentation gave rise to new concepts and methods for acquiring the military's weapon systems. This volume focuses on those changes.[1]

The definition of acquisition expanded greatly in the late 1980s. Starting in the early 1960s, and for the next quarter century, it included research and development, test and evaluation, production, and system modification prior to deployment. In September 1987, Department of Defense Directive 5000.1 (Major and Non-Major Defense Acquisition Programs) introduced a much enlarged definition encompassing most of a weapon system's life cycle from conceptualization through development and production to deployment and logistics support. The inclusion of logistics had a significant impact on the acquisition process in the 1990s. Program managers began to take it into account when making decisions related to a system's cost, schedule, and performance. Policymakers also sought to expand opportunities at the front end of the acquisition process to incorporate scientific and technological advances achieved outside of established weapon programs and to more thoroughly assess requirements. Changes in the title of the Defense Department's top acquisition official in the years covered by this volume illustrate acquisition's expanding meaning: from under secretary of defense for acquisition in 1987, to under secretary of defense for acquisition and technology in 1993, and finally to under secretary of defense for acquisition, technology, and logistics in 1999.[2]

This book concentrates on major weapon systems, most classed officially as Major Defense Acquisition Programs, such as aircraft, armored vehicles and artillery, missiles, ships and submarines, and some information technology systems. In 1992 Congress defined these major programs as either designated as such by the secretary of defense or expected to cost $300 million to develop or $1.8 billion to procure, measured in 1990 dollars. Those approximate amounts remained in effect for at least 20 years. The law permitted the secretary of defense to update them to account for inflation.[3]

Understanding how the acquisition process changed in the 1990s requires examining the actions of numerous participants, each with distinctive but overlapping authorities and responsibilities. The Office of the Secretary of Defense, the military services, the defense industry, and Congress were the major actors. In the 1990s OSD established department-wide policy, provided initial program guidance, approved the budgets of the military services, oversaw the acquisition process, and directly managed a small number of key weapon programs. Operating within the statutory framework and OSD policy, the Air Force, Army, Navy, and Marine Corps did most of the work of acquisition. They identified requirements for systems and prepared their performance specifications, initiated and managed programs, awarded and oversaw contracts, conducted research and development, and carried out much of the testing and evaluation. The services also maintained systems throughout their life cycles and trained their users. Private companies working under government contract performed nearly all of a system's design, development, and production. For its part, Congress authorized and appropriated funds for acquisition, monitored individual programs, and legislated wide-ranging changes in acquisition policy, such as the Defense Acquisition Workforce Improvement Act of 1990.

The end of the Cold War heavily influenced acquisition in the 1990s. For decades the East-West conflict had provided a clearly defined security environment. Its termination introduced years of uncertainty with respect to the nature of future threats and the weapons required to meet them. At the same time, the collapse of the Soviet Union and the Warsaw Pact produced demands for a "peace dividend" that resulted in a declining Defense budget. Despite this pressure, defense policymakers, as had their predecessors since World War II, continued to seek advantage over potential enemies through sustained efforts to develop and deploy the most technologically advanced weapon systems. Acquisition reform and experimentation, the major emphases of this volume, promised cost savings and other efficiencies that would make it possible for the nation to maintain its edge in weapons technology.

The defense secretary's office dominated acquisition throughout the decade. Its ascendance resulted in part from efforts proceeding in fits and starts since the 1960s to concentrate more power in OSD against great resistance from, and at the expense of, the military services. In the late 1980s the Defense Department had adopted the reforms recommended by President Ronald Reagan's Blue Ribbon Commission on Defense Management (known as the Packard Commission, after its chairman, former Deputy Secretary of Defense David Packard) and those required by the Goldwater-Nichols Department of Defense Reorganization Act of 1986. Two changes added significantly to OSD's influence, particularly in acquisition: establishment of the post of under secretary of defense for acquisition, which gained responsibility for department-wide acquisition policy and oversight; and creation of a new reporting structure for major weapon system programs, which strengthened civilian control and diminished the influence of the uniformed chains of command. The Bush and Clinton administrations followed the Packard and Goldwater-Nichols examples and further expanded OSD's acquisition authority.[4]

OSD's preeminence also stemmed from its role in formulating and spearheading the extensive acquisition reform program of the 1990s. When the Bush administration took office early in 1989, the Packard and Goldwater-Nichols reforms had not been fully implemented; Secretary of Defense Richard B. "Dick" Cheney intended to complete them. His changes involved mostly organization and oversight responsibilities—who sits where, who does what, and who reports to whom—and an insistence that department officials at all levels follow established acquisition policies and procedures.

OSD's pursuit of acquisition reform continued throughout the Clinton administration's eight years in office. In his first term, Clinton wanted to "reinvent government"—adopting management concepts originating in the private sector to improve the executive branch's productivity. Clinton's first secretary of defense, Leslie "Les" Aspin shared these views and had been a proponent of acquisition reform as chairman of the House Armed Services Committee. William J. "Bill" Perry, who came to the Pentagon in 1993 as deputy secretary of defense and succeeded Aspin as secretary in 1994, also planned to implement a wide-ranging reform program. Perry, like defense secretaries before him, sought to apply the most advanced technologies to weapon development programs and to deploy new systems rapidly. By the 1990s, however, the private sector was developing most leading-edge technologies. To ensure continued Defense Department access to those technologies, Perry steered the department toward forging a new relationship with industry. In place of the traditional "arm's-length" relationship, DoD encouraged government-industry cooperation and teamwork, even partnership. The department also adopted private-sector "best" business practices and increased its purchases of commercial "off-the-shelf" products in lieu of those manufactured to military specifications. To implement the department's acquisition reform program, a senior OSD official headed a new office dedicated solely to formulating, publicizing, and executing reform initiatives. Presuming that change depended on the active participation of the acquisition workforce, Clinton-era reformers paid particular attention to employee management, education, and training.

The military services embraced OSD reform measures. In fact, some reforms had originated in their own experimentation with acquisition practices. Each service formed an acquisition reform office that translated OSD directives into service-specific policies and procedures, publicized reform initiatives, and assisted in developing worker education and training programs.

This book employs case studies to show how acquisition functioned in major weapon system programs. At the beginning of the decade, mismanagement of the Navy's A–12 Avenger II attack aircraft program reaffirmed acquisition reformers' determination to correct the system's deficiencies. The yearslong effort to secure funding for the Marines' V–22 Osprey tiltrotor aircraft reveals the complex political environment in which acquisition took place. Most of the volume's case studies, however, describe the application and impact of acquisition reforms. In several programs—the Navy's F/A–18E/F Super Hornet fighter and *Virginia*-class attack submarine—acquisition reforms proved essential to their success. Or, as in the case of the Air Force's C–17 Globemaster III transport, they contributed significantly to saving a program that was close to failing. In other programs—the Navy's *San Antonio*-class amphibious ship and the Marines' Advanced Amphibious Assault Vehicle (later renamed the Expeditionary Fighting Vehicle)—reforms did not prevent major problems or forestall cancellation. Several case studies illustrate innovative approaches intended to quickly transform new technologies into reliable weapon systems while controlling the costs historically associated with developing advanced systems: the Predator unmanned aerial vehicle (UAV, or drone); the Joint Advanced Strike Technology aircraft program, which evolved into the F–35 Joint Strike Fighter; the Global Command and Control System; and the Army's digitized tactical information sharing system, Force XXI Battlefield Command, Brigade and Below.

The acquisition reform and experimentation initiatives of the late 1980s and the 1990s drew on several long-standing trends: the almost continuous pursuit of advanced weapon systems, the centralization of acquisition management authority in OSD, Congress's push for greater oversight, a belief by public officials that weapon system programs would benefit from adopting private-sector management techniques, and an increasing frustration with programs that fell short of cost, schedule, and performance expectations. The Bush administration came to power with an emphasis on discipline and decentralized execution and a mandate to fully implement the Goldwater-Nichols reforms. The end of the Cold War, the resulting uncertainty about future defense requirements, and the pressure to reduce spending brought these diffuse trends together in a broad program of acquisition reform during the Clinton administration.

Endnotes

1. Office of the Under Secretary of Defense (Comptroller) [DoD Comptroller], *National Defense Budget Estimates for FY 2014* (Washington, DC: DoD, May 2013), table 6-8; President's Blue Ribbon Commission on Defense Management [hereafter Packard Commission], *A Quest For Excellence: Final Report to the President* (Washington, DC: The Commission, Jun 1986), xxii.

2. Department of Defense Directive 5000.1 (Major and Non-Major Defense Acquisition Programs), 1 Sep 1987. Guided by the language in the 1987 DoD directive, the Defense Systems Management College defined acquisition as "the conceptualization, initiation, design, development, test, contracting, production, deployment, and logistics support of weapon and other systems, supplies, or services (including construction) to satisfy DoD needs, intended for use in or support of military missions." See Defense Systems Management College, *Glossary: Defense Acquisition Acronyms and Terms*, ed. Wilbur D. Jones Jr., 4th ed. (Fort Belvoir, VA: Defense Systems Management College, Oct 1989), 1. In contrast, the 1987 edition of the *Glossary* had defined acquisition as "the process for obtaining systems, equipment, or modifications to existing inventory items. In DoD, it includes development (RDT&E) and production (procurement)." See Defense Systems Management College, *Glossary: Defense Acquisition Acronyms and*

Terms, ed. Wilbur D. Jones Jr., 2d rev. (Fort Belvoir, VA: Defense Systems Management College, Jul 1987), 1. For the origins and evolution of the term acquisition, see Elliott V. Converse III, *Rearming for the Cold War, 1945–1960*, vol. 1 of *History of Acquisition in the Department of Defense* (Washington, DC: OSD Historical Office [OSD/HO], 2012), vi–vii.

3. U.S. Congress, *National Defense Authorization Act for Fiscal Year 1993*, 102d Cong., 2d sess., P.L. 102-484 (23 Oct 1992), sec. 817; "Major Defense Acquisition Program (MDAP) Lists," 19 Dec 2000, copy in author files, OSD/HO.

4. U.S. Congress, *Goldwater-Nichols Department of Defense Reorganization Act of 1986*, P.L. 99-433 (1 Oct 1986) (hereafter *Goldwater-Nichols Act*).

Acknowledgments

No book is researched, written, and prepared for publication without the help and support of many talented individuals. The late Jacques Gansler, under secretary of defense for acquisition, technology, and logistics in the second Clinton administration, chartered the series on the history of acquisition in the Department of Defense of which this volume is a part. During the years the U.S. Army Center of Military History directed the acquisition history project, this volume received guidance and personal attention from Jeffrey Clarke, the Army's chief historian, and Richard Stewart, his successor. Members of the project provided ideas, perspective, criticism, and materials for this volume from their own research and writing: David Allen, Glen Asner, Nancy Berlage, Shannon Brown, Andrew Butrica, Joel Davidson, Carolyn Halladay, Thomas Lassman, Walton Moody, and Walter Poole. The acquisition history project also benefited enormously over several years from the knowledge and experience of J. Ronald Fox, a former assistant secretary of the Army responsible for that service's procurement, contracting, and logistics, and an emeritus professor of the Harvard Business School's faculty of Business Administration.

Our greatest debt is to the OSD Historical Office, which took over sponsorship of the series from the Army. The office's chief historian, initially Alfred Goldberg followed by the late Stuart Rochester, and then Erin Mahan, steadfastly supported the project. So did Diane Putney, who filled in briefly after Dr. Rochester's untimely death. Dr. Mahan's backing at a critical time and her ongoing enthusiasm ensured the volume's completion. Glen Asner, the office's deputy chief historian and general editor of the acquisition history series, guided the work of this volume for a decade with skill, patience, and good humor.

The authors greatly benefited from the assistance of a number of skilled historians. Matthew Ambrose conducted research and wrote initial drafts of three weapon system case studies. Peter D'Arpa, Micheal Fasulo, Brian Fennessy, Aaron George, David Hadley, James Helicke, Jessica Shirvanian-Wolfe, Scott Thompson, and Corbin Williamson provided research assistance. Andrew Butrica, Joel Christenson, Larrie Ferreiro, John Glennon, Thomas Lassman, Roger Launius, Erin Mahan, and Richard Stewart reviewed the manuscript, either as a whole or in part, and made

excellent recommendations for changes. Timothy Mehan, Cynthia Minnifield, and Carolyn Thorne helped the authors overcome vexing administrative hurdles.

Former officials and acquisition experts greatly assisted the study by giving oral history interviews, including former Secretary of Defense William Perry, former Under Secretary of Defense Gansler, his immediate predecessor Under Secretary of Defense for Acquisition and Technology Paul Kaminski, Thomas Christie, Gary Christle, Col. Peter Cole, Paul Francis, Col. Bernard Griffard, Maj. Gen. David Gust, David McNicol, Colleen Preston, Frederic Scherer, Maj. Gen. John Slinkard, Franklin Spinney, Robert Stohlman, and Barry Watts. Many of these individuals also supplied important documents, especially Under Secretary Kaminski and Major General Gust.

Other individuals in the broader acquisition and historical communities offered useful advice and information, including Linda Brandt, Paul Alfieri, Larrie Ferreiro, and Evelyn Layton of Defense Acquisition University; Gary Bliss of the Office of the Secretary of Defense; Clifton Chappell of the Defense Logistics Agency; Maj. David King, Maj. Ross McNutt, and Bobby Smart of the Office of the Assistant Secretary of the Air Force for Acquisition; L. Parker Temple of the National Reconnaissance Office; Frances Lussier and Robert "Bill" Thomas of the RAND Corporation; William Schneck of the U.S. Army's Night Vision Laboratory; Susan Wisniewski of Business Executives for National Security; John Smith of the Air Force Historical Studies Office; James Ciborski and Paul Ferguson of the Air Force Materiel Command Office of History; Jeffrey Barlow and Gregory Martin of the Naval History and Heritage Command; and David Leech, Col. Carl Sahlin, Harvey Sapolsky, and James Stevenson. Blair Haworth, David Hogan, and Edgar Raines of the Center of Military History gave their friendship as well as valuable information. Jim Edgar, who helped launch the acquisition history project, shared his knowledge of the origins of the Defense Acquisition Workforce Improvement Act. Sadly, he did not live to see any of the products of his vision.

The tireless staffs of several Washington, D.C. area archives and libraries assisted the authors' research: the Defense Acquisition University Library, Fort Belvoir, Virginia; the Center of Military History Library and Archives, Fort Lesley J. McNair, Washington, D.C.; the National Defense University Library, Fort Lesley J. McNair, Washington, D.C.; the Navy Department Library, Washington Navy Yard, Washington, D.C.; and the Washington National Records Center, Suitland, Maryland (WNRC). The dedicated librarians of the Pentagon Library were dogged in their efforts to find obscure articles and documents. Sandra Lee "Sandy" Meagher facilitated access to the records at the WNRC.

We very much appreciate the efforts of several people who provided photographs for the volume. They include Gordon Blaker and Richard Roadruck of the U.S. Army Artillery Museum, Fort Sill, Oklahoma; Col. James Burton; and Ross McNutt.

Completion of a manuscript is only one stop on the long road to publication; many months of hard work are required to turn it into a book. Sandra Doyle, the OSD Historical Office's skilled and experienced senior editor, managed this process patiently and efficiently. She worked closely with the OSD Graphics and Presentations

Division, particularly with Brenda White, the division's deputy chief, and Amy Bunting, who ably prepared the book's illustrations and designed its layout. Paul Jacobsmeyer of the Defense Office of Prepublication and Security Review coordinated review of the manuscript and cleared it for publication.

While acknowledging the important contributions others have made to this volume, the authors reserve to themselves responsibility for their interpretation of the history of defense acquisition in the 1990s and for any errors these pages may contain.

CHAPTER I

The International Order in Flux: From the Fall of the Berlin Wall to the 9/11 Attacks

In the late 1980s and early 1990s, the global political landscape underwent a breathtaking transformation. When George H. W. Bush took office in January 1989, the United States and its North Atlantic Treaty Organization (NATO) allies were still facing off in Europe against the forces of the Union of Soviet Socialist Republics (USSR) and its Warsaw Pact allies. But on 9 November 1989, the Berlin Wall, for decades the symbol of Communist repression and the Cold War, crumbled. In less than a year most of Eastern Europe broke free of Communist rule and the two Germanys reunited. In February 1991 Warsaw Pact members declared their alliance disbanded, followed 10 months later on Christmas Day, almost unimaginably, by the dissolution of the Soviet Union itself. The East-West confrontation that had dominated the international order and provided an organizing framework for U.S. national security policy for more than 40 years was over. For the next 10 years, the new order that was taking shape offered U.S. planners no strategic guideposts akin to the Cold War's competition. In the absence of clarity regarding the nature of the international order, the period became known as the post–Cold War era. Until Islamic extremists carried out attacks on American soil on the morning of 11 September 2001 and the nation responded with a global war on terrorism, national security policy lacked a sharp focus.[1]

The dozen or so years that witnessed the collapse of the old international framework and the slow emergence of a new, much less orderly arrangement had important consequences for American military policy and strategy. It was a period of uncertainty, disagreements, debates, and a rethinking of approaches to a new world. For the Department of Defense, it meant making adjustments to the decline of traditional threats, diminished budgets, and reduced spending on major weapon systems. Seeking consensus in this uncertain atmosphere, department leaders chose a moderate course based on the experience of the Cold War reinforced by the example of large-scale conventional warfare in the Persian Gulf.

AMERICA'S SEARCH FOR A POST–COLD WAR STRATEGY

The incoming Bush administration was divided over the meaning of signs that the Cold War world was coming to an end. By the end of 1989, the fall of the Berlin Wall, the collapse of Communist regimes in Eastern Europe, and a successful summit with Soviet leader Mikhail S. Gorbachev had persuaded President Bush, Secretary of State James A. Baker, National Security Advisor Brent Scowcroft, and other moderates of Gorbachev's sincerity and the significance of his reforms. Their guarded optimism met strong resistance from administration hardliners, notably Secretary of Defense Dick Cheney. He maintained a pessimistic skepticism of the Soviet Union's intentions, urged caution and firmness in dealing with the Soviets, and opposed any unilateral initiatives or extra concessions during treaty negotiations.[2]

With the Soviet threat receding, but still present, and with the Reagan military buildup having crested years earlier, the Bush administration wrestled with Congress over the Defense budget. Lawmakers pressured the administration to justify its defense proposals with a revised strategy and force structure appropriate for the evolving international situation. A few weeks after entering office, Bush ordered National Security Review 12, a comprehensive reexamination of national defense strategy by various executive departments and agencies. This review accomplished little, producing only "a bland work, full of generalities and truisms, doomed to the dustbin," according to General Colin L. Powell, chairman of the Joint Chiefs of Staff (JCS). At the end of 1989, Cheney initiated a reassessment of defense strategy led by Under Secretary of Defense for Policy Paul D. Wolfowitz and allowed Powell to continue working on a proposal for significant reductions in the force structure.[3]

Cheney eventually endorsed the concepts proposed by the Powell and Wolfowitz reviews, and Bush unveiled the new strategy in outline form in a speech in Aspen, Colorado, on 2 August 1990. The administration fleshed out and codified it a year later in the 1991 *National Security Strategy of the United States*. In that report, the president made clear there would be no return to isolationism in the post–Cold War era. "For America, there can be no retreat from the world's problems," he stated. The new strategy comprised four basic elements: nuclear deterrence, forward presence, crisis response, and reconstitution. It maintained the policy of strategic deterrence against the still-formidable nuclear arsenal of the Soviet Union—and the largest of its successor states, Russia—using strategic nuclear forces, nonstrategic nuclear forces, and missile defense. However, it shifted the focus of conventional forces away from global war toward regional threats and crises. U.S. forces would remain abroad to reassure allies that the United States intended to honor its treaty commitments and remain engaged in world affairs. In the event of regional aggression, these forces would provide the first line of defense, reinforced if necessary by active and reserve "crisis response" forces based in the United States. Finally, although the threat of conventional global war was then quite low, the United States would maintain the capability to "reconstitute" a larger, Cold War–size force able to deter or defeat any competitor.[4]

Secretary of Defense Richard B. Cheney (left) and President George H. W. Bush wave to the crowd during Cheney's swearing-in ceremony at the Pentagon, 21 March 1989. *(DIMOC)*

On 2 August 1990, barely hours before Bush outlined the new regional strategy, Iraqi forces attacked and seized oil-rich Kuwait. For Bush, the response to that attack would be the model for handling such contingencies. With extensive diplomacy and a United Nations (UN) mandate, he organized a coalition of U.S. allies and Arab states. During Operation Desert Shield (7 August 1990–17 January 1991), the U.S.-led coalition steadily built up its forces and developed plans to expel the Iraqis from Kuwait. It went on the offensive on 17 January 1991 (Operation Desert Storm) with a devastating 37-day air campaign. A ground campaign launched on 24 February liberated Kuwait and drove into Iraq in only four days; the coalition declared a cease-fire on 28 February. The decision to halt the advance without seeking to remove Saddam Hussein from power was controversial but followed the UN mandate. The campaign achieved its objectives, and coalition casualties, expected to be in the thousands, included only 190 combat deaths, of which almost a quarter were caused by friendly fire. Desert Storm would have a tremendous impact on American military policy and strategy, as well as on public perception of military operations. Henceforth wars were expected to be brief and, more importantly, cost a minimum of lives.

The victory in the Gulf War and the breakup of the Soviet Union at the end of 1991 made it impossible to deny that the international situation had been transformed for the United States and its allies. General Powell admitted he saw no threats looming on the horizon for at least five years. "I'm running out of demons," he told a reporter. "I'm running out of villains. I'm down to [Fidel] Castro [of Cuba] and Kim Il Sung [of North Korea]." Cheney, too, acknowledged the United States faced no serious global challenger or competitor.[5]

The decreasing likelihood of a superpower conflict after the fall of the Berlin Wall opened the door for greater UN involvement in maintaining a stable international order. Having served as U.S. ambassador to the United Nations in the early 1970s, and remembering how superpower confrontation had paralyzed the Security Council, President Bush was initially wary of the international organization. But as he and Gorbachev formed close personal ties, the confrontational atmosphere dissipated and the Soviet leader began to speak of a "partnership" with the West. The payoff for Bush came in 1990. Gorbachev did not interfere as Bush put together the coalition that, with UN authorization, confronted Saddam Hussein and liberated Kuwait.

Critics had accused Bush of lacking an overarching vision for the emerging post–Cold War world—"this vision thing," he called it. Now, in the midst of the Gulf War crisis, he came up with one. He had long been thinking about the notion of the birth of a "new world," and his ideas came together in a concept he called the "new world order," a phrase borrowed from a speech Gorbachev had made to the United Nations in 1988. Bush believed that henceforth "a new partnership of nations," led by Western democracies in close cooperation with a reformed Soviet Union, would uphold international law and ensure peace and stability collectively. The principles that animated the new world order, as codified in the National Security Strategy of 1991, included active engagement with the world, participation in collective action in pursuit of peace and freedom, and a leadership role for the United States—all in an aggressive pursuit of an expanded view of the national interest.[6]

In addition to U.S. leadership of the coalition against Iraq, Bush promoted his activist vision through increased American involvement in international peacekeeping and humanitarian operations. In 1992 the president instructed Secretary Cheney "to place a new emphasis" on those activities, including training U.S. military units and establishing a permanent peacekeeping curriculum in U.S. military schools. He also offered greater U.S. technical expertise and other assistance to United Nations peacekeepers and declared the need to revise the system for funding international operations. The number of UN peacekeeping missions rose dramatically in the 1990s, from 13 between 1948 and 1988 to 40 between 1988 and 2000.[7]

While Bush supported "robust peacekeeping," he was cautious about involving U.S. troops in combat. In situations that might entail combat, he was guided by the principles on the use of force formulated by former Secretary of Defense Caspar W. Weinberger with advice from General Powell, who became their strongest proponent (thus the principles were often referred to as the Weinberger-Powell or just the Powell Doctrine). This doctrine delineated in a general way the appropriate circumstances that would call for combat troops: when U.S. national interests were involved, when military and political objectives were clear and well defined, when the operation would be conducted wholeheartedly and with determination to win, and when the full support of the American people was assured. Powell added an additional condition—an "exit strategy" in place to ensure that U.S. troops could be extricated without being caught in a quagmire.[8]

Adherring to Weinberger-Powell principles, Bush emphasized that every case was unique and that the determination to use force required judgment. Thus, Bush did not intervene in Bosnia and Herzegovina in the Balkans, where vicious ethnic warfare followed the breakup of Communist Yugoslavia and threatened to destabilize an entire region, because he could not see how combat forces could be used effectively to end the conflict. On the other hand, after the Gulf War he provided humanitarian assistance and protection, first to the Shiites in southern Iraq, then to the Kurds in the north, by enforcing no-fly zones.[9]

United States resolve to engage in peacekeeping operations received a stern test in the East African nation of Somalia. In 1991 the government collapsed, the crops failed, and the country, rife with sectarian and ethnic warfare, fell into anarchy. The UN and nongovernmental organizations (NGOs) began to supply and distribute food as part of the United Nations Operation in Somalia (UNOSOM), but powerful warlords interfered with the distribution by extorting bribes, hijacking convoys, and stealing the food. The Bush administration contributed a military force of 28,000—mostly soldiers and Marines—to an international force of more than 38,000 from nearly 25 nations under American command to secure food distribution and protect relief workers. Bush declared, "Our mission is humanitarian, but we will not tolerate armed gangs ripping off their own people, condemning them to death by starvation. . . . [The] troops have the authority to take whatever military action is necessary to safeguard the lives of our troops and the lives of Somalia's people." The experience of the United States in Somalia, however, demonstrated that not every military action America would undertake in the 1990s would unfold with the decisiveness of the Gulf War.[10]

By 1993 it was apparent that the post–Cold War world was becoming a messier place than most political and military leaders had expected. Ethnic violence had increased, humanitarian disasters had spilled over borders, and some countries, such as Yugoslavia and Somalia, had collapsed into chaos and war. Developing nations that once enjoyed the patronage and support of the superpowers, especially from the Soviet Union, found themselves adrift and threatened by insurgents armed with cheap weapons made by former Warsaw Pact members. The United Nations saw increasing demand for its services, and with the end of the superpower stalemate, the Security Council could act almost without threat of a veto.[11]

Elected in 1992 mainly on domestic concerns, President Bill Clinton continued the national security strategy he had inherited—to be engaged abroad, diplomatically and when necessary militarily, in promoting democracy, preserving stability, and protecting American interests. That strategy also sought to maintain a reduced nuclear deterrent, develop a ballistic missile defense system, respond to terrorism, and prevent the spread of weapons of mass destruction (WMDs).

Inheriting the Somalia mission from its predecessor, the Clinton administration intended to put even greater emphasis on peacekeeping and humanitarian assistance in cooperation with allies and the United Nations. A major obstacle to reestablishing a functioning state in Somalia was Mohamed Aidid, a warlord. A Washington, D.C. newspaper described his operation as "so primitive it fails to make a blip on the screen," and whose "ragtag army" had "no extensive communications network whose signals could be intercepted." With weapons no more sophisticated than AK–47 assault rifles and rocket-propelled grenades (RPGs), Aidid's forces would overwhelm U.S. Army troops and inflict a defeat that influenced American policy for the rest of the decade.[12]

As the Somali warlords, Aidid in particular, became bolder in their attacks on the peacekeepers, what had begun as a humanitarian mission turned into a combat operation. On 5 June 1993, Aidid's militia ambushed and killed 24 Pakistani troops. On 3 October, Task Force Ranger, a small but elite U.S. joint-service special operations force attempted to capture Aidid at his headquarters in Mogadishu. The raid met unexpectedly heavy resistance: two UH–60 Black Hawk helicopters were shot down, several others were damaged, and U.S. personnel were trapped. The aroused population of Mogadishu ambushed an element of a multinational relief force made up of Americans, Pakistanis, and Malaysians. Nonetheless, the relief force rescued all but one of the survivors. (The other, a Black Hawk crew member, was held for a time and then released.) Total U.S. casualties were 19 dead and 91 wounded.[13]

The Clinton administration had approved the operation to capture Aidid, but at the time had not been focused on the situation in Somalia. Other pressing concerns competed for attention, including civil war in the Balkans, the president's desire to reduce the Defense budget, Secretary of Defense Les Aspin's defense posture review, and attempts to find a solution to the problem of gays in the military. Once committed to Aidid's capture, the Clinton team held unrealistic expectations about the capability of military forces to conduct operations in a densely populated city. The result was a disaster that Clinton privately likened to the failed Bay of Pigs invasion of Cuba in the early days of John F. Kennedy's presidency. Aspin resigned under heavy criticism, and the president announced his intention to withdraw U.S. forces in March 1994. The last peacekeepers departed a year later, having failed in their mission to bring peace and stability to the country.[14]

The Battle of Mogadishu had significant consequences for U.S. policy. It dampened considerably the administration's enthusiasm for participating in peacekeeping under UN auspices and made it more cautious about committing combat troops. Subsequently, Clinton resisted intervening in the Rwandan genocide in 1994 and in Bosnia until Serb atrocities turned the conflict into a humanitarian crisis and forced his hand in 1995. Yet the administration did not abandon its activist foreign policy that sought to increase the number of democratic and free-market nations, and it continued to deploy U.S. forces in humanitarian, peacekeeping, and other operations around the world, primarily in Haiti, the former Yugoslavia, and the Persian Gulf.[15]

Although ground forces were not used in most of these deployments, there were a number of combat operations. The fear of quagmires and casualties led the

Clinton administration to favor using aircraft and Tomahawk cruise missiles almost entirely; none of the military campaigns conducted after Somalia involved any significant ground combat. Thus the administration launched missile strikes against Iraq in 1993 in retaliation for an attempted assassination of former President Bush; airstrikes in Bosnia in 1995—the first NATO combat operation in its history—in part to force the Serbs to the negotiating table; missile strikes in 1996 to halt Saddam Hussein's invasion of Iraqi Kurdistan; cruise missile strikes in Afghanistan and Sudan in retaliation for the bombing of U.S. embassies in Africa in 1968; and four days of air and missile strikes in 1998 in conjunction with British aircraft to punish Iraq for its refusal to allow UN inspectors to look for weapons of mass destruction. But these were minor military actions compared with Operation Allied Force, NATO's attack on Serbia in 1999. Intended to stop genocidal "ethnic cleansing" in Kosovo, Allied Force was an extended 78-day air campaign against targets in Serbia and Kosovo that began on 24 March 1999. The Clinton administration, fearing the impact of American casualties on public support for the campaign, insisted from the outset that no ground troops would be used. Despite this limitation, the operation contributed to ending Serbian repression in Kosovo.[16]

STRUCTURING THE POST–COLD WAR FORCE

The uncertain nature of the post–Cold War international order stimulated sharp debate over the Defense budget and the size and structure of the armed forces. The opening of the Berlin Wall had convinced many Americans that the Cold War was indeed over and that the country could collect a peace dividend of reduced military spending, which could be applied to social programs, deficit reduction, or tax cuts. Facing significant budget deficits in the early Bush administration, support in Congress for defense cuts spanned the political spectrum. Brushing aside Cheney's protestations that "the peace dividend is in fact peace," Congress demanded greater reductions for fiscal year (FY) 1991 than the administration was prepared to give; even so, the White House revised its budget estimates for FY 1991. In January 1990, the administration requested $295.1 billion (in "current" or "then-year" dollars) for the Defense Department, representing a 2.5 percent reduction in "real" or "constant" dollars (adjusted for inflation) from FY 1990, with 2 percent annual reductions to follow. Congress wanted greater reductions but could not agree internally or with the administration over how much and where to cut. Ultimately, the prospect of automatic cuts in both defense and domestic spending mandated by the Balanced Budget and Emergency Deficit Control Act of 1985 (usually known as Gramm-Rudman-Hollings, or simply Gramm-Rudman, after its sponsors) forced the White House and Congress to negotiate. The compromise budget agreement enshrined in the Budget Enforcement Act of 1990 set DoD budget authority (money available to be obligated) at $288.3 billion for FY 1991, for a planned real reduction of 8 percent. Ultimately research, development, and test and evaluation spending dropped by 6 percent while the procurement appropriation, which funded production, was cut by 13 percent, by far the largest hit to any of the defense accounts.[17]

The Joint Staff under Colin Powell had devised a plan to preserve U.S. military capabilities in an austere environment for defense spending. The JCS chairman proposed reducing the Cold War force by 25 percent, a figure he considered workable and hoped would preempt Congress from imposing greater cuts. He called his plan the Base Force to emphasize that it represented what he believed to be the minimum force necessary to protect the nation's security—it was to be a floor, not a ceiling. By 1995 the Base Force was to number 1.65 million personnel, with a force structure of 12 active Army divisions, 452 ships (including 13 aircraft carriers), 13 active Navy and 3 active Marine Corps aircraft wings, and 15 active Air Force fighter wings. It called for proportional cuts in the National Guard and the Reserves. The Base Force would also slim down all three legs of the strategic triad, cutting ballistic missile submarines, heavy bombers, and land-based ICBMs.[18]

The administration's claim that the Base Force had been carefully constructed to meet the country's evolving military needs was debatable. Powell later acknowledged that the 1991 Defense budget lacked an overarching strategic vision and allocated cuts to the services equally, leaving each branch to decide what to do with a reduced budget. Admiral William A. Owens, Cheney's military assistant in 1989–1990 and later JCS vice chairman, subsequently noted that Powell had no formal means for discussing changes that would have affected the existing force structure and budgetary

General Colin L. Powell, chairman of the Joint Chiefs of Staff, gives a speech during the 50th Anniversary celebration of the Pentagon, 12 May 1993. *(NARA)* balance among the military services. Each of them would have fought any attempt to cut its budget disproportionately to the others. While the Base Force made no radical changes in the nature and balance of the force structure—other than to make it smaller—the services resisted making any cuts whatsoever. The Goldwater-Nichols Act of 1986, however, did not require the chairman to obtain the concurrence of the service chiefs when making decisions, and although Powell tried hard to obtain their acceptance, he presented the plan to the civilian leadership without it. The chiefs eventually did come around.[19]

Victory in the Gulf War and the dissolution of the Soviet Union made the cuts proposed by the Base Force appear to be too modest to meet congressional demands for a peace dividend. In response, the administration made significant changes to its strategic posture, including taking the heavy bomber force off ground alert (nuclear armed and able to take off within 15 minutes), deactivating almost half of the ICBM force, and curtailing or canceling several strategic weapon systems then under development, including the stealth B–2 Spirit bomber. The Defense Department also proposed curtailing, restructuring, or canceling a number of conventional system programs, including the V–22 Osprey tiltrotor aircraft, the second and third boats in the *Seawolf*-class of nuclear-powered attack submarines, and a follow-on to the M1 Abrams tank. Much to the consternation of major defense contractors, the department announced a new acquisition policy that emphasized research and development at the expense of production, which was to be cut back sharply. With few threats on the horizon and an inventory bulging with weapons unlikely to be used in the foreseeable future, there seemed to be little urgency to field new systems. The new policy focused on developing advanced technologies and reducing technical and financial risk, with production approved only in exceptional circumstances.[20]

Despite proposed program cuts, the administration offered a relatively small decrease in defense spending—$50 billion over six years, or 4 percent per year in real terms—and did not reduce the planned force structure, even though the Base Force had been designed to deal with an ongoing, albeit much reduced, Soviet threat. Cheney warned that cutting the armed services too much and too fast would cause serious damage that would jeopardize their ability to perform as well as they had in the Gulf War. The *National Military Strategy of the United States* issued by Powell and the Joint Staff in January 1992 echoed the call for a robust and capable force. The strategy highlighted the problem of uncertainty: "The real threat we now face is the threat of the unknown, the uncertain," the document stated. Nonetheless, the administration's shifting rationale for the Base Force and its difficulty in justifying it on the basis of defined requirements made the plan a target for attack.[21]

One of the most influential and outspoken critics of the Base Force was then-Representative Aspin (D-WI), the chairman of the House Armed Services Committee. Aspin believed Powell's approach to planning the Base Force, known as "capabilities-based planning"—in which the military sought to define the capabilities it considered necessary for the tasks it might be called on to perform—provided no real guide for determining what forces were necessary and led to arbitrary, “top-down” force reductions that merely produced a smaller version of the Cold War military. Aspin instead advocated a “threat-based” methodology that measured the military’s force size, structure, and weapon requirements against specific existing or foreseeable threats. Once the threats had been defined, the force could then be redesigned from the “bottom-up” to deal with them. Aspin’s methodology, however, encountered problems similar to Powell’s proposed Base Force. Given the prevailing climate of strategic uncertainty, a bottom-up review would still be a difficult undertaking. Military requirements depended to a large degree on political decisions about how and when to use military force and how much operational risk to accept.[22]

When Aspin became President Clinton’s first secretary of defense in January 1993, he had the opportunity to put the threat-based methodology into practice. One of Aspin’s first assignments was to prepare the FY 1994 Defense budget. Focused on domestic issues, Clinton believed a greater peace dividend could be squeezed out of that budget. As a candidate during the 1992 presidential campaign, he had pledged to reduce defense spending by an additional $60 billion over four years, or 5 percent. The Defense budget the White House submitted in March 1993 cut $88 billion of budget authority during fiscal years 1994–1998 from the spending plan the Bush administration had submitted before leaving office in January.

Clinton requested and received about $251 billion for the Department of Defense in FY 1994, which represented a real cut of almost 8 percent from the previous year. The heaviest blow again fell on the procurement appropriation, down

President Bill Clinton arrives at Admiral’s Landing, Hawaii, along with Secretary of Defense Les Aspin (left) and Admiral Charles R. Larson, commander in chief, U.S. Pacific Command, July 1993. *(NARA)* almost 18 percent in real terms—this after cuts averaging 15.5 percent to those accounts in each of the preceding three years. The procurement budget by FY 1994 amounted to just half of what it had been in 1990. The budget request also emphasized readiness at the expense of force structure, cutting 2 additional Army divisions, 27 Navy ships (including 2 aircraft carriers), and 3 active and reserve Air Force fighter wing equivalents from the planned Base Force level for 1994. Despite the heavy cut in procurement spending, the budget avoided choosing among competing weapon programs and did not cancel any. In fact, it restored some the Bush administration had wanted to eliminate, such as the *Seawolf*-class submarines and the V–22 Osprey. Aspin himself acknowledged that in terms of weapons acquisition DoD was merely "treading water" rather than pursuing a vision.[23]

The vision would have to wait for the results of a complete defense policy review, performed "from the bottom up," that Aspin launched in spring 1993. Directed by Under Secretary of Defense for Acquisition John M. Deutch, the Bottom-Up Review, in theory at least, was not "budget-driven." That is, it would propose a force structure and weapons acquisition plan according to the country's strategic needs and not just the resources available. The strategic assumptions were largely those inherited from the Bush administration. Aggressive regional powers represented the greatest threat to international stability and therefore their capabilities should determine the size, force structure, and equipment of the U.S. armed forces. The review studied scenarios for Northeast Asia (Korean Peninsula) and Southwest Asia (Persian Gulf), the most likely locations for major regional contingencies in the foreseeable future. Each scenario involved an aggressor nation invading a neighbor with a large force that included modern aircraft and armor—exactly the way Iraq had overrun Kuwait and threatened Saudi Arabia. Using the threat-based approach, analysts determined a minimum force that could halt the invaders and launch a successful counterstroke. It constituted 4 or 5 Army divisions, 4 or 5 Marine expeditionary brigades, 10 Air Force fighter wings and 100 heavy bombers, 4 or 5 aircraft carriers with their escorts, and special operations forces.[24]

The Bottom-Up Review analysts then used this force as a base for building four, force size and structure options, each associated with a certain level of capability and risk. These capabilities ranged from the ability to fight and win only a single major regional conflict (MRC) to being able to prevail in two MRCs and conduct another, smaller operation, all nearly simultaneously. The review chose an option between the two—the capability to fight and win two major regional wars at the same time. Thus, the Bottom-Up Review, released on 1 September 1993, established a force size and structure for two major regional contingencies. This involved a significant but hardly radical reduction from the Base Force (see table 1-1). To compensate for the smaller projected force, the Bottom-Up Review called for "force enhancements," including improved high-technology weapons and more airlift and sealift prepositioned weapon stockpiles to reduce transportation requirements.[25]

Within a few months of the review's release, there was widespread displeasure with its conclusions. Supporters of a restrained foreign policy and fiscal conservatives argued that the review had used unrealistic planning scenarios, leading to inflated requirements that justified an excessively large and expensive force. Hawks complained the Bottom-Up Review had been driven by fiscal constraints imposed by the administration's domestic spending priorities—leading to an underfunded force and an inadequate procurement program. From this perspective, the allotted forces were insufficient to fight two conflicts at the same time. Or, as officers on the Joint Staff joked at the time, "Two major regional wars are doable, but I want to be in the first one."[26]

From the mid-1990s on, the pace, number, and extent of U.S. military operations became a concern as the armed forces shrank in accordance with the plan laid out in the Bottom-Up Review. (From the 1980s to the 1990s, military "response days" had increased from 17,382 to 66,930.) By 1997 the Army was down to 10 active divisions, the Navy to 354 battle force ships, and the Air Force to 52 active squadrons. The total number of active-duty personnel fell to under 1.4 million in 1999, a 36 percent drop from the high of 2.2 million in 1987. (See Appendix I, Table: U.S. Forces, FY 1989–FY 2001.) The budget, too, continued to fall during the mid-1990s, finally bottoming out in real terms in 1998, at $258.5 billion. According to DoD's own figures, the 1998 budget was still higher in real terms than it had been in 1975 during the Cold War. Defense spending did increase in 1999 for the first time in 14 years, a trend that continued in subsequent years, but public apathy over defense issues, political turmoil in both parties, and the quest for a balanced budget all contributed to keeping those increases modest.[27]

By 1997 dissatisfaction with the military posture established by the Bottom-Up Review, a downsized version of the Cold War force, had grown. To replace it, organizations and individuals with differing visions of the future of warfare promoted a variety of alternative warfighting theories and weapon systems. Those who feared enemies might attack with ballistic missiles armed with nuclear, biological, or chemical warheads called for developing and deploying defenses against those systems. Airpower proponents, convinced that the air campaign had won the Gulf War and that airpower would dominate wars of the future, maintained the Air Force was not being given the priority it deserved in either the budget or joint warfighting doctrine. Proponents of alternative warfighting theories decried the emphasis on heavy, ponderous military organizations and weapon systems in favor of more decentralized and agile forces. Other strategists, focused on peacekeeping and the so-called military operations other than war, criticized the Bottom-Up Review's almost exclusive emphasis on major conventional wars.[28]

Table 1-1: Base Force and Bottom-Up Review Plans

	FORCES FY 90	BASE FORCE FY 95 (FEB 92)	BOTTOM-UP REVIEW, FY 99 (OCT 93)
ARMY			
Divisions	18 active 10 reserve[1]	12 active 6 reserve	10 active 5+ reserve
NAVY			
Battle Force Ships	547	452	346
Aircraft Carriers[2]	16	13	12
Carrier Air Wings	13 active 2 reserve	11 active 2 reserve	10 active 1 reserve
MARINE CORPS			
Divisions[3]	3 active 1 reserve	3 active 1 reserve	3 active 1 reserve
Aircraft Wings	3 active 1 reserve	3 active 1 reserve	3 active 1 reserve
AIR FORCE			
Fighter Wings	24 active 12 reserve	15 active 11 reserve	13 active 7 reserve
STRATEGIC FORCES[4]			
Ballistic Missile Submarines	33	23	18
Heavy Bombers	268	181	114
Land-based ICBMs	1,000	500	500
PERSONNEL			
Active Military	2.07 million	1.65 million	1.4 million

[1] Reserve includes the National Guard.

[2] Includes one training carrier.

[3] Although retaining its three active and one reserve divisions, Marine Corps active strength was to decline from 197,000 personnel in FY 90 to 159,000 under the Base Force but only to 174,000 under the Bottom-Up Review.

[4] Strategic force levels were to be set by the Strategic Arms Reduction Treaty (START) of 31 July 1991 and START II (signed 3 January 1993 but never went into effect).

Sources: Secretary of Defense Dick Cheney, *Annual Report to the President and the Congress*, Feb 1992, 25; Lorna S. Jaffe, *The Development of the Base Force, 1989–1992* (Washington, DC: Office of the Chairman of the Joint Chiefs of Staff, Joint History Office, Jul 1993), 15, 34, 38, 44; Table 8 (Department of Defense Active Duty Personnel Levels, FY 1950–2000), in Stephen Daggett and Amy Belasco, *Defense Budget for FY 2003: Data Summary*, CRS Report RL31349 (Washington, DC: Congressional Research Service, 29 Mar 2002); Les Aspin, *Report on the Bottom-Up Review* (Washington, DC: DoD, Oct 1993), 26, 28, 30, 54, 82.

TECHNOLOGY AND THE SEARCH FOR NEW METHODS OF WARFARE

Most dissatisfied with the Bottom-Up Review were those who proclaimed that a "revolution in military affairs" (RMA) was underway and that the United States should reorganize and reequip its military to take advantage of the opportunities it offered. The RMA meant different things to different people, but it generally held that technologies, especially those dealing with information such as advanced computers, sensors, and data networks, made possible new capabilities that would radically change how wars would be fought and won. These included a greater ability to locate and track friendly and enemy forces on the battlefield; the transmission of surveillance imagery, targeting data, and other high-bandwidth information in real time; the rapid processing of that data; and the capability to guide munitions precisely to their targets. RMA advocates claimed that together these capabilities would do more than enable U.S. forces to operate better; they would create synergies that would change the fundamental nature of those operations. For example, smaller forces could operate at a faster tempo to defeat a larger, slower enemy force quickly and efficiently, with fewer casualties on both sides.[29]

Many considered the RMA's central component to be the "reconnaissance-strike complex," also known as "precision engagement" or, more colloquially, "sensor-to-shooter." In this concept, sensors mounted on ships, manned or unmanned aircraft, satellites, or other surveillance platforms would locate enemy ground, sea, or air forces and relay the information to a central command and control facility. In turn, this facility would quickly—and perhaps automatically—identify potential targets and assign the most appropriate available weapons, whether a Navy cruise missile, Air Force bomber, or Army artillery system. The weapons selected would then quickly engage and destroy the target. Eventually, it was hoped that all of the disparate, geographically dispersed elements of a single-service or joint task force would link together seamlessly under an overarching information grid to operate as a coordinated whole and even as a single unified weapon system, an approach known as "network-centric warfare."[30]

Secretary of Defense William J. Perry. After serving as deputy secretary of defense for nearly a year, Perry became secretary on 3 February 1994. *(DoD)*

The revolution in military affairs of the 1990s was a continuation of a key element of U.S. national security policy and strategy in place since the onset of the Cold War: reliance on technologically superior weapons to neutralize the numerical advantages in equipment and personnel possessed by Communist adversaries. Its most recent formal manifestation had been the Carter administration's "offset strategy," which depended on high-technology systems to counter the Warsaw Pact's superiority in numbers.[31] William Perry, then the under secretary of defense for research and engineering and the offset strategy's chief architect, would argue shortly after the Gulf War that the coalition's success was due to the combined effects of three classes of technologies: command, control, communications, and intelligence (C3I); the suppression of enemy air defenses, which depended heavily on stealth technology; and precision-guided munitions. What made each component more effective was the "synergy" that occurred when they worked together, an interaction that Perry, borrowing a term from the field of systems engineering, described as a "system of systems."[32]

The RMA concept received a powerful boost when Perry returned to the Pentagon as deputy secretary of defense in 1993. In September he launched the Department of Defense Revolution in Military Affairs Initiative, led by a senior steering group chaired by John Deutch, the acquisition under secretary. Aided by five task forces, the group's mission was to define the most plausible defense environment for the years 2010 to 2015, identify the most promising technologies and operational concepts, and then run war games to test conclusions. Much of the work of devising and implementing RMA-related changes fell to the services and the Joint Staff. Admiral Owens's appointment as JCS vice chairman in January 1994 was especially important. Owens, the most energetic uniformed proponent of the RMA, found an ally on the Joint Staff in Vice Adm. Arthur K. Cebrowski, a fellow "revolutionary" strategically placed as the JCS director of Command, Control, Communications and Computer Systems (J-6).[33]

Admiral William A. Owens, vice chairman of the Joint Chiefs of Staff, 1994–1996. *(NARA)*

Owens's tool for change was the Joint Requirements Oversight Council (JROC), which he chaired. Consisting of the service vice chiefs, the council approved the services' requirements for weapon programs. Traditionally the JROC, established in 1984 to reduce conflict among the services over joint weapon programs, had rubberstamped the services' requests. With support from the Office of the Secretary of Defense and that of General John M. D. Shalikashvili, Powell's successor as JCS chairman, Owens revamped the procedures for considering those requirements, forcing the members to combine their resources, consider joint needs, and promote systems furthering the revolution in military affairs, such as unmanned aerial vehicles. Shalikashvili and Owens instituted the Chairman's Program Assessment, which allowed the JCS chairman direct input to DoD's budget process. Owens also adopted the phrase system of systems and made it into a construct for shaping requirements generation and acquisition decisions: New systems had to fit into the system of systems construct to be acceptable.[34]

Simultaneously, the services were exploring how to adapt RMA systems and concepts to meet their specific warfighting needs. In the Army, General Gordon R. Sullivan, the chief of staff, and General Frederick M. Franks Jr., head of the service's Training and Doctrine Command, had embraced the RMA early on. They believed that in the future the Army would rely on more agile forces organized to fight in a flatter, less hierarchical structure connected by data links, an early version of network-centric warfare. Soon after assuming their posts in 1991, they explored ways to implement changes in the Army's doctrine, organization, and planning to support that vision. The Marine Corps Warfighting Laboratory's Sea Dragon experiment studied the use of small, widely dispersed teams that operated virtually independently of each other, maneuvering and calling in fire on enemy forces they encountered. The Navy proposed an "arsenal ship," a floating missile battery that received target assignments from the rest of the fleet through communications links.[35]

In July 1996 General Shalikashvili issued *Joint Vision 2010*, the revolutionaries' template for warfare in the 21st century. Advanced sensors on a variety of platforms, integrated through high-bandwidth networks, would provide commanders with "dominant battlespace awareness," a more complete picture of the battlespace than had ever been achieved. By integrating all of the platforms, weapons, and equipment, the joint task forces could achieve "massed effects" without physically massing forces. The services, resentful of the attack on their autonomy and traditional prerogatives regarding weapon system acquisition, resisted the JROC reforms. All four service chiefs had written to Shalikashvili demanding he rein in his vice chairman.[36]

As the budget continued to fall and furious debates took place within the Pentagon, in 1997, at congressional direction, the Defense Department conducted another strategy review—the first Quadrennial Defense Review (QDR). It proved to be a disappointment to RMA advocates and other critics of the Pentagon status quo in Congress and elsewhere. Whereas the Bottom-Up Review disappointed some because of the decisions it made, the QDR came under fire for the decisions it *did not* make. It continued on the course set by the Bottom-Up Review and did not recommend any major changes in weapon programs or the force structure.[37]

* * * * *

In dramatically altering the international political framework, the end of the Cold War brought reduced defense spending and demands to downsize and reshape U.S. armed forces. Although recognizing the emergence of new threats to security such as terrorism or the collapse of order in nation states torn apart by ethnic and sectarian violence, defense policymakers throughout much of the 1990s, based on the example of the Gulf War, continued to believe large-scale conventional conflict with regional powers would present the most dangerous threat. Thus acquisition remained focused on the systems—most developed for the Cold War—that had brought victory against Saddam Hussein. At the same time, others in the defense establishment argued that a revolution in military affairs, based largely on information technologies, was transforming warfare and that U.S. forces should be organized and equipped to reflect this transformation. But these views took hold slowly. For the most part, acquisition adhered to traditional weapon systems. Such a characterization, however, did not apply to acquisition organizations and processes. The decade witnessed wide-ranging reforms and experimentation in those areas, beginning with the Bush administration's determination to implement fully the changes recommended by the Packard Commission and those directed by the Goldwater-Nichols Act.

Endnotes

1. For general accounts of the end of the Cold War, see Michael R. Beschloss and Strobe Talbott, *At the Highest Levels: The Inside Story of the End of the Cold War* (Boston: Little, Brown, 1993); John Lewis Gaddis, *The Cold War: A New History* (New York: Penguin Books, 2007); Hal Brands, *From Berlin to Baghdad: America's Search for Purpose in the Post–Cold War World* (Lexington: University Press of Kentucky, 2008); Derek Chollet and James Goldgeier, *America Between the Wars: From 11/9 to 9/11: The Misunderstood Years Between the Fall of the Berlin Wall and the Start of the War on Terror* (New York: Public Affairs, 2008); Mary E. Sarotte, *1989: The Struggle to Create Post–Cold War Europe* (Princeton, NJ: Princeton University Press, 2009); Robert Service, *The End of the Cold War, 1985–1991* (New York: Public Affairs, 2015).

2. George Bush and Brent Scowcroft, *A World Transformed* (New York: Alfred A. Knopf, 1998), passim; Beschloss and Talbott, *At the Highest Levels*, passim; Stanley R. Sloan, *The U.S. Role in a New World Order: Prospects for George Bush's Global Vision*, CRS Report 91-294 RCO (Washington, DC: Congressional Research Service [CRS], 28 Mar 1991), 7–9; Gaddis, *Cold War*, 239; Colin Powell, with Joseph E. Persico, *My American Journey* (New York: Random House, 1995), 439.

3. Gaddis, *Cold War*, 239–240; memo, Bush for the Vice President et al., 3 Mar 1989, National Security Review 12, subj: Review of National Defense Strategy, copy in author files, OSD/HO; Powell, *American Journey*, 437 (quote), 439; Barbara Amouyal and Myron Struck, "Cheney Orders Reassessment of DoD Strategy, Weapon Systems," *Defense News*, 8 Jan 1990; Lorna S. Jaffe, *The Development of the Base Force, 1989–1992* (Washington, DC: Office of the Chairman of the Joint Chiefs of Staff, Joint History Office, Jul 1993), 18, 20.

4. Transcript of Bush news conference, 24 Jan 1990, *Public Papers of the Presidents of the United States: George [H. W.] Bush, 1990* (Washington, DC: National Archives and Records Administration [NARA], 1991), 1:77 (hereafter *Bush Public Papers*); Jaffe, *Development of the Base Force*, 35–36; President George H. W. Bush, "Remarks at the Aspen Institute Symposium in Aspen, CO, 2 Aug 1990," *Bush Public Papers 1990*, 2:1089–1094; *National Security Strategy of the United States* (Washington, DC: The White House, Aug 1991), v (quote), 25–31 (hereafter *National Security Strategy*, 1991). See also Dick Cheney, *Defense Strategy for the 1990s: The Regional Defense Strategy* (Washington, DC: DoD, Jan 1993); Dick Cheney, *Annual Report to the President and the Congress*, Feb 1992, 1–9; Cheney, testimony before the Senate Committee on Armed Services [SCAS], *Department of Defense Authorization for Appropriations for Fiscal Years 1992 and 1993: Hearings . . . on S. 1507,* 102d Cong., 1st sess., 21 Feb 1991, S. Hrg. 102-255, pt. 1:24–27. For a good discussion of the strategy, see Richard L. Kugler, *U.S. Military Strategy and Force Posture for the 21st Century: Capabilities and Requirements* (Santa Monica, CA: RAND National Defense Research Institute, 1994), 26–39.

5. Quoted in Jim Wolffe, "Powell Outlines Plan for Small, Versatile Force of the Future," *Air Force Times*, 15 Apr 1991, 3; Cheney, testimony before the House Committee on Armed Services [HCAS], *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 and Oversight of Previously Authorized Programs*, 102d Cong., 2d sess., 6 Feb 1992, HASC No. 102-41, 26, 27.

6. Sloan, *U.S. Role*, 5–7, 8 ("vision thing"), 13, 24; Don Oberdorfer, "Bush's Talk of a 'New World Order': Foreign Policy Tool or Mere Slogan?" *Washington Post*, 26 May 1991, A31; Staff of U.S. News and World Report, *Triumph Without Victory: The Unreported History of the Persian Gulf War* (New York: Times Books [Random House], 1992), 140–142; *Bush Public Papers 1990*, 2:1289, 1331 ("partnership"); *Bush Public Papers 1990*, 1:44. See also, ibid., 1:123–124, 221, 238, 366; *Bush Public Papers 1991*, 2:1201, 1203; *National Security Strategy*, 1991, 13. Bush first used the phrase "new world order" publicly at a press conference on 30 August 1990. See *Bush Public Papers 1990*, 2:1179.

7. *Bush Public Papers 1992–1993*, 2:1599–1600; Marjorie Ann Brown, *United Nations Peacekeeping: Issues for Congress*, CRS Report RL3370 (Washington, DC: CRS, 11 Feb 2011), 38–43.

8. Remarks Prepared for Delivery by The Honorable Caspar W. Weinberger, Secretary of Defense, to the National Press Club, Washington, DC, 28 Nov 1984, *Public Statements of Caspar W. Weinberger, Secretary of Defense, 1984* (Washington, DC: OSD/HO, n.d.), 4:2462–2463; Colin Powell, "U.S. Forces: Challenges Ahead," *Foreign Affairs* 71, no. 5 (Winter 1992): 38–40.

9. Chollet and Goldgeier, *America Between the Wars*, 126, 182–183.

10. Kenneth Allard, *Somalia Operations: Lessons Learned* (Washington, DC: National Defense University [NDU] Press, 1995), 11–14; Richard W. Stewart, *The United States Army in Somalia, 1992–1994,* CMH Pub 70-81-1 (Washington, DC: U.S. Army Center of Military History [CMH], 2002), 5–14; *Bush Public Papers 1992–1993*, 2:2175–2176 (quote).

11. Muzaffer Ercan Yilmaz, "UN Peacekeeping in the Post–Cold War Era," *International Journal on World Peace* 22, no. 2 (Jun 2005): 17–18.

12. Rowan Scarborough and Bill Gertz, "Aidid's Simplicity Baffles Rangers," *Washington Times*, 1 Sep 1993, A1.

13. Stewart, *United States Army in Somalia*, 16–23.

14. Taylor Branch, *The Clinton Tapes: Wrestling History with the President* (New York: Simon & Schuster, 2009), 3; Chollet and Goldgeier, *America Between the Wars*, 72–77.

15. Madeleine Albright, Statement on Export Financing and Related Programs before the Subcommittee on Foreign Operations of the House Appropriations Committee, Washington, DC, 5 May 1994, *U.S. Department of State Dispatch* 5 (16 May 1994): 316; Chollet and Goldgeier, *America Between the Wars*, 91–93, 126–129; W. Eugene Cobble, H. H. Gaffney, Dmitry Gorenburg, *For the Record: All U.S. Forces' Response to Situations, 1970–2000 (with Additions Covering 2000–2003)* (Alexandria, VA: Center for Naval Analyses, May 2005), 35–37.

16. Wesley K. Clark, *Waging Modern War: Bosnia, Kosovo, and the Future of Combat* (New York: Public Affairs, 2001), 430–432, 437–438; Chollet and Goldgeier, *America Between the Wars*, 222–226.

17. Secretary of Defense Richard B. Cheney News Briefing on the FY 1991 Budget of the Department of Defense, 29 Jan 1990, *Public Statements of Richard B. Cheney, Secretary of Defense, 1990* (Washington, DC: OSD/HO, n.d.), 1:240 (quote); Michael Oreskes, "Poll Finds U.S. Expects Peace Dividend," *New York Times*, 25 Jan 1990, B9; Office of Management and Budget [OMB], *Budget of the United States Government, Fiscal Year 1991*, 1990, 153; DoD Comptroller, *National Defense Budget Estimates – FY 1991* (Washington, DC: DoD, Mar 1990), table 1-2; Cheney, *Annual Report to the President and the Congress*, Jan 1990, table 3, 10; Andy Pasztor, "Accord Is Reached on $288.3 Billion Defense Measure," *Wall Street Journal*, 23 Oct 1990, 9; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, 92. The Balanced Budget and Emergency Deficit Control Act provided for automatic cuts in both defense and domestic spending when the budget deficit reached a certain level. See P.L. 99-177 (12 Dec 1985), 99 Stat. 1037-1101. Its sponsors were Senators W. Philip "Phil" Gramm (R-TX), Warren B. Rudman (R-NH), and Ernest Frederick "Fritz" Hollings (D-SC).

18. Cheney, testimony before the HCAS, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993*, 102d Cong., 1st sess., 7 Feb 1991, 14; Colin Powell, testimony before the House Committee on Appropriations [HCA], Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1992*, pt. 8: *Base Force Concept*, 102d Cong., 1st sess., 25 Sep

1991, 25; *National Military Strategy of the United States* ([Washington, DC:], Joint Chiefs of Staff, Jan 1992), 19; Jaffe, *Development of the Base Force*, 21, 29. For a good discussion of the nature and significance of the Base Force, see Eric V. Larson, David T. Orletsky, and Kristin Leuschner, *Defense Planning in a Decade of Change: Lessons from the Base Force, Bottom-Up Review, and Quadrennial Defense Review* (Santa Monica, CA: Project Air Force, RAND, 2001), 5–39. See also William W. Kaufmann, *Assessing the Base Force: How Much Is Too Much?* Studies in Defense Policy (Washington, DC: Brookings Institution, 1992); General Accounting Office (GAO), *Force Structure: Issues Involving the Base Force*, GAO/NSIAD-93-65 (Jan 1993). GAO reports cited throughout this volume are found on the Government Accountability Office website at www.gao.gov.

19. Powell, *American Journey*, 437, 452; William A. Owens, with Ed Offley, *Lifting the Fog of War* (New York: Farrar, Straus and Giroux, 2000), 32–33, 165–166; Jaffe, *Development of the Base Force*, 11–15, 23, 27–28, 29–30, 32, 34, 38–44; David McCormick, *The Downsized Warrior: America's Army in Transition* (New York: New York University Press, 1998), 29.

20. Bush, "Address to the Nation on United States Nuclear Weapons Reductions," 27 Sep 1991, *Bush Public Papers 1991*, 2:1221–1223; Bush, "Address Before a Joint Session of the Congress on the State of the Union," 28 Jan 1992, *Bush Public Papers 1992–1993*, 1:158; Cheney, testimony before the HCAS, 6 Feb 1992, 42–44, 49–50; Cheney, *Annual Report*, Feb 1992, vii–viii, 24–25. The keel of *Seawolf* (SSN 21), the first boat in the class, had been laid in October 1989.

21. Cheney, testimony before the HCAS, 6 Feb 1992, 27, 37, 51; *National Military Strategy*, Jan 1992, 4; Patrick E. Tyler, "Pentagon Imagines New Enemies to Fight in Post-Cold War Era," 17 Feb 1992, A1; Eric Schmitt, "Senators Challenge Pentagon's War Scenarios," 21 Feb 1992, A8; Tyler, "U.S. Strategy Plan Calls for Insuring No Rivals Develop," 8 Mar 1992, 1; Tyler, "Lone Superpower Plan: Ammunition for Critics," 10 Mar 1992, A12; Tyler, "Senior U.S. Officials Assail Lone-Superpower Policy," 11 Mar 1992, A1; Tyler, "Pentagon Drops Goal of Blocking New Superpowers," 24 May 1992, 1: all in *New York Times*; Kugler, *U.S. Military Strategy*, 36. Curiously, in hearing testimony Cheney claimed the Base Force was designed for a post-Soviet world, and then confused the legislators by displaying a two-year-old chart that included the Soviet threat. See Cheney, testimony before the HCAS, 6 Feb 1992, 13–15, 24, 113–117; Cheney, testimony before the Senate Committee on the Budget, *Concurrent Resolution on the Budget for Fiscal Year 1993: Hearings*, vol. 2: *The 1993 Budget: Defense and Domestic Spending in the Post–Cold War Era*, 102d Cong., 2d sess., 3 Feb 1992, S. Hrg. 102-596, 34–36.

22. Les Aspin, *National Security in the 1990s: Defining a New Basis for U.S. Military Forces* (policy paper presented to the Atlantic Council of the United States, 6 Jan 1992), 4–6; John F. Troxell, *Force Planning in an Era of Uncertainty: Two MRCs as a Force Sizing Framework* (Carlisle Barracks, PA: Strategic Studies Institute, U.S. Army War College, 1997), 3–4, 10–11. See also Les Aspin, *An Approach to Sizing American Conventional Forces for the Post-Soviet Era: Four Illustrative Options* (n.p., 25 Feb 1992). For Powell's "capabilities-based" approach, see Jaffe, *Development of the Base Force*, 22–23; Paul K. Davis, "Planning Under Uncertainty Then and Now: Paradigms Lost and Paradigms Emerging," in *New Challenges for Defense Planning: Rethinking How Much Is Enough*, ed. Paul K. Davis (Santa Monica, CA: RAND, 1994), 33, 39.

23. Aspin, Statement before the House Armed Services Committee in Connection with the Clinton Defense Plan, 30 Mar 1993, file 1993, box SecDef Les Aspin, OSD/HO; *Congressional Quarterly Weekly Report*, 10 Apr 1993, 893; Aspin, briefing on the budget, Pentagon, 27 Mar 1993, *Defense Early Bird Supplement*, 29 Mar 1993, A-6 (quote).

24. GAO, *DoD Budget: Future Years Defense Program Needs Details Based on Comprehensive Review*, GAO/NSIAD-93-250 (Aug 1993), 2–4; Les Aspin, *Report on the Bottom-Up Review* (Washington, DC: DoD, Oct 1993), 4, 7–8, 13–19 (hereafter *Report on the BUR*).

25. Michael R. Gordon, "Cuts Force Review of War Strategies," *New York Times*, 30 May 1993, 1; Barton Gellman and John Lancaster, "U.S. May Drop 2-War Preparedness," *Washington Post*, 17 Jun 1993, A01; Art Pine, "Aspin Backs Capability for 2 Wars at a Time," *Los Angeles Times*, 25 Jun 1993, 10; DoD News Release 403-93, "Secretary Aspin Announces Bottom-Up Review Results," 1 Sep 1993, with news briefing of the same date, in *Public Statements of Les Aspin, Secretary of Defense, 1993–1994,* 3:1316–1335; Aspin, *Report on the BUR*, 7. (The report itself was not actually issued until

October.) Dealing with two wars simultaneously was deemed impracticable because of limitations in the available airlift and sealift assets needed to transport the forces.

26. Ann Markusen, "Bring Back the Old Les Aspin," *New York Times*, 18 Sep 1993, 19; David Isenberg, "The Pentagon's Fraudulent Bottom-Up Review," Cato Institute Policy Analysis No. 206, 21 Apr 1994, 1–11, https://www.cato.org/publications/policy-analysis/pentagons-fraudulent-bottom-review, accessed 6 Oct 2020; William T. Pendley, "Mortgaging the Future to the Present in Defense Policy: A Commentary on the Bottom-Up Review," *Strategic Review* 22, no. 2 (Spring 1994): 36–39; Owens, *Lifting the Fog*, 35; Dov S. Zakheim, "Tough Choices: Toward a True Strategic Review," *The National Interest* 47 (Spring 1997): 32–43; Lawrence T. DiRita, Baker Spring, and John Luddy, "Thumbs Down to the Bottom-Up Review," *Backgrounder* No. 957, 24 Sep 1993, 1–9, https://www.heritage.org/defense/report/thumbs-down-the-bottom-review, accessed 6 Oct 2020; Jeane Kirkpatrick, "Aspin Reinvents National Defense," *Baltimore Sun*, 21 Sep 1993, https://www.baltimoresun.com/news/bs-xpm-1993-09-21-1993264082-story.html, accessed 5 Mar 2020; David Evans, "Aspin Defense Plan Glorifies Old Thinking," *Chicago Tribune*, 19 Sep 1993, C1; Art Pine, "Pentagon's 'Bottom-Up Review' Appears to Be Down and Out," *Los Angeles Times*, 23 Aug 1994, A5; Bradley Graham and John F. Harris, "Can the Pentagon Afford Its Future?" *Washington Post*, 8 Aug 1994, A1, A6: "Mismatch: The 'Bottom Up Review' and America's Security Requirements in the New Era" (written testimony by Carl Conetta for the House Committee on Armed Services, 10 Mar 1994), http://www.comw.org/pda/congress.htm, accessed 2 Apr 2020; John T. Correll, "The Bottom-Down Review," *Air Force Magazine* 76, no. 12 (Dec 1993), https://www.airforcemag.com/article/1293edit/, accessed 7 Oct 2020; Mark Gunzinger, "Beyond the Bottom-Up Review," in *Essays on Strategy XIV*, ed. Mary A. Somerville (Washington, DC: NDU Press, 1997), 95–147; William Mathews, "Leaks in the Bottom-Up," *Navy Times*, 1 Aug 1994, 30 (quote).

27. Cobble, Gaffney, and Gorenburg, *U.S. Forces' Response to Situations*, 35–37; William S. Cohen, *Annual Report to the President and the Congress*, 2001, tables C-1 and D-2; DoD Comptroller, *National Defense Budget Estimates for FY 2001* (Washington, DC: DoD, Mar 2000), 112, 115. In the Cobble, Gaffney, and Gorenburg study, "response days" included the days U.S. forces were engaged in combat, show of force, support of peacekeeping and military supply, contingent positioning of forces, reconnaissance, and protection and evacuation of noncombatants. The authors excluded from the calculation humanitarian assistance and disaster relief operations that were not in harm's way. See *U.S. Forces' Response to Situations*, 7–8.

28. Chollet and Goldgeier, *America Between the Wars*, 234–242; Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War* (Washington, DC: Smithsonian Institution Press, 1992), 264, 267; Bradley Graham, "Two-War Scenario: A Strategy Straining the Pentagon," *Washington Post*, 12 Dec 1996, A14.

29. For overviews of the RMA, see Michael J. Mazarr, Jeffrey Shaffer, and Benjamin Ederington, *Military Technical Revolution: A Structural Framework: Final Report of the CSIS Study Group on the MTR* (Washington, DC: Center for Strategic and International Studies [CSIS], Mar 1993); Michael G. Vickers and Robert C. Martinage, *The Revolution in War* (Washington, DC: Center for Strategic and Budgetary Assessments, Dec 2004), copy in author files.

30. Arthur K. Cebrowski and John J. Garstka, "Network Centric Warfare: Its Origins and Future," U.S. Naval Institute *Proceedings* 124, no. 1 (Jan 1998): 28–35; David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2d ed. (n.p.: C4ISR Cooperative Research Program, 1999), 87–108; DoD, *Network Centric Warfare: Report to Congress*, 27 Jul 2001, chap. 3:1–19, copy in author files.

31. Owens, *Lifting the Fog*, 81–83; James R. Blaker, *Understanding the Revolution in Military Affairs: A Guide to America's 21st Century Defense*, Progressive Policy Institute Defense Working Paper No. 3 (Washington, DC: PPI, Jan 1997), 5. For the offset strategy, see William J. Perry and Cynthia A. Roberts, "Winning Through Sophistication: How to Meet the Soviet Military Challenge," *Technology Review* 85, no. 5 (Jul 1982): 27–35.

32. Perry seems to have first used the term "system of systems" in testimony before Congress in 1992. See Perry, prepared statement for the HCAS, Procurement and Military Nuclear Systems Subcommittee, 30 Apr 1992, *Hearings on National Defense Authorization Act for Fiscal Year 1993—*

H.R. 5006, and Oversight of Previously Authorized Programs . . . on Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement, 102d Cong., 2d sess., HASC No. 102-42, 363. See also Perry, "Military Action: When to Use It and How to Ensure Its Effectiveness," in *Global Engagement: Cooperation and Security in the 21st Century*, ed. Janne E. Nolan (Washington, DC: Brookings Institution, 1994), 240. The idea of a system of systems dates to the mid-1950s and the emergence of systems engineering as a distinctive field, although the first use of system of systems to describe an engineering technology system was in 1989. See Alex Gorod, Brian Sauser, John Boardman, "System-of-Systems Engineering Management: A Review of Modern History and a Path Forward," *IEEE Systems Journal* 2, no. 4 (Dec 2008): 486, 498; Perry, "Desert Storm and Deterrence," *Foreign Affairs* 70, no. 4 (Fall 1991): 66–82.

33. Theodor W. Galdi, *Revolution in Military Affairs? Competing Concepts, Organizational Responses, Outstanding Issues*, CRS Report 95-1170 F (Washington, DC: CRS, 11 Dec 1995); memo, John Deutch, Under Secretary of Defense for Acquisition and Technology (USD[A&T]), for Secretaries of Military Departments et al., 2 Mar 1994, subj: Revolution in Military Affairs Project—Formal Authorization of Task Force Activities; Andrew W. Marshall, memo for record, 2 May 1994, subj: RMA Update: copies of both in author files; Owens, *Lifting the Fog*, 166–172.

34. Owens, *Lifting the Fog*, 172–176; William A. Owens, "The Emerging U.S. System-of-Systems," Strategic Forum 63, NDU, Institute for National Strategic Studies, Feb 1996, 1–6; Jim Blaker, "The Owens Legacy," *Armed Forces Journal International* 133 (Jul 1996): 20.

35. James L. Yarrison, *The Modern Louisiana Maneuvers* (Washington, DC: CMH, 1999); TRADOC Pamphlet 525-5, *Force XXI Operations: A Concept for the Evolution of Full-Dimensional Operations for the Strategic Army of the Early Twenty-First Century*, 1 Aug 1994; Eric Schmitt, "Aircraft Carrier May Give Way to Missile Ship," *New York Times*, 3 Sep 1995, 1; William S. Cohen, *The Report of the Quadrennial Defense Review* (Washington, DC: DoD, May 1997), 43.

36. John M. Shalikashvili, *Joint Vision 2010* (Office of the Chairman of the Joint Chiefs of Staff, n.d.); William A. Arkin, "Spiraling Ahead," *Armed Forces Journal International* 143 (Feb 2006). The term "battlespace" had replaced "battlefield" to emphasize its three-dimensional nature.

37. Philip Shenon, "Pentagon Plan on Shaping the Military Is Under Fire," *New York Times*, 15 May 1997, B14; Bradley Graham, "Pentagon Faulted for Short-Sighted Plans," *Washington Post*, 20 May 1997, A17.

CHAPTER II

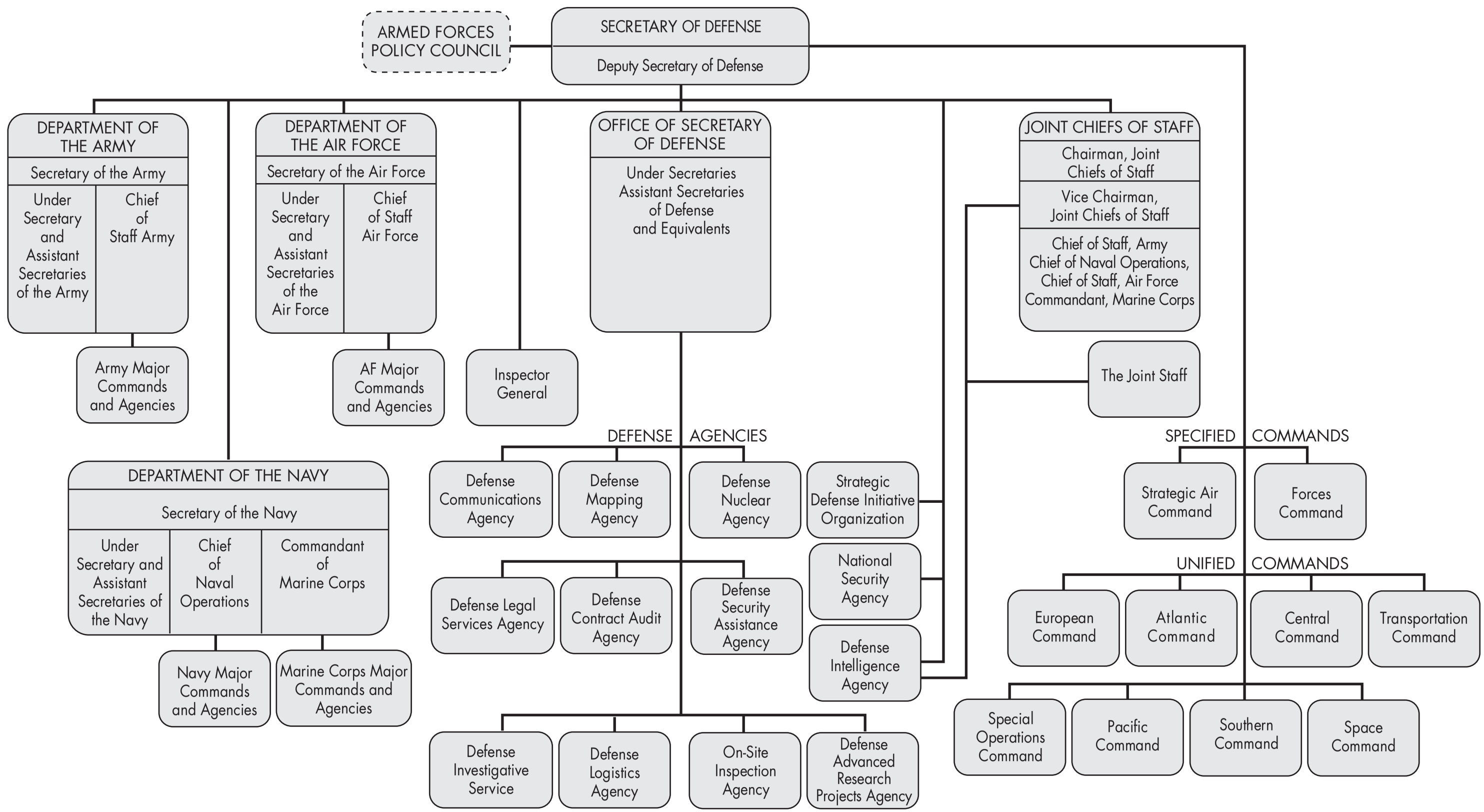
In Packard's Wake: The Defense Management Review, 1989–1990

George H. W. Bush had been elected president in part on the slogan "Stay the course"—that is, continue the policies of his predecessor, Ronald Reagan. Improving management of the Defense Department, especially in acquisition, was among them. In 1986 the Packard Commission recommendations and the Goldwater-Nichols legislation aimed directly at that objective. But when Bush took office in 1989, reforms had not been realized; in acquisition, procurement scandals and unsatisfactory outcomes in weapon system programs continued. After a comprehensive review of the department's management, Secretary of Defense Dick Cheney concluded that implementation of the Packard and Goldwater-Nichols reforms was incomplete and that full execution, buttressed by strong enforcement, would address the acquisition system's problems.

THE QUEST FOR ACQUISITION REFORM

Defense Department acquisition had been subject to widespread and intense criticism in the first half of the 1980s. So-called horror stories of price gouging on spare parts and ordinary items such as $436 hammers and $640 toilet seats and allegations of corruption among contractors provoked outrage and calls for reform. The major impetus for change came from Congress, which held numerous hearings and passed a steady stream of laws (140 bills were introduced in 1985 relating to acquisition, and another 100 the following year) that attempted to reform the acquisition process, revamp the department's acquisition organization, and reduce the opportunity for waste, fraud, and other abuses. Some of the legislation had a significant impact. In 1983, as part of the Department of Defense Authorization Act for 1984, Congress established the post of director of operational test and evaluation in DoD (Secretary of Defense Weinberger initially opposed it) to coordinate, monitor, and evaluate operational testing of major weapon systems. Operating independently of the department's acquisition structure, the official would report both to the secretary of defense and

Figure 2-1: Department of Defense, 1989



Source: Figure 1 (Department of Defense), in Wilbur D. Jones Jr., *Introduction to Defense Acquisition Management* (Fort Belvoir, VA: Defense Systems Management College [DSMC], Mar 1989), 2.

to Congress. The next year Congress passed the Competition in Contracting Act to promote the use of competitive procedures before contracts were awarded. By far the most important mid-decade legislation was the Goldwater-Nichols Act of 1986, enacted in conjunction with the Packard Commission reforms.[1] The creation of a high-level position for an independent test and evaluation official in the Pentagon signaled a victory for the Congressional Military Reform Caucus, a bipartisan coalition that had formed in 1981 and grew to over a hundred members in both houses, evenly split between the parties but largely run by conservative Republicans. The caucus was part of a broader military reform movement that also included a small number of military and civilian DoD insiders (some were whistleblowers), journalists, think-tank analysts, and advocacy groups seeking to change defense policy.[2] They believed the Pentagon was buying weapons that were too complex and expensive and based on faulty concepts of warfare. They also argued that the Pentagon's planning, programming, and budgeting processes were ineffective, leading the Defense Department to formulate inaccurate and exaggerated funding requirements.[3]

Secretary Weinberger resisted outside oversight so vigorously that some observers labeled his position "anti-reform." Nonetheless the department did pursue acquisition reforms of its own. In 1981 the Office of the Secretary of Defense established the Acquisition Improvement Program comprising 32 measures called the Carlucci Initiatives, after Deputy Secretary of Defense Frank C. Carlucci who formulated them. They included using more economical production rates, increasing competition, adopting multiyear procurement funding, and planning for equipment upgrades, all aimed at reducing costs and shortening development cycle times. The department's record with respect to the Carlucci Initiatives, however, was spotty and uneven—only 10 of the 32 initiatives were implemented, and of those, only four had any significant impact. The General Accounting Office concluded that "the Acquisition Improvement Program has made little or no difference in the acquisition process."[4]

Under pressure from several directions for acquisition reform, particularly from moderates in Congress, President Reagan appointed the President's Blue Ribbon Commission on Defense Management (Packard Commission) in July 1985, led by former Deputy Secretary of Defense David Packard. In two reports the commission called for major structural reforms in the Pentagon's system for acquiring weapons, including the appointment of an "acquisition czar" in OSD with broad authority to manage the system, new or restructured boards to oversee the acquisition process, and a new acquisition organizational structure in the military departments separate from the existing chain of command. Although many of its recommendations merely restated the findings of earlier reviews going back at least to 1970, the commission possessed great moral authority due to public and government concern over the recent scandals and the state of the acquisition system. Even before the commission issued its final report in June 1986, President Reagan signed National Security Decision Directive (NSDD) 219 on 1 April, implementing many of the recommendations of an interim report published in February. Congress responded to Packard by creating the position of under secretary of defense for acquisition (USD[A]) and, through the landmark Goldwater-Nichols legislation, transferred responsibility for acquisition in the services from the uniformed chain of command to the civilian leadership of the military departments. The Packard Commission recommendations, which would guide reform efforts well into the 1990s, raised hopes that the acquisition system could be repaired.[5]

By 1989 that system had been extensively reshaped generally along the lines called for by the Packard Commission. The under secretary of defense for acquisition, the third ranking official in acquisition matters after the secretary and deputy secretary of defense, advised the secretary and had the authority to formulate and execute acquisition policy. The under secretary also oversaw the progress of major acquisition programs as chairman of the 10-member Defense Acquisition Board (DAB), established in 1987, replacing the Defense Systems Acquisition Review Council. The DAB comprised the vice chairman of the Joint Chiefs of Staff, various assistant secretaries of defense, the service acquisition executives (SAEs), the directors of operational test and evaluation and of program analysis and integration in OSD, and, as appropriate, program managers (PMs) for specific weapon systems and chairs of one or more of the board's 10 support committees. The board oversaw the acquisition process, conducted the milestone reviews of major programs, and advised the USD(A), who made recommendations to the secretary. The under secretary was also a member of the Defense Resources Board, chaired by the deputy secretary. Whereas the Defense Acquisition Board oversaw the acquisition process, the Defense Resources Board controlled every step of the Planning, Programming, and Budgeting System (PPBS), by which the department allocated resources through its annual budgets and Future Years Defense Program (FYDP).[6]

Also in line with the Packard recommendations, the acquisition chain of command had been streamlined by reducing the number of management layers between the system program managers and the under secretary. Each military service had established program executive officers (PEOs) with responsibility for a group of programs. The program managers reported directly to the PEOs, who in turn reported to the service acquisition executive, a civilian official—usually an assistant secretary—responsible for acquisition in that military department. The SAEs reported directly to the defense acquisition executive (DAE), the under secretary for acquisition. This structure ensured that there were no more than two layers of management between the program managers and the under secretary. It also strengthened civilian control by giving civilians authority over service acquisition (see figure 2-2).[7]

The Packard Commission reforms were officially in place—yet there was a growing sense that implementation had been more form than substance. Representatives Les Aspin, chairman of the House Armed Services Committee, and Nicholas J. Mavroules (D-MA), chairman of the committee's Subcommittee on Investigations, noted in 1989 that the Reagan administration had established the formal organization called for by Packard, but "the spirit of what the Packard Commission intended has yet to be fulfilled."[8] These impressions were confirmed by congressional hearings, extensive audits by the General Accounting Office, and a study published in November 1988 by the Institute for Defense Analyses (IDA), a federally funded research and development corporation hired by the under secretary for acquisition to study the problem. These reviews concluded that the services, to a large extent, had implemented the letter but not the spirit of the Packard Commission recommendations. They cited several areas in which execution fell short of intention. One was the role of the under secretary. As the commission envisioned it, the "acquisition czar" was to have broad authority to centralize policymaking and execution and bring discipline to the process. Yet defining that authority was the source of a long-running debate in the Pentagon, as the service secretaries fought to maintain their autonomy and right to appeal the under secretary's decisions to the deputy secretary or the secretary. They won that argument, as the secretary reserved for himself and his deputy the right to make decisions at program milestones, thereby practically inviting the service secretaries to go around the under secretary. A related issue was the role of the Defense Acquisition Board, chaired by the USD(A). The DAB did not control funds. It was an advisory body only, primarily concerned with whether a program should proceed from one milestone to the next, and its recommendations were often modified or ignored by the Defense Resources Board, chaired by the deputy secretary.[9]

The brief and unhappy tenure of Richard P. Godwin demonstrated the limits of both the USD(A)'s authority and the new structure for managing acquisition. Godwin became under secretary in 1986 expecting to wield the power he believed the Packard Commission had recommended. But entering office late in the administration and with little experience working within the Pentagon bureaucracy, he had difficulty establishing his official and personal authority in the face of long-established relationships and procedures. The services and other OSD officials undercut him repeatedly. He complained that the new management structure had been imposed on top of the old, without shaking up those relationships or diminishing the power of those who held it. Godwin received little support from his superiors, Secretary Weinberger and Deputy Secretary William H. Taft IV. In one incident, he tried to restore the Deadeye laser-guided munition program that had been canceled by the Navy, but Navy Secretary John F. Lehman Jr. went behind his back, going to Taft for support. Godwin resigned after a tumultuous year in office. His successor, Robert B. Costello, had by most accounts a much more successful tenure, in large part because he adopted a less confrontational and more consensus-based approach and worked more smoothly within the existing system. Whereas Godwin had tried to reform the system in a single blow, Costello chose his battles carefully and largely avoided open confrontation. However, the basic questions regarding the authority of the under secretary remained unsettled.[10]

Along with the under secretary post, the acquisition management structure, especially in the services, failed to live up to Packard Commission expectations. As directed, each service had implemented the organizational framework called for by Packard, but each had done so in its own way, adapting the new structure to the old and making it weaker than before. For example, only the Air Force had assigned an assistant secretary as a full-time service acquisition executive. Both the Army, initially, and the Navy assigned the position to their under secretaries who had ongoing responsibilities in other areas and, consequently, relied on existing assistant secretaries,

Richard Godwin, the first under secretary of defense for acquisition, 1986–1987. *(NARA)*

Richard P. Godwin (1922–2005)

Richard Godwin became the first under secretary of defense for acquisition on 30 September 1986. He came to the Defense Department from the Bechtel Corporation, an engineering and construction company. Employed by Bechtel since 1961, he had risen to become executive vice president and a member of the board of directors of the Bechtel Group of Companies, a division of the corporation. (Secretary of Defense Caspar Weinberger had also been a board member.)

Born in Clifton, New Jersey, in March 1922, Godwin was raised in Connecticut, graduated from Yale with a bachelor's degree in engineering, and served as a Navy officer in World War II. Before moving to Bechtel, he was assistant director of reactor development for the Atomic Energy Commission and project director for the development of *Savannah*, the first nuclear-powered merchant ship.

Prior to becoming DoD's third-ranking official, Godwin's only significant experience with the department had been as a member of the Defense Science Board. His tenure as under secretary was brief and frustrating. Believing he had been appointed to carry out the Packard Commission reforms, Godwin encountered significant resistance within the department to their implementation and to his authority. He resigned on 30 September 1987.

Godwin did not return to industry following his departure from the Pentagon. Instead he pursued much different interests—establishing a vineyard on his ranch in Northern California and coproducing two Broadway musical revivals.[1]

who also had responsibilities in other areas, to carry out those duties. The service acquisition executives reported to the service secretaries as well as to the USD(A), setting up potential conflicts between OSD and the services. Meanwhile, only the Army had created a separate structure of program executive officers. They reported to the under secretary of the Army, the service's acquisition executive (until May 1989), rather than to the uniformed head of Army Materiel Command, the service's major acquisition organization. The Navy and Air Force had assigned PEO responsibilities to the uniformed commanders of their major acquisition organizations. The program executive officers came from those organizations and reported not only to the civilian service acquisition executive on program matters but also up the uniformed chain of command through the acquisition organization commander to the service chief. In all of the services, program executive officers and program managers depended on the existing acquisition organizational structure for financial and personnel support. The Packard Commission had called for program managers to be responsible only to program executive officers, but significantly only in the Army, where the PEO evaluated the program manager as part of the separate acquisition reporting structure, was this true. In the Navy and Air Force, ratings of program manager performance took place in the existing uniformed command chain. As David Packard told the Senate Armed Services Committee in July 1988, the services "had flunked out" when it came to the issue of having a single chain of command in acquisition (see figure 2-2).[11]

Robert Costello, as assistant secretary of defense for production and logistics in February 1987, prior to his becoming the second under secretary of defense for acquisition, 1987–1988. *(NARA)*

Robert B. Costello (1926–1998)

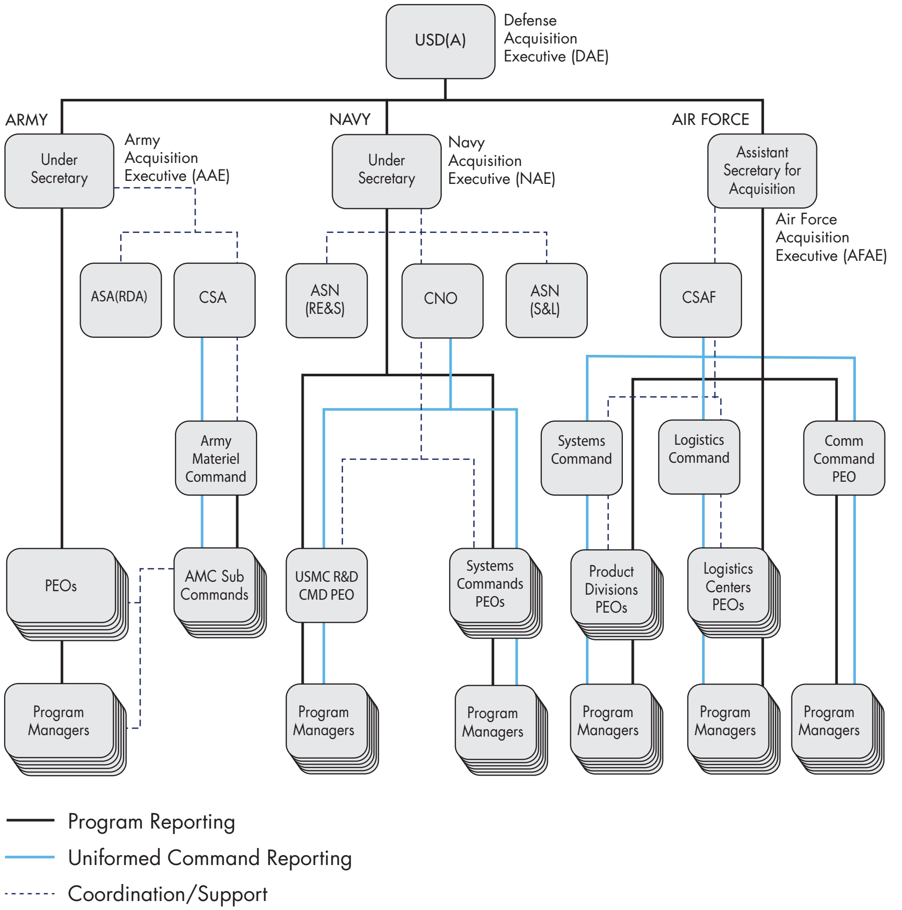
On 18 December 1987 Robert Costello succeeded Richard Godwin as under secretary of defense for acquisition. Having served since March as the assistant secretary for production and logistics and having dealt with the development of major weapon systems during more than a quarter-century as an executive with General Motors, he was more familiar with defense acquisition than his predecessor.

Costello was born in June 1926 in New Rochelle, New York. He attended Yale University for a time and, in 1944, enlisted in the Navy, serving until war's end. (He would be recalled to active duty as an officer during the Korean War and would remain in the Naval Reserve until 1978.) Trained as a civil engineer, Costello earned a bachelor's and a master's in civil engineering from Rensselaer Polytechnic University in 1947 and 1948, respectively. In 1951 Cornell University awarded him a doctorate in civil engineering.

In his years with the General Motors Corporation, Costello held top positions in the Allison Division as chief of missile engineering and as director of the liaison group for the main battle tank program; in the Delco Electronics Division as director of materials management; and finally as GM's executive director of purchasing activities from 1982 until his appointment as assistant secretary.

Like Godwin's, Costello's tenure as under secretary was short. He left the Pentagon post on 12 May 1989, subsequently becoming a senior fellow at the Hudson Institute, a nonprofit think tank.[II]

Figure 2-2: Program Manager's Reporting Chain



AMC – Army Materiel Command
ASA(RDA) – Assistant Secretary of the Army for Research, Development, and Acquisition
ASN(RE&S) – Assistant Secretary of the Navy for Research, Engineering, and Systems
ASN(S&L) – Assistant Secretary of the Navy for Shipbuilding and Logistics
CNO – Chief of Naval Operations
CSA – Chief of Staff, Army
CSAF – Chief of Staff, Air Force
PEO – Program Executive Officer
USD(A) – Under Secretary of Defense for Acquisition
USMC R&D CMD – U.S. Marine Corps Research and Development Command

Source: Adapted from Figure 3 (Program Manager's Reporting Chain), in Jones, *Introduction to Defense Management*, 13.

To force the services to implement Packard reforms, Congress, as part of the FY 1987 Defense Authorization Act, required the secretary of defense to designate 10 major programs as Defense Enterprise Programs. Among the 10 programs were the Army's TOW II missile, the Navy's *Seawolf*-class attack submarine, and the Air Force's C–17 transport. These programs were to benefit from streamlined management; that is, they were to follow the more direct chain of command from the program manager through the program executive officer to either the service or the defense acquisition executive, and be freed from reporting requirements and policies, rules, regulations, or guidelines not specified in the Federal Acquisition Regulation (FAR), the Defense FAR Supplement (DFARS), or statutes. To promote stability, programs under development were "milestone authorized"; they were to receive guaranteed funding, not just for a year but until they reached the next milestone, a key program decision point (see figure 2-4). In other words, the Defense Enterprise Programs would be models of the Packard-inspired reforms. But the reality was much different.

The Reagan administration did little to issue or to enforce guidance for the programs. Streamlined management was not fully implemented and funding was never stabilized. The programs also encountered considerable resistance from the Pentagon bureaucracy and often received more scrutiny, not less. Besides, many of the most burdensome regulations were statutory and could not be waived. Indeed, the Defense Department found it difficult to determine exactly how many relevant regulations there were and which were codified by law or by the Federal Acquisition Regulation. The Air Force's Defense Enterprise Program staff studied them and came up with 177 regulations that it believed the service's programs could do without. However, when the study team sought the necessary waivers, it encountered objections from within the Air Force itself and from OSD, each vested interest wanting to keep the regulations that fell within its jurisdiction.[12]

In another example of unrealized objectives, the Packard Commission's goal of achieving financial stability for weapon system programs had not yet occurred. Acquisition plans frequently changed with the funding climate, leading to uncertainty, delays, and added expense. The commission had proposed several possible solutions for the problem, including:

- *Baselining*—in which the program manager committed to particular schedule, cost, and performance parameters, in exchange for an assured level of funding

- *Milestone authorization*—in which Congress agreed to fund a program through each phase, until the next milestone was achieved

- *Multiyear procurement*—in which Congress would permit DoD to sign contracts committing the government to procuring a specified number of systems over several years

- *Biennial budgeting*—in which DoD submitted, and Congress funded, budgets on a two-year cycle instead of one year at a time

None of these potential solutions were fully implemented, though sometimes through no fault of DoD. For example, Congress had authorized the use of multiyear procurement in 1981, and the secretary had requested up to 15 such programs per year, but Congress had imposed significant restrictions on the practice and had refused to approve more than seven at any one time. Similarly, each year the Defense Department submitted separate budgets for the next two years, but each time Congress refused to consider the second year's budget because its members did not want to commit themselves to a two-year spending plan.[13]

Part of the problem in implementing Packard reforms was the lack of interest within the Defense Department, especially by Secretary Weinberger. Another difficulty was in the ambiguity of the commission's recommendations. Its reports had represented a philosophy for acquisition—of centralized control and decentralized execution, of streamlined management, of deregulation and empowerment of the workforce, and of commercialization and competition—but they often lacked a clear statement on how to achieve this vision. There was ample room for those who opposed Packard—and even for those who supported it—to interpret its recommendations according to their own ideas and preferences.[14]

The fundamental obstacle to acquisition reform, however, was cultural, not organizational or procedural. In an organization as large as the Defense Department, it was difficult to change ingrained ways of thinking and doing. One thing was clear: Strong leadership was essential. The 1988 Institute for Defense Analyses report had concluded that implementing reforms "will require relentless high-level support."[15]

THE MANAGEMENT REVIEW AND REPORT

President Bush was determined to shake up and straighten out the acquisition system. The Institute for Defense Analyses report had emphasized commitment from the top. By 1989 there was new urgency triggered by the findings of a three-year Federal Bureau of Investigation sting operation (Ill Wind) that resulted in the convictions on corruption charges of a dozen service officials and about 60 civilian consultants and employees of defense contractors. The fallout from the investigation brought public confidence in the acquisition system to a new low and increased congressional impatience with the pace of reform. Harsh criticism of Defense Department management also came from within the fold. Noting his service in OSD and as chief of naval operations, retired Admiral Elmo R. Zumwalt Jr. wrote to the secretary of defense in July 1989, "I can state flatly that the senior decision-making process has gone from bad to worse over the last twenty years and is now in a state of absolute chaos."[16]

In his first weeks in office, Bush made it clear that acquisition reform would be one of his top defense priorities. "I am determined to expand the national consensus that is necessary for proper support of our nation's defenses," he said in late January. "I firmly believe that the vital first step . . . is to wring the last drop of waste and mismanagement out of the way we buy our weapons." A few days later, in his first address to a joint session of Congress, he announced he was directing the Defense Department to develop a plan to improve Pentagon management and the procurement process, "one which will fully implement the Packard Commission report." He also called upon Congress to assist in the effort by enacting specific reforms called for by Packard: "We need fewer regulations. We need less bureaucracy. We need multiyear procurement and 2-year budgeting. And frankly . . . we need less congressional micromanagement of our nation's military." Soon after, Bush signed National Security Review (NSR) 11, ordering the secretary of defense to undertake the management review.[17]

After the Senate rejected Bush's first nominee for secretary of defense, former Senator John G. Tower (R-TX), the president, in a choice that boded well for acquisition reform, nominated Representative Dick Cheney (R-WY), a founding member of the Military Reform Caucus. Cheney was determined to discipline the acquisition system and be a hands-on manager. When he went to the White House living quarters to accept the appointment, Bush emphasized the importance of the reform effort. "It was front and center on [the president's] list of priorities," Cheney recalled. The new secretary made it his own priority as well. When asked to state DoD's top objectives for the president's Management by Objectives initiative, the first four of the five he submitted related to acquisition reform.[18]

Cheney had an additional incentive to promote reform: preventing Congress from imposing even more radical measures on DoD. The recent scandals had revived proposals by members of the Military Reform Caucus that had been floating around the halls of Congress for several years. One, by Senator William V. Roth Jr. (R-DE), would remove the acquisition function from the military services and assign it to an independent agency within the Defense Department under the USD(A), following the approach used by many European countries. Others, by Representatives Barbara L. Boxer (D-CA) and Dennis M. Hertel (D-MI), would remove acquisition from military hands altogether by creating an independent corps of civilian acquisition specialists. Such proposals were rejected by DoD, but they had currency in the atmosphere of early 1989 and the department acted vigorously to block them. In June, Assistant Secretary of Defense for Legislative Affairs David J. Gribbin III advised the deputy secretary of defense, Donald J. Atwood Jr., to meet with House Armed Services Committee staff "to informally discuss how to best fend off legislation being drafted by Rep. Boxer and others that would drastically change the way we now do acquisition."[19]

When Cheney became secretary in late March, he found the management review ordered by NSR 11 already underway, being carried out largely by consultants brought in by Tower. (Curiously, Costello and his staff were not consulted for this review, a reflection, the under secretary thought, of the animosity of Tower and his consultants toward him.) Atwood, Cheney's deputy, took responsibility for the review when he assumed office a month later. Although the review would be conducted internally, Cheney and Atwood sought advice from former Secretaries of Defense Melvin R. Laird and Harold Brown and from some industry leaders. Cheney believed the review's internal origins would help ensure there would be no ambiguity or misinterpretation about its conclusions, and—he hoped—no dissent from within the

Pentagon. The results of the Defense Management Review, as NSR 11 was called, were forwarded to the president in June 1989 and published in July with White House endorsement as *Defense Management: Report to the President*.[20]

The Defense Management Report, or DMR, as it was commonly known, ordered the full implementation of the Packard Commission recommendations. It called for decentralization of authority, accountability, and innovation, and defined the roles and responsibilities of key OSD and service officials. For example, it specified that the under secretary of defense for acquisition "will be responsible for policy, administration, oversight and supervision regarding acquisition matters DoD-wide," and would have the authority to direct the service secretaries on the manner in which their departments were to execute their acquisition responsibilities. Additionally, the USD(A) was to have "the full confidence and active support of the Secretary and Deputy Secretary as their principal staff assistant on such matters, including implementation of numerous initiatives stemming from the Defense Management Review." To better coordinate acquisition planning and resources, the under secretary also received an expanded role in the budget process.[21]

The Defense Management Report reorganized the acquisition oversight boards. It reduced the Defense Acquisition Board to nine members with instructions for it to "rigorously oversee major systems acquisition." For the under secretary, who remained its chairman, the "paramount objective" was "to discipline the acquisition system" through the DAB reviews. The report also reduced the size of the Defense Resources Board and renamed it the Defense Planning and Resources Board to emphasize its long-range planning function. The board's mission was to assist the deputy secretary "to develop stronger links between our national policies and the resources allocated to specific programs and forces." Finally, the DMR created the DoD Executive Committee, comprising the secretary, deputy secretary, under secretaries for acquisition and for policy, service secretaries, and the JCS chairman, to be the senior deliberative and decision-making body for acquisition within DoD.[22]

Regarding the acquisition system, the DMR's guiding principles reflected those of the Packard Commission:

- Clear command channels with well-defined authority and responsibility and short, unambiguous chains of command
- Program stability by adhering to an agreed-upon baseline for cost, schedule, and performance
- Limited reporting requirements following the principles of "management by exception"
- Small, high-quality staffs consisting of well-trained and highly motivated professionals
- Communication with system users to ensure the systems met their needs
- Better system development through prototyping, investment in the technology base, and the use of commercial products and commercial-style competition[23]

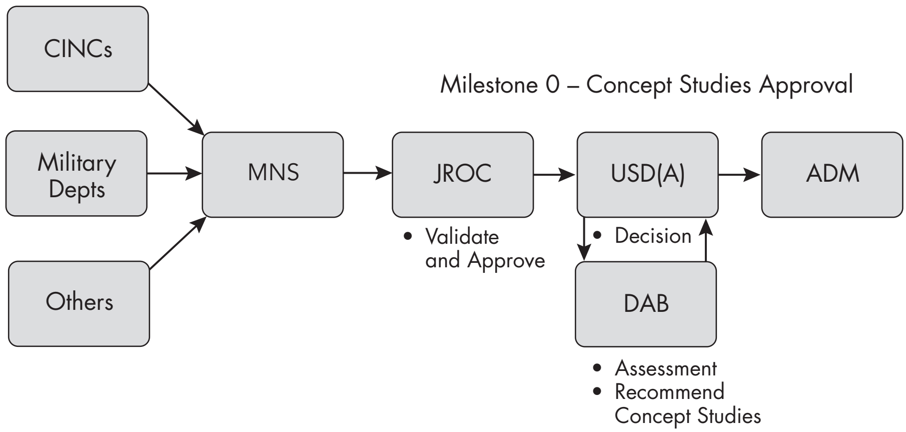
Acknowledging that none of the services had fully implemented the Packard recommendations regarding acquisition organization, the report specified that the service acquisition executives were to be civilian officials with full-time acquisition responsibilities. The program executive officers were also to devote themselves full-time to acquisition; that is, they could not double as commanders of their service's major acquisition organizations (generally referred to as "systems commands"). The program managers were to report only to their respective program executive officer or service acquisition executive on matters concerning program cost, schedule, and performance. The systems commands—Air Force Systems Command and Air Force Logistics Command, Naval Sea Systems Command and Naval Air Systems Command, and Army Materiel Command—were to provide the program managers with support services only, and were not to assume management functions. This approach was intended, in part, to relieve the program managers of burdensome reviews, briefings, and reporting.[24]

At last, in a revision of the position's charter in August 1989, the under secretary for acquisition received the authority the Packard Commission had intended. The under secretary would now exercise authority over the services in acquisition matters, a question left unanswered by the Reagan administration. For example, the under secretary (instead of the deputy secretary) would henceforth write the Acquisition Decision Memoranda, the documents that decided key issues presented to the Defense Acquisition Board.[25]

In accordance with the spirit of the Goldwater-Nichols Act, the Defense Management Report also strengthened the JCS chairman's role in determining requirements for systems through the Joint Requirements Oversight Council, headed by the JCS vice chairman. When it was established in 1984 (originally as the Joint Requirements and Management Board), the JROC's authority extended only to joint programs. The services jealously guarded their prerogatives in setting their own requirements for service-unique programs, which constituted the large majority. Under Cheney and Atwood, the council would have authority to validate all new requirements set by the services, not just joint programs, and to review and approve the requirements documents, known as Mission Need Statements, before the Defense Acquisition Board would consider approving a new program (see figure 2-3). In addition to its stronger role in requirements generation, the council would review each ongoing program before its DAB review. Because the JROC reported to the chairman of the Joint Chiefs of Staff as well as the secretary of defense, its new roles enhanced the chairman's influence in acquisition.[26]

The Defense Management Report also recommended changes in the acquisition workforce. It called for expanding training and applying innovative personnel management policies to improve the work environment, the reward system, and the recruitment and retention of civilian workers. Uniformed personnel were to be organized into a separate acquisition corps in each service. Instead of serving a tour in an acquisition assignment and then returning to the combat arms—an approach that treated acquisition assignments as a ticket to be punched—uniformed acquisition officers were to be specialists who would spend their careers in the acquisition corps, enjoying attractive career paths and promotion potential "up

Figure 2-3: Requirements Generation and Validation: Mission Need Statement



ADM – Acquisition Decision Memorandum
CINCs – Commanders in Chief
DAB – Defense Acquisition Board
JROC – Joint Requirements Oversight Council
MNS – Mission Need Statement
USD(A) – Under Secretary of Defense for Acquisition

Source: Adapted from Figure 9 (Mission Need Statement Flow), in Joseph H. Schmoll, *Introduction to Defense Acquisition Management*, 2d ed. (Fort Belvoir, VA: DSMC Press, Mar 1993), 22.

to the highest flag grades." The report also called for streamlining the acquisition workforce through more efficient organization, though it shied away from specifying the levels of personnel reductions, as had earlier drafts. For example, all DoD contract administration services, then divided and duplicated among the services and the Defense Logistics Agency, were to consolidate into a new organization called the Defense Contract Management Agency (DCMA).[27]

The Defense Management Report addressed the recent ethics scandals by calling for self-policing and voluntary disclosure of ethics violations by defense contractors. It also encouraged legislative action by Congress, which would have to approve many of the recommended regulation changes. Cheney especially wanted Congress to provide relief from the micromanagement that many believed plagued defense acquisition. The report noted that every working day the Defense Department usually underwent three audits by the General Accounting Office, received 450 written and 2,500 telephone inquiries from Congress, and submitted an average of three required reports. Cheney also estimated that senior department officials spent more than 40 hours preparing for an average of six appearances as witnesses and 14 hours of testimony for each day Congress was in session. The need for reform legislation and relief from micromanagement would be one of Cheney's major themes during the coming months. In May he told Atwood, "We want to put some heat on these guys [Congress] to support us when we need legis[lation] to clean up [the] acquisition process."[28]

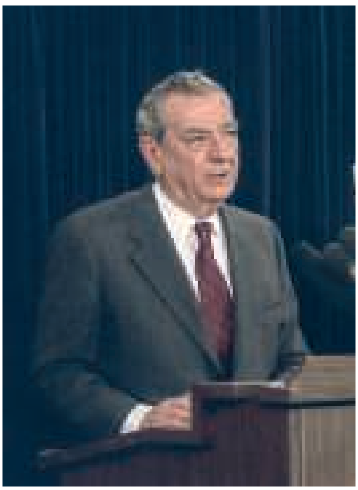
IMPLEMENTING THE REPORT

Not surprisingly, reaction to the Defense Management Report was a matter of perspective. Cheney received much praise from outside observers, including industry leaders, who were happy with the report's call for deregulation and self-managed ethics programs, and former Defense Department officials, notable among them David Packard. "I'm very pleased," he said at a press conference several days after the DMR's release, "they've got a good plan of action." Reaction from Congress was cautious but favorable. Within the department, especially in the services, the response was more reserved, ranging from quiet apprehension to open frustration. The services had objected to perceived infringements on their traditional prerogatives and influence. In their view, the targets for personnel cuts were too large; the service acquisition executives had too much authority and the systems commanders too little; a separate acquisition corps would weaken the authority of the service chiefs; consolidated contract administration would separate the contracting officers from the program managers; and allowing Joint Requirements Oversight Council review of service-unique programs was more "jointness" than they wanted. The services were particularly concerned that the under secretary for acquisition would use the new authority to interfere in the management of their programs.[29]

Shortly after the report was published, Atwood presented it to senior OSD, Joint Staff, and service personnel. His executive assistant, Paul S. Stevens, warned him the day before, "As you may gather, I do not think this audience will be completely friendly, or completely supportive of the actions you have in mind." Stevens advised Atwood to impress the audience with his determination to implement the report, thereby forestalling any inclination by opponents to play a waiting game. "Bureaucratic resistance to such efforts often exploits perceived ambiguities in management direction," Stevens cautioned. "The resistance movement is already underway."[30]

The most outspoken critics opposed the plan's call for vesting the research and development and procurement functions in a single civilian acquisition executive in each service and for diminishing the power and autonomy of the systems commands. With respect to the latter, the Army objected to cutting the staff of Army Materiel Command, and the Air Force temporarily fended off proposals to merge its Logistics Command and its Systems Command. The Navy's protests were the loudest of all. It opposed creating a service "acquisition czar" and the removal of the program executive officers from its systems commands. In 1991 the commander of Naval Sea Systems Command, Vice Adm. Peter M. Hekman Jr., publicly derided the Defense Management Report, commenting that OSD had discovered a new element called "Administratium," which has no protons or electrons but "two neutrons, 117 assistant neutrons, 175 vice neutrons and 20 deputy neutrons, giving it an atomic weight of 312." The element, he said, is inert and "impedes every action it touches." It has a half-life of three years and then undergoes a reorganization in which "the assistant, deputy and vice neutrons all change positions."[31]

Cheney and Atwood persevered. Putting the Defense Management Report into practice would occupy several senior officials and much of the OSD staff for the rest of 1989. Atwood took charge of the implementation. He assigned tasks to the OSD staff and demanded regular progress reports. He required the services to submit their own plans for implementing the DMR and graded them on their compliance with its provisions. For oversight, Atwood created the Defense Management Report Implementation Coordination Office, which reported directly to him. He and other senior OSD officials, including Under Secretary for Acquisition John A. Betti, who had succeeded Costello in August 1989, organized several task forces and working



Deputy Secretary of Defense Donald Atwood responds to a question during an annual budget briefing held at the Pentagon. *(NARA)*

Donald J. Atwood Jr.
(1924–1994)

Donald Atwood became deputy secretary of defense on 24 April 1989 following a 30-year career as a General Motors executive. Tasked by Secretary Dick Cheney to conduct the Defense Management Review and implement its report, Atwood guided the expansion of authority of the Office of the Secretary of Defense over the services in acquisition.

Born in Haverhill, Massachusetts, in May 1924, Atwood served in the Army from 1943 to 1946, including duty with the Signal Corps in Burma. After World War II he earned a bachelor's and a master of science degree in electrical engineering from the Massachusetts Institute of Technology in 1948 and 1950, respectively. While at MIT he participated in its Instrumentation Laboratory's program to develop inertial guidance for ballistic missiles. Atwood left MIT in 1952 but continued his work on ballistic missile guidance as treasurer and chief engineer of the Dynatrol Corporation. He joined General Motors in 1959 when the automotive behemoth acquired Dynatrol.

Atwood's first position at GM was as an associate director of the Boston Research and Development Laboratory of the company's AC Spark Plug Division. Over the next three decades he held a variety of top-level management posts, rising to become vice chairman of the board and president of Hughes Electronics Corporation, a GM subsidiary. Notably, during the 1960s, Atwood directed GM's involvement in the Apollo space program and later managed the company's acquisition of both the Hughes Aircraft Company and Electronic Data Systems Corporation.

Atwood left the deputy secretary post on 20 January 1993 and died just over a year later in April 1994.[III] groups to plan and oversee high-priority efforts. One task force under Betti reviewed internal DoD regulations and recommended revising or eliminating many. By January 1990 the task force had reviewed all 500 acquisition directives and decided to alter or eliminate three-quarters of them, including the cancellation of about 90. Although the task force had no jurisdiction over the Federal Acquisition Regulation, it reviewed 80 clauses and 44,000 lines of text in the Defense FAR Supplement and eliminated half of those regulations. It also reviewed at least 50,000 specifications and standards used to guide procurement and planned to revise 9,000 and cancel 5,000 outright.[32]

Another task force examined the problem of program advocacy. Multiple DoD staff offices and officials existed solely to review programs and to advocate special regulatory or statutory requirements. For example, advocates ensured that programs met quotas for small and minority-owned businesses and logistics requirements like packaging and transportability. These advocates could make time-consuming demands for information—with little accountability. They continued to exercise authority over programs even after the requirements they advocated had been institutionalized in the acquisition process.[33]

The Defense Management Report also intended to revitalize the Defense Enterprise Program concept. OSD instructed the services to nominate a new slate of programs for this status and established a working group in December 1989 to develop operating procedures for the program. The services together nominated seven programs, but the working group concluded there was little point to continuing with the concept. The DMR mandated the same streamlined management for all major programs, and the ongoing budget turmoil made program stability impossible. The Defense Enterprise Program plan was put on hold and eventually dropped.[34]

The Defense Management Report sought to achieve savings and efficiency by consolidating various department functions. For example, as noted above, contract administration services would be consolidated in the Defense Contract Management Agency. Previously, contracting was divided among the Defense Logistics Agency's Defense Contract Administration Services (mostly for the purchase of commodities) and the individual services, which managed the contracts for their major weapon system programs. Even within the services, these functions were dispersed throughout the systems commands. This dispersion led to considerable duplication of resources and effort, although the services argued that this arrangement kept the contract managers closer to the programs they assisted. A DCMA task force devised a plan to transfer all personnel and contracts to a single organization. The original plan was to create a new agency reporting directly to the under secretary for acquisition, but the organization was ultimately established as a command within the Defense Logistics Agency in February 1990. Subsequently, 5,400 personnel, 100,000 contracts worth $400 billion, and 44 service Plant Representative Offices (later renamed Defense Plant Representative Offices) on-site at contractor facilities transferred to the new command. Nine Defense Contract Administration Services regions were reorganized into five Defense Contract Management districts. Army Maj. Gen. Charles R. Henry became the first commander of the new Defense Contract Management Command.

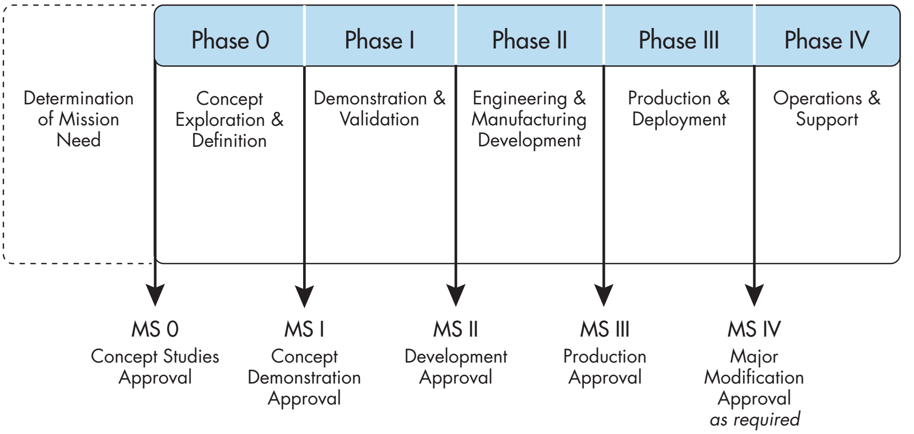
Accounting services were similarly consolidated into a single organization, the Defense Finance and Accounting Service, under the authority of the DoD comptroller.[35]

OSD followed the reforms of the Defense Management Report with a revision of the 5000 series documents, in addition to the DFARS the most important guidance governing acquisition. The overhaul would reflect OSD's vision of how defense acquisition would be conducted. A five-person working group led by Army Brig. Gen. William Fedorochko Jr. and made up of a representative from each of the other two military departments, the Joint Staff, and OSD managed the revision. The "Fedorochko Five" prepared drafts and sought input from the services, other DoD components, OSD offices, and the JCS chairman. OSD had hoped to complete the task by summer 1990 but did not publish the new guidance until the following February. Directive 5000.1 (Defense Acquisition), the capstone document of the acquisition system, defined the department's fundamental philosophy for acquisition. Instruction 5000.2 (Defense Acquisition Management Policies and Procedures) and Manual 5000.2-M (Defense Acquisition Management Documentation and Reports) explained in detail the new policies and their implementation. The new policies were, according to one expert, "easily the most far-reaching changes enacted since the 5000 [series] was originally published in 1971." They had four fundamental goals: to create a uniform system of acquisition policy throughout the Defense Department; to discipline the acquisition process by enunciating and enforcing clear rules and procedures; to consolidate and reduce the welter of separate regulations that were hard to track; and to address a number of common complaints about the existing system, such as the "advocates" mentioned above.[36]

The new guidance documents made a number of changes in the acquisition system. Now only three committees supported the Defense Acquisition Board instead of 10. Some of the milestones and phases changed—programs were now initiated at Milestone I instead of Milestone 0, and the Full-Scale Development phase became Engineering and Manufacturing Development (EMD) (see figure 2-4). Whereas the previous guidance recognized only two categories of programs, major and non-major, the new 5000 series documents recognized four acquisition categories (ACATs), with ACAT I representing Major Defense Acquisition Programs (see table 2-1). Other changes ambitiously sought for the first time to connect acquisition management with requirements generation and the Planning, Programming, and Budgeting System.[37]

Covering virtually every aspect of acquisition, the new guidance canceled at least 60 directives, instructions, memoranda, and manuals, compiling them into three comprehensive 5000 series documents, totaling over 900 pages, to which every acquisition manager or worker could refer. (By contrast, the 1987 documents, 5000.1 and 5000.2, together totaled only 40 pages; no previous total of the two had ever exceeded 60 pages during the 20 years they had been issued.) OSD intended the guidance to be clear, comprehensive, and located in one place so that no one could claim they could not find the documents or did not understand them. OSD even asked Ford Motor Company about the firm's program to use "plain English" in dealing with customers.[38]

Figure 2-4: Acquisition Milestones and Phases, 1991



Source: Adapted from Figure 10 (Acquisition Milestones and Phases), in Schmoll, *Introduction to Defense Acquisition Management*, 2d ed., 26.

OSD also wanted the acquisition guidance to be universal and applied uniformly. No longer would the services be permitted to customize organizations and procedures—essentially create their own acquisition systems—with little relationship to each other, or make changes to the new directives that would alter the way they would be carried out. Service regulations could implement but not supplement the 5000 series. OSD enforced that order strictly. It required the services to submit the draft revisions of their acquisition regulations for review by the under secretary's office, which rejected any deviation from the 5000 series documents. In an effort to force a common language across the department, OSD refused to allow the services to use their own terms for specific activities or functions when the 5000 series used a different one. These changes increased the defense secretary's control over acquisition while maintaining decentralized program execution in the services, as opposed to the centralized acquisition agency proposed by some in Congress.[39]

Meanwhile, Cheney pressed for legislative support for DMR actions. In April 1990 he sent his legislative package, the Defense Management Improvement Act, to Capitol Hill. Rather than one, all-encompassing reform, the bill sought relief from statutory legislation preventing the department from implementing certain administrative measures. For example, the proposed act promoted the use of multiyear contracts, which made for more stable programs by removing the statutory requirement that such contracts must reduce program costs by at least 10 percent. It also authorized commercial-style purchasing procedures for buying off-the-shelf products and permitted the department to establish up to six pilot programs to test the approach. Additionally, in awarding contracts, the act allowed the government to consider a potential contractor's past performance, instead of automatically selecting the lowest bidder; authorized the secretary to waive the requirement to name at least two

Table 2-1: Acquisition Categories

CATEGORY	CATEGORY DESIGNATION CRITERIA
ACAT ID	DAB review; designated by DAE; milestone decision by DAE; value $300M RDT&E or $1.8B procurement
ACAT IC	Component (Service HQ) review; designated by DAE; milestone decision by Service Secretaries/CAE; value $300M RDT&E or $1.8B procurement
ACAT II	Does not meet ACAT I criteria; designated by Service Secretaries/CAE; milestone decision by Service Secretaries/CAE; value $75M RDT&E or $300M procurement
ACAT III	Does not meet ACAT I or II criteria; designated by CAE; milestone decision at lowest appropriate level
ACAT IV	All others; designated by CAE; milestone decision at lowest appropriate level.

Note: Defense acquisition programs were grouped into categories based on their milestone decision authority and dollar value (in 1993 in FY 90 constant dollars). ACATs ID and IC were for major system programs. By 1999 the value of ACAT ID and IC programs was $355M RDT&E or $2.135B procurement; ACAT II, $135M RDT&E or $640M procurement (all in FY 96 constant dollars).

CAE – Component Acquisition Executive
DAB – Defense Acquisition Board
DAE – Defense Acquisition Executive

Sources: Schmoll, *Introduction to Defense Acquisition Management*, 2d ed., 17; Schmoll and Chuck B. Cochrane, *Introduction to Defense Acquisition Management*, 4th ed. (Fort Belvoir, VA: DSMC Press, Jun 1999), 26–28.

sources for each product or system if dual sourcing was not justified by the cost; and gave DoD some flexibility in managing its civilian and military workforce.[40]

Cheney's legislative package was relatively modest. He did not need much help from Congress to promote his reforms. His main objective was relief from what the Defense Department considered excessive statutory regulations, requirements, and mandates. To drive home the point, at the press briefing announcing the results of the Defense Management Report, Cheney and Atwood presented two huge stacks of documents they said represented a year's worth of reports required by Congress. On the same day he sent his legislative package to the Hill, Cheney released a report enumerating his complaints. The *White Paper on the Department of Defense and the Congress* noted the dramatic increase in the amount of information Congress demanded. Budget justifications had grown from 12,350 pages in 1977 to 30,114 pages in 1988. Between 1970 and 1988, the number of reports required by annual legislation increased 2,000 percent, from 36 to 719. "DoD reporting requirements are so voluminous and imposed in so many different ways that compiling a comprehensive list is virtually impossible," the white paper stated.[41]

Cheney also argued that congressional action muddied the acquisition process and sowed contradictions and confusion. Legislators, the white paper asserted, focused too much on specifics instead of broad policy and used the annual budget process to tinker with programs, significantly complicating program management. Lawmakers were often intent on promoting the interest of their constituents at the expense of good management. And Congress continually reopened supposedly "final" decisions and encouraged the services to deal with legislators directly, creating factions within the Pentagon and weakening the centralizing discipline required for effective program planning and execution. "This effort to divide is an enduring aspect of Congressional defense policy," the white paper stated. "All this led to increased program costs and a slower process." "In summary," Cheney concluded, "the current Congressional defense process is characterized by a multiplicity of actors, frequent decisions, lack of finality, disintegration and lack of accountability."[42]

The Defense Management Improvement Act met with what might be described as "benevolent ambivalence" on Capitol Hill. While some in Congress complained the reforms did not go far enough, the legislators largely approved what Cheney was doing. The Senate Armed Services Committee staff and House Armed Services Committee Chairman Aspin expressed themselves as anxious to cooperate with Cheney and foster an ongoing dialogue with the Defense Department. However, Congress shied away from playing a leadership role or spending much time on the reforms. The budget process was particularly contentious in 1990, and the DMR was "not a sexy subject," observed Assistant Secretary of Defense for Legislative Affairs David Gribbin. Also, Congress wanted to see some sign that the DMR was a serious initiative and not a sham reform to get Congress off DoD's back. Two weeks after the bill was introduced, Gribbin noted, "Congress is not anxious to handle the Department's legislative proposals dealing with . . . the DMR." The House was genuinely interested but more concerned about legislation on the acquisition workforce. The Senate showed little enthusiasm at all for the bill, except as a tool for countering the House's workforce proposals.[43]

Ultimately, much of what Cheney asked for became part of the FY 1991 National Defense Authorization Act. It enacted intact six of the proposals relating to acquisition, including easing the restrictions on multiyear contracting and the requirements for dual-sourcing, and allowing the government to consider past performance in awarding contracts. Four other proposals passed in altered form. Eight were not enacted, including the streamlined procedures for commercial contracting, although Congress allowed the secretary of defense to try his pilot programs for commercial contracting.[44]

Complicating further changes in the statutes was a lack of clarity over the scope and nature of acquisition law. Everyone in the Defense Department and Congress agreed that the acquisition laws needed an overhaul, but no one knew how many existed. Early in his term, Secretary Cheney publicly used the figure of 1,600 procurement laws, a number given to him by Assistant Secretary of Defense for Public Affairs J. Daniel Howard. The Pentagon had been using the number for several years, but no one knew where it came from. Howard tracked it to the 1972 report of Congress's Commission on Government Procurement. He then asked the department's Office of the General Counsel how many laws governed DoD acquisition. It had no idea. An office attorney suggested 2,200 but admitted that it was just a guess. "I find this all very hard to believe," Howard reported to Cheney in exasperation. "No wonder things are in such a mess."[45]

The general counsel had noted, "There is probably no way of coming up with a meaningful number that could be readily understood and accepted." Much of the problem lay in defining an "acquisition law," given the broad nature of the acquisition concept. Provisions relating to acquisition were scattered throughout a number of congressional enactments, including authorization and appropriations acts. Provisions relating to disparate and often unrelated aspects of acquisition were often bunched together in the same piece of legislation. Did each clause count as a "law?" Each amendment? The general counsel warned that simply laying the groundwork for a study by establishing such definitions, and then counting the relevant provisions, would be a daunting undertaking.[46]

Acting on the suggestion in the Defense Management Report that Congress take the lead on this issue, legislators added a provision to the FY 1991 National Defense Authorization Act to form the Advisory Panel on Streamlining and Codifying Acquisition Laws. The panel, known as the Section 800 Panel (for the number of the provision in the act), was to consist of experts in acquisition law and procurement policy from the public and private sector working under the sponsorship of the Defense Systems Management College, the primary institution for professional acquisition education and training in DoD. The panel was to review all laws relating to acquisition and recommend any for repeal or amendment, with a view toward streamlining the acquisition process. It was to present its findings to the under secretary of defense for acquisition in December 1992, and in turn the secretary of defense was to transmit the report to Congress in January.[47] (For the Section 800 panel recommendations, see chapter VI.)

The most important piece of reform legislation that passed in 1990 was not requested by DoD. The Defense Acquisition Workforce Improvement Act (DAWIA), passed as part of the FY 1991 National Defense Authorization Act, was the most far-reaching measure ever enacted relating to the acquisition workforce. It laid out a comprehensive reform of workforce management, including requirements for training and career progression. Each service was to create an acquisition corps, with its own requirements and regulations, to provide a career path for acquisition professionals.[48] (For a detailed discussion of acquisition workforce reforms in the 1990s, see chapter XV.)

* * * * *

Determined to correct the failings of the acquisition system, President Bush called for full implementation of the Packard Commission reforms. To this end, Secretary Cheney's Defense Management Report strengthened the authority of the under secretary for acquisition, particularly with respect to the services, and directed the services to adhere to the streamlined acquisition reporting structure from program manager through program executive officer to the civilian acquisition executive that had been established in each military department. The DMR also increased the role of the Joint Chiefs in acquisition, notably by giving the chairman authority to approve service-proposed requirements for weapon systems. Additionally, the report established the Executive Committee as the department's senior decision-making body for acquisition, emphasized the Defense Acquisition Board's role in disciplining the acquisition system through its reviews of major programs, called for consolidating the department's contract administration in one organization (the Defense Contract Management Command), and directed each service to establish a uniformed acquisition corps. In the wake of the review, OSD initiated a revision of the 5000 series documents that contained acquisition policy and process guidance for DoD. The revision sought to provide clear, comprehensive guidance that would be applied uniformly throughout the department. Although Cheney's acquisition reforms did not go as far as some observers would have liked, they applied the spirit as well as the letter of the Packard recommendations and probably represented the limit of what the secretary reasonably could have hoped to achieve in four years. The reforms would be severely tested during the remainder of the Bush presidency, under the stress of new scandals, the early resignation of Under Secretary for Acquisition Betti, a severe budget decline, and Operations Desert Shield and Desert Storm.

Endnotes

1. J. Ronald Fox et al., *Defense Acquisition Reform, 1960–2009: An Elusive Goal* (Washington, DC: CMH, 2011), 120–121, 128–129; Jacques S. Gansler, *Affording Defense* (Cambridge, MA: MIT Press, 1989), 188–189, 195–196; GAO, *Test and Evaluation: Impact of DoD's Office of the Director of Operational Test and Evaluation*, GAO/NSIAD-98-22 (Oct 1997), 1–2; Bill Keller, "Pentagon; The 'Junkyard Dog' Earns a Blue Ribbon," *New York Times*, 29 Aug 1985, B10.

2. For the origins and makeup of the military reform movement, see Winslow T. Wheeler and Lawrence J. Korb, *Military Reform: A Reference Handbook* (Westport, CT: Praeger Security International, 2007), 17–32; Peter W. Chiarelli and Raymond C. Gagnon Jr., *The Politics of Military Reform* (Newport, RI: Center for Naval Warfare Studies, Jun 1985), 1–3, 7–11, 14–29, 32–34, 37–40, 46–54, 63–64; James Fallows, *National Defense* (New York: Random House, 1981), 95–106; Robert Coram, *Boyd: The Fighter Pilot Who Changed the Art of War* (Boston: Little, Brown, 2002), 188–368; James G. Burton, *The Pentagon Wars: Reformers Challenge the Old Guard* (Annapolis, MD: Naval Institute Press, 1993), 7–98; Walter Kross, *Military Reform: The High-Tech Debate in Tactical*

Air Forces (Washington, DC: National Defense University Press, 1985), 13–15; A. Ernest Fitzgerald, *The Pentagonists: An Insider's View of Waste, Mismanagement, and Fraud in Defense Spending* (Boston: Houghton Mifflin, 1989), 130–132; Charles Mohr, "New Breed of Military Reformer," *New York Times*, 12 Oct 1983, B6.

3. For key statements of the reformers, see Franklin C. Spinney, *Defense Facts of Life: The Plans/Reality Mismatch* (Boulder, CO: Westview Press, 1985). For a more concise summary, see Fallows, *National Defense*, 22–24, 35–75. See also Pierre Sprey, "The Case for Better and Cheaper Weapons," in Asa A. Clark IV, et al., eds., *The Defense Reform Debate: Issues and Analysis* (Baltimore, MD: Johns Hopkins University Press, 1984), 193–208. For an overview of the reform debate as a whole, see John M. Oseth, "An Overview of the Reform Debate," in Clark et al.

4. Fox et al., *Defense Acquisition Reform*, 99–100, 106–120; Chiarelli and Gagnon, *Politics of Military Reform*, 54–55; Andrew J. Butrica, "An Overview of Acquisition, 1981–1990," in *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*, ed. Shannon A. Brown (Washington, DC: CMH and Industrial College of the Armed Forces, 2005), 216–217 (quote, 217).

5. Wheeler and Korb, *Military Reform*, 56–58; Fitzgerald, *Pentagonists*, 226, 229; President's Blue Ribbon Commission on Defense Management [Packard Commission], *A Formula for Action: A Report to the President on Defense Acquisition* (Washington, DC: The Commission, Apr 1986), 1–35; Packard Commission, *Quest for Excellence*, 39–71; National Security Decision Directive (NSDD) No. 219 (Implementation of the Recommendations of the President's Commission on Defense Management), 1 Apr 1986, https://www.reaganlibrary.gov/reagans/reagan-administration/nsdd-digitized-reference-copies, accessed 10 Mar 2020; Packard Commission, *An Interim Report to the President* (Washington, DC: The Commission, 28 Feb 1986), 13–21. The position of under secretary for acquisition was created by the *Military Retirement Reform Act of 1986*, P.L. 99-348 (1 Jul 1986), Title V, sec. 501. The position (and that of deputy under secretary) was defined by the *Defense Acquisition Improvement Act*, identical versions of which were included in several acts, all passed by the 2d session of the 99th Congress: P.L. 99-500 (18 Oct 1986), Title X, secs. 900–902; P.L. 99-591 (30 Oct 1986), Title X, secs. 900-902; *National Defense Authorization Act for Fiscal Year 1987*, P.L. 99-661 (14 Nov 1986), Title IV, secs. 900–902 (later corrected to Title IX). Section 6 of the *Defense Technical Corrections Act of 1987*, P.L. 100-26 (21 Apr 1987), declared that the *Defense Acquisition Improvement Act* was to be considered as having been enacted only once. For *Goldwater-Nichols Act*, see P.L. 99-433 (1 Oct 1986), Title V, Part A, sec. 501(a)5; Part B, sec. 511(c)2; and Part C, sec. 521(a)3.

6. Wilbur D. Jones Jr., *Introduction to Defense Acquisition Management* (Washington, DC: DSMC, Mar 1989), 9–12, 21–22; David Graham et al., *Defense Acquisition: Observations Two Years after the Packard Commission*, vol. 1: *Main Report*, IDA Report R-347 (Alexandria, VA: Institute for Defense Analyses [IDA], Nov 1988), III-7–III-11; DoD Directive 5134.1 (Under Secretary of Defense [Acquisition]), 10 Feb 1987, 1–5; DoD Directive 5000.49 (Defense Acquisition Board), 1 Sep 1987.

7. Jones, *Defense Acquisition Management*, 12–14; DoD Directive 5000.1 (Major and Non-Major Defense Acquisition Programs), 1 Sep 1987, 2, 8–9.

8. Ltr, Aspin and Mavroules to President George Bush, 17 May 1989 (quote), doc 56878, folder 400.13 (May-Jun), box 74, Acc 330-91-0095, Records of the Office of the Secretary of Defense (Record Group 330) [hereafter OSD Records], Washington National Records Center (WNRC), Suitland, MD. See also memo, Donald B. Rice for Richard Cheney and Donald Atwood, 15 Mar 1989, subj: Managing the Pentagon, doc 24644, folder 310.1 (Jan-Jun), box 50, ibid. Aspin's and Mavroules's statement seems to have been based on the testimony of David R. Graham, the lead author of a study on the implementation of the Packard Commission's recommendations, who had testified just a week before that "the literal mandates have been implemented, but the spirit has not." HCAS, Investigations Subcommittee, *Department of Defense Implementation of the Packard Commission Report of 1986: Hearings*, 101st Cong., 1st sess., 11 May and 12 Jul 1989, 10.

9. GAO, *Defense Management: Status of Recommendations by Blue Ribbon Commission on Defense Management*, GAO/NSIAD-89-19FS (Nov 1988), 30–31, 47–49; GAO, *Acquisition Reform: DoD's Efforts to Streamline Its Acquisition System and Reduce Personnel*, GAO/NSIAD-90-21 (Nov 1989), 14–15; Graham et al., *Defense Acquisition*, III-1–III-4, IV-2–IV-3, IV-19–IV-20; SCAS, *Defense*

Acquisition Process: Hearings, 100th Cong., 2d sess., 11, 12, 27 Jul and 4 Aug 1988, S. Hrg. 100-963; HCAS, Investigations Subcommittee, *Department of Defense Implementation of the Packard Commission Report*, 20–24.

10. Graham et al., *Defense Acquisition*, II-9–II-14; HCAS, Investigations Subcommittee, *Department of Defense Implementation of the Packard Commission Report*, 15, 19; James Kitfield, "Reforms: Running in Place?" *Military Forum* 5, no. 5 (Mar 1989): 40–48; "Acquisition Reform Under Costello," *National Security Record* [Heritage Foundation], Mar 1989, 2–3.

11. Graham et al., *Defense Acquisition*, III-12–III-18; GAO, *Status of Recommendations*, 33–37; GAO, *DoD's Efforts*, 19–21, 24–28, 31–33, 36–37; SCAS, *Defense Acquisition Process,* 27 Jul 1998, 146 (quote). In May 1989 the secretary of the Army appointed the assistant secretary of the Army for research, development, and acquisition to replace the under secretary as the SAE.

12. Graham et al., *Defense Acquisition*, V-3–V-4; "Information Paper: Defense Enterprise Program," n.d., attached to memo, USD(A) John Betti for Secretaries of Military Departments, 13 Sep 1989, subj: Defense Enterprise Programs, folder 13 Sep 1989, box 8, Acc 330-92-0136, OSD Records, WNRC; "Final Report: Defense Enterprise Program Working Group," n.d., attached to memo, Acting USD(A) Donald Yockey for Secretaries of Military Departments et al., 29 Jan 1991, subj: Defense Enterprise Program Working Group – Final Report, folder 29 Jan 1991, box 1, Acc 330-94-0007, OSD Records, WNRC. For background and analysis of the Defense Enterprise Programs, see Mark Robert Radice, "The Defense Enterprise Program: A Managerial Assessment" (master's thesis, Naval Postgraduate School, Jun 1992), 8–101, particularly the initial list of programs on page 61.

13. Packard Commission, *Quest for Excellence*, 25–27, 59–60; Richard H. P. Sia, "Risks Outweigh Savings on Multiyear Arms Contracts, Critics Say," *Baltimore Sun*, 16 Apr 1989, 19. For background on multiyear contracting, see Karen W. Tyson et al., *The Effects of Management Initiatives on the Costs and Schedules of Defense Acquisition Programs*, vol. 1: *Main Report*, IDA Paper P-2722 (Alexandria, VA: IDA, Nov 1992), chap. 7:1–8; and Karen W. Tyson, David E. Hunter, and Daria C. Renden, *Acquisition Initiatives in the New Environment: Multi-year Procurement Update*, IDA Paper P-2185 (Alexandria, VA: IDA, 1999), 6–10.

14. Graham et al., *Defense Acquisition*, chap. 7:1–6; GAO, *DoD's Efforts*, 40–43.

15. Graham et al., *Defense Acquisition*, ES-13.

16. Ltr, Zumwalt to SecDef Richard Cheney, 6 Jul 1989, folder 310.1, doc 60540, box 49, Acc 330-91-0095.

17. Karen Hosler, "Bush Promises Sailors He'll End Pentagon Waste," *Baltimore Sun*, 1 Feb 1989, 3 ("wring the last drop"); President George H. W. Bush, "Address on Administration Goals Before a Joint Session of Congress," 9 Feb 1989, *Bush Public Papers 1989*, 1:79.

18. George Hackett, with John Barry and Douglas Waller, "A 'Radical' Reformer?" *Newsweek*, 23 Jan 1989, 19; Andy Pasztor, "Cheney Effort to Revamp Arms-Buying Hobbled by Opposition of Military Brass," *Wall Street Journal*, 17 Nov 1989, A9A ("front and center"); ltr, Cheney to Richard G. Darman, Director Office of Management and Budget, 29 Jun 1989, doc 59618, folder 310.1, Acc 330-91-0095. The four acquisition objectives were: 1) provide streamlined management of the defense acquisition process; 2) provide stability in funding major defense acquisition programs; 3) secure improvements for a more capable and efficient civilian and military acquisition workforce; and 4) improve DoD procurement practices to increase industry effectiveness. The White House modified these objectives before publishing them.

19. *Department of Defense Acquisition Reorganization Act of 1989*, 101st Cong., 1st sess., S. 1202; *Department of Defense Acquisition Reorganization Act of 1989*, 101st Cong., 1st sess., S. 433; *Department of Defense Acquisition Reorganization Act of 1989*, 101st Cong., 1st sess., H.R. 2897; *Independent Procurement Corps Act of 1989*, 101st Cong., 1st sess., H.R. 965; memo, Gribbin, 16 Jun 1989, subj: Meeting with HASC Staff on Acquisition Reform (quote), folder 400.13, box 74, Acc 330-91-0095. See also memos, USD(A) Robert Costello for General Counsel, 5 Apr 1989, folder 5 Apr 1989, box 4; Costello for General Counsel, 5 May 1989, folder 5 May 1989, box 5; ltr, Acting USD(A) Michael W. Stone to Sen. William Roth, 31 Jul 1989, folder 31 Jul 1989, box

7; Stone to General Counsel, 11 Aug 1989, subj: S. 1202, 101st Congress, A Bill "To Amend Title 10, United States Code, to provide for the centralized planning and conduct of major defense acquisition programs of the Department of Defense, to establish with the Dept. of Defense a Defense Acquisition Agency, and For Other Purposes," folder 11 Aug 1989, box 8; Stone to General Counsel, 11 Aug 1989, subj: H.R. 2632, 101st Congress, A Bill "To Amend Title 10, United States Code, to Improve the Management of Major Weapon Systems in the Department of Defense"; and USD(A) Betti to General Counsel, 1 Sep 1989: all in Acc 330-92-0136; memo, USD(A) Yockey for DepSecDef, 3 Feb 1992, folder 3 Feb 1992, box 1, Acc 330-95-0057, OSD Records, WNRC.

20. Myron Struck, "Former Undersecretary for Acquisition Critical of Management Review," *Defense News*, 2 Oct 1989, 26; ltrs, Melvin Laird to Atwood, 19 May 1989, doc 57110; Harold Brown to Cheney, 13 Jun 1989, doc 59082; and E. E. Hood to Paul S. Stevens, 6 Jun 1989, doc 58547: all in folder 310.1 (Jan-Jun), box 50, Acc 330-91-0095; Secretary of Defense Dick Cheney, *Defense Management: Report to the President* (Washington, DC: DoD, Jul 1989).

21. Cheney, *Defense Management*, 3–4. DMR was also often represented as standing for "Defense Management Review."

22. Ibid., 8.

23. Ibid., 9.

24. Ibid., 8–10.

25. GAO, *Acquisition Reform: Authority Delegated Under the Secretary of Defense for Acquisition*, GAO/NSIAD-90-183 (Jun 1990), 1–4. For a word-for-word comparison of the original 1987 charter with the 1989 charter, see ibid., 8–14.

26. Undersecretary of Defense (Acquisition) Background Transition Book, tabs 3E and 3H, folder References, Transition Briefing Books, box 1, Acc 330-93-0047, OSD Records, WNRC; Cheney, *Defense Management*, 7, 17–18. As of October 1988 there were 43 joint programs of the total of 118.

27. Cheney, *Defense Management*, 12–17.

28. Ibid., 22–23, 25–27; Cheney, marginal note on ltr, Aspin and Mavroules to President Bush, 17 May 1989, doc 56878, folder 400.13 (May-Jun 1989), box 74, Acc 330-91-0095.

29. Frank Carlucci, David Packard, and James Woolsey, "Defense Management Review," press conference, 14 Jul 1989, *Defense Issues* 4, no. 23, 1; memo, General Robert T. Herres, Vice Chairman, JCS, for the DepSecDef, 27 Apr 1989, subj: Comments on Defense Management Review Briefing, doc 55105, folder 400.13 (Jun-Apr 1989), box 75; memo, SecNav H. Lawrence Garrett III for Paul Stevens, ExecAsst to the SecDef, 18 Apr 1989, subj: Consolidation of DoD Contract Administration under DLA, folder 020 DLA, box 12; memo, Admiral Leon A. Edney, Vice Chief of Naval Operations, for Director, Joint Staff, 6 Jun 1989, subj: Defense Management, folder 020 DoD, box 12: all in Acc 330-91-0095.

30. Memo, Stevens for DepSecDef, 19 Jul 1989, subj: July 20th meeting on Defense Management Review, doc 61385, folder 310.1 (Jul), box 49, Acc 330-91-0095.

31. John Grano, "Services Balk at System Command Cutbacks Mandated by Management Review," *Inside the Pentagon*, 13 Oct 1989, 1 (quote); Pasztor, "Cheney Effort to Revamp Arms-Buying," A9A; "NavSea Commander Blasts Cheney's Pentagon Overhaul," *Navy News & Undersea Technology*, 1 Apr 1991, 1.

32. Memo, DepSecDef Donald Atwood for Secretaries of Military Departments et al., 4 Oct 1989, subj: Defense Management Report Implementation Coordination Office, doc 65822, folder 310.1 (Sep-Oct), box 49, Acc 330-91-0095; memo, Ann Reese, Director, Defense Management Report Implementation Coordination Office, for the DepSecDef, n.d., subj: Status of Various DMR Actions, folder 16 Jul 1991, box 5, Acc 330-94-0007; USD(A) Betti, "Joint OSD-DoD Component Regulatory Relief Task Force Report," Jan 1990, attached to memo, Betti for DepSecDef, 9 Jan 1990, folder 400.13 (Jan-Feb), box 71, Acc 330-92-0097; memo, Director of Acquisition Policy and Program Integration for DepSecDef, 24 Jun 1992, subj: Acquisition DMR Regulatory Relief Update, folder 30 Jun 1992, box 5, Acc 330-95-0057: all in OSD Records, WNRC.

33. Advocacies existed for:
    - Cost control
    - User interface (incl. training, safety, security, technical requirements)
    - Total Quality Management (incl. quality assurance, reliability, availability, maintainability)
    - Industrial preparedness (incl. mobilization planning, nuclear survivability)
    - Production
    - Logistics (incl. transportation, packaging, maintenance, standardization)
    - Competition and right to technical rights
    - Personnel, staffing, and contract services
    - Small and disadvantaged business utilization
    - International cooperation
    - Environmental protection
    - Interagency coordination
    - Management reviews
    - Test and evaluation
    - Command, control, communications, and intelligence
    - Research and development/technology
    - Labor
    - Procurement process (incl. procurement planning, contract administration, source selection, acquisition streamlining)

See Joint OSD-DoD Component Program Advocacy Reduction Task Force: A Defense Management Review Report, n.d. [Apr 1990], tab A, folder 6 Apr 1990, box 4, Acc 330-94-0006, OSD Records, WNRC.

34. Memo, DUSD(A) Robert McCormack for Secretaries of Military Departments et al., 28 Dec 1989, subj: Revitalization of the Defense Enterprise Program, folder 28 Dec 1989, box 11, Acc 330-92-0136; "Report of the Defense Enterprise Program Working Group" (draft), n.d., attached to memo, Acting DUSD(A) Duane Andrews for Secretaries of Military Departments et al., 17 May 1990, subj: Defense Enterprise Program Working Group – Final Report (Draft), folder 17 May 1990, box 5, Acc 330-94-0006; Final Report: Defense Enterprise Program Working Group, n.d., attached to memo, Acting USD(A) Yockey for Secretaries of Military Departments et al., 29 Jan 1991, folder 29 Jan 1991, box 1, Acc 330-94-0007. The programs nominated by the services were the Army's Light Helicopter Experimental (LHX), Anti-Satellite (ASAT), and Abrams tank (M1A2); the Navy's Advanced Interdiction Weapon System (AIWS) and Advanced Air-to-Air Missile (AAAM); and the Air Force's Advanced Tactical Fighter (ATF) and Earth Penetrating Weapon.

35. DCMA Task Force, "Defense Contract Management Agency Implementation Plan," Sep 1989, folder 020, 21 Sep 1989, box 11, Acc 330-91-0095; "The Defense Contract Management Command (DCMC) –'How-Goes-It,'" n.d., attached to memo, CO DCMC for DepSecDef, 10 Jun 1991, subj: To inform the Deputy Secretary about some important events for the Defense Contract Management Command (DCMC) over the past year, folder 18 Jun 1991, box 4, Acc 330-94-0007; memo, Maj. Gen. Charles Henry (CO, DCMC) for SecDef, 16 Nov 1992, subj: End of Tour Report, folder 8 Dec 1992, box 9, Acc 330-95-0057: all in OSD Records; William H. Andersen, "Future U.S. Army Finance Corps' Structure at the Department of the Army Level," Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, 21 Feb 1996), 18–19; DoD Directive 5118.5 (Defense Finance and Accounting Service), 26 Nov 1990. In March 2000 the Defense Contract Management Command separated from the Defense Logistics Agency and became an independent organization named the Defense Contract Management Agency reporting to the deputy under secretary of defense for acquisition and technology. See DoD Directive 5105.64 (Defense Contract Management Agency [DCMA]), 27 Sep 2000.

36. Richard Sylvester, "Defense Acquisition Directives: A Major Overhaul," n.d., in folder Briefings, 5000 Series 1991 Revision Files, OSD/HO; memo, DUSD(A) Yockey for DepSecDef Atwood, 23 Jan 1991, subj: DoDD 5000.1, folder 23 Jan 1991, box 1, Acc 330-94-0007; DoD

Directive 5000.1 (Defense Acquisition), 23 Feb 1991; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991; DoD Manual 5000.2-M (Defense Acquisition Management Documentation and Reports), 23 Feb 1991; Joe Ferrara, "DoD's 5000 Documents: Evolution and Change in Defense Acquisition Policy," *Acquisition Review Quarterly* 2 (Fall 1996):121 (quote). See also 5000 Series 1991 Revision Files.

37. Unsigned memo for DSMC faculty and students, 2 May 1991, subj: DoDD 5000.1, DoDI 5000.2, and DoD 5000.2-M, attached to [Charles B.] Chuck Cochrane, DSMC, to Ric Sylvester, Office of the Under Secretary of Defense for Acquisition (OUSD[A]), 3 May [1991], in folder Staff Clarifications, 5000 Series 1991 Revision Files; Ferrara, "DoD's 5000 Documents," 121–122; Cochrane, "Defense Acquisition Policy: A New Set of Directives for 'A Disciplined Management Approach,'" *Program Manager* 20 (May–Jun 1991): 29–34. For detailed descriptions of the changes, see briefings in the Briefings folder in the 5000 Series 1991 Revision Files, especially Highlights of DoD Acquisition Changes: New DoD 5000 Series [Dec 1991].

38. Ferrara, "DoD's 5000 Documents," 122; ltr, J. P. King, Manager, Parts and Service Engineering, Ford Parts and Service Division, to John D. Christie, 8 Jan 1990, folder 14 Feb 1990 to Betti, 5000 Series 1991 Revision Files.

39. Memo, Acting USD(A) Yockey for Defense Acquisition Board Members et al., 25 Mar 1991, subj: DoD Directive 5000.1, DoD Instruction 5000.2, and DoD 5000.2-M, folder DoD 5000.1/DoDI 5000.2 Implementation; memo, Yockey for Secretaries of Military Departments and Directors of Defense Agencies, 7 Jun 1991, subj: Defense Acquisition Regulatory Relief, folder Army Implementation: both in 5000 Series 1991 Revision Files; Yockey for CJCS et al., 1 Jul 1991, subj: Defense Acquisition Regulatory Relief, folder 1 Jul 1991, box 5, Acc 330-94-0007. For examples of OSD's enforcement of these instructions, in this case with the Army, see memos, Ric Sylvester, Office of the Deputy Director, Acquisition Systems Management, for Jay Dutcher, 16 Dec 1991, subj: Proposed Army Regulation 73-XX; unsigned for Director, Operational Test and Evaluation (DOT&E), Resources and Administration, 19 Dec 1991, subj: Review of Draft Army Regulation AR 73-XX; Director, Acquisition Policy and Program Integraton [AP&PI] through DUSD(A) for USD(A), 20 Dec 1991, subj: Comments on Proposed Army Implementation to DoDD 5000.1/ DoDI 5000.2; John E. Smith, DepDir, Acquisition Systems Management, for John Christie, Director AP&PI, 23 Dec 1991, subj: Review of Draft AR 70-1; Christie for Deputy Assistant Secretary of the Army (Plans and Programs), 9 Mar 1992, subj: Review of Draft Army Regulation 70-1; Christie for Deputy Under Secretary of the Army (Operations Research), 28 Apr 1992, subj: Comments on Draft Army Regulation (AR) 73-XX (Test and Evaluation Policy); Christie for Deputy Under Secretary of the Army (Operations Research), 28 Apr 1992, subj: Draft Army Regulation (AR) 73-XX (Test and Evaluation Policy); and Sylvester through Mr. Smith for Christie, 15 May 1992, subj: "Heads Up": all in folder Army Implementation, 5000 Series 1991 Revision Files. For the Air Force, see memos, Sylvester for Christie, 19 Sep 1990; Christie for Deputy Assistant Secretary of the Air Force (Management Policy and Program Integration), 22 Jul 1991, subj: Air Force Implementation of DoD 5000-Series; Christie for Assistant Secretary of the Air Force (Acquisition), 12 Sep 1991, subj: AFR 800-1 (Air Force Acquisition System); Christie for Assistant Secretary of the Air Force (Acquisition), 16 Sep 1991, subj: AFR 80-14 (Test and Evaluation), attached to Christie for Yockey; Smith to Christie, 30 Oct 1991, subj: Air Force Supplement to DoDI 5000.2; Christie for Assistant Secretary of Air Force (Acquisition), 31 Oct 1991, subj: Draft Air Force Supplement 1 to DoD Instruction 5000.2; and Christie for Assistant Secretary of the Air Force (Acquisition), 19 Jan 1993, subj: Air Force Supplement 1 to DoD Instruction 5000.2: all in folder Air Force Implementation, 5000 Series 1991 Revision Files.

40. Memo, General Counsel for SecDef, 4 Apr 1990, subj: Defense Management Improvement Act, folder 310.1, box 40, Acc 330-92-0097; "Talking Paper on the DMR Legislative Package," n.d., 5 Apr 1990, same folder; ltr, Cheney, SecDef, to Dan Quayle, President Pro Tem of the Senate, 5 Apr 1990, with attached CRS summary of the bill, same folder. The bill was introduced in the Senate by Samuel A. Nunn Jr. (D-GA) on 5 April as S. 2440, and in the House by Nicholas J. Mavroules (D-MA) on 10 May as H.R. 4794.

41. Peter Almond, "Cheney Unveils $30 Billion Package of Reforms," *Washington Times*, 12 Jul 1989, 3; Cheney, *White Paper on the Department of Defense and the Congress: Report to the President by the Secretary of Defense* (n.p., Jan 1990), 7, 10–11.

42. Cheney, *White Paper*, 12–30 (quotes, 27, 30).

43. Memo, General Thomas V. Draude, Director, DMR Implementation Coordination Office, for DepSecDef, 7 Feb 1990, subj: DMR Related Concerns Expressed by Congressional Staffs, with attachments, folder 310.1 (Feb); memo, Gribbin for USD(A), 7 Feb 1990, subj: DMR meeting with Members of Congress (quote), attached to ibid.; memo, Gribbin for DepSecDef, 18 Apr 1990, subj: DMR and Base Closure Legislation (quote), folder 310.1 (Mar-Jun): all in box 40, Acc 330-92-0097.

44. Memo, Ann Reese, Director DMR Implementation Coordination Office, for DepSecDef, n.d., subj: Status of Various DMR Actions, folder 16 Jul 1991, box 5, Acc 330-94-0007; *National Defense Authorization Act for Fiscal Year 1991*, P.L. 101-510 (5 Nov 1990), Title VIII, Part A.

45. Memo, Dan Howard, Assistant Secretary of Defense for Public Affairs (ASD[PA]), for SecDef, 17 May 1989, subj: Procurement Laws, doc 56957, folder 400.13 (May-Jun), box 74, Acc 330-91-0095.

46. Memo, Dennis H. Trosch, Assistant General Counsel for ASD(PA), 17 May 1989, subj: Request for Assistance in Determining Number of Laws Specifically Related to the Regulation of DoD Acquisition, 9 May 1989, attached to ibid.

47. *National Defense Authorization Act for Fiscal Year 1991*, P.L. 101-510 (5 Nov 1990), Title VIII, sec. 800, "Advisory panel on streamlining and codifying acquisition laws."

48. Ibid., Title XII, Chap. 87, "Defense Acquisition Workforce."

I. "Nomination of Richard P. Godwin To Be Under Secretary for Acquisition, August 1, 1986," *Public Papers of the Presidents of the United States: Ronald Reagan, 1986* (Washington, DC: NARA, 1989), 2:1032; Jon Thurber, "Richard P. Godwin, 82; Defense Official Worked to Reform Procurement System," *Los Angeles Times*, 11 Mar 2005, http://articles.latimes.com/2005/mar/11/local/me-godwin11, accessed 26 Feb 2020; Christopher Lehmann-Haupt, "Richard Godwin, 82, Leader in Bid to Alter Military Buying," *New York Times*, 12 Mar 2005, http://query.nytimes.com/gst/fullpage.html?res=9D02E0DC143CF931A25750C0A9639C8B63, accessed 26 Feb 2020; James Kitfield, "'Acquisition czar' gains supporters," *Military Logistics Forum*, Oct 1986, 13.

II. "Biographical Sketch of Dr. Robert B. Costello," U.S. Senate, *Nominations Before the Senate Armed Services Committee, First Session, 100th Congress: Hearings*, 3 Feb 1987, S. Hrg. 100-573, 18; Robert B. Costello, "Centennial Banquet Address," *Naval Engineers Journal* 100, no. 4 (Jul 1988): 95–97, http://onlinelibrary.wiley.com/doi/10.1111/j.1559-3584.1988.tb00795.x/abstract, accessed 26 Feb 2020; William J. Broad, "Pentagon Wizards of Technology Eye Wider Civilian Role," *New York Times*, 22 Oct 1991, http://www.nytimes.com/1991/10/22/science/pentagon-wizards-of-technology-eye-wider-civilian-role.html?pagewanted=all&src=pm, accessed 26 Feb 2020.

III. "Biographical Sketch of Donald J. Atwood," U.S. Senate, *Nominations Before the Senate Armed Services Committee, First Session, 101st Congress: Hearings,* 17 Mar 1989, S. Hrg. 101-573, 135–136; "Donald J. Atwood '48," *The Tech* 114, no. 24 (29 Apr 1994): 1, 11, http://www.nap.edu/openbook.php?record_id=5427&page=10, accessed 26 Feb 2020; B. Paul Blasingame, "Donald J. Atwood," *Memorial Tributes: National Academy of Engineering*, vol. 8 (Washington, DC: National Academies Press, 1996), 11–14, http://www.nap.edu/openbook.php?record_id=5427&page=10, accessed 29 Dec 2013.

IV. Schmoll, *Introduction to Defense Acquisition Management*, 2d ed., 17; Schmoll and Cochrane, *Introduction to Defense Acquisition Management*, 4th ed., 26–28.

CHAPTER III

The Failure of Oversight and Management: The A–12 Program

When Dick Cheney ran the Defense Department, two successive under secretaries with different backgrounds and approaches to the job were responsible for acquisition oversight. John Betti, Cheney's first under secretary for acquisition, was a reform-minded auto company executive with no experience in defense acquisition. Betti supported implementing the Packard Commission recommendations as called for by the Defense Management Report but also hoped to accomplish a broader reform of the system. However, even before his first year as under secretary ended, he faced a crisis with the Navy's attack aircraft program, the A–12 Avenger II. Oversight and management of the program had failed at all levels. Betti, whose relaxed management style played a part in the program's failure, received particularly heavy criticism and was forced to resign by the end of 1990. His successor, Donald J. Yockey, a retired Air Force officer and an experienced veteran of defense acquisition, did not support broader reform but instead tightened discipline and brought the system more firmly under OSD control. During his tenure the autonomy of the military departments in acquisition declined.

THE NEW ACQUISITION CZAR

In his efforts to overhaul defense management and reform the acquisition system, Secretary Cheney had the support of his senior staff. His deputy, Donald Atwood, intended to take a firm and active hand in managing the Defense Department, including the acquisition process. At his confirmation hearing on 5 April 1989, Atwood noted the department lacked discipline; the new acquisition procedures were frequently ignored in the rush to get systems into production. In the generally friendly hearing, the only controversy arose over Atwood's earlier statement that the under secretary for acquisition will "work with the service secretaries and service acquisition executives" as opposed to directing them. This concerned senators who believed the authors of the Packard Commission recommendations and the Goldwater-Nichols Act clearly intended the under secretary to exercise authority over the services. Atwood backed down, subsequently amending his answers in accordance with the legislators' view.[1]

In his pursuit of reform, Cheney had one significant advantage his predecessors lacked: the right to name the service secretaries. Typically the president chose those officials, but John Tower had extracted a promise from Bush that he would be allowed to do so if he became defense secretary, and the president accorded the same privilege to Cheney. Holding the power to handpick the civilian department heads strengthened the hand of the secretary in disputes with the services. Believing the previous administration had ceded too much power to the services, Cheney showed no reluctance to challenge them. In office only eight days, he publicly rebuked the Air Force chief of staff, General Larry D. Welch, for his lobbying activities on Capitol Hill. In November 1990 he summarily fired Welch's successor, General Michael J. Dugan, for discussing sensitive U.S. policy issues with respect to Iraq in comments to the press.[2]

Cheney replaced nearly every appointee in the Office of the Under Secretary for Acquisition, including Under Secretary Robert Costello, who departed on 12 May 1989. The search for a replacement was long, at least in part because of the perceived weakness of the position, and in part because of the new, stringent ethics laws that made it more difficult for officeholders to return to previously held positions in the private sector at the end of their government service. Cheney and Atwood spent three months on the search and asked as many as 20 people before finally swearing in John Betti as the third under secretary for acquisition on 11 August. Betti, then 58 years old, was an automotive engineer who had worked at Ford for most of his career, rising to executive vice president for diversified products operations.[3]

Betti came to the Pentagon with strong views about management. In particular, he was a follower of total quality management (TQM), which was hardly surprising since Ford was the first major American company to adopt the approach. TQM is both a philosophy and technique of management pioneered by American industrial and organizational consultants, most notably W. Edwards Deming. It emphasizes the importance of quality, as measured by customer satisfaction and achieved by continually improving processes and applying statistical tools to measure progress and results. Eschewing the traditional quality control efforts that focused on the final inspection of the product before its transfer to the customer, TQM advocates argue that quality must be a priority at every step of the industrial or service process, from the production and delivery of raw materials to the customer's use of the final product or service. They consider this quest for process improvement the responsibility of the entire organization from top to bottom, not just of management. Even workers at the bottom of the hierarchy must have the authority to act as they believe necessary to further the goals of the organization. Authority must match responsibility. Thus, TQM advocates reject traditional approaches to management-employee relations that emphasize the authority of management and the control of workers through reward, punishment, and exhortation. Instead, total quality management focuses on improving teamwork among workers and management.[4]

John Betti, under secretary of defense for acquisition, 1989–1990. *(NARA)*

John A. Betti

John Betti, the third under secretary of defense for acquisition, was born in January 1931 in Ottawa, Illinois. After receiving a B.S. in mechanical engineering from the Illinois Institute of Technology in 1952, he joined the Chrysler Corporation as a project engineer. At Chrysler during the next decade, Betti became an assistant chief engineer and earned an M.S. in automotive engineering from the Chrysler Institute of Automotive Engineering.

In 1962 Betti went to work for the Ford Motor Company. In more than 25 years with Ford, he held a series of engineering management positions, including the posts of vice president for powertrain and chassis operations, vice president for manufacturing and business development, executive vice president for technical affairs and operating staffs, membership on the company's board of directors, and finally, in 1988, executive vice president for diversified products operations. While at Ford, Betti established a close relationship with W. Edwards Deming, a leading proponent of total quality management and a consultant to the auto company. Betti's implementation of TQM techniques in Ford's powertrain and chassis operations resulted in increases in quality and productivity, inspiring a company-wide change in Ford's corporate culture.

After becoming under secretary in August 1989, Betti, like his predecessor, advocated the Defense Department adopt TQM philosophy and methods and supported the acquisition reform measures identified in the Defense Management Report. He initially came under fire for lack of knowledge of the department's major weapon system programs. Then, following a report by the DoD inspector general charging he had failed to inform Secretary of Defense Dick Cheney of significant delays and cost growth in the Navy's A–12 Avenger II attack aircraft program, Betti was forced to resign. He officially left his post on 31 December 1990.[I]

Teamwork required a significant shift in organizational culture, a major reason why efforts to implement TQM often proved difficult. Deming first noted the problems involved in changing organizational culture in the early 1950s, when American companies, flush from the postwar industrial boom, showed little interest in the concept. He was much more successful in Japan, which was struggling to rebuild its industrial base after World War II. By the 1980s the Japanese "economic miracle" had achieved great success, and many American companies, concerned about their own loss of productivity and market share to Japan in industries from automobiles to electronics, searched for that country's "secret" and found TQM. In response, many prominent companies, such as Ford, attempted to adopt the concept.[5]

The methodology of total quality management infused much of the reform movement in defense acquisition. Strategies that reflected TQM principles included improving education and training in the acquisition workforce, breaking down barriers between staff elements, promoting teamwork both within acquisition organizations and with customers (military forces) and suppliers (contractors), and awarding contracts based on quality instead of solely on price. Thanks to the efforts of Costello, a strong advocate of the concept, TQM became DoD policy in 1988 with Secretary of Defense Frank Carlucci's endorsement and the issuance of the Total Quality Management Master Plan. Costello's office became the focal point for TQM implementation in the Defense Department and he worked tirelessly to spread its gospel throughout DoD and among defense contractors. Deputy Secretary Atwood also endorsed the concept. By 1990 OSD had a deputy under secretary for total quality management and each military department had a similar civilian official and a flag officer (general or admiral) responsible for implementing TQM. By this time, the concept had become a government-wide initiative coordinated by the multiagency Federal Quality Institute.[6]

When he became under secretary, Betti preached total quality management to his staff and to the acquisition community. He criticized the "common assumption[s] that knowledge is power, that turf is a measure of worth, and that face time with the top person is most important." At his urging, the senior leadership in his office adopted a USD(A) Organization Vision of Success that stated, "We are recognized as a leading team member in providing the men and women in uniform high quality, superior products and services, when required, at a cost representing value to the taxpayer." Betti favored acting by consensus after a full and open discussion, though he insisted that decisions once made were final—contrary to the common bureaucratic tactic of revisiting or rehashing unfavorable decisions. "I am a firm believer," he told General Colin Powell, the chairman of the Joint Chiefs of Staff, "that an 80 percent decision that is stable and is 90 percent effectively implemented, is better than a 98 percent decision 50 percent implemented or a decision that never seems to be quite finalized and, therefore, never quite gets implemented."[7]

Betti also emphasized trust within the chain of command: "The secret to good management is finding the proper balance between micromanagement and the willingness to be held accountable for someone else's performance without being directly involved in that performance. I believe the key is trust." Trust, in turn, is based on integrity, honesty, and open communication, he argued. To promote accountability and informed decision-making, managers and workers at all levels had to pass on essential information, because "[w]ithholding essential information is as dishonest as providing false information." Betti himself set an example of trust with a restrained management style. "I don't like making assignments in a 'how to' manner," he explained, "when they are really intended to stimulate creativity on how to meet the objective."[8]

Believing problems were best avoided if they were revealed early, Betti took every opportunity to promote communication among his staff, the Defense Acquisition Board, and the acquisition community, through both formal and informal channels. He issued directives stipulating how to run board meetings (curiously at odds with the TQM approach), identifying the documentation the services were to provide for those meetings, and specifying the information he required to make informed decisions on the programs under review. He promoted informal dialogue through weekly breakfasts with the service acquisition executives and occasional lunches with industry officials. During the first week of April 1990, he sponsored the Acquisition Leadership Conference in Panama City, Florida, which gave acquisition personnel an opportunity to meet senior OSD and service acquisition officials and hear about new policies and goals. Betti's office held its own off-site conference in August. Betti also circulated memoranda about new policies and ideas within the office "to improve the information flow and foster teamwork," and he contributed a regular column to *Program Manager*, the acquisition community's professional journal.[9]

Betti fully supported the goals of the Packard Commission and the Defense Management Report and worked enthusiastically to promote reform in the acquisition system, but he believed the DMR was only the first step. "Although many previous attempts have been made to 'streamline' acquisition programs, a real breakthrough has not been achieved," he wrote. "As a whole, the process still remains ponderous and inefficient." Accomplishing such a reform required a better understanding of the system as a whole. He asked the Defense Science Board to form a task force to study the problem and recommend a streamlined acquisition process, in the form of a pilot program similar to the Defense Enterprise Programs described in chapter II. Betti wanted the board to address the root causes of schedule stretchouts and cost growth. Its task force was to produce a road map for cutting acquisition cycle time by 50 percent while also reducing costs and improving quality. In keeping with his TQM background, Betti emphasized the importance of addressing the entire acquisition process rather than just parts of it in isolation. He insisted on the task force's absolute independence from any service, industry, or other group: "To be effective, the Task Force must not be seen as an agent for *any* constituency."[10]

In a complementary effort, Betti established the Defense Acquisition Improvement Team "to serve as the focal point and catalyst for improving the DoD acquisition system through continuous process change." Led by Betti's military assistant, Vice Adm. James B. Greene Jr., the team would operate under the mandate of the Defense Management Report, but pursue reforms that went beyond those the report had called for and also "identify, track and report on acquisition initiatives which have potential for improving the DoD acquisition process."[11]

In the meantime, Betti acted to meet the goals outlined in the Defense Management Report. He initiated an aggressive program to increase the use of commercial products and non-developmental items (those requiring no more than minor modification). To promote a greater emphasis on past performance when selecting contractors, he established the Defense Contractor Performance Review System, allowing DoD components to share data on contractor performance. He insisted on strict enforcement of the statutes and Defense Department policy limiting the use of fixed-price development contracts, and refused to delegate the authority to approve such contracts. He also demanded that all programs have "a disciplined, event-driven acquisition strategy that explicitly linked milestone decisions to demonstrated accomplishments in development, testing, and initial production by means of exit criteria."[12]

Betti pressed the services to follow established policies and regulations and to maintain high standards of economy, efficiency, and timeliness. When the Air Force requested a six-month extension of the demonstration/validation phase for the Advanced Tactical Fighter (the F–22 Raptor), Betti demanded more information. "Jack, I apologize if this seems to be a chore, but frankly, I'm a firm believer that all programs need well thought out plans to have any chance of success," he explained to John J. Welch Jr., the assistant secretary of the Air Force for acquisition. "Those plans then have to be superbly executed." He warned that discipline in meeting commitments for performance, schedule, and cost was essential to build credibility and confidence in the acquisition process: "If we are not committed to our plans, or if our plans are inadequate, then our process will continue to be bankrupt."[13]

Thanks to the revised charter for the under secretary of defense, signed three days before Betti took office, the USD(A) was vested with considerably more authority than his predecessors, but he was not heavy-handed in exercising it. He approved the requests of the services in all but one of his first 15 program reviews, although he sometimes attached additional guidance or conditions. Practicing what he preached, Betti readily trusted the officials in the acquisition chain of command and worked to reduce OSD interference. In late February 1990 he said OSD should not act as police to catch the services if they did not comply with policy and direction; rather, the services should be expected to "indict themselves."[14]

Betti was particularly protective of program managers. If he had had a motto, it would have been, *let the program manager manage*. For example, in January 1990 Betti signed a memorandum limiting the authority to withhold and release program funds to himself and his deputy. Previously, other OSD officials could order funds withheld from programs if certain regulations and other requirements were not followed—or even if the official wanted to gain some leverage over the program. Such withholds were naturally disruptive to the programs and unpopular with the program managers. "[My] management philosophy and practice places fully on the [program manager] the authority and responsibility to ensure compliance with the Department's policies," Betti explained in the memo. "It in no way indicates any reduction in my desire for disciplined and responsive management of our acquisition programs. Rather, it signals my belief that *self-disciplined and responsible program managers are a more responsive and cost-effective control system than are* [*sic*] *a system of hierarchical reviews* [emphasis added]." Betti personally reviewed the existing withholds with the goal of eliminating as many as possible.[15]

Addressing one of industry's biggest complaints, Betti also reduced oversight of contractors. In June 1990 his principal deputy, Donald Yockey, formed a team on oversight that issued a report in September calling for fewer in-plant government representatives and auditors, fewer contract audits, and a shift in responsibility for many audits from the DoD inspector general to the Defense Contract Audit Agency.[16]

THE A–12 FIASCO

Despite the reform climate created by the Defense Management Report, new acquisition scandals and controversies marred Betti's tenure. The Pentagon was again accused of paying too much for aircraft tooling and parts, and contractors were accused of mismanaging programs such as the C–17 transport and the B–2 stealth bomber, leading to serious schedule delays and cost overruns. Northrop Corporation became the target of federal sting operations and grand jury investigations, which uncovered extensive corruption and price-gouging. In February 1990 federal agents raided a Northrop plant making B–2s and then raided three F–18 fighter plants in May. An Air Force review of the company, completed in July, found lax management and poor program execution. The *New York Times* noted four months later that "the name Northrop has become virtually synonymous with fraud among prosecutors and in the halls of Congress."[17]

In July, Betti testified at a congressional hearing on Northrop's "management collapse." Clearly unprepared, he performed poorly, coming across as evasive and uninformed. He acknowledged that he did not know much about the investigation or the charges and, in the face of congressional outrage over Northrop's apparent malfeasance, expressed little additional indignation of his own. Indeed, he told the incredulous panel that he had not reviewed the allegations with the Justice Department in any detail, except to discuss "how to improve the overall process," and evinced little concern about them, even stating they would not affect his future recommendations regarding Defense Department business dealings with the company. Representative John Wiley Bryant (D-TX) brought up a raid on an F–18 plant, in which FBI agents "actually went down the production line and pulled out parts that were thought to be suspect and potentially defective or substandard," and pointedly asked the under secretary, "Are you aware of that?" Betti responded, "I'm not aware of that . . . but I'm not surprised."

> Bryant: Well, what is your understanding of the criminal grand jury investigating their behavior on the F–18 contract?
> Betti: Just that, that there was a raid, and . . . there is an investigation. That's all the details I have.
> Bryant: You mean you don't know—did you inquire further to find out what's going on?
> Betti: No, I didn't.
> Bryant: You did not inquire?
> Betti: I did not inquire.
> Bryant: You mean to tell me that you were told that the FBI raids the production plant where a Defense contractor is under suspicion for defrauding the taxpayer, and you're in charge, and you didn't ask anybody any questions about what was going on?[18]

Betti's testimony revealed much about his management style and priorities. His primary concern was having the proper oversight and management organization and processes in place. "I think the issue is whether we have adequate controls in place today," he argued. Satisfied they were adequate, and in keeping with his "hands-off" leadership style, Betti trusted without verifying the information the services provided and accepted their assurances all was well. As would become evident in the A–12 scandal, this meant that he received a distorted and sanitized picture of the acquisition environment. When Representative Gerald E. Sikorski (D-MN) raised the investigation into the Air Force's B–1 Lancer bomber, Betti interjected:

Betti: But Congressman, we're precluded to act [*sic*] on the allegations. We have to act on evidence.
Sikorski: Do you know what the Justice Department has?
Betti: I do not know what the Justice Department has.
Sikorski: You just told me you have to act on the evidence.
Betti: That's correct.
Sikorski: But you don't have the evidence.
Betti: I don't have the evidence. . . . I can only respond on the basis of the evidence that I have. *I have to talk to the people who are on site, who are dealing with this thing on a day-to-day basis, and that is exactly who I have talked to* [emphasis added].[19]

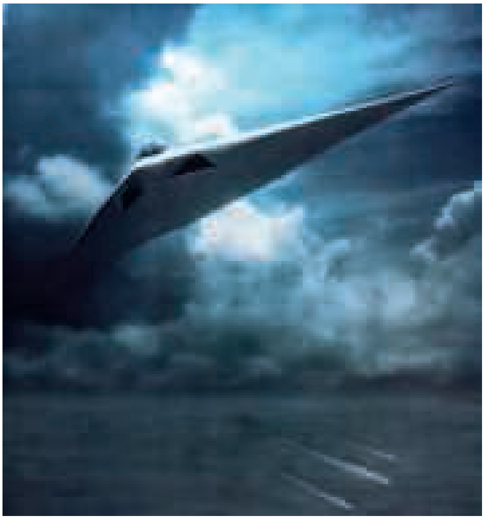
Betti described the nature of those conversations: "I had reviewed with the people on the scene just what they are doing. . . . I asked them . . . are there proper management control processes, procedures, disciplines in place?" But that was the extent of his oversight. When Betti stated his belief that the Air Force acquisition executive was probably following the investigation, Bryant asked him, "Did he follow it?" to which Betti responded, "I have no idea."

Bryant: Why? Why didn't you call and ask him?
Betti: Why didn't I call and ask him?
Bryant: Why don't you know whether or not those levels have been following this?
Betti: I don't know how to answer that question.[20]

The under secretary's responses showed that he was unaware of important acquisition matters. He could not even say how many corporations found guilty of fraud had been disbarred. Dismayed with Betti's responses, Bryant remarked, "I have serious doubts about whether you're the man for the job which you now hold, or at least serious doubts about whether you're willing to answer our questions here today honestly."[21]

The program that brought Betti down—and shook the acquisition community—was the Navy's A–12 Avenger II, a stealth attack aircraft intended to replace the A–6 Intruder for the long-range strike mission and conceived during the 1970s (like the Air Force's stealth aircraft, the F–117 fighter and B–2 bomber). Paul W. Thayer, who followed Frank Carlucci as deputy secretary of defense, pressured the Navy to accept the A–12 concept, and his successor, William Taft, formally initiated the "black" (highly classified) research and development program in February 1984. It entered the concept formulation phase in November 1984 with two competing design teams—General Dynamics/McDonnell Douglas and Northrop/Grumman (Northrop and Grumman did not merge until 1994). (Before the redesignation of milestones and phases in the February 1991 revision of the 5000 series documents, described in chapter II, programs went through three development phases: concept formulation, demonstration/validation, and full-scale development.)

In December 1987 the Navy selected the General Dynamics/McDonnell Douglas triangular flying wing design over the similar Northrop/Grumman entry. The winning team received a fixed-price incentive contract for full-scale development, with a ceiling price of $4.77 billion and a target price of $4.379 billion (in 1988 dollars). The contract projected a cost of $3.981 billion and a profit to the team of $398 million. The use of the fixed-price contract was intended to reduce the government's liability for cost overruns. The contractors agreed to deliver eight test aircraft for the contract price and to absorb any charges over the ceiling. They accepted the risk in the belief any losses would be made up in the full-scale production phase. At the time, high-risk development programs required a cost-reimbursable contract. In an action which contravened the spirit of these regulations, Under Secretary Costello signed a certification saying the A–12 was low-risk, in which case the law permitted using a fixed-price contract.[22]



A 1990 artist's concept of the A–12 Avenger, under development as the Navy's advanced attack aircraft for the 21st century. *(DIMOC)*

By 1989 it was becoming apparent the program had run into difficulties. The aircraft was not going to meet the maximum weight limit specified in the contract. Evidence indicates that the Navy knew this would be a problem when it signed the contract. As the contractors contended with weight growth, they were also developing essentially new subsystems, the engines and the avionics. The Navy had assured OSD and Congress these would be off-the-shelf items. The contractors had little experience with stealth technology and struggled to produce components such as composite struts and low-observable air intakes. The ongoing B–2 program had already encountered and overcome many of these challenges, yet the government refused to reveal the relevant information to the A–12 contractors. Meanwhile, the program steadily fell behind schedule and costs mounted. The program's cost analyst at the Naval Air Systems Command, Debbie D'Angelo, recognized and reported these trends, but the program manager, Navy Capt. Lawrence G. Elberfeld, refused to acknowledge them and did not warn his superiors that the program faced potential trouble.[23]

In fall 1989, during the preparation of the FY 1990 budget, an analyst in the DoD comptroller's office, Tom Hafer, performed his own calculations based on information supplied by the A–12 program office. "These are the worst cost projections I've ever seen so early in a program. This program is headed for disaster," he exclaimed to D'Angelo upon seeing her data. Hafer concluded that the program faced a schedule delay of two years and an overrun of approximately $500 million. He wrote a draft Program Budget Decision proposing to eliminate $1.448 billion in A–12 funds for fiscal years 1991 and 1992, which would have required a restructuring of the program. However, the draft document met stiff resistance from the Navy, which persuaded Betti to oppose it as well. When Elberfeld argued the case for the A–12 before the Defense Acquisition Board's Conventional Systems Committee, representatives of the comptroller's office, including Hafer (who was reluctant to speak when his superiors remained silent), declined to challenge him. The committee reaffirmed the program's phasing and funding levels, and Sean O'Keefe, the DoD comptroller, soon withdrew the draft Program Budget Decision.[24]

A few weeks later, on 19 December 1989, Secretary Cheney ordered OSD to review the highest cost aircraft programs: the Advanced Tactical Fighter (F–22), the Advanced Tactical Aircraft (the A–12 and an Air Force version), the C–17, and the B–2. With the Soviet threat easing and the Defense budget in decline, whether the country needed and could afford those systems, several struggling with cost overruns and schedule delays, came into question. Cheney ordered the Major Aircraft Review to examine the country's aircraft requirements, the fitness of the current programs to meet those requirements, and the relative health of the programs, including cost, schedule, and performance considerations. Deputy Secretary Atwood placed Betti in charge of the review's steering group.[25]

Betti ignored Cheney's instructions to examine the health of the programs and focused almost entirely on an analysis of their requirements. Although rumblings persisted about problems in the A–12 program, the review did not address them directly. Betti did lead a team on a site visit to the A–12 contractors (and went back a few days later with Cheney on 14 March), but accepted their assurances the program was on track and any problems they were encountering could be rectified.[26]

Gaylord E. "Gary" Christle, deputy director for cost management in Betti's office, estimated early in the last week of March 1990 that the program would run a year late and a billion dollars over the cost ceiling. On 27 March, Christle informed Yockey about the results of his analysis. The next day, during a briefing on the Major Aircraft Review, Cheney learned the program was at least $500 million over its budget ceiling and six months behind schedule and perhaps as much as $1 billion over cost (the latter being the Christle estimate, apparently mentioned only in passing). At a subsequent Major Aircraft Review briefing on 5 April, Cheney was told unambiguously the cost overrun was $1 billion and the schedule would slip one year. The secretary did not react strongly and Betti, present at the briefing, minimized the issue. Nevertheless, Betti was concerned enough to warn Cheney in a memo on 19 April that of the programs under review, the A–12 was the only one with serious cost and schedule problems—an inaccurate and ironic statement given that the others were encountering, or would soon encounter, similar problems. Yet when Cheney announced the results of the review to Congress on 26 April, the secretary said nothing about problems with the A–12, including the $1 billion overrun. On the contrary, he singled out the A–12 for praise, saying "the program appears to be reasonably well-handled at this point."[27]

However, at that hearing Cheney also announced a change that would hasten the collapse of the program. In his testimony, he stated the Navy would buy only 620 of the aircraft instead of 858, and the Air Force would not buy any of the projected 400 of its version. Thus the total number of A–12s to be procured was cut in half. Cheney estimated the cost of the aircraft at $83.8 million each, and the total program (development and production) at almost $52 billion—although a few days later he revised these estimates to $92 million and $57 billion, respectively. The 50 percent reduction in the total buy put the contractors in a difficult position. General Dynamics and McDonnell Douglas had accepted a slim profit margin on the development contract and even poured their own money—funds not obtained through the A–12 contracts—into the effort, as the Navy assumed they would, with the expectation they would make it all back on the production run. Now the companies would sell too few airplanes to turn a profit. Faced with a billion-dollar overrun they said they could not absorb, the contractors asked the Navy to restructure the program. When the Navy refused, the General Dynamics/McDonnell Douglas team formally notified the service on 1 June 1990 that it could not meet the contract's technical, schedule, and cost requirements. Two weeks later the companies' chief executive officers (CEOs) met with Cheney, laid out the state of the program, and requested a restructuring of the contract.[28]

The deteriorating condition of the program, now fully exposed, produced an angry reaction. Recalling that Vice Adm. Richard M. Dunleavy, the assistant chief of naval operations for air warfare, had told Congress in March 1990 that the A–12 was "awesome, mind-boggling, and eye-watering," Representative John D. Dingell Jr. (D-MI), chairman of the House Committee on Energy and Commerce, acidly observed that "with the cost of the A–12 now at $96 [*sic*] million a copy and climbing, I can certainly understand how the A–12 is 'eye-watering,' especially for the U.S. taxpayer." Secretary of the Navy H. Lawrence Garrett III launched a major investigation headed by his principal deputy general counsel, Chester Paul Beach Jr. The Navy released the A–12 Administrative Inquiry, better known as the Beach Report, on 28 November 1990. Beach's conclusions were damning. The report criticized the program and the Navy's acquisition chain of command, which failed in its oversight responsibility and its duty to provide critical information to senior civilian leaders. Consequently, Secretary Garrett formally censured Captain Elberfeld and Rear Adm. John F. Calvert, the program executive officer. Vice Adm. Richard C. Gentz, commander of Naval Air Systems Command, was forced to retire early.[29]

Yet the Beach Report went beyond citing the misbehavior of individuals. Beach argued that serious, systemic problems with the Navy's acquisition system required more than simply enforcing accountability and strengthening the existing procedures. The culture, which promoted the suppression of bad news, was at fault. Furthermore, he wrote,

> There is no reason to believe that the factors which made these officials choose to respond the way they did are unique to this Military Department. Indeed, experience suggests they

Capt. Lawrence Elberfeld, A–12 program manager. *(NARA)*

Capt. Lawrence G. Elberfeld

When he became program manager for the Navy's A–12 Avenger attack aircraft in June 1986, Capt. Lawrence Elberfeld, then 43, appeared particularly well qualified for the position. A Naval Academy graduate (1964) and naval aviator, he possessed an M.S. in aeronautical engineering from the Naval Postgraduate School, and an M.S. from MIT. He also had substantial experience in acquisition as an engineering duty officer with the A–7 program; as deputy director of the sensors and avionics technology directorate and then director of tactical aircraft programs at the Naval Air Development Center; as assistant project manager for systems and engineering (chief engineer) for the F/A–18 program; and as a Navy plant representative at McDonnell Douglas. Despite Elberfeld's excellent preparation for the A–12 job, in December 1990, the Navy faulted his management of the program, relieving him as program manager and censuring him and other senior Navy officers for failing to inform their superiors of extensive delays and cost overruns. Although Elberfeld subsequently was promoted to rear admiral, protests in Congress caused the promotion to be withdrawn, forcing his retirement in 1992.[II]

are not. Unless means can be found to solve this abiding cultural problem, the failures evidenced in this report can be anticipated to occur again in the same or a similar form.[30]

Disappointed and "personally irritated" by the revelations now coming out of the program, Betti welcomed the Beach Report. The A–12 contractors had previously assured Betti that any cost and schedule problems would be manageable. During his and Cheney's site visit on 14 March, McDonnell Douglas had created a "Potemkin village," according to a Navy officer, laying out parts and materials not intended to go into the aircraft to give the impression work had progressed further than it had. By July, however, Betti was no longer under any illusion about the program: "I believe that the situation brings into question the adequacy of the program management process of both the contractors involved and the Navy," he told Garrett. At the under secretary's request, Garrett had added two members from Betti's office to Beach's team and broadened the inquiry "to identify the process root causes that permitted the problem to develop to the extent it did before management of either the contractor or the DoD were aware of the risk, let alone the problems."[31]

Betti wholeheartedly endorsed Beach's suggestion that the systemic and cultural problems were both deep and widespread. "I believe it is important that we be seen and be aggressive in following the Beach investigation," he wrote Atwood on 11 December. "There's no reason to believe that the problems are limited to the A–12 or the Navy." Betti told the deputy secretary he was developing plans to implement Beach's recommendations and also proposed a broader response—a blue-ribbon panel of outside experts to study the root causes of the problems that Beach uncovered and to recommend solutions.[32]

Betti never had the opportunity to form such a panel because the day after he suggested it he was fired. Deputy Secretary Atwood had become increasingly disenchanted with the under secretary, especially after the latter's poor performance in the July congressional hearing on Northrop's management problems. An ultimately unsuccessful movement emerged to weaken Betti's authority by removing the director of defense research and engineering (DDR&E) from the USD(A)'s purview and having that official report directly to the secretary and deputy secretary. Betti accepted some of the blame for the A–12. "We should've looked harder," he commented bitterly to Beach. "I trust people too damn much." The DoD inspector general, Susan J. Crawford, went further, settling on Betti as the source of the problem. In a letter, later expanded into a full audit report, sent to Representative Andrew Ireland (R-FL) on 29 November—the day after the Beach Report was released—and in testimony to a congressional hearing on 10 December, she accused Betti of neglecting to raise any warning flags during the Major Aircraft Review and of failing to impress upon either the secretary or his own staff the seriousness of the problem.[33]

Following publication of the Navy's and the inspector general's reports, OSD and the Navy acted quickly. On 12 December 1990 Navy Secretary Garrett recommended canceling the A–12 contract. Although Garrett subsequently changed his mind, Cheney nonetheless signed a memorandum two days later ordering the Navy to "show cause by 4 January 1991, why the Department should not terminate the A–12 program and pursue other alternatives." On 17 December the Navy issued a "cure notice" demanding the contractors fix the A–12's weight and schedule problems by 2 January. In their formal response, General Dynamics and McDonnell Douglas denied they had defaulted on the contract, claiming its terms were invalid. The schedule and weight requirements could not be met and, they argued, the Navy knew this all along. They claimed, furthermore, the fixed-price contract may have been void from the start as it had been awarded "in violation of statutes and regulations requiring suitable risk reduction" to permit realistic pricing in a fixed-price contract. Additionally, asserted the contractors, the Navy had not provided "very important information vital to the performance of the contract" (data from the Air Force's experience with stealth technology). Five days later, at Cheney's direction, the Navy terminated the contract "for default" and ordered the contractors to repay $1.35 billion in progress payments they had received for work not yet performed.[34]

Several reasons have been offered for the A–12's cancellation. The official DoD position, presented in the press release announcing the contract's termination, was that the contractors had defaulted on its terms. They had failed "to design, develop, fabricate, assemble, and test A–12 aircraft within the contract schedule and to deliver an aircraft that meets contract requirements." The program, stated the press release, would be able to continue only if the contract was restructured and additional funds provided. The secretary of defense, however, was unwilling to spend more money: "No one can tell me how much more it will cost to keep this program going. And I do not believe a bailout is in the national interest." The contractors, denying they had defaulted, had a different view. They would later argue the program was canceled because the Defense Department no longer needed the capabilities provided by the A–12. In a detailed and well-documented study, veteran trade journalist and acquisition expert James P. Stevenson supports the contractors' position. He contends that with the end of the Cold War and the decreased likelihood of a NATO/Warsaw Pact conflict, the requirement for the Navy to carry out deep strikes in Europe with carrier-based aircraft, the role for which the A–12 had been designed, had diminished substantially. This, along with pressure to cut the Defense budget and a conviction within OSD that missiles and unmanned aerial vehicles could perform deep strikes, made the expensive and behind-schedule A–12 program vulnerable. A desire to avoid further congressional scrutiny of the acquisition system may have been additional motivation for terminating the A–12. Beach and Betti had both warned that the underlying problems went well beyond the A–12 program, and Representative Ireland, an outspoken critic of defense acquisition, agreed.[35] By canceling the program, the Defense Department appeared to be taking a stand against wasteful and undisciplined contracting and succeeded in muting calls for an overhaul of the entire acquisition system.

LESSONS OF THE A–12

The experience of the A–12 program demonstrated many failings of the acquisition system. One lesson was the danger of the fixed-price contract. Acquisition experts had long known fixed-price contracts were inappropriate for research and development programs, when the exact costs could not be determined with certainty. A fixed-price contract threw the entire burden of risk onto the contractor, and with it the possibility that unexpectedly high cost growth might threaten the company's financial health and even drive it out of business. For this reason, since 1971 DoD regulations had strongly discouraged the use of fixed-price contracts.[36] In 1987 Congress prohibited fixed pricing on development contracts worth more than $10 million unless the under secretary for acquisition signed a waiver certifying these contracts did not pose undue risk to the contractor. For such a program, a "cost-plus" contract, which reimbursed a contractor for actual costs in addition to providing an agreed-upon profit or fixed fee, was preferred. Only when the program was entering full-scale production, at which time presumably the costs of producing the system were known, would the fixed-price contract become appropriate. However, the services had been much afflicted by uncontrolled cost growth in the 1970s and became fond of fixed-price contracts. Even after 1987, they routinely waived laws and regulations requiring stringent estimates of financial and technological risk be made first.[37]

Thus, the General Dynamics and McDonnell Douglas team had made its fixed-price bid for full-scale development—and the Navy had awarded the contract—without a clear idea of how much the aircraft's development would actually cost. The companies discovered that working with composite materials was far more difficult than expected, but they were locked into their contract. After cancellation of the A–12, however, the Defense Department, alarmed that the two firms might go out of business, deferred its demand for repayment of the $1.35 billion, leading to charges that the Pentagon was again bailing out underperforming contractors. These accusations led to an ironic situation, in which Congress attacked the department for allegedly coddling contractors at the same time those contractors were suing the department for unfair treatment.[38]

As the program began to run into trouble, the fixed-price contract exacerbated the problem. Indeed, Navy and OSD officials downplayed the dangers of cost growth on the A–12 because of the nature of the fixed-price contract. When the vice chairman of General Dynamics warned Secretary Garrett that the company would lose money on the A–12 research and development contract, the Navy secretary brushed him off, responding with words to the effect, "that's the beauty of a fixed-price contract."[39]

A second problem in the A–12 program was the failure of independent cost estimation. Since 1983, the law had required an independent estimate of the cost of a program before the secretary of defense could approve it for full-scale development and again before production and deployment. The estimate would be considered independent only if performed by an office separate from the military department or defense agency carrying out the acquisition program. In other words, the secretary could not simply accept the estimate of the organization conducting the program. DoD regulations instituted in 1987 required an independent estimate before every Defense Acquisition Board milestone review, although additional reviews could be made for the board as required.[40]

Cost estimation began in the military department or defense agency initiating the program. First, the program office made its best estimate as to how much the program would cost. Then another, separate organization within the department or agency made its own independent estimate, compared it to that of the program office, and then reconciled any discrepancies. These estimates then went to OSD, where the Cost Analysis Improvement Group (CAIG) provided a further review of program costs. The group was expected to check on the data provided by the department or agency and produce its own independent estimate.[41]

The law exempted highly classified programs such as the A–12 from the requirement for an independent cost estimate,[42] but the Cost Analysis Improvement Group was twice tasked to prepare an estimate for the A–12, in late 1987 for a Defense Acquisition Board milestone review and again in January 1990 for the Major Aircraft Review. In each case, the group reviewed the data and approved Navy estimates after only a perfunctory analysis. Its first report, prepared in January 1988 for the A–12's Defense Acquisition Board review for entry into full-scale development, amounted to a single paragraph that merely approved Navy estimates presented in two briefings by a Navy analyst. The CAIG prepared its second report in January 1990 for the Major Aircraft Review. After receiving figures separately from the program office, Naval Air Systems Command, and the Navy Plant Representative Office, "the CAIG would take these numbers and play devil's advocate with them," explained its director, David L. McNicol. "We found that the navy's independent cost group were [*sic*] usually fairly accurate with their [*sic*] numbers."[43]

The Navy's estimates were not accurate, and the Cost Analysis Improvement Group did not receive all the data it needed to evaluate them properly. Both the DoD comptroller and John Betti's office, but not the CAIG, discovered the tremendous cost overrun of the A–12 program. Staff shortages were to blame partly for the group's problems. During the late 1980s its workload expanded rapidly as a result of the Packard Commission reforms. Whereas from 1977 to 1986 the group handled between 4 and 14 independent cost estimates per year, in 1988 the number jumped to 29. Thereafter, it was assigned between 24 and 44 cost estimates, averaging about 30 annually. Faced with this burden—with no increase in its staff—McNicol chose to focus his resources on the most important and contentious programs, including the B–2, the C–17, the Advanced Tactical Fighter, and the *Seawolf*-class submarine. For uncontroversial programs—such as the A–12 before June 1990—the Cost Analysis Improvement Group, with approval of the DoD general counsel and the under secretary for acquisition, relied on the "component cost analyses" produced by the military departments for the milestone reviews. The A–12 program's highly classified status made its milestone reviews more difficult. Only two CAIG members, including McNicol, had the necessary clearances for the program, so they had to do all of the work themselves with no other staff assistance.[44]

Even before its difficulties in the A–12 program, the independent cost estimation process in the post-Packard era was already a matter of concern. A DoD inspector general report released in 1989 disclosed that cost estimates failed to incorporate all relevant life-cycle costs, lacked the documentation required to verify estimates, and frequently accepted program office estimates without independent scrutiny, especially when fixed-price contracts were involved. The Cost Analysis Improvement Group did not usually challenge these "pass throughs." The inspector general also found problems that raised doubts about the objectivity and independence of the services' cost estimation processes. In July 1990, at the request of Representative Ireland, Inspector General Crawford began a new investigation. Her report, released on 5 February 1992, found many of the same problems still existed in the services and the CAIG, but the Defense Department was working to improve the situation. The new 5000 series guidance published the year before imposed stricter requirements for documentation so that any competent cost analyst could reproduce the estimate. All relevant costs—spelled out in great detail in the acquisition guidance—were to be included in the new Cost Analysis Requirements Document. The CAIG no longer had to produce its own estimate from scratch but was to validate carefully the service estimates based on the information in the cost analysis document and on the estimators' notes. Also, classified programs were now required to develop cost estimates prior to Defense Acquisition Board reviews, the same as unclassified programs. Meanwhile, OSD was preparing a new, more stringent charter for the CAIG, which in turn was preparing a detailed guide on cost analysis; both would be published before the end of 1992. More importantly, the group received 19 additional analysts in 1992 and 1993, effectively tripling its staff and allowing it to perform more in-depth reviews. Whereas before 1992 only about 2 of every 5 of the group's reports included an independent cost estimate, from 1992 through 1996 all but 5 of 135 did.[45]

Finally, the A–12 program suffered from a lack of discipline—a general failure to follow established acquisition procedures, regulations, and statutes. Officials at all levels skirted, evaded, and even ignored those requirements. Most egregiously, the Navy on several occasions signed contracts even though no funds had been authorized or appropriated, in violation of the Anti-Deficiency Act, which prohibited the obligation of funds not authorized and appropriated by Congress.[46] The Navy also neglected to submit many of the documents required for the A–12's milestone reviews. The missing paperwork included such key documents as the Mission Need Statement certifying the requirement for the aircraft; a cost and operational effectiveness analysis (COEA), which showed how well the proposed aircraft would meet the requirement at a reasonable cost; the program baseline, which laid out how the Navy expected the program to progress; and independent cost estimates. Indeed, the Navy approved the program to move into the demonstration/validation phase before the Joint Requirements and Management Board (forerunner of the Joint Requirements Oversight Council) had even met to approve the requirement.[47]

The Navy's program advocates evaded the spirit of the laws and regulations through bare-knuckle tactics. In 1988, when seeking certification, as required by law, that the risk was acceptable for a fixed-price contract, the Navy gave the deputy assistant secretary of defense for procurement, Eleanor R. Spector, two hours to examine the program prior to a Defense Acquisition Board review of the contract. Her review consisted largely of a briefing by the Navy, along with its written answers to her questions, which contained suspect and even demonstrably false information. Doubting the Navy's claims that technical and financial risks were low, Spector refused to support the certification. Captain Elberfeld recalls that on 6 January 1988, at the Defense Acquisition Board meeting considering the contract, Under Secretary Costello mentioned he had received a memorandum on certification from Spector (apparently without disclosing its contents) and said he was satisfied with the type of contract the Navy proposed to award. The board then approved the fixed-price contract, and Costello signed the certification soon after.[48]

Information flows, both among and within the services, appeared dysfunctional at best. In a bureaucracy such as the Pentagon, information is power, and it was passed along or not according to the interests of the possessor, even when that meant violating the chain of command. For example, Capt. Eric V. Vanderpoel, a Navy aviator assigned to Betti's office as an A–12 specialist for the Defense Acquisition Board's Conventional Systems Committee, funneled critical information back to his service. When he learned about Gary Christle's findings exposing the A–12's cost overrun, Vanderpoel informed a senior Navy acquisition official before telling his superiors in OSD. Sometimes, deliberately or not, the presentation of information came too late to allow questions. Harried analysts often had too little time to prepare and conduct assigned reviews and failed to obtain the data they had requested. Requests for documents were ignored, and frequently the requestor let them drop, perhaps because he or she was too busy to follow up. A CAIG team visiting General Dynamics to conduct a cost review submitted its detailed notes to the company for security review, but not all of them were returned—the program office claimed they had been lost. Contractor and Navy proponents of the A–12 ensured that serious problems with the program did not come to light until the crisis broke.[49]

As the Beach Report and similar inquiries pointed out, failures of oversight occurred at all levels within the Navy and in OSD. A review of the role of the Navy Plant Representative Offices at contractor facilities concluded these offices had failed in their responsibilities.[50] An internal review within the USD(A)'s office also found serious lapses: failure to follow oversight procedures, misuse of documents and other oversight tools, and warning signs unnoticed and unheeded. Staff concerns about the A–12 program were ignored in favor of Navy promises and contractor assurances. In transmitting the report, Director of Defense Research and Engineering Charles M. Herzfeld commented, "Bureaucratic practices should not inhibit our ability to listen to common sense."[51]

Meanwhile, the DoD comptroller's office investigated the performance of the Defense Contract Audit Agency (and found it wanting), and a special panel of the Defense Science Board reviewed the aircraft's design. Criminal investigations began, with the Defense Criminal Investigative Service assisting a grand jury in St. Louis to consider charges against McDonnell Douglas and General Dynamics for possible fraudulent progress payments. As if to show that no matter was too small to probe, the Naval Criminal Investigative Service looked into the possibility that Betti's signature had been forged on a pro-A–12 memorandum, perhaps using his autopen.[52]

The Defense Department even mishandled the termination of the program. After his initial announcement canceling the contract, Secretary Cheney backtracked: Only the Navy could cancel the contract. And it did. But in its rush to do so before the contractual deadline for obligating additional funding for the program, the Navy ignored legal procedures. These and other irregularities occurring from the beginning to the end of the program led to a lawsuit that lasted more than two decades and went in 2011 to the Supreme Court, which returned the case to the U.S. Court of Federal Claims, ruling it was preferable to leave both parties without a remedy than risk revelation of "state secrets" (the classified stealth technology data). Finally, in late 2013, the government and General Dynamics and Boeing (which absorbed McDonnell Douglas in 1997) settled out of court, with the contractors agreeing to pay the government $400 million (less than one-third of the $1.35 billion the Navy had demanded) "in kind" rather than in cash.[53]

Exposure of the A–12 program's failures—and the firing of the managers responsible—sent shockwaves through the Pentagon and throughout the acquisition community. The Avenger's story was particularly embarrassing because, as the Beach

Report pointed out, it should have been a model program. It followed the streamlined acquisition chain of command reformers had promoted, gaining full funding and top-level support and progressing initially with no congressional micromanagement or external oversight. The program manager served for a long tour (four-and-a-half years), appeared to have most of the qualifications expected of a good program manager, and had the luxury of handpicking his staff. "In short," Beach noted, "the PM in this case is the archetype of the well-trained, highly motivated professional . . . that we are seeking to develop under the acquisition corps plans and matrix management approach reflected in the Defense Management Report." Elberfeld's superiors were similarly well qualified. Nonetheless, Beach added, the program management structure "unquestionably . . . failed that test." So did Betti's inclination to trust the system. Clearly, achieving effective acquisition outcomes required more than appropriate procedures, regulations, and organizational structures.[54]

DISCIPLINING THE SYSTEM

On 16 July 1990, as the storm over the A–12 was breaking, Don Yockey, Betti's deputy, asked John D. Christie, a senior official in the USD(A)'s office, how the Department of Defense got into and continued programs that were flawed from the beginning. In other words, "What is the root cause of the problem?" As director of acquisition policy and program integration, Christie had responsibility for preparing acquisition policy, reviewing programs, and making sure the Defense Acquisition Board ran smoothly. He was an old hand at acquisition, having served as a systems analyst in the Richard M. Nixon and Gerald R. Ford administrations and later as a member of the Army Science Board. So when Yockey posed his question, Christie had a ready reply, which he sent as a memorandum to Yockey and Betti: "My answer is: lack of discipline—not the policies or procedures—is the primary root cause of DoD's acquisition problems."[55]

Christie went on to describe his early experience dating to 1971 as a program analyst and a member of the Defense Systems Acquisition Review Council (forerunner of the Defense Acquisition Board). Then Deputy Secretary of Defense Packard had recently created the council and issued the first 5000 series document, DoD Directive 5000.1 (Acquisition of Major Systems), to provide OSD with more effective oversight. However, Christie noted, senior Defense Department officials continually bent the rules or found excuses to exempt favored programs from them. They often ignored the recommendations of independent advisers such as testers and cost analysts in favor of the services. In other words, they failed to enforce discipline on the acquisition system.[56]

This situation had continued through the 1980s, in spite of regular revisions of the 5000 series, most recently in 1987. "Over the last ten months that I have been back in the building," wrote Christie, "we have made a tremendous effort to revise and further improve the basic acquisition policies and procedures in [DoD Directive] 5000.1 and [DoD Instruction] 5000.2," which were then in the midst of an overhaul. "I have not seen a commensurate effort to discipline the acquisition process." In fact, little had changed. The services usually got their way on priority issues in the Defense Acquisition Board, and OSD still found ways to "make exceptions to the rules or find a rationale for not enforcing extant acquisition policies and procedures." Christie concluded:

> Thus, I assert that our continuing lack of good discipline in enforcing extant policies and procedures, is the "root cause" of our acquisition problems. No amount of revising policies, procedures, and/or organizations . . . will solve real or perceived problems if we do not discipline the process. If: (1) major acquisition programs are approved with flaws from the beginning and/or continue to have problems in development; and (2) the individuals with the responsibility and authority to plan, execute, and control the programs are not disciplined in their actions; then we will not make major substantive improvements in DoD's acquisition of systems.[57]

It is likely that Christie was alluding to Betti's focus on process while he overlooked or failed to see the problems stemming from violations of that process. Christie's final statement—"Working on the process without enforcing discipline is like 'rearranging the deck chairs on the Titanic'"—was as much a plea to Betti as to Yockey. Betti could not bring himself to follow this advice before the A–12 scandal consumed his office.

However, Betti's successor, Donald Yockey—who was acting under secretary until he was sworn in to the position in his own right in June 1991—would be much more receptive to Christie's advice. Just shy of his 70th birthday when he took office, Yockey differed from his three predecessors in having extensive experience in defense acquisition, in both the military and industry.[58]

Unlike his predecessors, Yockey thought most necessary reforms had already been accomplished, especially through the Defense Management Report and the publication of the long-awaited 5000 series revision in February 1991. "I believe that the acquisition system is inherently sound," he said. "It doesn't need to be overhauled or reworked in a major way—in spite of word to the contrary from some quarters." Primarily, he wanted to "discipline the system, to use it as it was intended to be used." He argued this was the major thrust and intent of both the Packard Commission recommendations and the Defense Management Report. He articulated three basic principles. The first required getting "back to the basics of good management" in such areas as delegating authority, demanding accountability, and making timely decisions. The second promoted "realism" in all aspects of acquisition, from assessing its role in national security strategy and the health of the defense industry to budgeting, planning, estimating costs, and evaluating technology and programs—"hard-nosed realism at all decision points." The third principle emphasized integrity, of both the individual and the acquisition process. Yockey would be much more of a hands-on acquisition executive than Betti and would devote much of his energy during the last two years of the George H. W. Bush administration to enforcing discipline and dealing with the disruptions and changes that followed the end of the Cold War.[59]

Yockey knew his way around the Pentagon and enjoyed the full support of the secretary and deputy secretary. Atwood shared Yockey's belief in discipline and maintained a firm grip on the inner workings of the department. Right from the start, during his confirmation hearing in April 1989, Atwood highlighted the issue of discipline in acquisition. In one of his first speeches as deputy secretary, in early May 1989, Atwood again emphasized the issue, focusing on the Defense Acquisition Board's oversight process. "One area that will get my personal attention is defense acquisition," he told the American Institute of Aeronautics and Astronautics. "There must be greater discipline in the process. Weapon systems that fail to meet stated objectives cannot be allowed to proceed into the next phase of development. We can no longer afford to postpone the tough decisions on new weapons, hoping that problems will eventually be fixed or that performance specifications will eventually be attained. . . . Only those

Donald Yockey, under secretary of defense for acquisition, 1991–1993. *(NARA)*

Donald J. Yockey (1921–1997)

When he became acting under secretary of defense for acquisition in January 1991, after John Betti's departure amid the A–12 controversy, Don Yockey, who had been the principal deputy under secretary since March 1990, possessed more than 40 years' experience in defense acquisition in government and industry, much more than any of his predecessors. In June 1991 the Senate confirmed his nomination to be the under secretary, and he would serve in the position until January 1993.

Yockey was born in Buffalo, New York, in January 1921 and attended the University of Buffalo in 1941–1942 before entering military service. He flew B–17 bombers in combat during World War II and C–54 transports during the Berlin Airlift. In the course of a 22-year career in the Air Force, he earned a bachelor's degree in business administration from the University of Oklahoma and served in several acquisition assignments, retiring as a colonel and command pilot in 1966.

Immediately following his retirement from the Air Force, Yockey went to work for Rockwell International Corporation, specializing in defense electronics. In more than two decades at Rockwell, he held key management posts, including, successively, president of the Electronic Systems Group, president of Defense Electronics Operations, and two years as corporate senior vice president, before retiring from the company in 1988. While at Rockwell, Yockey also served on the board of visitors of the Defense Systems Management College and on the board of directors of the nonprofit Armed Forces Communications and Electronics Association, two years as the board's chairman.[II] programs that meet all established milestone criteria should be allowed to transition to the next phase."[60]

By summer 1991 Atwood believed OSD was making progress, especially in forcing adherence to the prescribed Defense Acquisition Board process. He credited Betti with initiating the effort, but he gave more credit to Yockey, who "has been even stronger in that regard." He also believed the A–12's cancellation contributed to strengthening DAB reviews, sending a "simple" message that the Pentagon expected programs to accomplish their performance, schedule, and cost goals or they would be held up or sent back to an earlier phase. Atwood argued the cancellation would "signal that the one thing we cannot stand is bad information. We have to have accurate and timely information." It would be no accident that demands for information from the services would mark Yockey's tenure as under secretary.[61]

Yockey reorganized his office, redesignating the deputy assistant secretary of defense for procurement as the director of defense procurement, reporting directly to the under secretary. The new position would be in the civil service and not a political appointment as before, so that someone with long experience in the field would oversee procurement issues. To fill the post, Yockey promoted Eleanor Spector, who had held the deputy assistant under secretary slot since 1985. Yockey also ordered several officials in the Office of the Director of Defense Research and Engineering to report directly to him, boosting his control over technology policy in OSD.[62]

More importantly, Yockey, in accordance with the spirit of the Defense Management Report and the 5000 series revision, continued to assert OSD's authority over the military departments. The new DoD Directive 5000.1, signed by Atwood on 23 February 1991, appeared to weaken the influence of both the under secretary for acquisition and the director of defense research and engineering. Atwood corrected this ambiguity in August 1991 with a memorandum clarifying and strengthening their roles. He gave both broad authority within their respective spheres. The under secretary, Atwood wrote, had the authority "to direct" the military departments and defense agencies "on all matters of acquisition," and use that authority "to institute greater discipline and ensure improved performance within acquisition programs." In addition to reviewing each program as part of the Defense Acquisition Board process, the under secretary now had the authority to review the state of acquisition management in the services. Each military department was to consult with the USD(A) before assigning program

Director of Defense Procurement Eleanor R. Spector, 1991–2000. *(NARA)* managers and program executive officers and before submitting changes in budget plans or estimates relating to major acquisition programs. The under secretary also gained a say in the transfer or reprogramming of funds for such programs, assumed responsibility for general oversight of the acquisition workforce (including training, education, and career development), and took over supervision of test and evaluation. In all, Atwood's memorandum represented an unprecedented expansion of the under secretary's power and of the authority of OSD over the services in acquisition.[63]

The under secretary believed the failure of service and industry officials to bring problems to the attention of the senior leadership in the Navy and especially in OSD was the main cause of the A–12 program's difficulties. Well before Atwood's 12 August memo, Yockey was demanding—and scrutinizing—information from the acquisition chain of command. For example, he dropped the plan to reduce oversight and auditing of contracts that he had proposed the previous year under Betti. In April 1991 Yockey instituted a policy of personally reviewing all major requests for proposal (RFPs) and contracts before the services issued them. For example, he reviewed and approved the $95 billion Air Force contract awarded that month to a team led by Lockheed for the development and production of the Advanced Tactical Fighter. He also delayed signing a contract for a next-generation light attack helicopter (eventually the RAH–66 Comanche) out of concern the Army had not funded the program adequately. In August 1991 he asked the service acquisition executives to send him weekly reports on their major acquisition activities, such as the selection and award of contracts; the achievement of or failure to achieve key milestones in a program's development, such as first flight or first delivery; and legal actions, such as debarments and contract terminations. Increasing reporting requirements provided Yockey the sort of information about the department's acquisition activities that Betti had lacked.[64]

Yockey used these reviews, as well as those of the Defense Acquisition Board, to ensure the services did not award fixed-price contracts for development programs.[65] He promoted program stability by forcing the services to certify funding was available throughout the course of the contract—the "realism" in planning and budgeting he often mentioned. He believed one of the biggest problems of the acquisition system was the mismatch between planning and resources. In the past, the services simply assumed that the "top line"—the total resources available to the Defense Department in any given year—would be enough to support overly optimistic acquisition plans. When the funding did not materialize, the services would then go back to OSD and Congress, pleading poverty and warning of dire consequences if additional funding was not approved. Meanwhile, funding levels would vary month to month as OSD and the services juggled budgets, creating the program instability that led to delays and ultimately higher costs.[66]

In June 1991 Yockey set out to tackle the mismatch between planning and resources with a memorandum requiring the services to identify the resources in the five-year Future Years Defense Program to ensure full funding for a program before the Defense Acquisition Board would approve it for the next acquisition phase. If the funding was not available, the service had to identify the offsets that would support the program. Otherwise, he argued, OSD would be "kicking the can down the road," leading to greater problems in the future. "We have already started to accumulate a number of approved but underfunded programs," Yockey warned. He named 14 of them, including the Air Force's Advanced Tactical Fighter, the Army's new light attack helicopter, and Navy shipbuilding.[67]

Yockey intended his effort to ensure adequate program resources to be a major step in bridging the gap between the acquisition system and the Planning, Programming, and Budgeting System, which largely had operated independently of each other. However, Yockey's colleagues appeared less than pleased at this encroachment on their traditional turf. DoD Comptroller Sean O'Keefe protested that the Defense Acquisition Board should focus on the progress of programs and not on resource issues, which were the exclusive responsibility of the Defense Planning and Resources Board. The services objected also. The Army wanted to compete for Air Force and Navy funds, which it was precluded from doing under the new policy. The Navy objected to having to specify the funding sources. The Air Force said the whole issue was none of the DAB's business and the under secretary could not make the funding changes stick. Yockey held his ground and Atwood supported him. However, an important piece of Yockey's plan was dropped: a mechanism for obtaining formal approval of changes in "outyear" funding (funding not specifically provided for in the budget) and regularly updating the FYDP to reflect the agreements reached in the Defense Acquisition Board. To smooth ruffled feathers, Yockey promised to consult with the deputy secretary and other OSD officials before making resource decisions. He also asked the service acquisition executives to submit a description of the best acquisition strategy at currently available funding levels and their preferred strategy if the level of funding changed.[68]

A 1992 General Accounting Office review considered the policy to be a positive step and noted that DoD was making a sincere effort to force the services to identify the necessary funding. Of the 16 programs reviewed by the Defense Acquisition Board since the policy went into effect the year before, the GAO marked three as underfunded: the Air Force's F–22, the Navy's VTX–TS pilot training system (centered on the T–45 Goshawk trainer), and the Navy's F/A–18E/F fighter. The services eventually found the necessary funding for all three programs.[69]

Yockey drove the services hard on the issue of program funding. He demanded they explain certain budget choices and show how they intended to carry out decisions his office or the Defense Acquisition Board had made. For example, in December 1991 he noted that the Navy's proposed budget amendments included reductions and deferrals in a half-dozen programs and asked the service for assurance that the changes "will preserve the proper match of funding and acquisition strategy." In spring 1992 Yockey ordered the services to consult with him in advance on any "significant changes" to ACAT I programs. "This requirement for consultation should not be construed as limiting your management flexibility to structure your POM proposals as you deem best," Yockey stated. The Program Objective Memorandum (POM) identified each service's proposed programs and funding required in the Future Years Defense Program.[70]

* * * * *

Under Cheney, the Office of the Secretary of Defense was in the process of establishing the Packard Commission recommendations as acquisition policy through implementation of the Defense Management Report. The scandal surrounding the A–12 program cast doubt on the integrity of the department's acquisition system. Revelations of wrongdoing showed what could happen when managers at all levels ignored established acquisition procedures, policies, and regulations. The blame lay not solely with Navy officials but was shared by the top leadership in OSD. Under Secretary for Acquisition Betti, convinced he could trust lower-level managers if the proper organization and processes were in place, saw no need for intrusive supervision. Indeed, he worked to reduce OSD oversight of both the services and defense contractors.

The termination of the A–12 program, the firing of Navy officials, and Betti's dismissal shocked the department and gave OSD both the incentive and the opportunity to impose its authority. Under Secretary Yockey believed the acquisition system was sound; additional reforms were not required. The main task was to enforce the policies and procedures laid out in the revised 5000 series documents. Supported by Deputy Secretary Atwood, Yockey took steps to discipline the acquisition system and assert OSD's authority over it. He demanded more information from the services on their programs and assurances that funds would be sufficient to execute them, increased his oversight of contracting by personally reviewing RFPs for major systems, and insisted that the Defense Acquisition Board base its milestone recommendations on realistic assessments of a program's progress.

For the remainder of the administration's term, however, new problems—the crisis in the Persian Gulf, the shrinking Defense budget and force structure drawdown, and a weakened American economy, especially the defense industrial and technology base—turned the Defense Department's attention away from the mechanics of the acquisition system to making difficult choices between R&D and procurement in weapon system programs.

Endnotes

1. "Atwood Says DoD Lacks Discipline to Enforce Acquisition Procedures," *Federal Contractor's Report*, 10 Apr 1989, 695 (quote); Patricia Gilmartin, "Senators Criticize Defense Nominee for Statement on Acquisition Chief," *Aviation Week & Space Technology* 130, no. 15 (10 Apr 1989): 29; ltr, Atwood to Sen. Sam Nunn, 10 Apr 1989, folder 020 DoD, box 12, Acc 330-91-0095, OSD Records, WNRC.

2. Donna Hasely, "Cheney's DoD Takes Shape with Lower Profile for Service Secretaries, Unders," *Inside the Pentagon*, 29 Sep 1989, 5; Bob Woodward, *The Commanders* (New York: Simon & Schuster, 1991), 74–80, 110, 292–296.

3. "The Honorable John A. Betti, Under Secretary of Defense for Acquisition," undated DoD biography, in VIIA, R&E Management (Acquisition), folder 1989, OSD/HO; Andy Pasztor, "Ford Senior Executive Betti Is Expected to Be Nominated for Pentagon Post," *Wall Street Journal*, 23 Jun 1989, 16; Jane Callen, "Defense Observers See Big Weakening of DoD Buying Chief Under New Regs," *Inside the Army*, 6 May 1991, 5. Because of the ethics laws, Betti had to certify after

every action he took as under secretary that Ford was not involved or affected. This requirement was dropped in 1990.

4. In addition to Deming, other leading proponents of TQM included J. M. Juran, A. V. Feigenbaum, Kaoru Ishikawa, Philip B. Crosby, and Genichi Tuguchi. Total quality management is a complex subject; there are many different approaches, tools, and even conceptions as to what exactly it represents. In 1990 DoD defined TQM as both a philosophy and a set of guiding principles focused on "the application of quantitative methods and human resources to improve the material and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met, now and in the future." See DoD, *Total Quality Management Guide* [final draft], vol. 1 (Washington, DC: DoD, 15 Feb 1990), 1.

5. There is extensive literature on TQM, but see especially W. Edwards Deming, *Out of the Crisis* (Cambridge, MA: MIT Center for Advanced Engineering Study, 1986); Mary Walton, *The Deming Management Method* (New York: Putnam Perigee, 1986); Joseph M. Juran, *Juran on Planning for Quality* (New York: Free Press, 1988); Hedrick Smith, *Rethinking America* (New York: Random House, 1995). For Deming's life see Rafael Aguayo, *Dr. Deming: The American Who Taught the Japanese about Quality* (New York: Carol Publishing Group, 1990); Kenneth T. Delavigne and J. Daniel Robertson, *Deming's Profound Changes: When Will the Sleeping Giant Awaken* (Englewood Cliffs, NJ: PTR Prentice Hall, 1994); and Henry R. Neave, *The Deming Dimension* (Knoxville, TN: SPC Press, 1990). For the groundbreaking work on the "corporate culture," a concept that is crucial for TQM, see Terrence E. Deal and Allan A. Kennedy, *Corporate Cultures: The Rites and Rituals of Corporate Life* (Reading, MA: Addison-Wesley, 1982).

6. Memo, DepSecDef William H. Taft IV for Defense Council on Integrity and Management Improvement, 4 Jan 1989, subj: Implementation of Total Quality Management, folder 310.1, box 50; memo, DepSecDef Atwood for Secretaries of Military Departments et al., 1 May 1989, subj: Improving the Acquisition Process—Buying Best Value, folder 400.13, box 74: both in Acc 330-91-0095; USD(A) Costello, memo for distribution, 8 Feb 1989, subj: Total Quality Management (TQM) Planning Seminar for Defense Acquisition Board Members (DAB) and Production and Logistics (P&L) Committee Members, box 2; memo, Costello for Secretaries of Military Departments et al., 19 Aug 1988, subj: Implementation of Total Quality Management in DoD Acquisition, attached to ibid.; memo, Costello for Secretaries of Military Departments et al., 16 Feb 1989, subj: Total Quality Management in the Test and Evaluation Process, box 2; memo, Costello for DUSD(A), 2 Mar 1989, subj: Initiatives to Incentivize Defense Contractors and Reduce Overall Weapon System Procurement Costs, box 3; memo, Costello for Secretaries of Military Departments, 9 Mar 1989, subj: Concurrent Engineering—A Total Quality Management Process, box 3; memo, Costello for DepSecDef, 21 Mar 1989, subj: Department of Defense (DoD) Briefings on Total Quality Management (TQM) Implementation, box 3; memo, Costello for DepSecDef, 20 Apr 1989, subj: Improving the Acquisition Process, box 3; memo, Costello for SecDef, 8 May 1989, subj: Total Quality Management, box 5: all in Acc 330-92-0136, OSD Records, WNRC; "Point Paper: Total Quality Management in the DoD," 17 Dec 1990, folder 310.1, box 40, Acc 330-92-0097, OSD Records, WNRC.

7. "OUSD(A) Top Leadership Offsite, 13–14 Aug 1990 – Summary," attached to memo, USD(A) Betti for all USD(A) staff, 6 Sep 1990, subj: Internal USD(A) Communications, 2 ("common assumption" and "leading team member"), box 8, Acc 330-94-0006, OSD Records, WNRC; ltr, Betti to General Colin Powell, CJCS, 13 Nov 1989 ("firm believer"), box 10, Acc 330-92-0136.

8. Betti, "Acquisition Improvement Update," *Program Manager* 19, no. 5 (Sep-Oct 1990): 1 ("proper balance" and "essential information"); Betti, marginal note on cover brief attached to memo, Betti for DAB principals and DAB committee, 3 Jan 1990, subj: DAB Process ("making assignments"), box 1, Acc 330-94-0006.

9. Memo, Betti for Service Acquisition Executives [SAEs] and DAB Committee Chairmen, 5 Dec 1989, subj: Structuring DAB Meetings, box 11, Acc 330-92-0136; memo, Betti for Secretaries of Military Departments and DAB Committee Chairmen, 21 Feb 1990, subj: Defense Acquisition Board (DAB) Milestone Reviews, box 2; ltr, USD(A) Betti to John P. Carroll, President, Oshkosh Truck Company et al., 15 May 1990, box 5; Rear Adm. James B. Greene Jr., memo for distribution

[OUSD(A)], 27 Feb 1990, subj: Acquisition Leadership Conference '90, box 2; memo, Betti for all USD(A) staff, 26 Sep 1990, subj: Internal USD(A) Communications (quote), box 8: all in Acc 330-94-0006; Betti, "Acquisition Improvement Update," *Program Manager* 19, no. 4 (Jul–Aug 1990): 1, 5; Betti, "Acquisition Improvement Update," 1; Betti, "Acquisition Improvement Update," *Program Manager* 19, no. 6 (Nov-Dec 1990): 1; Betti, "A Resignation in DoD," *Program Manager* 20, no. 1 (Jan–Feb 1991): 2.

10. Memo, Betti for Chair, Defense Science Board, 6 Nov 1989, subj: Terms of Reference – Defense Science Board Task Force on Acquisition Streamlining, folder 23 Jan 1990 ("ponderous and inefficient"), box 1, Acc 330-94-0006; ltr, Betti to John Rittenhouse, Senior VP, General Electric Co., 24 Nov 1989 ("*any* constituency," emphasis in source), box 11, Acc 330-92-0136.

11. Memo, Rear Adm. James Greene, for SAEs et al., 26 Feb 1990, subj: Defense Acquisition Improvement Team, box 2, Acc 330-94-0006.

12. Memo, DUSD(A) Robert C. McCormack for Secretaries of Military Departments and Director of DLA, 18 Oct 1989, subj: Nondevelopmental Item Program, box 9; handwritten note, McCormack to ASD(P&L) Jack Katzen, 13 Nov 1989, attached to ltr, McCormack to Dr. J. R. Burnett, 14 Dec 1989, folder 14 Dec 1989, box 11: both in Acc 330-92-0136; memo, Betti for Secretaries of Military Departments and Directors of Defense Agencies, 30 Jul 1990, subj: Role of Contractor Past Performance in Contract Awards, box 7, Acc 330-94-0006; memo, Betti for Secretaries of Military Departments and Directors of Defense Agencies, 25 Sep 1989, subj: Under Secretary of Defense for Acquisition Approval of Certain Fixed-Price Type Contracts, box 8; memo, McCormack for Secretaries of Military Departments and Directors of Defense Agencies, 15 Dec 1989, subj: Implementation of Section 9048 of the Fiscal Year (FY) 1990 Department of Defense Appropriations Act Concerning Fixed-Price Development Contracts, box 11: both in Acc 330-92-0136; memo, Betti for Secretaries of Military Departments and Chairmen of DAB Committees, 21 Feb 1990, subj: Defense Acquisition Board (DAB) Milestone Reviews ("event driven acquisition strategy"), box 2, Acc 330-94-0006.

13. Memo, Betti for ASAF(A), 24 Nov 1989, subj: ATF Risk Assessment, box 11, Acc 330-92-0136.

14. "Budget Review Process Meeting: Summary & Actions," n.d., attached to memo, Betti for Comptroller, 6 Mar 1990 (quote), box 2, Acc 330-94-0006; GAO, *Acquisition Reform: Authority Delegated Under the Secretary of Defense for Acquisition*, GAO/NSIAD-90-183 (6 Jun 1990), 3.

15. Memo, Betti for Secretaries of Military Departments and Directors of Defense Agencies, 26 Jan 1990, subj: Funding Withholds (quotes), folder 26 Jan 1990, box 1; memo, Betti for SAEs, 16 Apr 1990, subj: Release of Funding Restrictions, box 4: both in Acc 330-94-0006; GAO, *Acquisition Reform: Authority Delegated*, 4.

16. Bruce Schoenfeld, "Dingell, Pentagon Do Battle over Proposal to Reduce Oversight," *Defense Week*, 1 Apr 1991, 13. The team was led by ASD (Production & Logistics) Colin McMillan and consisted of McMillan's principal deputy, David J. Berteau; DUSD (Acquisition Planning) Jed Babbin; DASD (Procurement) Eleanor R. Spector; and Maj. Gen. Charles Henry, commander of the Defense Contract Management Command.

17. Ralph Vartabedian, "FBI Agents Raid Northrop's B–2 Bomber Plant," *Los Angeles Times*, 22 Feb 1990, https://www.latimes.com/archives/la-xpm-1990-02-22-fi-1571-story.html; Vartabedian and Douglas Frantz, "U.S. Agents Raid 3 Northrop Plants in Southland," *Los Angeles Times*, 23 May 1990, https://www.latimes.com/archives/la-xpm-1990-05-23-fi-233-story.html; Vartabedian, "Secret Review of Northrop May Stir Furor," *Los Angeles Times*, 28 Sep 1990, https://www.latimes.com/archives/la-xpm-1990-09-28-fi-1112-story.html; Richard W. Stevenson, "Can a Tarnished Northrop Regain Its Momentum?" *New York Times*, 21 Oct 1990, https://www.nytimes.com/1990/10/21/business/can-a-tarnished-northrop-regain-its-momentum.html: all accessed 19 May 2020.

18. House Committee on Energy and Commerce, Subcommittee on Oversight and Investigations, *Northrop Corp. Investigation: Hearings*, 101st Cong., 2d sess., 27 Jul and 9 Oct 1990, Ser. No. 101-216, 89; Molly Moore, "Pentagon's Chief Weapons Builder, Under Fire and Over Cost, Quits Post," *Washington Post*, 13 Dec 1990, 21; Jack Weible, "Unless Yockey Wins Job, Lengthy Hunt Anticipated to Find Betti's Successor," *Defense News*, 16 Dec 1990, 4; transcript, Betti's testimony before the Committee on Energy and Commerce, Subcommittee on Oversight and Investigations,

27 Jul 1990, 134, 154–155 (quoted material), folder Betti 27 Jul 1990–Northrop/B–2 (House Committee on Energy and Commerce), box 7, Acc 330-94-0009, OSD Records, WNRC (hereafter Betti transcript).

19. Betti transcript, 174 (“adequate controls”), 118–119 (Betti/Sikorski exchange).

20. Ibid., 158 (“people on the scene”), 179–180, 157 (Bryant exchange).

21. Ibid., 100, 103.

22. James P. Stevenson, *The $5 Billion Misunderstanding: The Collapse of the Navy’s A–12 Stealth Bomber Program* (Annapolis, MD: Naval Institute Press, 2001), 31–41, 77, 128–140, 143. The contract for the concept formulation phase was for $2.9 million. When modified for the demonstration/validation phase, the contract provided an additional $78 million. See ibid., 34, 63, 78. For the pre-1991 5000 series program milestones and phases, see Jones, *Defense Acquisition Management*, 15.

23. Stevenson, *$5 Billion*, 105, 108–110, 118–119, 122, 152–153, 156–158, 160–163, 166, 168, 171, 172–173, 175–184, 215n, 224, 370, 381–382.

24. Ibid., 172–173 (quote, 173), 175–184.

25. Memo, SecDef Cheney for DepSecDef Atwood, 19 Dec 1989, subj: Major Aircraft Review; memo, Atwood for Under Secretaries of Defense and CJCS, same subject: both in folder 452, box 77, Acc 330-91-0095; Stevenson, *$5 Billion*, 188–189, 194n. A working group comprising members of various OSD offices, the Joint Staff, the Navy, and the Air Force conducted the review.

26. Stevenson, *$5 Billion*, 189–191, 210–214.

27. Ibid., 6, 215, 218, 220, 221–222, 226, 228–229 (quote, 229), 230.

28. Ibid., 79-80, 89–90, 229–232, 236, 242–245.

29. Ltr, Dingell to Cheney, 17 Jul 1990, attached to ltr, Betti to Dingell, 7 Sep 1990 (Dunleavy/Dingell quotes), box 8, Acc 330-94-0006; memo, Chester Paul Beach Jr. for SecNav, 28 Nov 1990, subj: A–12 Administrative Inquiry. A copy of the Beach memorandum is in HCAS, Procurement and Military Subcommittee, Research and Development Subcommittee, and Investigations Subcommittee, *The Navy’s A–12 Aircraft Program: Joint Hearing*, 101st Cong., 2d sess., 10 Dec 1990, HASC No. 101-84, 9–50 (hereafter *A–12 Program Hearing*); Rick Atkinson and Barton Gellman, “Navy Fires 3 Working on Top Jet,” *Washington Post*, 5 Dec 1990, 1; Eric Schmitt, “Admiral Is Ousted Over Plane Delay,” *New York Times*, 5 Dec 1990, http://www.nytimes.com/1990/12/05/us/admiral-is-ousted-over-plane-delay.html, accessed 12 Dec 2013; [Rep.] Andy Ireland [R-FL], “The A–12: Accountability in Military Procurement,” *Christian Science Monitor*, 24 May 1991, http://www.csmonitor.com/1991/0524/24182.html, accessed 19 May 2015. Robert Thompson, a civilian member of the Navy acquisition executive’s staff, was also reprimanded.

30. *A–12 Program Hearing*, 34–35.

31. Ltr, Betti to Dingell, 7 Sep 1990, box 8, Acc 330-94-0006; Stevenson, *$5 Billion*, 214 (“Potemkin village”); memo, Betti for SecNav H. Lawrence Garrett III, 10 Jul 1990, subj: A–12 Program Cost Growth and Schedule Delay (quote), folder 10 July 90, box 7, Acc 330-94-0006; memo, Garrett for Betti, same subject, 12 Jul 1990, attached to ibid.; *A–12 Program Hearing*, 1–2 (quote). A McDonnell Douglas official denied the accusation.

32. Ltr, Betti to DepSecDef Atwood, 11 Dec 1990 (quote), box 11, Acc 330-94-0006; memo, Betti for Atwood, 11 Dec 1990, subj: A–12 Program Information, attached to ibid. Betti told the secretaries of the Army and Navy, “I believe the report to be an excellent piece of work which addresses problems that I believe are cultural in nature and not confined to the Navy.” See memo, Betti for Secretaries of the Army and Navy, 4 Dec 1990, subj: Navy Report on the A–12 program (quote), ibid.

33. Stevenson, *$5 Billion*, 289; David C. Morrison, “Another Czar Bows Out,” *National Journal*, 5 Jan 1991, 43; *A–12 Program Hearing*, 35 (quote), 88–92; memo, Susan Crawford, DoD, Office of the Inspector General (DoD IG) for SecDef through DepSecDef, 29 Nov 1990, subj: Investigation into cost and schedule information on the A–12 aircraft program, folder 452, box 73, Acc 330-92-0097; ltr, Crawford to Rep. Andrew Ireland (R–FL), 29 Nov 1990, attached to ibid.; DoD IG, *Review of the A–12 Aircraft Program*, Audit Report 91-059, 28 Feb 1991, app. C, 33–37.

34. Stevenson, *$5 Billion*, 290–320, 323, (quotes, 304).

35. OASD(PA) Press Release, "Navy Terminates A–12 Program," 7 Jan 1991 (quotes); Stevenson, *$5 Billion*, 232, 378–379; *A–12 Program Hearing*, 6 (Ireland quote).

36. The exact wording seems relatively mild: "Fixed price contracts are normally not appropriate for research and development phases," but the language was interpreted as a ban (though not always obeyed as such). DoD Directive 5000.1 (Major and Non-Major Defense Acquisition Programs), 1 Sep 1987, 6. See DoD Directive 5000.1 (Acquisition of Major Systems), 13 Jul 1971, 5, for an early statement of OSD's preference for cost-type contracts over fixed-price contracts in development programs.

37. J. Ronald Fox, *Arming America: How the U.S. Buys Weapons* (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1974), 236–239; Stevenson, *$5 Billion*, 128–132; *Department of Defense Appropriations Act for Fiscal Year 1988*, P.L. 100-202 (22 Dec 1987), sec. 8118. Similar restrictions on fixed-price contracts appeared in subsequent legislation.

38. Stevenson, *$5 Billion*, 322–324, 334–338.

39. Ibid., 181, 194, 212–213 (quote, 213), 220, 222, 275.

40. "Independent Cost Estimates; Operational Manpower Requirements," 10 U.S.C. 2434. The original requirement was included in *Department of Defense Authorization Act for Fiscal Year 1984*, P.L. 98-94 (24 Sep 1983), sec. 1203; DoD Instruction 5000.2 (Defense Acquisition Program Procedures), 1 Sep 1987, 8.

41. DoD Directive 5000.4 (OSD Cost Analysis Improvement Group), 30 Oct 1980; Milton Margolis, "Understanding and Controlling System Cost Growth," in *The Cost Analysis Improvement Group: A History* (McLean, VA: Logistics Management Institute, 1998), 22.

42. Although Section 2434 of Title 10, U.S. Code, required that a cost estimate be made for all major defense acquisition programs, the definition of "a major defense acquisition program" in section 2430 explicitly excluded "a highly sensitive classified program (as determined by the Secretary of Defense)."

43. Stevenson, *$5 Billion*, 120–124, 192–193 (quote, 193).

44. David McNicol, "Growth in Demand, CARDS and IPTs," in *Cost Analysis Improvement Group*, 32–34; Stevenson, *$5 Billion*, 120.

45. DoD IG, *Independent Cost Estimating for Major Systems*, Audit Report 89-055, 24 Feb 1992; DoD IG, *Independent Cost Estimating for Major Defense Acquisition Programs*, Report 92-OIG-01, 5 Feb 1992, 7–15, 35–36; DoD Directive 5000.1 (Defense Acquisition), 23 Feb 1991, pt. 3:2; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 4, sec. D, 2–3, and sec. E, 4; pt. 10, sec. A, 1–4; pt. 13, sec. C, 1–5; DoD 5000.2-M (Defense Acquisition Management Documentation and Reports), Feb 1991, pt. 4:2–5, and sec. C: 1–3; pt. 8:8–10, and attach. 1:1–2; pt. 15:1–5, and attach. 1, 2, and 3; DoD Directive 5000.4 (Cost Analysis Improvement Group), 24 Nov 1992; DoD, *Cost Analysis Guidance and Procedures* (Washington, DC: Assistant Secretary of Defense (Program Analysis and Evaluation [PA&E], Dec 1992); McNicol, "Growth in Demand," 34–35. For a side-by-side comparison of the old and new versions of the 5000 series documents, see DoD IG, *Independent Cost Estimating* (1992), app. D. Many of the DoD IG audit reports cited in this volume are found at http://www.dodig.mil/reports.

46. Stevenson, *$5 Billion*, 63–66, 80, 88–90, 241, 368. It should be noted that according to Stevenson, the Anti-Deficiency Act was rarely enforced. He quotes from a ruling by the Armed Services Board of Contract Appeals in 1996: "Holding the Navy responsible for a violation of the statutory and regulatory requirements would 'wreak havoc' on the federal procurement process." See ibid., 66.

47. Ibid., 86–88.

48. Ibid., 134–140; memo, DASD (Procurement) Eleanor Spector for USD(A), 5 Jan 1988, subj: ATA Risk Management, folder 11 Jul 1991, box 5, Acc 330-94-0007, OSD Records, WNRC.

49. Stevenson, *$5 Billion*, 123, 134–138, 182–183, 195–196, 200–201, 216.

50. Defense Contract Management Command, *Report on Inquiry of DPRO Involvement in A–12 Program*, n.d., folder 5 Apr 1991, box 3, Acc 330-94-0007. DCMC also looked into how progress payments were made. See Gene E. Foster, Progress Payment Deficiencies on the A–12 Program, report attached to ltr, Maj. Gen. Charles R. Henry, CO DCMC, to Yockey, 28 Nov 1990, folder Secretary of the Navy, 5000 Series 1991 Revision Files, OSD/HO.

51. Memo, Brig. Gen. Arthur E. Johnson, Assistant DDR&E (Strategic and Theater Nuclear Forces), for DDR&E, 15 Jan 1991, subj: DDR&E (TWP [Tactical Warfare Program]) A–12 Supervisory and Management Review, with attached memo, DDR&E Charles Herzfeld for Acting USD(A), 22 Jan 1991, same subject, folder 28 Jun 1991 (quote), box 5, Acc 330-94-0007.

52. Memo, DoD Comptroller Sean O'Keefe for DepSecDef, 14 Jan 1991, subj: A–12 Program Information, 18 Jan 1991, with attached memo, O'Keefe for Director, Defense Contract Audit Agency, folder 452A, box 65, Acc 330-93-0004, OSD Records, WNRC; memo, Atwood for USD(A), 10 Dec 1990, subj: Defense Science Board Special Panel on Certain Aspects of the A–12 Program, with attachments, folder 452, box 73, Acc 330-92-0097; ltr, Stephen B. Higgins, U.S. Attorney, Eastern District of Missouri, to Barbara A. Corprew, Chief, Defense Procurement Fraud Unit, re: A–12 Program, 5 Dec 1990, folder 452, box 73, Acc 330-92-0097; Stevenson, *$5 Billion*, 178, 282. Neither Betti nor Captain Vanderpoel, who wrote the document, could remember Betti signing it, but Betti stated he probably did and, if not, he would have. See Stevenson, *$5 Billion*, 178.

53. Stevenson, *$5 Billion*, 308, 312–320, 334–367; Stevenson, "What The Supreme Court's A–12 Decision Means," *Federal Times*, 5 Jun 2011; "With Ruling, 'Flying Dorito' Case Goes On (and On and On)," *The Wall Street Journal Law Blog*, 24 May 2011, http://blogs.wsj.com/law/2011/05/24/with-high-court-ruling-flying-dorito-case-goes-on-and-on-and-on/, accessed 28 Jun 2011; Jen DiMascio, "A–12 Avenger Suit Reconciled, At Last," *Aviation Week Network*, 3 Feb 2014, http://aviationweek.com/awin/12-avenger-suit-reconciled-last, accessed 26 May 2015. In their settlement with the government, Boeing agreed to provide the Navy three EA-18G Growler electronic warfare aircraft without charge and General Dynamics $198 million in credits for DDG 1000 *Zumwalt*-class destroyers.

54. *A–12 Program Hearing*, 34–35 (quotes).

55. Memo, Director AP&PI Christie for Yockey, 17 Jul 1990, subj: Acquisition Process for Major Programs (quotes), attached to memo, Christie for Betti through Yockey, 17 Jul 1990, subj: Root Cause of DoD's Problems in Acquisition, box 2, Acc 330-96-0008, OSD Records, WNRC. For Christie's career, see his brief biography in Committee on Naval Analytical Capabilities and Improving Capabilities-Based Planning, Naval Studies Board, National Research Council, *Naval Analytical Capabilities: Improving Capabilities-Based Planning* (Washington, DC: The National Academies Press, 2005), 79.

56. Memo, Christie for Yockey, 17 Jul 1990.

57. Ibid. Christie's comments to Betti were bold, but he did remind the under secretary that when he was hired Christie had said, "I would call the shots as I saw them." Memo, Christie for Betti through Yockey, 17 Jul 1990, subj: Root Cause of DoD's Problems in Acquisition.

58. OASD Press Release, "Donald J. Yockey Sworn in as Under Secretary of Defense for Acquisition," *Defense Daily*, 20 Jun 1991; "Biographical Sketch of Donald J. Yockey" (25 Jan1990) and other biographical information, *Nominations Before the Senate Armed Services Committee, Second Session, 101st Congress: Hearings*, 5 Mar 1991, S. Hrg. 101-909, 185–187; Steven Pearlstein, "Incoming at Pentagon: A 'Czar,'" *Washington Post*, 22 May 1991, 19.

59. USD(A) Yockey (speech delivered at the Cost/Schedule Control Systems Criteria (C/SCSC) National Workshop, Falls Church, VA, 28 Oct 1991) (quotes), attached to memo, DUSD(A) Donald C. Fraser for Component AEs, 30 Jan 1992, subj: Contract Cost Performance Measurement, box 1, Acc 330-95-0057, OSD Records, WNRC. See also Pearlstein, "Incoming at Pentagon."

60. David Everett, "Pentagon's Low-Key 2d-in-Command," *Philadelphia Inquirer*, 22 Jan 1991, 9; "Donald Atwood: Taking Control," *Government Executive* 23, no. 8 (Aug 1991): 54; "Atwood Says DoD Lacks Discipline to Enforce Acquisition Procedures," *Federal Contracts Report*, 10 Apr 1989, 694; Atwood, "Balancing Security Needs and Fiscal Realities," (remarks prepared for delivery to the American Institute of Aeronautics and Astronautics, Arlington, VA, 3 May 1989), *Defense Issues* 4, no. 15, 1 (quotes).

61. "Donald Atwood: Taking Control," 54.

62. "Yockey Reorganizes Office, Elevates Spector to Director of Procurement," *Federal Contracts Report*, 4 Mar 1991, 275; memo, Yockey for OUSD(A) staff, 21 Feb 1992, subj: Functional Review, box 1, Acc 330-95-0057. Two months later Yockey asked for three new positions in his office covering tactical systems, strategic and space systems, and test and evaluation; memo, DUSD(A) Fraser for Director, Administration and Management, 10 Apr 1992, subj: Realignment of Technology and Acquisition Functions, box 3, Acc 330-95-0057.

63. Callen, "Defense Observers See Big Weakening of DoD Buying Chief Under New Regs," 5; memo, DepSecDef Atwood for Secretaries of Military Departments et al., 12 Aug 1991, subj: Strengthening Technology and Acquisition Functions, folder 27 Sep 1991, box 7, Acc 330-94-0007.

64. Schoenfeld, "Dingell, Pentagon Do Battle"; memo, Yockey for Secretaries of Military Departments and Directors of Defense Agencies, 11 Apr 1991, subj: Review of Requests for Proposal (RFPs) and Contracts Prior to Solicitation and Award, box 3, Acc 330-94-0007; Caleb Baker, "Yockey Tightens Review of DoD's Arms Purchases," *Defense News*, 29 Apr 1991, 1; memo, Yockey for SAEs, 30 Aug 1991, subj: Weekly Acquisition Reports, box 6, Acc 330-94-0007.

65. Memo, Yockey for SAEs, 23 Aug 1991, subj: Fixed Price Development Contracts, box 6; ltr, Yockey to Lawrence F. Skibbie, President, American Defense Preparedness Association, 1 Aug 1991, box 5: both in Acc 330-94-0007; "Yockey Aims to Discourage Use of Fixed-Price Production Options in Development Contracts," *Federal Contracts Report*, 20 May 1991, 682. Yockey also opposed a cost cap on the F/A–18E/F fighter development program because it would have the same effect as a fixed-price contract. See Yockey to Sen. Alfonse D'Amato, 15 May 1992, box 4, Acc 330-95-0057.

66. Memo, Yockey for DoD Comptroller Sean O'Keefe, 3 Jun 1991, subj: Stability of Acquisition Programs, folder 400.13, box 63, Acc 330-93-0004. Betti had worried about this problem too. See "Budget Review Process Meeting: Summary & Actions," n.d., attached to memo, USD(A) Betti for Comptroller, 6 Mar 1990, box 2, Acc 330-94-0006.

67. Memo, Yockey for DoD Comptroller O'Keefe, 3 Jun 1991.

68. Memo, O'Keefe for USD(A), 14 Jun 1991, subj: Stability of Major Acquisition Programs, attached to ibid.; memo, David S. Addington, SpecAsst to DepSecDef and SecDef, for DepSecDef Atwood, 25 Jun 1991, subj: Fiscal Discipline in Programs Reviewed by the Defense Acquisition Board, folder 28 Jun 1991, box 5; memo, Atwood for Secretaries of Military Departments. et al., same subject, 2 Jul 1991, folder 3 Oct 1991, box 7; memo, Yockey for Secretaries of Military Departments, 1 Oct 1991, same subject, box 7; "Summary of SAE comments on Draft Memorandum," attached ibid.: all in Acc 330-94-0007; GAO, *Weapons Acquisition: Implementation of the 1991 DoD Full Funding Policy*, GAO/NSIAD-92-238 (Sep 1992), 3, 4.

69. GAO, *DoD Full Funding Policy*, 2–11.

70. Memo, Yockey for SecNav, 6 Dec 1991, subj: Line Item Allocation of FY 1994 Undistributed Other Procurement, Navy Reduction, box 8, Acc 330-94-0007; memo, DUSD(A) Fraser for Assistant Secretary of the Navy (Research, Development, and Acquisition) [ASN(RDA)] and Assistant Secretary of the Air Force (Acquisition) [ASAF(A)], 9 Apr 1992, subj: Implementation of Acquisition Decisions; memo, Yockey for Secretaries of Military Departments and Director, Strategic Defense Initiative Organization, 30 Mar 1992, subj: Notification of POM Changes to DAB Programs (quote): both in box 3, Acc 330-95-0057. Yockey defined "significant changes" as at least 15 percent in RDT&E funding, 5 percent in procurement funding, 15 percent in average unit cost, or six months in the schedule from the FY 1993–1997 FYDP.

I. "Biographical Sketch of John A. Betti," *Nominations Before the Senate Armed Services Committee, First Session, 101st Congress: Hearings*, 3 Aug 1989, S. Hrg. 101-587, 514–515; Schmitt, "Pentagon Official Resigns After Criticism About Overruns on Plane"; "John A. Betti," app. A to Committee on Optimizing U.S. Air Force and Department of Defense Review of Air Force Acquisition Programs, Air Force Studies Board, Division on Engineering and Physical Sciences, National Research Council, *Optimizing U.S. Air Force and Department of Defense Review of Air Force*

Acquisition Programs (Washington, DC: National Academies Press, 2009), http://www.nap.edu/catalog.php?record_id=12673, accessed 25 Feb 2020.

II. Stevenson, *$5 Billion*, 80–81, 333–334; Schmitt, "Admiral Is Ousted Over Plane Delay"; Larry Elberfeld, LinkedIn profile, http://www.linkedin.com/pub/larry-elberfeld/b/70b/1b5, accessed 12 Dec 2013.

III. "Biographical Sketch of Donald J. Yockey," *Nominations Before the Senate Armed Services Committee Second Session, 101st Congress*, 6 Mar 1991, 191–192, and "Biographical and Financial Information Requested of Nominees," ibid., 11 Mar 1991, 192–197; Rockwell International Corporation, "Rockwell Mourns the Death of Donald J. Yockey," 24 Nov 1997, http://www.theautochannel.com/news/press/date/19971124/press008235.html, accessed 25 Feb 2020.

CHAPTER IV

The V–22 Osprey and the Politics of the Defense Drawdown, 1989–1992

While Defense Department leadership was seeking significant but evolutionary reforms of the acquisition system, it was also dealing with fundamental changes stemming from circumstances beyond its control. The easing of Cold War tensions, culminating in the dissolution of the Warsaw Pact and then the Soviet Union itself in 1991, led to the drawdown of the armed forces and the continued reduction of the Defense budget. The department responded by cutting some acquisition programs, even major systems Congress supported, favoring instead a tough policy of winnowing out lesser priority programs altogether and shutting down unneeded production lines. It preferred to invest in next-generation systems then under development, but Congress made clear there were limits to this policy, especially during a period of economic distress. These disagreements led to battles over acquisition, especially during 1990 but continuing through the remainder of the George H. W. Bush administration. The struggle between Secretary of Defense Cheney and Congress over the V–22 Osprey tiltrotor aircraft illustrates not only the issues then at stake but also the methods supporters employed to keep particular programs going in the face of determined opposition and the compromises that often resulted from these political conflicts.

THE PEACE DIVIDEND

Cheney took office in March 1989 knowing Defense budget cuts were inevitable; in fact, the budget declined throughout his term, falling in current or then-year dollars from $291 billion in FY 1989 to $267 billion in FY 1993. When adjusted for inflation, the budget decrease amounted to 17 percent. However, to keep the numbers in perspective, defense spending in FY 1993 still exceeded FY 1979 spending, the year before the Reagan-era buildup began, by almost 11 percent.[1]

During fiscal years 1989–1993 the RDT&E and procurement (production) appropriations fell sharply. Procurement declined by 40 percent, the most of any major

Defense budget category during the Bush administration, and RDT&E dropped 10 percent, although it managed a small increase in FY 1993.[2]

FY 1990: Programs Terminated and Rescheduled

The president had already cut the DoD budget by the time Cheney began his tenure. Submitted in January 1989 by the outgoing Reagan administration, the FY 1990 budget had called for a total of $305.6 billion in budget authority for the department, a plan that would increase defense spending over the course of the Future Years Defense Program by about 2 percent annually. On 9 February newly inaugurated President Bush announced his support for a one-year freeze on defense spending for FY 1990 but for increases in subsequent years. He presented a revision of Reagan's budget that cut an additional $6.3 billion from defense to $299.3 billion for FY 1990. The revised budget proposal included a real increase of 1 percent for FY 1991 and 2 percent for the rest of the FYDP (1992–1994). Congress insisted on further reductions, however, and after two months of negotiations, it reached an agreement with the White House on 14 April that cut an additional $3.7 billion from defense in FY 1990, a reduction of $10 billion from the January federal budget, nearly all of it from defense. The agreement also reduced the FYDP for fiscal years 1990–1994 by over $64 billion. Cheney's task was to decide how to make Defense Department priorities and obligatory spending fit into the budget authority.[3]

Table 4-1: Budget Authority for Future Years Defense Program
FY 1989–FY 1994
(in billions, current/then-year dollars)

	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	CUMULATIVE: FY 90–94
Reagan Budget, January 1989	$290.2	$305.6	$320.9	$335.7	$350.7	$365.6	$1,678.5
2d Bush Budget, April 1989		295.6	311.0	322.0	335.9	349.8	1,614.3
Change from previous year		-10	-9.9	-13.7	-14.8	-15.8	-64.2
Percent change		-3.3%	-3.1%	-4.1%	-4.2%	-4.3%	-3.8%

Source: Figures derived from Table 14 (Trends in Department of Defense Future Years Defense Plans), in Daggett and Belasco, *Defense Budget for FY 2003: Data Summary*.

Eleven days after the agreement, Cheney presented a revised budget. He was determined not to sacrifice the quality of personnel or the readiness of strategic and conventional forces. Suspicious of Soviet leader Mikhail Gorbachev's efforts to push the Soviet bloc toward reform, Cheney chose to make only modest reductions in force structure. The bulk of the funding cuts, almost $13.5 billion of the $20 billion total, fell on acquisition, mostly on procurement.[4]

The question then was, How should the cuts be distributed? A common approach during the second Reagan administration had been to spread the pain more or less evenly among the acquisition programs, specifically by extending ("stretching out") development or production schedules. This practice saved money in the short run and it kept production lines running, albeit at a reduced rate, which kept workers employed and left open the possibility of ramping up production later, modifying the system, or manufacturing a variant. Politically, this was the most popular approach, but it cost more in the long run. It disrupted the execution of programs, as program managers had to reschedule and reprioritize tasks such as engineering and testing. More importantly, it also forced the Defense Department to procure systems at uneconomical production rates, as manufacturing facilities with fixed overhead costs had to adjust their schedules and produce fewer units. Program stretchouts ultimately increased unit costs—the cost of producing a single system, such as one aircraft, ship, tank, or missile—while extending the acquisition cycle and delaying the fielding of weapons. Robert Costello, the outgoing under secretary for acquisition, condemned this approach. Instead of stretching out many programs, he recommended to the department's new leadership terminating a few altogether, thereby "taking a longer term view and making tough decisions now on some of our major acquisition programs."[5]

Cheney agreed. The Packard Commission's and other reports had emphasized the importance of program stability and maintaining economical production rates, that is, the most efficient level of production, the lowest unit cost, and the best return for the government's investment. With the strategic picture changing, the time seemed favorable to eliminate the least important Cold War programs, allowing higher priority programs to proceed economically and on schedule. Cheney therefore determined to make "vertical cuts"—that is, terminate entire programs: "The worst possible thing we can do is fund everything in a half-way fashion. That way we will end up with the worst of all worlds. We will end up without adequate defense capability and spend far too much for it."[6]

To determine which programs to cut, Cheney asked the advice of OSD's assistant secretary of defense for program analysis and evaluation (PA&E), David S. C. Chu, an experienced Pentagon hand and one of the most senior Reagan holdovers involved in acquisition to stay on in the Bush administration. Based on Chu's advice, Cheney's budget for FY 1990, presented to Congress on 25 April 1989, sought to terminate nine systems, mostly those in production but also some research and development programs. As a hedge against the resurgence of Soviet power, the secretary was determined to protect strategic programs such as the MGM–134A Midgetman small ICBM, the B–2 stealth bomber, and the Strategic Defense

The nuclear-powered fast-attack submarine *Seawolf* (SSN 21) during sea trials in July 1996. *(DoD)*

Initiative ("Star Wars"), the antiballistic missile system. He therefore targeted conventional weapons, especially current-generation "legacy" systems that were either deployed in sufficient numbers for the downsizing military or scheduled for replacement by a more advanced system already in the development pipeline. The Army programs slated for termination were the AH–64 Apache attack helicopter and the upgrade that would arm the OH–58 Kiowa reconnaissance helicopter (both to be replaced by the next-generation LHX reconnaissance and attack helicopter, later named Comanche), as well as the M88 Improved Recovery Vehicle for pulling damaged tanks off the battlefield. The Air Force was to lose the F–15E Strike Eagle long-range interdiction fighter and the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods that went with the aircraft. Navy victims were to be the new-production F–14D Super Tomcat fighter—Cheney considered converting existing F–14As into the more economical "D" variant—and the AIM–54 Phoenix air-to-air missiles they carried, as well as the last improved fast-attack submarine of the *Los Angeles* class, scheduled to be replaced by the *Seawolf class* by the mid-1990s. Finally, breaking the pattern of the other terminations, Cheney canceled the V–22 Osprey, an innovative vertical-takeoff-and-landing (VTOL) transport aircraft then under development mostly for the Marine Corps, in favor of a mix of existing helicopters.[7]

Cheney also proposed stretching out 11 conventional and strategic systems. In these programs, he wanted to reduce the quantities of units purchased or delay delivery schedules because he believed either there was little urgency for the systems or they were not ready for quantity production. He did, however, plan to reschedule in ways that would maintain efficient production rates. Finally, Cheney proposed closing some government-owned production facilities, including the Detroit Army Tank Plant and the Mississippi Army Ammunition Plant, the latter a state-of-the-art manufacturer of artillery shells that had been open only six years. During congressional hearings, Cheney's budget drew searching questions that explored the ramifications of his proposals, especially the program terminations. Committee members expressed concern, for example, that canceling the Apache helicopters and Super Tomcat fighters would leave the country without a "warm" (active) production line for those systems and would place heavy reliance on the timely development and procurement of relatively risky, advanced-technology follow-on programs. Shutting down the Apache line would reduce helicopter production to a single manufacturer, while closing the tank plant in Michigan would restrict tank production to a single facility

An F–14D undergoes a preflight check at Naval Air Station Miramar, California, October 1990. *(NARA)*

in Lima, Ohio. Defense Department officials thought the Ohio plant would be sufficient given the reduced requirement for new M1 Abrams tanks, but some in Congress feared this would leave the country dangerously short of production capacity in an emergency. Furthermore, the two plants actually made different components and performed different tasks, their supporters argued, and to consolidate the production processes in Lima would involve considerable expense that would offset much of the savings. Members of Congress, determined to save favored programs, questioned whether the terminations would produce any savings at all. For example, Cheney argued that the Navy could save $2.5 billion over five years by upgrading existing F–14As, then in plentiful supply, instead of manufacturing new F–14Ds. Not so, said critics: Converting F–14As into F–14Ds would result in a system with only half the service life of a newly built aircraft. Thus, if the system intended to replace the F–14 was delayed, the Navy might be short of critically needed air superiority fighters by the turn of the century, and the costs of restarting a cold production line could wipe out any short-term savings.[8]

In the end, Congress provided most of the funding the administration requested but accepted only some of the terminations. In the FY 1990 Appropriations Act, the House rejected Cheney's request to cancel the Phoenix missile. It also added money to keep other programs going that he proposed to terminate, including new F–14Ds, OH–58 upgrades, and the V–22. To fund some conventional systems, Congress took money from operation and maintenance accounts and from appropriations for acquiring strategic systems. With respect to the latter, it slowed B–2 production and cut $1.1 billion from the Strategic Defense Initiative.[9]

In the debates on program funding, members broke party ranks on critical votes. Alliances formed on specific issues and then evaporated. One such alliance saw the unlikely joining of a liberal Democrat, Representative Ronald V. Dellums of California, with two conservative Republicans, John R. Kasich of Ohio and John G. Rowland of Connecticut, to cosponsor a measure to end B–2 procurement. Particularly noteworthy among the bipartisan coalitions were the attempts by Representative Aspin of Wisconsin, the Democratic chairman of the House Armed Services Committee, to rally support for the Republican secretary's program, relying heavily on Republican votes. When the House passed its authorization bill repudiating Cheney's proposals, Aspin infuriated members of his own party by condemning it as "a Dukakis defense budget," an attempt to tar it with the name of the losing presidential candidate of 1988, Michael S. Dukakis—a fellow Democrat.[10]

FY 1991: Congress Forces Deep Cuts

The following year, 1990, the administration and Congress renewed their battle over the federal budget. This time, concern over the growing deficit—which threatened to trigger the automatic budget cuts mandated by the Gramm-Rudman-Hollings legislation of 1985—drove much of the conflict. Meanwhile, the collapse of the Soviet empire in Eastern Europe, and especially the fall of the Berlin Wall in November 1989, led to calls for deep cuts in the Defense budget, a so-called peace dividend. The debate over the federal budget was prolonged and bitter. The White House and Congress finally reached agreement on 30 September 1990, one day before the start of the fiscal year. The agreement, the Budget Enforcement Act of 1990, capped both defense and domestic spending at specified levels for three years, ensuring that the pro-defense and pro-domestic spending camps could not take money from the other. Some Republicans were furious that President Bush agreed to raise taxes, while an unlikely coalition of liberal Democrats and conservative Republicans in the House of Representatives, although accepting the principles of the agreement, rejected the specific numbers. But not until 27 October did the legislators finally pass the agreement into law, only hours before adjourning.[11]

The battle over defense spending was an important element in White House and congressional efforts to come to terms on the FY 1991 budget. Cheney's plan, presented at the end of January 1990, accepted for the first time the need for a long-term reduction in defense spending. It included $295.1 billion in budget authority for the Defense Department for FY 1991, a reduction of 2.6 percent (after inflation) from the previous year. The decline continued at 2 percent annually during the subsequent years of the FYDP. Cheney expected to pay for some of the required cuts with savings achieved through the organizational and process reforms recommended by the Defense Management Report; consequently, cost reduction grew in priority within the reform implementation effort. In February 1990, six months after releasing the report, Cheney announced that the DMR reforms would save the department $2.3 billion in FY 1991 and $39 billion through FY 1995.[12]

Cheney hoped to achieve additional savings by reducing force structure, by closing 35 bases and other facilities, and, especially, by cutting acquisition programs. As with the FY 1990 budget, Cheney was determined to protect strategic systems, the B–2, the LGM–118A ICBM (Peacekeeper), and the Strategic Defense Initiative, so again the axe fell on conventional programs. He continued his approach of eliminating older production programs in favor of research and development of more advanced systems. Cheney proposed terminating 20 major systems, including 6 he had tried to cut in the previous year's budget—among them the V–22, the new manufacture F–14D, the AH–64, and the M1. He tried again to shut down associated production facilities, including both the Detroit and Lima tank plants. Meanwhile, he wanted to continue funding the LHX helicopter (the Comanche), the Advanced Tactical Fighter (the F–22), the A–12 attack aircraft, and the C–17 airlifter, next-generation systems that in some cases would only become available in the late 1990s at the earliest.[13]

Strong sentiment existed across the spectrum for greater cuts, but members had difficulty reaching agreement over how large they should be and how to distribute them. One observer, Bob Benenson of the *Congressional Quarterly*, called the debates "the dark side of the so-called peace dividend." Benenson noted that "fighting for the folks back home can require political contortions, forcing liberal Democratic critics of defense spending to fight for weapons programs the Pentagon says it can live without. Conservative Republicans find themselves battling their own administration and the military."[14]

Fatal Beauty, the first Northrop B–2A stealth bomber built, was delivered to the Air Force following its first flight on 17 July 1989.
(National Museum of the U.S. Air Force)

Senators and representatives looking for additional cuts or funds for favored projects targeted strategic programs. The ever-controversial B–2, which had first flown in July 1989, was at the center of a particularly contentious debate. Democrats renewed their assault on the bomber, arguing its cost was too high, its mission—to penetrate Soviet air defenses—was no longer required, and the entire program was technically too risky. Once a staunch supporter of the B–2, Aspin now turned against it. Even Republicans were outspoken in their criticism. Senator Warren Rudman (R-NH) of the Armed Services Committee complained the administration appeared to change the purpose of the aircraft to suit the international situation:

> We get a threat assessment that says, well, now, maybe, with arms control, that program really is not all that necessary. And then all those smart people you have over there [in DoD] and all those smart folks, the contractors, sit down and say, 'OK, guys, we need a new mission for this.' And you come up here next year with a new mission. You have charts, graphs, and computer slides. You will have the darndest mission for that airplane that anybody ever thought of, and it will sell.

As with the FY 1990 budget, bipartisan coalitions formed, with Republican Kasich and Democrat Dellums opposing the aircraft in the House and Republican John W. Warner of Virginia and Democrat Samuel A. "Sam" Nunn Jr. of Georgia, chairman of the Armed Services Committee, fighting for it in the Senate. Congress deadlocked on the issue until the two chambers reached a compromise to provide $2.35 billion for procurement, a little more than half of the $4.5 billion Cheney had requested. Both sides claimed victory.[15]

Congress remained uncomfortable with Cheney's approach of killing older programs in favor of new systems that could be years from production. Arguing that DoD should "think smarter, not richer," the Senate Armed Services Committee rolled back funding for production of a number of systems still in development in favor of more testing, including the B–2, the V–22, the LHX, the A–12, the Advanced

Tactical Fighter, and the C–17. It also deferred procurement in FY 1991 of the *Seawolf* (SSN 21), whose keel had been laid on 25 October 1989, and substituted two *Los Angeles*-class submarines to preserve the industrial base. Additionally, the committee pronounced itself in favor of upgrading existing systems such as the AH–64, the F–15, and the M1.[16]

Two events ultimately eased the pressure on the secretary and his budget. The first was Cheney's presentation of the department's Major Aircraft Review on 26 April 1990, during which he announced cutbacks in C–17, B–2, and A–12 procurement: 120 C–17s instead of 210, 75 B–2s instead of 132, and 620 A–12s instead of 858. The numbers for procurement of Air Force F–22s and its version of the A–12 would remain the same, but the production schedule for each system would slip two years. The cuts would result in a net savings of $2.4 billion in FY 1991 and $16.8 billion in total for FYs 1991–1994 and help deflect demands for more radical cuts or terminations, although critics quickly noted unit costs would increase dramatically. For example, the unit price of a single B–2 would jump from $530 million to $815 million. "We are cutting a little bit, and we are stretching a lot," Kasich complained, "and when you cut and stretch you drive up the cost." Cheney, who had opposed stretching out programs during his first year in office, had been forced to bow to political realities.[17]

The second critical event was Iraq's invasion of Kuwait on 2 August 1990 and the subsequent Desert Shield and Desert Storm campaigns to contain and ultimately to expel the Iraqi forces. A burst of patriotism, the instinctive tendency of the public to rally around an administration in wartime, and the distraction of impending military operations all helped to mute criticism of the Defense budget and dampen debate. Bush's new national security strategy, announced on the same day as the Iraqi invasion, offered a rationale for maintaining substantial military forces in the face of such regional crises. Nonetheless, the final budget represented a significant cut from what the administration had requested. Congress authorized a total budget (including non-DoD defense-related programs) of $288 billion, more than $18 billion less than Bush's $307 billion request. Instead of a steady 2 percent decline in defense spending over the next five years as the administration had proposed, Congress voted for a 3 percent average annual reduction.[18]

The approved budget achieved the reductions through significant cuts in force structure (including 100,000 personnel) and strategic systems. The B–2 program alone lost nearly a billion dollars. Congress refused to grant the administration the authority or funding to procure the five new stealth bombers it had requested, but it did not terminate the program either, yet again putting off a final decision. The Strategic Defense Initiative took a bigger hit, almost $1.7 billion from the president's request, along with restrictions on the system's configuration and on how the secretary of defense could spend the money. In conventional weapons, Congress again showed a preference for keeping open production lines that Cheney wanted to close, including those at the two tank plants and Grumman Aerospace Corporation's Bethpage, New

York facility for manufacturing F–14Ds. And again, Congress refused Cheney's request to cancel the V–22 Osprey.[19]

FY 1992: Congress Reconsiders

By 1991 numerous legislators had begun rethinking the rush to cut the Defense budget. Of particular importance to the debates of that year was the slow recovery from the recession that began the month before the invasion of Kuwait and ended the month after the cease-fire. Congress was beginning to understand fully the ramifications of the drawdown, as defense plants closed and hundreds of thousands of former military personnel looked for work. Furthermore, the 1990 budget agreement between the White House and Congress prohibited moving funds from defense accounts to domestic programs and vice versa and set caps on discretionary spending in both areas. The changes reduced the incentive for cutting defense below the cap, since such cuts could apply only to deficit reduction, not domestic programs. Therefore the agreement temporarily muted fighting over the size of the Defense budget while leaving plenty of room to debate priorities within it. Finally, the threat of sequestration—a crushing, all-or-nothing, across-the-board budget cut—was replaced by "mini-sequesters" that allowed a more organized approach to deficit control, giving the White House Office of Management and Budget (OMB) a greater role in the budget process and limiting Congress's ability to challenge the president's budget.[20]

For all these reasons, the budget debates of 1991 seemed relatively mild compared with those of the previous two years. The president's FY 1992 budget, presented on 4 February 1991, asked for $278 billion in budget authority for the Department of Defense. It called for a significant reduction in the military force structure in keeping with the administration's Base Force plans promulgated by JCS Chairman General Colin Powell. By 1995 the administration's proposals would cut the Army from 18 to 12 active-force divisions; the Navy from 13 to 12 carrier battle groups, from 547 to 452 battle force ships (with the last two operational battleships among those being deactivated), and from 13 to 11 active-force carrier air wings; and the Air Force from 24 to 15 active-force fighter wings. The number of U.S military personnel, not counting reserves, would fall below 1.7 million, a 25 percent reduction from the Cold War years of the Reagan administration.[21]

The budget also proposed reducing procurement from $64.1 billion in FY 1991 to $63.4 billion in FY 1992. Cheney again cut into the acquisition portfolio, proposing cuts to 81 programs, large and small. His proposed cuts included 13 major systems, among them the Army's Bradley Fighting Vehicle, the *Ohio*-class ballistic missile submarine, a new helicopter-carrying amphibious ship for the Marine Corps, the Navy's variant of the F–22 fighter, the remanufactured F–14D, and of course the A–12. Cheney again proposed terminating the V–22 tiltrotor but continued to support the development of other advanced technology systems. If the United States was going to field a smaller force, Cheney argued, that force should be more capable. He continued to fund the Army's Comanche helicopter and the Air Force's F–22 Raptor, and he approved the Navy's request for a replacement for the A-6 Intruder attack aircraft, the A–X, in lieu of the canceled A–12 Avenger II. And, as before, the secretary supported expensive strategic systems, including the B–2 and the Strategic Defense Initiative. In defense of his proposed program, he argued that Operation Desert Storm was demonstrating the importance of stealth and missile defense technologies and that Soviet strategic capabilities were still intact.[22]

Congress made some changes in the administration's proposals to reflect its own priorities. Discounting Cheney's warnings about the continued threat from the visibly crumbling Soviet Union, it again cut strategic systems heavily in favor of conventional weapons. Congress did allow continued development of the B–2 but limited production to the 15 aircraft previously approved (Cheney had wanted 4 more); it also authorized a reduced version of the Strategic Defense Initiative. Otherwise, Congress approved most of the administration's requests, but it also continued funding several programs the Pentagon had not asked for or sought to terminate. These funds would keep open production lines that many in Congress considered critical to maintaining the defense industrial base. The extra appropriations included $225 million to upgrade the M1 tank to the M1A2 variant, $274 million for the Army's Helicopter Improvement Program, $560 million to resume production of the Air Force's F–117 stealth fighter, and $625 million to prepare for full-scale production of the V–22.[23]

The first Army RAH–66 Comanche helicopter prototype conducts flight operations in Palm Beach, Florida, 4 January 1996. *(DoD)*

THE FIGHT FOR THE OSPREY: STRATEGY AND TACTICS

The V–22 Osprey was annually high on Cheney's list of acquisition programs to cut—he proposed its termination in FYs 1990, 1991, and 1992. Congress, however, continued to fund the aircraft. Cheney responded by refusing to spend any money appropriated for production. The battle over the V–22 became a test of wills between the administration and Congress that lasted through Cheney's four years at the Pentagon and nearly provoked a constitutional crisis between the two branches of government. The long contest reflected Cheney's determination to achieve his defense priorities as well as Congress's political sensitivity to constituent concerns.

The V–22 tiltrotor aircraft could pivot its two engines to take off and land like a helicopter but also cruise like a conventional turboprop aircraft. Its maximum cruising speed was 280 knots (322 mph) and its mission radius, carrying 24 combat troops, 242 nautical miles (278 statute miles). The Osprey originated as a joint-service program—the Navy and Air Force planned to purchase a few for a variety of missions—but it was primarily intended to replace the Marines' Vietnam-era medium-lift helicopter, the CH–46 Sea Knight, for use in amphibious assaults.[24]

The tiltrotor concept had been studied and its technology experimented with for more than 50 years before the initiation in December 1981 of the joint-service program that became the V–22. In the early 1950s the Army, Air Force, and National Advisory Committee for Aeronautics (predecessor of the National Aeronautics and Space Administration, or NASA) began to fund work on experimental tiltrotor designs. Transcendental Aircraft Company's Model 1–G successfully transitioned from vertical to horizontal flight in December 1954 and made more than 100 flights. But, after the Model 1–G crashed in mid-1955, Bell Helicopter, which had also received some government funding for tiltrotor experimentation, became the leader in the field. Its XV–3, built in 1953 and in operation until the late 1960s, carried one pilot and was equipped with a single engine located in the fuselage that powered a pylon-mounted movable rotor on each of its wingtips. In 1971 Hans Mark, then director of NASA's Ames Research Center and a future secretary of the Air Force, suggested NASA and the Army support further development of tiltrotor technology. Two years later Bell (Bell Helicopter Textron beginning in 1976) won a design competition, beating out Boeing Vertol, for a NASA/Army contract to build two experimental tiltrotors. Bell's machine, designated the XV–15, first flew in 1977. It was bigger than the XV–3 and had two pilots but differed primarily from the earlier tiltrotor because it had two engines, each housed in a wingtip nacelle; a cross-shaft connected the engines and coordinated movement of the rotors affixed to them.[25]

Flight test of the Bell XV–3 convertiplane. The VTOL tiltrotor aircraft hovers at Moffett Field, California, October 1962. *(NASA)*

The Bell XV–15 (NASA–703) tiltrotor takes off at Crows Landing, California, 1982. *(NASA)*

Even before the XV–15 was in the air, Bell representatives were aggressively promoting the tiltrotor's potential throughout the Defense Department and in Congress. Marine Corps aviators were the most receptive audience. Bell's key selling point was that a tiltrotor aircraft could fly twice as fast and twice as far as a helicopter. To the Marines, these capabilities would overcome the helicopter's limitations in amphibious operations. Although Marine Corps aviation was sold on the tiltrotor, the rest of the Marine leadership and top-level officials in the Navy and in the Office of the Secretary of Defense needed convincing evidence. At the end of August 1981, Under Secretary of Defense for Research and Engineering Richard D. DeLauer wrote a memo to the service secretaries suggesting a single aircraft, perhaps a derivative of the XV–15, might meet their V/STOL (vertical/short takeoff and landing) requirements. But decisive support likely came from Secretary of the Navy John Lehman, a former Navy pilot, who had witnessed the XV–15 fly at the Paris Air Show in June. He later recalled he was "very taken with the technology" because it promised rapid entry into and exit from the battle area, overcoming the helicopter's weaknesses. In September he told General Paul X. "P.X." Kelley, the Marine Corps commandant, to forget about developing a new helicopter and to pursue tiltrotor technology.[26]

Deputy Secretary of Defense Frank Carlucci formally established the Joint Services Aircraft Program at the end of 1981 to explore alternatives for a V/STOL aircraft that all of the services could use; at that point a tiltrotor, although favored by many, was only one of several possibilities. Initially the Army ran the program, but the Navy, with primary interest in the system, took over a year later and installed a Marine officer as the program director. In May 1982 a joint-service technology assessment group reported that a tiltrotor was the best prospect for a multiservice aircraft. Six months later the program office issued a request for proposal for a preliminary design; its requirements did not exclude configurations other than a tiltrotor. In anticipation of the RFP, Bell Helicopter had joined with Boeing Vertol for the competition, but theirs was the only bid submitted. Subsequently, in April 1983, the Navy awarded a $68.7 million cost-plus-incentive-fee contract to the team for a preliminary design.[27]

After Naval Air Systems Command (NAVAIR) approved the Bell Boeing tiltrotor design, the companies signed a cost-plus-incentive-fee contract in summer 1985 for full-scale development. But Secretary Lehman, concerned about potential cost overruns, refused to approve the agreement, insisting a fixed-price contract be used instead. After renegotiation, the major deliverable of the fixed-price-incentive-fee contract awarded in May 1986 was for six prototypes for flight and ground testing at a target price of $1.714 billion and a ceiling price of $1.810 billion. Additionally, the contract included an option, also demanded by Lehman, for the Navy to buy 12 pilot production aircraft at a total cost of no more than $1.2 billion. As previously agreed, the two companies would compete with each other for subsequent production contracts. Also in May, NAVAIR concluded a firm-fixed-price $76 million contract with Allison Gas Turbine Division of General Motors to design and produce the engines for the tiltrotor prototypes.[28]

On 19 March 1989, two days before Cheney became secretary of defense, the Osprey made its first flight, in helicopter mode. But, despite the success, all was not well with the program. When the full-scale development contract was being negotiated, both Bell Boeing and NAVAIR had expected the first flight to take place in 1987. Moreover, the aircraft was overweight and would likely overrun its ceiling price. In the FY 1990 budget submitted in January 1989, the Reagan administration had requested $1.488 billion for the Osprey, including funding for R&D as well as money to build facilities and buy the tools, materials, and components required before production could begin. At a cost of $23 billion for 522 aircraft, however, Cheney considered the V–22 unaffordable. He accepted the recommendation of Assistant Secretary of Defense Chu, a longtime opponent of the V–22, to terminate the program in favor of a mix of the general-purpose, heavy-lift CH–53E Super Stallion helicopter and a variant of the Army's medium-lift UH–60 Black Hawk helicopter.[29]

The Osprey was the top acquisition priority for the Marines, who were committed to defending the system. They planned to use the aircraft in over-the-horizon amphibious assaults, but as program costs provoked increasing opposition during the late 1980s, the Marines began to highlight other possible missions: rapidly deploying reinforcements to Europe in the event of a Soviet invasion, shuttling troops around the battlefield for raids and surprise attacks, resupplyng combatants, rescuing hostages, supporting special forces, and even interdicting drug traffic. "As the Marines expanded their arguments for the Osprey, the tiltrotor's value seemed to increase in their own minds," notes Richard Whittle, the author of a history of the program. "Slowly but surely—not in a sudden shudder of inspiration, but in a gradual, osmotic way—the idea took hold within the Corps," that "the tiltrotor was going to transform the Marines," making them "truly indispensable," a critical consideration given the Corps' longstanding and deep-seated fear of being absorbed by the Army. General Alfred M. Gray Jr., the Marine Corps commandant during this time, reportedly declared that Marines wanted the V–22 "more than they want to go to heaven."[30]

A V–22 Osprey prototype in flight. *(NASA)*

As a former legislator himself, Cheney knew the Marines enjoyed substantial clout on Capitol Hill. "I was hoping that somehow I could camouflage the fact that I was a United States Marine, but there is no way on earth you could do that," Delegate Ben G. Blaz (R-Guam), a retired brigadier general and member of the House Armed Services Committee, explained to Cheney. "As luck would have it . . . I had lunch next door and what was in front of me? A life-sized portrait of Mt. Suribachi. So I have to talk as a Marine today." Of course, luck had nothing to do with the fact that a painting of the iconic flag-raising by the Marines at Iwo Jima was conspicuously hanging in a congressional dining room.[31]

Although V–22 supporters were initially surprised to discover that the aircraft was under attack, they rallied quickly and pulled together a formidable coalition in its defense. Wayne C. "Curt" Weldon (R-PA), whose district included Boeing's helicopter plant where the Osprey would be manufactured, led the opposition in the House and Arlen J. Specter (R-PA) in the Senate. Weldon organized an "Osprey team" consisting of House members or aides, corporate lobbyists, and a lobbyist of the United Auto Workers, which represented the Boeing and Bell workers. This group met at least every other week to plan strategy. He also assembled a group of congressional supporters known as the Tilt-Rotor Technology Coalition. By the end of 1989, 125 senators and representatives had joined. Osprey supporters also made alliances with members whose own favored programs were threatened by termination, including the New York delegation, which was trying to save the F–14D built at Grumman's plant in Bethpage.[32]

By fall 1989 Weldon had formulated an aggressive defense of the program he called the V–22 Action Plan. He vowed it would be "the largest, most comprehensive effort to resuscitate a program I've ever seen." The plan mobilized all available resources and used every public relations tool and technique. Bell and Boeing representatives held briefings for members of Congress on the economic importance of the Osprey to their states and districts, drafted questions for use in hearings, and sponsored trips for members to visit the plants, often paying them honoraria for doing so (a legal practice at the time). The companies sent out "political action packets" to their subcontractors with editorials to submit to local newspapers, form letters to send to legislators, and other helpful materials. Weldon's team even arranged for a tiltrotor—not an Osprey but an XV–15 demonstrator—to land on Capitol Hill, an impressive demonstration that garnered much support for the aircraft.[33]

Representative Wayne C. "Curt" Weldon (R-PA), member of Congress, 1987–2007. *(Collection of the U.S. House of Representatives)*

The Marines played a central role in this effort, helping to plan strategy—their congressional liaison often attended Weldon's meetings—lobbying members, and emphasizing the Osprey's importance to the Corps whenever they could. Like the other services, the Marines had always advocated programs and legislation of interest to them, but this time they had to exercise care because they were promoting a program the Defense Department officially opposed. Lest there be any doubt of the consequences, they had only to look at the experience of Air Force Chief of Staff General Larry Welch, publicly reprimanded by Cheney in 1989 for discussing Air Force programs directly with legislators. When the V–22 program manager, Marine Col. Harold W. "Harry" Blot, indiscreetly expressed confidence in the program's survival to a reporter, he received a pointed warning from OSD not to do it again. Soon after, when Blot contradicted the administration position in a discussion with congressional staff members, the Corps whisked him away for "refresher training" and then a command assignment far from Washington.[34]

Consequently the Marines worked quietly, even secretly, behind the scenes, while in public General Gray indignantly insisted no such activities were taking place. Led by Gray himself, they proclaimed in open testimony to Congress that they supported the V–22's cancellation but also made it clear they did not; they wanted the Osprey—badly. Repeatedly, Marine witnesses told congressional panels they agreed with OSD's conclusion that the aircraft was unaffordable given the tight budgets, but then they would immediately highlight the aircraft's virtues, stating it was the only option that would fully meet their requirements. Maj. Gen. Ray M. Franklin, commanding general of the Marine Corps Research, Development and Acquisition Command, stated the case succinctly when he testified that "we support the Secretary's decision. Operationally, we still think the V–22 is a good buy." The Marines avoided criticizing the secretary directly by implicitly blaming his civilian staff, arguing Cheney had made the correct decision based on the information shared with him, but the information itself was wrong. Gray suggested that civilians with no military experience—he likely had Chu and DoD Comptroller Sean O'Keefe, another Osprey opponent, in mind—had overruled the professional warfighters. "[Y]our Commandant"—he liked to refer to himself that way in public—"had the opportunity to lay out the operational requirements and the need and what in his view is the overriding justification for the MV–22," he testified in June 1989. "Your Commandant failed to carry the day. . . . Some of the people within DoD and I do not agree on some of the data and that is to be expected." A year later Gray was less subtle and more melodramatic: "I made a mistake in the last couple of years. . . . I came from the field with the idea that I should express operational requirements and 'lay it on the line,' and tell people what is needed. I assumed the Commandant would have credibility when talking about 'coming from the sea,' [because] that is what we do. Instead, I found out that others who never come from the sea have more credibility than I do." When the chairman of the Defense Subcommittee of the House Appropriations Committee, Democratic Representative John P. "Jack" Murtha —a Pennsylvanian, former Marine, and a strong Osprey supporter—asked Gray point blank if he was referring to "bureaucrats at the Pentagon," the commandant deflected the question; he had made his point.[35]

The Marines were in a difficult position because their intentions were readily apparent to OSD and to Congress. During a hearing in which the V–22's program manager, Blot's successor, Col. James H. Schaefer, testified, Representative George J. Hochbrueckner (D-NY) pointed out—unnecessarily—that "the Colonel is in the most delicate position."

General Alfred M. Gray Jr., commandant of the Marine Corps, speaks during the christening of the hospital ship USNS *Comfort* at the National Steel and Shipbuilding Company shipyard, San Diego, California, August 1987. *(NARA)*

> He, obviously, has a story he would like to tell. He reflects that the military really wants this aircraft, but he cannot publicly come out and say that this is the route we ought to follow. So I appreciate the position the Colonel is in, because you really can't answer the questions here today and hope to be a general, in my view. I would like to see you be a general, and so I am not going to ask any embarrassing questions.[36]

Yet the Marines were careful and apparently no one was ever punished for his testimony.

If at first Cheney did not anticipate the political turmoil the cancellation would cause, he quickly found out. When word first leaked out about the termination, Representative Weldon fired off a letter to the secretary, declaring his vehement opposition to the plan. The next day, 19 April 1989, Senators Theodore F. "Ted" Stevens Sr. (R-AK) and John H. Glenn Jr. (D-OH) introduced a "sense of the Senate" resolution calling upon the president to support funding for the Osprey, which passed by a voice vote in the nearly empty chamber. Two weeks later, in a hearing of the Senate Appropriations Committee, Senator Dale L. Bumpers (D-AR) told Deputy Defense Secretary Don Atwood he remained undecided on the issue but expressed wonder at the outpouring of support for the Osprey. "I am getting more flak," Bumpers said. "I was in Los Angeles the other night, and everybody converged on me there. [The V–22] is not even built in Los Angeles."[37]

The debate over the aircraft continued, prolonged and contentious, with Osprey supporters hounding Cheney, Atwood, and other senior DoD officials whenever they had the chance. They advanced several arguments. First, the helicopters employed older technology, while the Osprey was new and innovative and used the technology of the future. Second, the helicopters could not perform the missions the Marines had in mind nearly as well as the V–22, if at all. Third, the helicopter option would cost more in the long run because of the increased operations and maintenance costs required to keep an aging fleet of small helicopters airborne. Another argument supporters increasingly emphasized was that once the V–22 demonstrated its value, industry would embrace the technology and begin producing tiltrotors, a development that would revolutionize civil aviation by allowing aircraft to take off and land in places without airports. (The contractors had aggressively and successfully courted the Federal Aviation Administration during the 1980s to win its endorsement of the tiltrotor concept.) On the other hand, if the United States did *not* build tiltrotors, they warned, then other countries would, especially Japan—an argument that touched a nerve given the prevailing fear at the time that the United States could not compete with the Japanese economic powerhouse.[38]

As time went on, supporters began to let their enthusiasm carry them away. The tiltrotor is "the greatest technological step in the history of rotorcraft since the invention of the first practical helicopter," General Gray declared. "Make no mistake about it," Representative Hochbrueckner enthused, "the V–22 is the next generation of DC–3 [the commercial precursor of the famous C–47 transport of World War II]. We will see these aircraft all over the world." Advocates downplayed the numerous technical problems already plaguing the tiltrotor's development. "[L]et me tell you, this plane is going to happen," Hochbrueckner promised. "If it is a little overweight, if it is four knots slow, who cares?" The aircraft was then 3,000 lbs. overweight, 10 percent above specifications. This was perhaps the most serious of the technical problems with the V–22, and critics were raising concerns about its readiness for production.[39]

The Defense Department continued to insist that the Osprey was unaffordable in the constrained budget environment; simply put, its narrow range of missions did not justify the expense. A few weeks after the cancellation, Atwood suggested that technical problems drove the decision, but the department immediately began to downplay those as well—after all, every development program had problems, and that argument would inevitably raise questions about other troubled defense programs, such as the C–17 airlifter. Indeed, Cheney and Atwood praised the Osprey at every opportunity, describing it as a fine machine with interesting tiltrotor technology. They even acknowledged—reluctantly—that the V–22 had capabilities superior to existing helicopters but maintained the latter could accomplish the same missions acceptably. They had nothing against the Osprey and they would fund it if they could, but alas, the budget was tight, and something had to go. "The V–22 may appear to be superior to existing helicopters for some military missions," Comptroller O'Keefe told a House Armed Services Committee panel. "But our goal cannot be to spend whatever is required to achieve peak performance of those missions. Our goal is to find ways of performing our most critical missions acceptably, at a funding level that does not draw excessively from our many other critical military missions." OSD and Navy officials hewed closely to this line for more than two years.[40]

Maintaining that the V–22's cancellation rested purely on financial considerations and that the less-expensive helicopters were good enough played into the hands of Osprey supporters. At every opportunity the Marines, especially, took advantage of this lapse, arguing that, yes, the helicopters could, perhaps, accomplish the mission, but the tiltrotor had superior capabilities; the decision was purely budgetary. The Marines' message was clear, powerful, and not at all what OSD intended: DoD was deliberately sacrificing capability—and putting future missions and the lives of young Marines at risk—merely to save a few dollars. The Marines were necessarily circumspect when making this argument; their allies in Congress were less so. "You're going to be buying a much inferior product," warned Representative H. Martin Lancaster (D-NC), whose district included the huge Camp Lejeune Marine base. "You're going to be killing young men." After a fatal crash of a CH–46 Sea Knight—one of the helicopters the Osprey was intended to replace—Weldon demanded to know, "How much longer are we going to jeopardize the lives of Marines and Special Forces because [Cheney] has made the V–22 a personal issue?"[41]

The Marines and other Osprey supporters often countered OSD's cold budgetary logic with an appeal to emotion, arguing for the most advanced and capable technology possible to ensure the least risk to both mission and lives. Affordability was an essential attribute of any proposed weapon system throughout the lean years of the post–Cold War era—everybody, from all parts of the political spectrum, acknowledged that fact—but it was very difficult to sell on Capitol Hill if it was to be achieved at the expense of capability. Cheney tried that approach during the debate over the Osprey and failed.

THE FIGHT FOR THE OSPREY: CAT AND MOUSE

In 1989 affordability was on the minds of many on Capitol Hill, with both the budget deficit and V–22 program costs steadily growing. Support for the aircraft was hardly solid that year. Cheney received the backing of two powerful members of Congress, the Democratic chairmen of the two authorizing committees, Representative Les Aspin and Senator Sam Nunn. Aspin, who at that time considered the Osprey pork—he changed his mind later—was confident he could maneuver the House Armed Services Committee into accepting the elimination of all funding for the Osprey. He was therefore shocked when the committee overruled him and restored $351 million to continue development and $156 million for advance procurement. After the vote, Cheney proposed to have the federally funded Institute for Defense Analyses perform a cost and operational effectiveness analysis comparing the Osprey to various alternatives, including Cheney's helicopter mix, in the expectation the result would support DoD's position. The committee report on the bill directed the Defense Department to proceed with the COEA—the committee, too, expected the analysis to support its own position. The Senate Armed Services Committee under Nunn also authorized RDT&E funding—$255 million—but eliminated all procurement funding, not because it wanted to kill the program but because it expected that the other services or commercial customers would pay for production if the development effort succeeded. The final authorization act as passed by Congress and signed by the president included the $255 million for development but no money for procurement. The appropriations committees followed the lead of the authorizers, thus ensuring the V–22 would live another year.[42]

Congress did not place much significance on the lack of new funding for long-lead procurement because the program still had $336 million left over from the previous year. The appropriations conference committee expressly stated “it is important” that the Defense Department spend the FY 1989 procurement money during FY 1990 “in order to retain the option to execute a production decision in fiscal year 1991,” by which time the aircraft’s capabilities and the results of the cost and operational effectiveness analysis and other studies would be known. Congress

An MV–22 Osprey being assembled at the Bell plant in Amarillo, Texas. *(Copyright © Boeing, printed with permission)*

made it quite clear that until then it expected the department to keep the program alive, at least until the reviews of alternatives to the Osprey were complete.[43]

The authorizers and appropriators, however, did not realize Cheney had no intention of letting the matter rest and was determined to prevent the V–22 program from conducting any production activities until development was complete. He did not wait for the cost and operational effectiveness analysis. In December 1989—one week after Congress adjourned—OSD ordered the Navy to terminate all V–22 procurement contracts and recover all remaining funding not required for termination costs. Cheney’s special assistant, David S. Addington, noted with considerable understatement that the action was "likely to generate controversy with Members of Congress who have supported the V–22."[44]

Having made what he considered a firm decision to cancel the V–22, the secretary was loath to reverse it. He refused to accept Congress's decision to continue the Osprey program and ignored the provision in the appropriations conference committee report requiring him to maintain the option for production. Cheney justified this omission through a technicality. Traditionally, the authorization and appropriations acts provided only lump sums for the various spending accounts and budget categories. Earmarks, restrictions, and demands for information were contained in the accompanying committee reports. As a general rule, the Defense Department adhered to the instructions in the reports rather closely. Doing otherwise risked an angry response from Congress. Cheney apparently did not fear this prospect. Citing a 1975 decision of the U.S. comptroller general, he pointed out that unlike the statutes themselves, committee reports did not have the force of law and therefore were not legally binding. "However," he added, "we look to the reports as a source of guidance in interpreting statutes, and we undertake to be responsive to expressions of the committees' wishes set forth in the committee reports." In other words, instead of his termination of the Osprey being a proposal for Congress to decide, statements in its reports were merely advice to aid Cheney in deciding how to interpret congressional action. Cheney implied that final decisions about the V–22 and other programs were his to make.[45]

Cheney, notably, did not interfere with the development contracts and allowed that work to continue. There are several possible reasons for this. First, doing so enabled him to claim he was technically following the will of Congress by keeping the program alive. Second, Cheney's continuing the Osprey's R&D program may have reflected his growing preference for technology development and demonstration, which would later be a key component of his "new approach" to acquisition (see chapter V). He may have had a genuine interest in the technology and thought it was worth pursuing at least far enough to see if the concept worked. The V–22 prototypes already built and then being tested would essentially become technology demonstrators that would prove the tiltrotor concept without necessarily leading to the production and deployment of Ospreys. Once successfully demonstrated, the tiltrotor technology would be available "on the shelf" for future programs.[46]

Finally, Richard Whittle offers another possible explanation. He argues that Cheney continued the R&D work to hasten the death of the program without appearing to kill it himself. The key to Cheney's strategy lay in the nature of the contracts. As noted earlier, in 1985, as the program was preparing to move into full-scale development, Navy Secretary Lehman ordered NAVAIR to replace the cost-plus-incentive-fee contract it had just negotiated with the Bell Boeing team with a fixed-price-incentive-fee contract similar to that of the A–12. With the former type of contract, the government would pay the full cost of the development effort, and contractors would receive a fee based on whether or not they had kept that cost below a specified ceiling price. This placed the financial risk almost entirely on the government, which was responsible for covering all overruns, however large. In contrast, with a fixed-price-incentive-fee contract, the government and contractor would share any overruns above a certain target price (in this case about $1.7 billion) up to the ceiling price (about $1.8 billion), above which the contractors bore the sole responsibility. This type of contract placed almost the entire financial risk on the contractor, which had to cover all overruns above the ceiling price, however large. As the experience with the A–12 had demonstrated and the Bush administration recognized, a fixed-price type contract was ill-suited for complex development work involving much uncertainty and risk. The Reagan administration knew this also but judged the risk on the development of the Osprey to be low.[47]

Bell Boeing recognized the dangers and did not believe they could execute the contract at the price offered, but they wanted to do the work and were given little room to negotiate. Therefore, like General Dynamics and McDonnell Douglas with the A–12, they "bought in" to the program. They accepted that they would take a loss on the R&D effort (approximately $100 million, they estimated) in anticipation of making a much greater profit on the production run, which at that time was expected to be more than 1,200 aircraft at $15 million each.[48]

Predictably, costs soon rose as Bell Boeing engineers began to wrestle with unexpectedly challenging requirements, technical problems, and weight growth. By spring 1990 the Navy estimated that the overrun above the ceiling price would reach $150 million; a year later the figure jumped to at least $200 million, the contractors' estimate, and possibly as high as $242 million, according to the Defense Contract Audit Agency. For the Bell Boeing team, the development program was becoming a bottomless pit into which they kept pouring money in the hope of recovering it all in production. Cheney, according to Whittle, knew this. By canceling the production contract, the secretary could do to the V–22 deliberately what he had done to the A–12 accidentally: Take away that hope. Meanwhile, the Navy refused to consider bailing out the contractors or restructuring their R&D contracts, which were fully funded. By continuing the R&D program and holding the contractors to it, maintains Whittle, the Defense Department would keep funds flowing, until at some point the contractors might decide to cut their losses and quit the program. This approach would, in effect, "starve the Osprey to death." Indeed, days after the department announced the planned cancellation in April 1989, Bell and Boeing threatened to stop work on the Osprey. However, they soon retracted the threat when their lawyers told them the contract was ironclad and their allies in Congress told them to hang on.[49]

If Secretary Cheney's cancellation of the production contracts rested on firm legal, if not political, ground, what he did next did not. After deducting the money needed to cover the contractors' expenses of shutting down the program, the Navy recovered $200 million of the remaining procurement funds. By law, the Defense Department had to use those funds for whatever purpose Congress intended, unless it received Congress's permission to reprogram the funds or initiate a so-called "impoundment action"—either a "rescission" or a "deferral." Although Cheney did not want to spend money on the Osprey, the aircraft had strong support in Congress, making approval of a rescission—a request to take back the appropriated funding—unlikely. Therefore, the department initiated a deferral—a delay in spending allocated funds. The delay was supposed to be temporary, but barring explicit congressional instructions to the contrary, DoD could hang onto the money until it was ready to spend it or until the end of the fiscal year. Unlike rescissions, deferrals did not require congressional approval—silence signified assent—but there were restrictions on their use. Deferrals were allowed for only a few reasons, generally administrative in nature, such as achieving management efficiencies or creating a reserve for unanticipated contingent expenses. In the case of both deferrals and rescissions, the administration had to notify Congress and submit written justification for the request. The General Accounting Office, a legislative branch agency, then investigated the request and the U.S. comptroller general, head of the GAO, reported to Congress on the adequacy of the justification.

On 6 February 1990 President Bush submitted a request to defer nearly $2.2 billion from a list of 19 defense programs, including the V–22. But the administration's justifications for the request lacked sufficient information for the General Accounting Office to evaluate the action. In the case of deferring production funding for the Osprey, the administration stated only that the president had terminated the program in two separate budgets, FY 1990 and FY 1991, and that with respect to the latter, Congress had not yet voted new production funding for the program. Without congressional action, maintained the administration, the contract must be stopped; otherwise "aircraft components would continue to be procured that could not be used for any other aircraft program." Therefore the funds were being deferred "as a contingency against incurring additional unnecessary sunk costs." According to the General Accounting Office, the justification provided for the other deferrals of ships, aircraft, munitions, and an Army explosives plant were also inadequate.[51]

GAO investigators and sharp-eyed House members noticed other irregularities in the deferrals. Nearly all, including the V–22, had been funded by congressional initiative without the Pentagon asking for them, and the administration's FY 1991 budget specifically requested that money for most of these programs go instead to the M1 tank and F–15E aircraft programs. Clearly these deferrals were intended to be permanent, based not on administrative or management grounds but on the administration's policy disagreement with decisions of Congress and desire to thwart its will. The comptroller general determined the Impoundment Control Act of 1974 did not allow deferrals for policy reasons. Nearly all the deferrals, including that of the V–22, had a policy basis and were consequently "unauthorized."[52]

Coming on the heels of the contract cancellations, the deferrals naturally displeased legislators, who considered the unilateral redirection of appropriated funding tantamount to illegal line item vetoes. Representative Walter Leslie "Les" AuCoin (D-OR) declared, "I cannot think of a better way to invite war on both ends of Pennsylvania Avenue than a continuation of what we have just seen." The House inserted a provision into an emergency supplemental appropriation rejecting the deferrals, but it was struck from the final bill.[53]

By this time, spring 1990, support for the tiltrotor in Congress was growing, thanks to the activities of the well-organized pro-Osprey lobby, Cheney's aggressive stance, the "Tiltrotor Week" demonstrations at the Capitol, and especially the long-delayed cost and operational effectiveness analysis, which concluded unequivocally that the V–22 was clearly more capable and cost effective than any of the other options. Aspin, Cheney's ally of 1989, now switched sides, supporting the aircraft as being well adapted to the coming post–Cold War world. Rejecting Cheney's second attempt to cancel the Osprey in the FY 1991 budget, Congress again restored funding to the program. It appropriated $238 million to continue R&D work on the prototypes, reappropriated the $200 million for production, and added $165 million to the procurement account. This time, Congress put its instructions and restrictions on the use of the money directly into the text of the legislation. The authorization act specified that the production funds "may be used only for advance procurement of production representative V–22 aircraft, support equipment, and related activities," and that none of the RDT&E funds "may be used for research, development, test, and evaluation for a replacement aircraft to perform the medium-lift mission other than the V–22 aircraft."[54]

By 1990 a pattern was developing in which Congress allocated money for the V–22 and the Defense Department refused to spend it. Cheney was willing to keep the original development contract going, allowing the contractors to complete and test the prototypes they were working on, but he refused to allow them to purchase long-lead items or build finished "production-representative" prototypes, which would have created the designs and infrastructure for possible future production. Just as the department had held onto the $200 million in procurement funding in FY 1990, so it refused to spend the $365 million Congress appropriated for FY 1991, in direct violation of the authorization act. This time the administration did not bother to justify the deferral or even notify Congress, except to say it was withholding the new $165 million pending congressional approval to apply it to R&D instead of procurement. It also asked Congress to rescind the $200 million recovered from the canceled production contract "since the Department will not be able to use these funds before they expire six months from now."[55]

THE FIGHT FOR THE OSPREY: SHOWDOWN

By spring 1991 support for the Osprey in Congress was solid, with Weldon's coalition firmly in place and the Marines becoming more aggressive. Weldon was working closely now with the Marine Corps liaison to the House and with the contractors' lobbyists, who were helping him write the relevant legislation—a classic example of the "Military-Industrial-Congressional Complex," or "Iron Triangle." Until that time, Congress had shown considerable patience on the question of the V–22. No one except the most die-hard Osprey supporters, it seemed, wanted an open fight with Cheney over the aircraft. Now, however, the administration directly challenged congressional authority, and with the Gulf War over, tempers began to boil. In April 1991 Congress passed, and President Bush signed, an emergency supplemental appropriation ordering the Navy to put the withheld $200 million for the V–22 under contract within 60 days. To counter Cheney's claim that it was too late in the fiscal year to spend that money, the act specified the funds would never expire but would remain available until spent. The following month, the U.S. comptroller general reported to Congress that the administration's failure to spend the $165 million for early production activities was an unreported deferral and therefore failed to meet the requirements of the Impoundment Control Act. The purpose of the deferral, according to the comptroller general, "seemed to be to substitute the Administration's policy for one already decided by the Congress" and was therefore "unauthorized."[56]

Slowly but steadily, Congress drove Cheney into a corner by stripping away any room for legal maneuvering. The secretary responded by openly defying Congress. The day after the enactment of the emergency supplemental, amid accusations of administration stalling, lying, and lawbreaking during a tense 2½-hour hearing of the House Armed Services Committee, DoD Comptroller O'Keefe testified that Cheney now planned to apply the production funds to the Osprey's R&D program. "There is no intent on his part nor any plan nor any debate [in OSD] to consider alternatives or options to look at the production alternatives," he stated. "That is not in the cards at this time." Later, referring to the Osprey's "technical difficulties," O'Keefe commented, "Those are not holding up the production by any means. What is holding up the production is that the Secretary has no intention of proceeding with production of the program." O'Keefe also hinted there was nothing Congress could do about it. Aspin, who had called the hearing, tried to avoid a breach with the administration, telling O'Keefe, "I don't have any problem with you guys fighting the Congress on this. I mean God knows, the Congress fights you on a whole bunch of things. . . . [Y]ou have strong views and Secretary Cheney has strong views, and he ought to continue to pursue them, as indeed we do." Aspin argued that policy disputes underlay the legal issues and pleaded for a "meeting of the minds" on the Osprey, but after listening to O'Keefe the perplexed chairman asked him point blank if OSD was "trying to kill the program."[57]

The Defense Department's position was unyielding: There was no Osprey production program; there would be no Osprey production program; and the secretary had no intention of spending any money to start one. However, the department did come up with a new reason for inaction: The Osprey could not go into production because the existing prototypes had too many technical problems. One of the five prototypes had crashed in June 1991, the first of several accidents before the end of 2000 that would take numerous lives and delay the Osprey's entry into service. Technical problems ranked as probably the strongest justification for delaying production, yet the department had neglected that rationale for two years in favor of the affordability argument, until the public debate became more rooted in symbolism than in engineering reality. Now, for support, DoD again cited the GAO, which in fact had been making the same argument for some time—one of the rare occasions when the General Accounting Office found itself on the same side as the Pentagon in opposition to its own employer, Congress.[58]

Colonel Schaefer, the Osprey program manager, also knew the aircraft was far from ready. During summer 1991, when asked by the new Marine Corps commandant, General Carl E. Mundy Jr., what would be required to prepare the

V–22 for production in five years, he indicated it would take a new set of redesigned prototypes. At Mundy's direction, Schaefer prepared a plan for a new program that the Marine Corps liaison then wrote up as legislation, which Weldon and Murtha inserted into the House versions of the authorization and appropriations bills. On the surface, the acts did what Cheney asked: They transferred the unspent funding for early production activities to the RDT&E account. They also added a good deal more, for a total of $790 million. But the appropriations act specified the money was to be used for a new development program to build production-representative tiltrotors that would meet all of the original requirements by the end of 1996. Not mere demonstrators, these were to be fully functioning aircraft that would work out the bugs in the prototypes and undergo operational testing as a preliminary to possible production. In addition, the act directed they be built with tooling similar to that used for quantity production, to prove they could be manufactured. So the act did indeed fold the procurement funding into the Osprey's R&D program—but it then required the R&D program to lay the groundwork for future production, just what Cheney was trying to avoid. Finally, the law required the secretary of defense to submit a funding plan and schedule for the new program within 60 days and do nothing to delay the funding obligation.[59]

After internal discussions in OSD and the Navy, DoD concluded that issuing a new development contract would be premature. It even briefly considered terminating the existing contract for default because the contractors had failed to meet the contract's requirements. In January 1992, in lieu of a plan for the new development program, O'Keefe sent Congress a letter stating that the aircraft was not ready for such a program; building new aircraft to satisfy the requirements would cost much more than Congress appropriated (he cited a figure of at least $2.5 billion), and in any event no amount of money could meet the 1996 deadline. Finally, he wrote, the Defense Department could not spend the money Congress provided for the current fiscal year before it expired—the excuse it had used a year before. Two months later Speaker of the House Thomas S. Foley (D-WA) expressed disappointment that O'Keefe's letter was "not responsive" to the directions in the appropriations act and that the department was "not complying with the law and Congressional intent." He demanded a full plan within 15 days. Responding directly on 2 April, Cheney reiterated that DoD could not execute the program as described by Congress within the time and funding allowed. He estimated $2.8 billion would be required. He provided data to support his argument and noted, "We do not . . . intend to execute this program, because it is not affordable within the overall constraints we face on defense resources."[60]

Cheney's letter created an uproar. Osprey supporters in Congress accused him of exercising a "Cabinet veto" and threatened to go to court to see if a department secretary could veto a line item in an appropriations act signed by the president. For Republicans, the situation took on particular urgency because 1992 was a presidential election year. Governor Bill Clinton of Arkansas, who would soon become the Democratic nominee for president, expressed support for the V–22 in early March and formally endorsed it in August. Cheney's opposition to the Osprey was hurting

Republicans in the critical states of Pennsylvania and Texas (where the Bell plant was located) and causing a rift in the party. Joseph Coors Jr., a wealthy and influential industrialist and member of a panel writing the national security plank for the Republican Party platform, warned Cheney that his opposition was "becoming a liability" to the president. He sought a meeting with Cheney but was rebuffed, and afterward vowed to make the V–22 a major political issue within the party. In May congressional Republicans requested a meeting with the president in an attempt to bypass Cheney, but the White House turned them down too—it had never shown any interest in intervening in the debate. The following month a bipartisan group of 40 senators signed a letter to Bush telling him "it is time to end the impasse." A group of conservative legislators began another petition soon after.[61]

The House did not direct its ire solely at Cheney but also at his point man on the V–22 issue, Sean O'Keefe, a vocal V–22 opponent. The House Armed Services Committee expressed concern about the "growing activism" of O'Keefe and his staff, writing, "In recent years . . . the DoD comptroller has become increasingly engaged in what can only be described as budget legerdemain." Among other things, the committee accused O'Keefe of "absolutely" refusing to carry out the law with regard to the Osprey and of proposing many deferrals and rescissions aimed at programs of particular interest to Congress. "Apparently designed to keep the Congress off balance and focused on matters other than necessary oversight and program review," the committee concluded, "these activities have eroded the spirit of comity and common purpose needed for effective government." Because the comptroller's office seemed to have "ample resources available to engage in activities antithetical to good government," the House authorization bill for FY 1993 included a provision that would cut its staff by 5 percent for each month the Defense Department failed to spend all of the funds appropriated for the V–22. OSD released the money for the aircraft and O'Keefe moved over to the Navy Department as secretary in July, rendering the measure moot.[62]

The tipping point in the crisis came in the form of a GAO investigation, requested by Weldon, of DoD's withholding of the $790 million appropriated for the V–22. On 3 June 1992 the U.S. comptroller general declared the withholding a de facto attempt at a unilateral rescission, without making a formal request. The finding dismissed DoD's objections, arguing that whether or not fully operational tiltrotor prototypes could be built by 1996 as Congress specified, the date represented not a firm deadline but a goal, intended to spur the Defense Department to action. Congress was well aware of the V–22's technical problems when it passed the legislation, and was free to extend the program later if it so chose. Because the comptroller general's report constituted notification to Congress of the attempted rescission, the department had 45 legislative days to spend the money (by 3 August 1992).[63]

The U.S. comptroller general's ruling seemed final. Even O'Keefe told Cheney he was out of options. "This is it," he said. "Game, set, match." The next day, 4 June, a White House official met with members of the Tilt-Rotor Technology Coalition. The day after that, at the secretary's invitation, a half-dozen senators and representatives, including Weldon and Specter, met with Cheney, O'Keefe, and Chu and told them their opposition to the Osprey had become a major political liability for the president. Cheney listened to the delegation but gave no indication of his thoughts or plans. He grudgingly offered a compromise "to resolve the impasse," in which he agreed to spend $1.55 billion in new and previously appropriated money to build and test operational prototypes if Congress would drop the exacting provisions of the FY 1992 Defense Appropriations Act, and also allow the department to study helicopter alternatives. At a meeting with members of Congress at the same time, Cheney stated DoD would build five or six production-representative V–22s.[64]

But a month later the Defense Department already seemed to be backtracking. OSD began using delaying tactics again, dismissing congressional wishes, complaining about costs, and advancing new proposals for alternatives, all the while calling for additional concept studies and demonstrations to provide Cheney with options he could present to Congress. This time OSD officials carefully avoided open confrontation. In early August 1992, O'Keefe, newly installed as the acting secretary of the Navy, made another appearance before the ever-distrustful House Armed Services Committee to discuss the V–22. In his genial, accommodating way, O'Keefe presented a new justification for DoD's refusal to pursue the congressionally mandated program. He said the department's hands were tied by a legal finding of its general counsel that DoD could not sign contracts which could not be executed. For good measure, the general counsel had also determined that, because the Defense Department could not legally spend the money on such a program, withholding the V–22 funds did not constitute an impoundment action after all, the report of the U.S. comptroller general notwithstanding. This line of argument led one representative to grumble, "When DoD doesn't want a program it brings in the lawyers and decides on some way to kill it."[65]

However, DoD did launch a new V–22 development program—it would start in the engineering and manufacturing development, or EMD, phase, the new name for full-scale development. At the same time, the department would be looking for alternatives based on a more modest set of requirements for a "medium-lift replacement" aircraft. Congress approved the proposal on 1 October 1992. DoD had issued a request for proposal in August and expected to receive the Bell Boeing team's response in September, with the contract award slated for December. At this point presidential politics intruded. With the fall election approaching, the Navy hurried its preparations to issue an

Sean O'Keefe, comptroller of the Department of Defense, 1989–1992. *(NARA)*

EMD contract. Despite the emphasis on enforcing the new 5000 series acquisition policies, the Defense Department took shortcuts: The Joint Requirements Oversight Council did not validate a new set of requirements for the V–22; the Navy did not prepare a new baseline for the program; Under Secretary of Defense for Acquisition Yockey declined to review the contract before its award, despite his announced policy of reviewing all major contracts; and the Defense Acquisition Board did not meet to approve the program's reentry into systems development, at least not until the middle of 1993, long after the contract had been awarded and development was well underway. Indeed, no department official higher than the program executive officer authorized the contract. On 22 October the Navy awarded Bell Boeing a $550 million cost-reimbursable contract—DoD officials later confirmed to the department's inspector general that the White House had ordered DoD to move up the award from December to October, before the election. The next day Vice President Dan Quayle announced it personally at Boeing's plant in Pennsylvania.[66]

The contract award for engineering and manufacturing development did not end the Osprey saga. Development continued for another 15 years. During that time the tiltrotor's cost and technical problems provoked further debate. The program was plagued with crashes—the first crash with fatalities, which killed seven, occurred in July 1992. Two more crashes in 2000 would claim the lives of 23 more Marines. The next year, a V–22 squadron commander was relieved of command for falsifying maintenance records and forcing his personnel to lie to boost the aircraft's chances of approval for low-rate production. Two other Marines were also disciplined. Nonetheless, development continued and the aircraft was approved for full-scale production in 2005. It achieved initial operational capability (IOC) in 2007 and soon saw service in Iraq and Afghanistan. However, controversy continued to follow the Osprey amid reports of low reliability and additional crashes.[67]

The Osprey antagonists of 1989–1992 marshaled compelling arguments. The tiltrotor's supporters had justifiable interest in the technology's potential for the Marine Corps while Secretary Cheney and OSD had legitimate concerns about the V–22's cost, technical problems, and ultimate value. Cheney was unwilling to accept congressional authority and went to great lengths to have his way, including, according to the U.S. comptroller general, failing to meet the requirements of the law. Even when cornered during summer 1992, and in the face of extraordinary election-year political pressure, OSD refused to accept any action that could lead to a premature commitment to production. Even so, the program's reentry into engineering and manufacturing development meant the Osprey would live to see another day.

* * * * *

The relatively steep decline in the Defense budget and corresponding drawdown in the armed forces during the initial years of the post–Cold War era forced Secretary Cheney to make difficult choices. His priorities were to maintain the high quality of personnel in the armed forces and to ensure their readiness. Acquiring weapon

Marine Corps Ospreys in operation in Iraq, 2007. *(U.S. Navy)*

systems was of lesser importance, but in this area Cheney insisted the United States retain its lead in strategic weaponry even if that meant canceling production of proven conventional systems and slowing or terminating the acquisition of others. In Congress, concerns about the performance of the economy, and the need to preserve the industrial base and to create jobs, produced acquisition priorities that often differed from the secretary's and sometimes resulted in bitter clashes.

The battle between Cheney and Congress over V–22 production reflected those differing priorities. He sought to save money by limiting the program to development; the legislators wanted it to enter production, in large part for the anticipated economic benefits. But the struggle also revealed other characteristics of weapons acquisition decisions. They are often intensely political and the product of compromise between contending parties that leave neither entirely satisfied with the outcome. The alliance between Osprey supporters in Congress and its Marine Corps advocates proved to be sufficiently powerful and skillful to prevent Cheney from achieving his objective but not strong enough for them to realize theirs. No money would be spent on production; the program would continue, reentering full-scale development. Quantity production was still a possibility, but that decision lay in the future.

Endnotes

1. Figures derived from DoD Comptroller, *National Defense Budget Estimates for FY 2014*, May 2013, table 6-8.

2. Ibid.

3. OMB, *Budget of the United States Government, Fiscal Year 1990*, 9 Jan 1989, sec. 2, 16–17; *Congressional Quarterly* [*CQ*] *Almanac 1989* (Washington, DC: Congressional Quarterly, 1990), 68–69, 76, 81, 84–85, 87, 89, 440; online editions of the *CQ Almanac* are found at https://library.cqpress.com/cqalmanac/searchform.php; George H. W. Bush, "Address on Administration Goals Before a Joint Session of Congress," 9 Feb 1989, *Bush Public Papers 1989*, 1:78–79; Bush, "Remarks Announcing the Bipartisan Budget Agreement" and "White House Statement on the Bipartisan Budget Agreement," 14 Apr 1989, ibid., 422–426; HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1990–H.R. 2461 and Oversight of Previously Authorized Programs,* 101st Cong., 1st sess., 25 Apr 1989, HASC No. 101-7, 129.

4. HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1990–H.R. 2461*, 25 Apr 1989, 5, 6–11, 160 (quote).

5. Congressional Budget Office [CBO], *Effects of Weapons Procurement Stretch-Outs on Costs and Schedules* (Washington, DC: CBO, Nov 1987), xii–xiii, 1, 7–15, 17–26, https://www.cbo.gov/publication/16369; GAO, *Weapons Production: Impacts of Production Rate Changes on Aircraft Unit Costs*, GAO/NSIAD-91-12 (Dec 1990), 1–3, 8; "Zero Growth Topline: Stretchouts vs Cancellations vs Force Structure," in Undersecretary of Defense (Acquisition) Background Transition Book, Nov 1988, pt. C, tab 11, box 1, Acc 330-93-0047, OSD Records, WNRC; memo, Costello for the SecDef, 3 Mar 1989, subj: FY90–94 Program Adjustments–Information Memorandum (quote), box 3, Acc 330-92-0136, OSD Records, WNRC. The GAO report did note that some procurement programs were more sensitive to fluctuations in quantity than others, depending on the extent of the changes.

6. HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1990–H.R. 2461*, 25 Apr and 13 Jul 1989, 11, 273 (quote); SCAS, *Department of Defense Authorization for Appropriations for Fiscal Years 1990 and 1991: Hearings . . . on S. 1085*, 101st Cong., 1st sess., 15 Jun 1989, S. Hrg. 101-251, pt. 1:349–350. See also Senate Committee on Appropriations [SCA] Subcommittee, *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*, 101st Cong., 1st sess., 22 Jun 1989, S. Hrg. 101-149, pt. 6:8.

7. SCAS, *Hearings on S. 1085*, 3 May 1989, 11–12, 18–19; *CQ Almanac 1989*, 427–429.

8. SCAS, *Hearings on S. 1085*, 3 May 1989, 20; Philip Shiman, *Forging the Sword: Defense Production during the Cold War*, USACERL Special Report 97/77 (n.p.: U.S. Air Force Air Combat Command and the DoD Legacy Program, Cold War Project, Jul 1997), 79, 141; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*, 4 May 1989, pt. 6:125, 160, 390–393, 527, 588; HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1990–H.R. 2461*, 13 Jul 1989, 273.

9. *CQ Almanac 1989*, 414–423, 427, 435, 436–439, 462–463, 760, 762–763, 765. Money was shifted from operation and maintenance (O&M) to procurement because of deficit-reduction rules, which required the reduction not only of budget authority (money available to be spent) but also outlays (money actually spent). Money appropriated for O&M is generally expected to be spent during the year, whereas procurement money is often carried over to the outyears. Therefore, a reduction in O&M will reduce outlays more surely than a reduction of procurement. See House of Representatives, *Authorizing Appropriations for Fiscal Year 1990 for Military Activities of the Department of Defense . . . and for Other Purposes: Conference Report to Accompany H.R. 2461*, 101st Cong., 1st sess., 7 Nov 1989, H. Rep. 101-331, 359–360; Pat Towell, "House Democrats' Jockeying: Save Deep Cuts for Later," *Congressional Quarterly Weekly Report* 48 (17 Mar 1990): 842–843 (hereafter cited as *CQ Weekly Report*).

10. *CQ Almanac 1989*, 414–415, 430–431, 442, 446–447, 461 (Aspin quote).

11. *CQ Almanac 1990,* 111–138; *Omnibus Budget Reconciliation Act of 1990*, P.L. 101-508 (5 Nov 1990), Title XIII [Budget Enforcement Act of 1990] (104 Stat. 1388-573 to 1388-609).

12. OMB*, Budget of the United States Government, Fiscal Year 1991*, 153; Cheney, *Report of the Secretary of Defense to the President and the Congress*, Jan 1990, 10, table 3; Cheney, *Defense Management,* 16; HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1991—H.R. 4739*, 101st Cong., 2d sess., 6 Feb 1990, HASC No. 101-45, 19, 30; briefing slide, n.d. [ca. 25 Feb 1992], folder 400.13, box 60, Acc 330-95-0014, OSD Records, WNRC; GAO, *DoD Budget: Observations on the Future Years Defense Program*, GAO/NSIAD-91-204 (Apr 1991), 4–5; GAO, *Acquisition Reform: Defense Management Report Savings Initiatives*, GAO/NSIAD-91-11 (Dec 1990), 1, 4–5, 12.

13. Cheney, "Department of Defense Fiscal Year 1991 Budget," briefing, n.d. [ca. 29 Jan 1990], *Cheney Public Statements 1990*, 1:15–18, OSD/HO; OASD(PA) Press Release 50-90, "Defense Secretary Proposes Base Closings," 29 Jan 1990, ibid.; Sharon Perkinson, "Cheney's Endangered-Bases List," *CQ Weekly Report* 48 (3 Feb 1990): 41.

14. Bob Benenson, "Members Hustle to Protect Defense Jobs Back Home," *CQ Weekly Report* 48 (13 Jan 1992): 87–88.

15. SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1991: Hearings . . . on H.R. 5803/S. 3189*, 101st Cong., 2d sess., 20 Feb 1990, S. Hrg. 101-936, pt. 1:54 (Rudman quote); *CQ Almanac 1990*, 687–691.

16. SCAS, *National Defense Authorization Act for Fiscal Year 1991: Report*, 101st Cong., 2d sess., 20 Jul 1990, S. Rep. 101-384, 25–27.

17. HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1991—H.R. 4739*, 26 Apr 1990, 689, 695, 697, 700, 702, 704, 717; briefing slides on results of Major Aircraft Review, 26 Apr 1990, folder 452, box 73, Acc 330-92-0097, OSD Records, WNRC; *CQ Almanac 1990*, 688 (quote).

18. *CQ Almanac 1990*, 671; HCAS, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993–H.R. 2100 and Oversight of Previously Authorized Programs*, 102d Cong., 1st sess., 7 Feb 1991, HASC No. 102-6, 9–10.

19. *CQ Almanac 1990*, 684–693, 812–813, 815, 824–826.

20. Ibid., 173–176; *CQ Almanac 1991*, 73–74, 393.

21. OMB, *Budget of the United States Government, Fiscal Year 1992*, pt. 2:183, table A-1; HCAS, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100,* 7 Feb 1991, 13–14; *CQ Almanac 1991*, 394; *National Military Strategy of the United States*, Jan 1992, 19; Cheney, *Report of the Secretary of Defense to the President and the Congress*, Feb 1992, 25; Jaffe, *Development of the Base Force*, 15, 34, 38, 44.

22. *Budget, FY 1992*, pt. 2:190, table A-4; HCAS, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100*, 7 Feb 1991, 15–17; *CQ Almanac 1991,* 394.

23. *CQ Almanac 1991*, 393–394, 399–403, 408, 410, 621, 622, 638. The appropriations bill, passed soon after, made few changes in the acquisition provisions of the authorization act and, like the authorization act, also provided the administration its requested budget topline.

24. For the Osprey's capabilities, see the Naval Air Systems Command V–22 website: http://www.navair.navy.mil/v22/?fuseaction+aircraft.main, accessed 24 Jun 2015.

25. For the evolution of tiltrotor technology and Bell Helicopter's development of the XV–3 and the XV–15, see Richard Whittle, *The Dream Machine: The Untold Story of the Notorious V–22 Osprey* (New York: Simon & Schuster, 2010), chaps. 1–2; and Martin D. Maisel, Demo J. Giulianetti, and Daniel C. Dugan, *The History of the XV–15 Tilt Rotor Research Aircraft: From Concept to Flight*, NASA SP-2000-4517 (Washington, DC: National Aeronautics and Space Administration, Office of Policy and Plans, NASA History Division, 2000). See also Al Moyers, "The Long Road: AFOTEC's [Air Force Operational Test and Evaluation Center] Two Decades of V–22 Involvement," http://www.afotec.af.mil/news/story.asp?id=123057888, accessed 29 May 2015.

26. For Bell's sales campaign and the increasing support for tiltrotor technology, see Whittle, *Dream Machine*, 48–51 and chaps. 3–4 (Lehman quote, 85). See also GAO, *DOD Acquisition: Case Study of the Navy V–22 OSPREY Joint Vertical Lift Aircraft Program*, GAO/NSIAD-86-45S-7 (31 Jul 1986), 2.

27. GAO, *Case Study of the V–22 Osprey*, 2–8; Whittle, *Dream Machine*, 104. In addition to a tiltrotor, a joint-service technology assessment group considered other configurations, including conventional helicopters, the tilt-wing concept, and the Sikorsky-developed "Advancing Blade Concept," which employed contra-rotating rotors mounted one above the other on top of the fuselage along with a jet affixed to either side of the fuselage. See GAO, *Case Study of the V–22 Osprey*, 2, and Whittle, *Dream Machine*, 98.

28. Whittle, *Dream Machine*, 146–150; DoD IG, *Review of the V–22 Aircraft Program*, Audit Report 94-131 (Washington, DC: DoD, 14 Jun 1994), 2.

29. Whittle, *Dream Machine*, 139, 141, 153–154, 164–166, 172–173; SCA Subcommittee, *Hearings . . . on H.R. 3072*, 22 Jun 1989, pt. 6:19. The Osprey's first flight in fixed-wing mode was on 14 September 1989.

30. Whittle, *Dream Machine*, 53–59, 86–87, 112, 139–140, 153–155, 157, 204–205; quotes are on 155 and 204, respectively.

31. HCAS, *National Defense Authorization Act . . . 1990*, 12 Jul 1989, 102 (Blaz quote).

32. Whittle, *Dream Machine*, 174–175, 182–183, 185, 186; Mark A. O'Brien, "The V–22 Osprey: A Case Analysis" (master's thesis, Naval Postgraduate School, 1992), 20–21, 77–78.

33. Whittle, *Dream Machine*, 185–190; Nathan Gorenstein, "Weldon Shapes Plan to Save V–22," *Philadelphia Inquirer*, 8 Mar 1990, D03 (quote).

34. Whittle, *Dream Machine*, 177–181.

35. Ibid., 178–179, 185; HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1992: Hearings*, 102d Cong., 1st sess., 7 Mar 1991, pt. 1:789–790; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*, 16 May 1989, pt. 6:610 (Franklin, "we support the Secretary's decision"); ibid., 1 Jun 1989 pt. 6:389 (Gray, "Your commandant"); HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1991: Hearings*, 101st Cong., 2d sess., 22 Feb 1990, pt. 1:426 (Gray, "I made a mistake").

36. HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100 . . . on Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement*, 102d Cong., 1st sess., 11 Apr 1991, 206–207.

37. Whittle, *Dream Machine*, 175–176; "Continuation of the V–22 Aircraft Program," 101st Cong., 1st sess., *Congressional Record* 136 (19 Apr 1989): S4507–S4510; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*, 4 May 1989, pt. 6:131 (Bumpers quote).

38. "Continuation of the V–22 Aircraft Program," S4508–S4509; HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1990: Hearings*, 101st Cong., 1st sess., 10 May 1989, pt. 6:412–413; HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1991: Hearings*, 22 Feb 1990, pt. 1:426, 453–454; HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100 . . .* , 11 Apr 1991, 206; Whittle, *Dream Machine*, 140, 159–160, 192, 209–210.

39. HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1991: Hearings*, 22 Feb 1990, 453–454 (Gray quote); HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100. . .* , 11 Apr 1991, 206 (Hochbrueckner, "all over the world"), 207 (Hochbrueckner, "a little overweight"); GAO, *The V–22 Osprey—Progress and Problems*, GAO/NSIAD-91-45 (1990), 5; Martin Ferber, *Naval Aviation: Status of V–22 Osprey Full-Scale Development*, statement before the HCAS, Subcommittee on Research and Development and Subcommittee on Procurement and Military Nuclear Systems, 11 Apr 1991, GAO/T-NSIAD-91-19 (1991), 9. For the V–22's technical problems generally, see Ferber, *Status of V–22 Osprey*, 8–14. For an example of congressional concern about those problems, see SCAS, *National Defense Authorization Act for Fiscal Years 1992 and 1993: Report*, 102d Cong., 1st sess., 19 Jul 1991, S. Rep. No. 102-113, 115–116.

40. SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*, 22 Jun 1989, pt. 6:19; ibid., 4 May 1989, pt. 6:110–111; HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100 . . . ,* 11 Apr 1991, 146.

41. Lancaster as quoted in *CQ Almanac 1989*, 432; Weldon as quoted in Ron Hutcheson, "V–22 Backers Say Cheney Resistance Endangers Troops," *Fort Worth Star Telegram*, 9 Apr 1992, 5.

42. *CQ Almanac 1989*, 427, 430–431, 434, 435, 439, 442, 445, 449, 451, 454, 461, 763, 765, 768, 772, 776; HCAS, Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee, *The Status of the V–22 Tiltrotor Aircraft Program: Hearing*, 102d Cong., 2d sess., 5 Aug 1992, HASC No. 102-62, 12; House of Representatives, *National Defense Authorization Act for Fiscal Years 1990 –1991: Report . . . on H.R. 2461*, 101st Cong., 1st sess., 1 Jul 1989, H. Rep. 101-121, 54–55; House of Representatives, *Authorizing Appropriations for Fiscal Year 1990 for Military Activities of the Department of Defense . . . and for Other Purposes: Conference Report to Accompany H.R. 2461*, 7 Nov 1989, 460; House of Representatives, *Making Appropriations*

for the Department of Defense for the Fiscal Year Ending September 30, 1990, and for Other Purposes: Conference Report to Accompany H.R. 3072, 101st Cong., 1st sess., 13 Nov 1989, H. Rep. 101-345, 72–73, 103; Kenneth J. Szczublewski, "The V–22: A Turning Point in Congressional Behavior?" (master's thesis, Naval Postgraduate School, 1992), 56–61.

43. House of Representatives, *Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 1990, and for Other Purposes: Conference Report to Accompany H.R. 3072*, 13 Nov 1989, 72–73.

44. Memo, DepSecDef Atwood for SecNav, 1 Dec 1989, subj: Protection of the Public Fiscal Interest in Termination of V–22 Osprey Aircraft Procurement, folder 452V, box 79, Acc 330-91-0095, OSD Records, WNRC; memo, David S. Addington for DepSecDef, 30 Nov 1989, subj: Saving Funds on V–22 Procurement Termination, attached to ibid.

45. Undated note, David Addington, Special Assistant to SecDef & DepSecDef, to SecDef, on memo, W. M. McDonald, Director, Freedom of Information and Security Review, for Special Assistant to SecDef and DepSecDef through ASD(PA), 16 Jun 1989, folder 452V, box 79, Acc 330-91-0095; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1991: Hearings . . . on H.R. 5803/S. 3189*, 12 Jun 1990, pt. 1:321–322 (quote), 374. For a discussion of the status and significance of "report language," see Thomas J. Nicola and T. J. Halstead, *Earmarks Executive Order: Legal Issues*, CRS Report RL34373 (Washington, DC: CRS, 13 Feb 2008), 7–11.

46. HCAS, Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee, *Status of the V–22 Tiltrotor Aircraft Program*, 5 Aug 1992, 3.

47. Whittle, *Dream Machine*, 147–151, 204; Danny Roy Smith, "The Influence of Contract Type in Program Execution/V–22 Osprey: A Case Study" (master's thesis, Naval Postgraduate School, 1989), 8–9. The company building the Osprey's engines, the Allison Gas Turbine Division of General Motors, received a firm-fixed-price contract, which meant it absorbed overruns of the contract price

48. Whittle, *Dream Machine*, 148–149, 161, 204.

49. Whittle, *Dream Machine*, 177, 184, 204 (quoted material); HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1990: Hearings*, 10 May 1989, pt. 6:401–403; GAO, *The V–22 Osprey—Progress and Problems,* GAO/NSIAD-91-45 (Oct 1990), 5; Ferber, *Status of V–22 Osprey*, 3.

50. GAO, Office of the General Counsel, *Principles of Federal Appropriations Law*, 2d ed., GAO/OGC-91-5 (Jul 1991), pt. 1:19–21; Comptroller General of the United States, letter report to the President of the Senate and the Speaker of the House of Representatives, GAO/OGC-90-4 (Washington, DC: Comptroller General, 6 Mar 1990), 1–12.

51. Ltr, Sen. Lloyd Bentsen to Cheney, 21 Dec 1989, folder 452V, box 79, Acc 330-91-0095; Bush, "Message to the Congress Reporting Budget Deferrals," 6 Feb 1990, *Bush Public Papers 1990*, 1:165; HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1991–H.R. 4739*, 6 Feb 1990, 27; Comptroller General, letter report, 6 Mar 1990, 10–12 (quotes). For a list of the projects, see Comptroller General, letter report, encl. II; the projects are identified only as belonging to the general budget category but are named in ibid., 4n and 5n.

52. Comptroller General, letter report, 6 Mar 1990, 1, 4–12 (quotes "air components," 11; "as a contingency," 12); Pamela Fessler, "Hill-Administration Turf Fight Shaping Up Over Deferrals," *CQ Weekly Report* 48 (24 Feb 1990): 605, 606.

53. HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1991: Hearings*, 22 Feb 1990, pt. 1:423; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1991: Hearings . . . on H.R. 5803/S. 3189,* 20 Feb 1990, pt. 1:63; House of Representatives, *Dire Emergency Supplemental Appropriations for Disaster Assistance, Food Stamps, Unemployment Compensation Administration, and Other Urgent Needs, and Transfers, and Reducing Funds Budgeted for Military Spending for the Fiscal Year Ending September 30, 1990, and Other Purposes*, 101st Cong., 2d sess., 3 Apr 1990, H.R. 4404 (engrossed in House), Title II, Chap. II, sec. 202–203; Senate, *Dire Emergency Supplemental Appropriations . . . H.R. 4404* (reported in Senate), Title II, Chap. II, sec. 202.

54. Whittle, *Dream Machine*, 190–193; *CQ Almanac 1990,* 677, 686; *National Defense Authorization Act for Fiscal Year 1991 . . .* , P.L. 101-510 (5 Nov 1990), Title I, Part E, sec. 152, and Title II, Part B, sec. 211 (quotes, 104 Stat. 1505, 1509).

55. Ferber, *Status of V–22 Osprey*, 5–6; HCAS, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993 . . . on H.R. 2100*, 7 Feb 1991, 86, 104 (quote); ibid., 20 Feb 1991, 145–146, 188–189, 203, 207–208; GAO, *Navy Budget: Potential Reductions in Aircraft Procurement Budget*, GAO/NSIAD-91-95 (Jan 1991), 9.

56. Whittle, *Dream Machine*, 202–205; *Dire Emergency Supplemental Appropriations for Consequences of Operation Desert Shield/Desert Storm, Food Stamps, Unemployment Compensation Administration, Veterans Compensation and Pensions, and Other Urgent Needs Act of 1991*, P.L. 102-27 (10 Apr 1991), Chap. II, sec. 204 (105 Stat. 139); Comptroller General of the United States, letter report to the President and Speaker of the House of Representatives, GAO/OGC-91-8 (7 May 1991), 1–6 (quote, 2).

57. HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100* . . . , 11 Apr 1991, 172, 174, 183, 214.

58. DoD, *FY 1992 Appeal to the Authorization Conferees*, 9 Sep 1991, http://www.dod.gov/pubs/foi/logistics_material_readiness/acq_bud_fin/350.pdf, accessed 15 Oct 2014, 82; Whittle, *Dream Machine*, 205–206.

59. Whittle, *Dream Machine*, 205–208; *National Defense Authorization Act for Fiscal Years 1992 and 1993*, P.L. 102-190 (5 Dec 1991), Title II, pt. B, sec. 211; *Department of Defense Appropriations Act, 1992*, P.L. 102-172 (26 Nov 1991), Title VII, sec. 8090. See also HCAS, *National Defense Authorization Act for Fiscal Years 1992 and 1993: Report . . . on H.R. 2100*, 13 May 1991, H. Rep. 102-60, 144–146.

60. DoD IG, *Review of the V–22 Aircraft Program*, 14 Jun 1994, 18–19; ltr, O'Keefe to Rep. Thomas S. Foley, Speaker of the House of Representatives, 26 Jan 1992, *Cheney Public Statements 1992–1993*, 2:1119; ltr, Foley to Cheney, 23 Mar 1992, ibid., 1117–1118; ltr, Cheney to Foley, 2 Apr 1992, ibid., 1113–1116.

61. Whittle, *Dream Machine*, 208–210; Hutcheson, "V–22 Backers," *Fort Worth Star-Telegram*, 9 Apr 1992, 5; "Capitol Hill Supporters of V–22 Threaten Court Action on Cheney Refusal," *Aerospace Daily*, 9 Apr 1992, 53; Eric Rosenberg, "Republican Heavy Will Make the V-22 Osprey a Party Issue," *Defense Week*, 15 Jun 1992, 1 (quote); Rosenberg, "Cheney Says No to Meeting With Coors," *Defense Week*, 22 Jun 1992, 16; ltr, Cheney to Coors, 4 Jun 1992, *Cheney Public Statements 1992–1993*, 3:1434–1435; ltr, Rep. Robert K. "Bob" Dornan to Samuel Skinner, White House Chief of Staff, 4 May 1992, ibid., 3:1441; ltr, Nicholas E. Calio, Assistant to the President for Legislative Affairs, to Dornan, 20 May 1992, ibid., 3:1442; "Republicans Tell Cheney That Bush Could Be Hurt By DoD's Opposition to V–22," *Inside the Pentagon*, 11 Jun 1992, 1 (quote); ltr, Sen. Arlen Specter et al. to Bush, 4 Jun 1992, *Cheney Public Statements 1992–1993*, 3:1443–1446; 102d Cong., 1st sess., *Congressional Record* 138 (4 Jun 1992): S7576–S7577.

62. HCAS, *National Defense Authorization Act for Fiscal Year 1993: Report . . . on H.R. 5006*, 102d Cong., 2d sess., 19 May 1992, H. Rep. 102-527, 163–164; H.R. 5006, *National Defense Authorization Act for Fiscal Year 1993* (as reported in the House of Representatives), 102d Cong., 2d sess., 5 Oct 1992, Title II, subtitle B, sec. 212; Whittle, *Dream Machine*, 211. The committee also accused O'Keefe of attempting "to blackmail the Congress" into accepting the transfer of funds into operation and maintenance accounts by cutting funding for operational readiness and then blaming Congress for hurting readiness.

63. Comptroller General of the United States, letter report to the President of the Senate and the Speaker of the House of Representatives, GAO/OGC-92-11 (3 Jun 1992), 1–5; Whittle, *Dream Machine*, 211.

64. Whittle, *Dream Machine*, 211–212 (O'Keefe quote, 212); Tom Belden, "Backers of Osprey," *Philadelphia Inquirer*, 14 Jan 1992, C1; "Republicans Tell Cheney," *Inside the Pentagon*, 11 Jun 1992; memo, David Gribbin, Assistant Secretary of Defense (Legislative Affairs), for Cheney, 5 Jun 1992,

Cheney Public Statements 1992–1993, 3:1439–1440; HCAS, Procurement and Military Nuclear Systems Subcommittee and Research and Development Subcommittee, *Status of the V–22 Tiltrotor*, 5 Aug 1992, 29, 49.

65. HCAS, Procurement and Military Nuclear Systems and Research and Development Subcommittees, *Status of the V–22 Tiltrotor*, 5 Aug 1992, 15, 19–20, 21 (quote), 27.

66. DoD IG, *Review of the V–22 Aircraft Program*, 6–19; Whittle, *Dream Machine*, 233–234, 239.

67. For summaries of the Osprey's history and problems, see Christopher Bolkcom, *V–22 Osprey Tilt-Rotor Aircraft*, CRS Report RL31384 (Washington, DC: CRS, 7 Jan 2005), 1–8; Jeremiah Gertler, *V–22 Osprey Tiltrotor Aircraft: Background and Issues for Congress*, CRS Report RL31384 (Washington, DC: CRS, 10 Mar 2011), 6–16, 19–26. Numerous GAO reports during the 1990s and 2000s also documented the Osprey's troubled development and technical problems.

CHAPTER V

Acquisition Under Stress: Adapting to War and Rethinking Reform, 1990–1993

During 1990–1991, in Operations Desert Shield and Desert Storm, the Defense Department carried out its first wartime acquisition effort since the Vietnam War. Undertaken outside of the established acquisition system, it gave a glimpse of how acquisition might be remolded in the post–Cold War era. The use during Desert Storm of prototypes, such as the Joint Surveillance Target Attack Radar System (JSTARS), an airborne electronic surveillance system, suggested that technology could be developed and fielded more rapidly than in the past. In 1992 DoD announced new science and technology, acquisition, and industrial base policies that promoted the use of demonstrators and prototypes to facilitate advances in weapons technology while limiting the number of systems moving into full-scale production. The Office of the Secretary of Defense believed this “new approach” to acquisition would preserve the U.S. advantage in cutting edge weapons and, along with enforcement of the reforms mandated by the Defense Management Report of 1989, deliver those systems on time and at reasonable cost.

ACQUISITION FOR THE PERSIAN GULF WAR

Operation Desert Shield (August 1990–January 1991), initiated to deter Iraq from continuing its invasion of Kuwait into Saudi Arabia, involved the largest short-notice mobilization and deployment since the Korean War, 40 years before. As the summer passed and the invasion failed to materialize, the United States and its coalition allies concentrated on building up an offensive capability to evict the Iraqis from Kuwait. War planners began to consider the equipment and systems that would be required or useful for such a campaign. The U.S. inventory of weapons had been designed and produced during the Cold War primarily to fight the Soviets and their allies in Europe. Much of this materiel would require modification for the different climate and terrain of the Gulf region, which included high temperatures, sandstorms, and a lack of good roads. Some of these modifications were previously planned improvements or correctives that had not yet been completed, while others represented extemporaneous responses to unanticipated circumstances.

OSD acquisition officials moved quickly to find ways to support the war effort. Only two weeks after the invasion of Kuwait, U.S. Central Command (CENTCOM), in a message with the subject line High-Leverage Technology, asked DoD to acquire immediately additional precision-guided munitions and sensor technologies that could improve target acquisition and destruction. In turn, the Office of the Under Secretary of Defense for Acquisition suggested several ways for the service acquisition executives and other officials to assist CENTCOM, including accelerating systems then in development, extending production in programs that were about to end, and deploying critical prototypes. Meanwhile, the Office of the Director of Defense Research and Engineering, in charge of early stage research and development programs, held a series of discussions with CENTCOM's science adviser, evaluating the technology initiatives of the services to determine their potential for operations in the Persian Gulf. The DDR&E gave OSD and the service acquisition communities 37 proposals to consider. OSD then forwarded 12 to the Joint Chiefs of Staff and CENTCOM for review.[1]

On 17 October 1990, Deputy Under Secretary for Acquisition Donald Yockey asked the Defense Science Board to form a task force to study how high-leverage technology might bring a payoff in military operations and to recommend changes in procedures and organization that would assist in rapidly transitioning such technologies to the field. The task force consisted of prominent academic and industry technologists and private consultants, advised by various officials from OSD, the Joint Staff, and the Defense Advanced Research Projects Agency (DARPA), which specialized in developing and prototyping innovative technologies and systems. The group organized quickly and met for six days in November, during which it received briefings on various aspects of Gulf War operations. The task force presented its preliminary findings to the service secretaries, the JCS vice chairman, and Deputy Secretary of Defense Don Atwood by the end of the month. Its classified report, completed in May 1991, well after the end of Desert Storm, contained a number of recommendations, some of which were implemented.[2]

Within days of the decision to deploy U.S. forces to the Gulf, the service acquisition executives examined the systems in their respective pipelines, especially those undergoing operational testing, to see which could be sent to the theater of operations and to establish procedures for deploying them. Most notable in this regard was the Air Force, which organized and implemented the Rapid Response Process (RRP) to expedite acquisition for its air units in the Gulf. In this procedure, the commander of U.S. Central Command Air Forces (CENTAF) identified an urgent requirement and passed it on to one of the Air Force's major commands, such as Tactical Air Command or Strategic Air Command, which validated the need and referred it to Air Force headquarters in the Pentagon. There, staff officers planned an acquisition strategy, a committee of general officers assessed the plan, and the Air Force vice chief of staff gave his approval—all within 20 days. An Air Force

F–15E Strike Eagle aircraft at a desert airfield during Operation Desert Shield in Iraq. *(NARA)*

acquisition organization, normally Air Force Systems Command or Air Force Logistics Command, then assembled a special team to execute the development. To increase the chances of success, the teams sought priority support from government laboratories, industry, and the nation's transportation providers. The teams had leeway to use streamlined procedures and approaches, such as sole-source contracting, concurrency (beginning production before development was complete), and the procurement of non-developmental, especially commercial items.[3]

The Rapid Response Process developed or upgraded 15 Air Force systems by the end of Desert Storm. One crash program improved the software of the High-speed Anti-Radiation Missile (HARM), a joint Air Force and Navy air-to-surface missile used to destroy enemy radars. Within three days of notification, a reprogramming team of Air Force and Navy personnel and contractors deployed to the Gulf to perform the upgrades. Similarily, a Desert Eagle Team of Air Force and contractor technicians and specialists hurriedly deployed and prepared for combat the F–15E Strike Eagle, which had entered service a few months before the invasion of Kuwait. In response to urgent requests from the theater of operations, the F–15E System Program Office (SPO) executed upgrades and other modifications to the aircraft and quickly tested them at Eglin Air Force Base in Florida. During Operation Desert Storm, the F–15E flew with a remarkable 95.5 percent fully mission-capable rate—that is, each aircraft was ready to perform any assigned task more than 95 percent of the time—under adverse conditions. The LANTIRN targeting pod on the Strike Eagle was also new, with only 12 units delivered by August 1990. LANTIRN had not yet achieved initial operational capability, when a system is typically deemed ready for combat.

An M2A2 Bradley Fighting Vehicle in Kuwait, October 1994. *(NARA)*

It suffered from technical problems and lacked the support of a logistics system that would provide spare parts and make repairs. As with the HARM and the Strike Eagle, a product support team of Air Force personnel and contractors deployed with the LANTIRN pods to maintain them and fix any problems that arose.[4]

The Army, too, adapted quickly to theater requirements. The M2 Bradley Fighting Vehicles in the vanguard of Army forces going to Saudi Arabia were the basic models. Concerned about the capabilities of Iraq's veteran Republican Guard, the Army rushed the newer A2 variant of the Bradley to the Gulf, some directly off the production line. The M2A2 was equipped with interior protection from metal fragments, additional armor in the form of steel tile appliqués, a larger engine, and improved ammunition storage.[5] To defend against Iraqi Scud ballistic missiles, the Army adapted an existing air defense missile system, the MIM–104 Patriot, and deployed it to Israel. One of the stars of the war, the Patriots engaged in celebrated duels with the Scuds. The presence of Patriot batteries reassured the Israeli people, helping to keep Israel out of the war and preserve the fragile Western-Arab coalition.[6]

Meanwhile, the services procured Global Positioning System (GPS) receivers that would allow accurate navigation and positioning in the featureless desert. The NAVSTAR Global Positioning System was a constellation of satellites emitting signals that, with the proper receiving equipment, could pinpoint the receiver's location to within a few meters. The system was still in the prototype stage and was not due to achieve IOC until 1995. The Air Force, which managed the program, had placed just 13 of the planned 21 satellites in orbit by August 1990, allowing only a few hours of coverage each day. Three more satellites were launched during the summer and fall. Three malfunctioned but all were repaired remotely, and by the start of the Desert Storm air campaign on 17 January 1991, the Air Force had positioned five satellites over the theater of operations, providing 24-hour coverage.[7]

M–109 launching stations for the MIM–104 Patriot missile stand ready for use during Operation Desert Shield, December 1990. *(NARA)*

Coalition forces had a hard time obtaining access to GPS receivers. Before the war the United States had only 300 GPS-equipped aircraft. The Air Force sent 160 of them to the Gulf, including B–52G bombers, RC–135 Rivet Joint reconnaissance aircraft, MH–53 Pave Low combat search and rescue helicopters, and the E–8 JSTARS electronic surveillance aircraft. The Army sent 7 GPS-capable helicopters, and the Navy provided 10 aircraft. Additional receivers were mounted in other Air Force aircraft, but their weight and expense ($50,000 each) limited their application. Most of the Air Force aircraft relied on 1950s-vintage inertial navigation systems during the air campaign. The service also employed the GPS-guided AGM–86C, a conventional version of the nuclear Air Launched Cruise Missile-B. During the first night of the war, 35 AGM–86Cs were fired at high-priority communications and power-generation targets. The receivers were even more valuable to the troops on the ground, who faced the problem of finding their way through the trackless desert. They were also valuable to the artillery for targeting. By the end of Desert Storm, 6,300 GPS receivers were in use, including 4,800 inexpensive handheld models purchased commercially. There were never enough of these devices—only 3,000 of the 40,000 vehicles in VII Corps had them. Anxious to have GPS receivers, many personnel used their own credit cards to buy them. The system did not always work perfectly. At one point, two VII Corps battalions received a faulty signal and drove in a large circle before discovering the problem and switching to a new satellite. Nevertheless, the NAVSTAR GPS program accounted for much of the coalition's ability to outmaneuver the Iraqi army.[8]

The most celebrated story of rapid acquisition response during Desert Shield/Desert Storm was JSTARS, a surveillance and targeting system consisting of advanced radars mounted on an E–8A aircraft (a modified Boeing 707) and ground stations. JSTARS displayed maps of the battlefield and data regarding moving ground targets on consoles in the aircraft and on the ground. The system provided air and ground commanders with remarkably detailed information on enemy and friendly forces. The consoles showed the positions and movements even of individual vehicles, allowing commanders to locate enemy formations, divine their intentions, and attack them with artillery and aircraft. The joint Air Force and Army program that became JSTARS was an outgrowth of direction to the services from the director of defense research and engineering in 1973 to develop proposals for systems able to locate and strike moving targets—notably Warsaw Pact tanks in Central Europe—in any kind

An AGM–86 air-launched cruise missile is released from a B–52 Stratofortress, November 1979. *(NARA)*

of weather. Their efforts, largely conducted separately and built upon technologies under development since the later years of the Vietnam War, paralleled similar work being pursued by DARPA. In 1983 the under secretary of defense for research and engineering directed the establishment of the joint program with the Air Force as the lead service. In 1990 the system was still seven years from its projected IOC. Grumman Aerospace Corporation, the contractor, had produced only two aircraft and six ground station modules, and was still conducting developmental testing—the system had not yet been turned over to the services for operational testing and evaluation.[9]

Military leaders quickly recognized JSTARS's tremendous potential. According to one account, within days of the invasion of Kuwait, CENTCOM commander General H. Norman Schwarzkopf Jr. requested the two prototypes then undergoing developmental testing. The Air Force demurred, knowing that successful performance could aid the program politically but failure could kill it. Technical problems had already marred JSTARS development, and the program had survived several attempts to cancel it during the 1980s. In 1989, just a year before JSTARS went to war, the Senate Appropriations Committee cut the program's funding after learning of serious cost overruns, manufacturing problems, and disruptive changes in requirements. Schwarzkopf withdrew his request.[10]

However, JSTARS performed well in tests and had demonstrated its capabilities successfully during military exercises in Germany in February 1990 and again during VII Corps exercises in September. It quickly gained high-level supporters. During the latter exercise, Lt. Gen. Frederick Franks, the VII Corps commander, indicated that he was impressed with a JSTARS ground station data display he observed and used. Army General John R. Galvin, commander in chief of the U.S. European Command, asked for a ride in the aircraft, with a special request: to fly over the positions his forces had held when he was VII Corps commander during the 1980s, so he could see the once-hidden countryside that had been in front of him. After the flight, Galvin saw the radar images JSTARS had collected and transmitted to a ground station. "For the first time in my life, that whole area was lit up like a pinball machine," he told a congressional panel two years later. "I could see every vehicle that was moving down the roads, which roads had heavy or light traffic and all the rest. It was just like the blind man seeing. I was astounded by it. If I had a piece of information like that when I was a corps commander, what a difference it would have made." Both he and Franks, who would soon deploy to the Gulf with his corps, enthusiastically recommended the system for the force then gathering there. Schwarzkopf agreed and again requested that the Air

Force deploy the system to Saudi Arabia and make it operational by 15 January. The Air Force complied.[11]

There was reason to be nervous. The system was far from ready. It was a prototype with no trained maintenance teams or depot support, no spare parts, no training manuals, no standard procedures—virtually no logistics support at all. Everything had to be worked out on the fly, sometimes literally: The aircrews completed their training while the aircraft were en route to Saudi Arabia. The Air Force depended heavily on the contractor, Grumman, for assistance. The company's engineers and technicians maintained the aircraft and even flew on missions to service and assist with the operation of the onboard computer and other electronic systems. JSTARS "still had people in gray smocks running around with this," Galvin recalled, "and it had a team of scientists working it rather than just a military crew." Seventy Army and Air Force personnel were hastily trained to operate the communications and radar consoles.[12]

An Air Force E–8C, part of the Joint Surveillance Target Attack Radar System, or JSTARS, takes off for a combat sortie over Iraq during Operation Iraqi Freedom, April 2004. *(NARA)*

Once in the theater of operations, maintenance crews obtained spare parts from the E–3 Sentry Airborne Warning and Control System (AWACS), also housed on a modified Boeing 707 like JSTARS. When unique parts were required, program officials chartered aircraft to rush the needed items to Air Force Military Airlift Command bases for transshipment to the Gulf. The system program office made hasty modifications to the JSTARS aircraft. Meanwhile, the precious ground stations were doled out to the key air and ground force headquarters and a system worked out for the two aircraft to share their capabilities among the commands requesting JSTARS support. All of this was accomplished in "a dizzy three weeks," according to the program's director. By 11 January 1991, 24 days after receiving the order, JSTARS had arrived in Saudi Arabia and was fully operational. After just three days of engineering test flights, it went into combat.[13]

JSTARS proved to be a "spectacular success" during Desert Storm, according to one Air Force review. The system actually exceeded the already high expectations. During 55 days of operations at least one of the two aircraft was flying at any given time, covering the entire theater with each orbit. During the air campaign, the system located ground targets effectively. At the time of the ground war, JSTARS gave commanders an unprecedented view of the tactical situation and the course of operations. During the surprise Iraqi attack at al-Khafji at the end of January 1991, JSTARS accurately located the Iraqi forces and revealed their movements, enabling commanders to determine their intentions and react accordingly. At one point in the battle, Lt. Gen. Charles A. Horner, the CENTAF commander, asked for a JSTARS officer to identify targets for inbound B–52 bombers, but the only military member available was Private First Class Timothy Reagan, who pointed out to the lieutenant general an Iraqi convoy the system had been tracking for some time. The B–52s demolished it. In late February 1991, JSTARS revealed the attempted escape of Iraqi convoys from Kuwait City along what would soon be called the Highway of Death. During these operations, the doctrine and procedures for the system evolved quickly as its users learned through experience how to employ it most effectively. In its official report, *Conduct of the Persian Gulf War*, the Defense Department indicated that if there was any major problem with the system, it was that the two prototype airborne systems and the six ground stations were too few to satisfy demand for real-time battlefield intelligence.[14]

Because the war was so short, there were few opportunities to develop new systems. The laser-guided GBU–28, the famed "Bunker Buster" bomb, was a notable exception and a remarkable example of rapid acquisition. In September 1990 intelligence reports revealed the existence of up to 40 complexes of hardened bunkers scattered around Baghdad that were used as command and control facilities and as shelters for several Republican Guard divisions. The bunkers, which were large enough to house 1,200 men comfortably for a month, were covered with a 2-foot slab of reinforced concrete and buried 30 to 50 feet underground. None of the munitions in the U.S. inventory could penetrate them.[15]

At the end of October 1990, the commander of the Aeronautical Systems Division of Air Force Systems Command, Lt. Gen. Thomas R. Ferguson Jr., ordered the division's Development Planning Group, located at Eglin Air Force Base, to study possible solutions. Air Force engineers considered and rejected at least 11 designs. After the start of the air campaign, the Air Force asked industry for ideas. The service received eight responses and by the end of January 1991 had selected a design. A retired Army officer working for Lockheed Missiles and Space Company suggested using 8-inch artillery tubes, which possessed the requisite strength and weight for the bomb casings. The Army cooperated in the project enthusiastically, offering scrap tubes stored at Watervliet Arsenal in New York and machining them into bomb casings. The specifications were set by 7 February 1991 and manufacture of the new bomb began immediately. Watervliet machinists worked around the clock, seven days a week, to prepare the casings. At the same time, engineers at Eglin, Lockheed Missiles and Space Company (which designed the Bomb Live Unit [BLU]–109 hardened penetration bomb), Rockwell International (builder of the GBU–15 television-guided bomb and the avionics suite of the F–111 Aardvark, which would carry the "Bunker Buster"), and Texas Instruments hastily adapted nose cones with laser seekers and wrote the necessary software. Tests of the bomb's aerodynamics using a quarter-scale model in a wind tunnel and with computer simulations, which would normally require two years, were completed in one week. Manufacture of two prototypes and two operational bombs occurred concurrently. A test-drop of one concrete-filled prototype took place on 24 February. It hit the ground at supersonic speed and buried itself so deeply—about 100 feet—that the Air Force did not bother to dig it out. The second prototype, mounted on a horizontal rocket sled, pierced a stack of steel-reinforced concrete slabs 22 feet thick and kept going for another half mile.[16]

An F–15E Strike Eagle releases a GBU–28 "Bunker Buster." *(U.S. Air Force photo)*

The two operational bombs were rushed to the Gulf, still warm from the pouring of the explosive filler. They arrived on 27 February (the day before the cease-fire), were loaded onto two F–111F fighter-bombers within five hours, and immediately sent into action. The first missed its target, a pair of bunkers 35 miles northwest of Baghdad, but the second destroyed its target.[17]

Overall, the services adapted well to the need to acquire or modify systems rapidly for the Persian Gulf conflict. They created focal points to coordinate the processing of urgent requirements and ad hoc teams to execute the desired acquisition. For example, the Air Force Civil Engineering Support Agency created the Desert Shield Acquisition Cell (later the Desert Storm Acquisition Cell) to provide a quick response to CENTAF's needs from that support activity. In six months the cell handled more than 250 acquisition actions costing more than $9 million. Field headquarters, acquisition staffs, and contractors cooperated well and expeditiously to achieve the desired results.[18]

The Defense Advanced Research Projects Agency also worked closely with the services to address immediate short-term requirements. It supported the acquisition of GPS receivers and the steel tile appliqués for the deployed Bradleys. When fratricide—the loss of troops to friendly fire—became a major concern after the battle at al-Khafji, DARPA led an effort to find ways to improve the identification of friendly forces during combat. The agency evaluated 61 proposals for commercial off-the-shelf (COTS) solutions and selected the Anti-Fratricide Identification Device, a battery-powered beacon enabling aircrews to identify coalition vehicles. Engineers made over 100 in only four days; the entire procurement took only 24 days.[19]

The hurry-up nature of the steps taken to field new systems created problems. For one, finding adequate funds complicated wartime acquisition. Because no special funding existed for acquisition to support Desert Shield and Desert Storm, expenditures initially came from existing budgets. With the Defense budget already in steep decline, many organizations hesitated to commit scarce funds to short-term contingencies at the expense of long-term, ongoing programs. Reprogramming funds was disruptive and caused confusion. Supplemental appropriations provided by Congress in April 1991 partially alleviated the problem. Waiving regulations and adopting streamlined procedures for acquisition weakened oversight. In the Air Force, some programs used the conflict to fix support problems unrelated to the war. For example, the F–15E program took advantage of the aircraft's priority status to acquire nonessential spare parts and services. Setting aside regulations did not necessarily expedite procurement. The Army waived them for an emergency order for 6,000 widely marketed commercial radio receivers. However, it could not find a procurement official willing to waive the requirement for the vendor to certify it was offering the Army the lowest available price. Nor would any company official make that certification for fear of what could be interpreted as a felonious misstatement. The impasse was broken only when the Japanese government bought the radios without certification and donated them to the U.S. Army as part of its contribution to the war effort.[20]

The Defense Department learned useful lessons from the war. The services discovered shortcomings that generated new requirements—the need for improved combat identification systems to avoid fratricide and better night-fighting capabilities, for example. The Army retained the modifications of the M2A2 Bradley, added new ones based on combat experience (such as an eye-safe laser rangefinder), and created a new variant designated the M2A2 ODS (for Operation Desert Storm). The GBU–28 "Bunker Buster" continued in service with the Air Force.

OSD catalogued lessons learned from the conflict. As soon as the Desert Storm air campaign began, Yockey, now acting under secretary for acquisition, suggested to Deputy Secretary Atwood the importance of obtaining a reliable assessment of battle damage. He proposed developing a database for technical information on U.S., Iraqi, and allied weapons. Atwood agreed. Yockey's office compiled the Operations Desert Shield/Storm Data Directory in October and in early 1992 produced a follow-up list of completed and ongoing operational performance studies.[21]

Following the war, the ad hoc organizations and procedures set up during the brief conflict were quickly abandoned and the Defense Department returned to its established acquisition system. In one exception, the Air Force institutionalized its Rapid Response Process two years after the end of the conflict. "The RRP does not replace normal acquisition procedures," the service's instruction noted, "but rather speeds up the process of fielding systems to satisfy wartime needs." Despite the dissolution of most of the wartime arrangements, OSD and the services would continue to explore methods of speeding up acquisition.[22]

PROGRESS WITHOUT PRODUCTION

With the end of the Cold War and the swift victory in the Persian Gulf, a swirl of ideas about acquisition began circulating in the Pentagon, on Capitol Hill, and among other observers in the defense community. The astounding tactical success in Operation Desert Storm had given the world a glimpse of the capabilities of a new generation of weapons. The wartime performance of America's arsenal reinforced a broad consensus across the political spectrum that the United States, as it had throughout the Cold War, must continue to maintain its technological edge over potential adversaries. Beyond that, however, little agreement existed on how to accomplish this objective in an era of fiscal austerity, unclear threats, and rapidly advancing technology.

A strong current of thought held that the traditional Cold War assumption about the standard "pipeline" model for the acquisition process—in which R&D went in and weapons came out, years later and at great cost—was obsolete. Among the first politicians to question that assumption at the end of the Cold War was Les Aspin, chairman of the House Armed Services Committee. In a speech in January 1990, he suggested switching from a "develop and buy system" to "a real research and development system," and called upon the administration to delay production of some next-generation systems, such as the F–22. Elsewhere he mused, "Maybe we should develop systems, but not deploy them."[23]

Aspin's speech, in turn, helped inspire two defense consultants, Theodore S. Gold and Richard L. Wagner, to publish a paper later that month, entitled "Long Shadows and Virtual Swords." The authors argued that the pipeline model of acquisition was suited to a static strategic situation, but not to one characterized by uncertainty and change. They suggested R&D should itself be considered a strategic asset and that deterrence in the future would depend more on demonstrated technological prowess than on forces in being. Advanced technology could cast a "long shadow" over the world and function as a "virtual sword" to deter potential aggressors from challenging the United States. For example, the Strategic Defense Initiative arguably put tremendous pressure on the Soviets even though it remained years or decades away from deployment. The threat that SDI might work made it politically effective. Gold and Wagner maintained that R&D should no longer be considered a prelude to production, as in the pipeline model, but a product in itself. Its value would not require every program to proceed to deployment.[24]

Other studies echoed Gold and Wagner's emphasis on demonstration and prototyping. In August 1990 the Carnegie Corporation's Commission on Science, Technology, and Government convened a distinguished panel of experts from government, industry, and academia. This group was commonly called the Perry Panel, after its chairman, William Perry, the former acquisition chief in the Jimmy Carter administration and chairman of the Packard Commission's acquisition panel. Like Gold and Wagner's paper, the Perry Panel's report argued that R&D should be treated as a product in its own right. Under the existing system, the report stated, "R&D programs that do not lead to fielded hardware are viewed as failures, and industry has few incentives to explore systems that are 'going nowhere' in terms of production contracts. In the future, it should be normal practice for DoD to support exploration of weapon concepts . . . that have no immediate prospect of deployment." In this way, the country could develop a "reserve technology" capability—analogous to reserve military forces—that would consist of the knowledge base and tools that could respond quickly when a military need arose. The report went on to call for measures to strengthen the country's defense technology base, including increased spending on R&D, especially in basic research and exploratory development, the bottom rungs of the technology development ladder.[25]

A paper by the Institute for Defense Analyses, released around the same time as the Carnegie Commission report, to help prepare the Defense Science Board for a summer study on the Defense Department's R&D investment strategy, also reflected Gold and Wagner's point of view. The IDA paper put forward the concept of a "flexible acquisition strategy." It recommended four paths for system development: upgrades to existing equipment, modifications to systems in production, the development of new products, and designs and modifications that would not be produced immediately but could be manufactured quickly if a mobilization occurred. A system under development would not be assured of going to production but would have to pass through a series of decision "filters or valves" for determining whether the program should continue. The objective of this process "would be to provide the armed forces with as many technology and acquisition options as possible, without having an R&D process that is too focused on new starts and the complex procedures required to bring the new system into production." In this acquisition approach, the development of prototypes would play a major role in ensuring the military had a number of "live options" to pursue according to circumstances. "The old argument against prototyping—that we do not want to build something we won't use—is no longer applicable," the report stated. John E. Krings, the director of operational test and evaluation in DoD during the Reagan administration, advocated a similar concept he called "just-in-time" weapons acquisition, in which, comparable to the Army's approach between World War II and Korea, modular subsystems and components would be assembled as needed during a mobilization.[26]

The Defense Science Board summer study's recommendations expanded upon the IDA prototype concept. It called for "fieldable brassboards," or "fieldable prototypes," that could be used to test concepts or engineering designs prior to production but could also operate in the field as functioning systems. According to the study, these prototype systems should bypass the normal acquisition pipeline through a fast-track process lasting only one to three years, which would get them into the hands of the users quickly (they were not to be linked to formal requirements); should have a revolutionary impact on cost, performance, or tactics; should be financed through a flexible funding pool; and should be produced in very small quantities with no clear intent to deploy. JSTARS and the Global Positioning System demonstrated that fieldable prototypes could have a positive impact, but those systems were hardly models of this concept because they already were being developed through the standard acquisition process, and their fielding was merely a temporary interruption of that process caused by an unexpected need and opportunity. The idea of fieldable prototypes would later come to fruition in the Clinton administration as the advanced concept technology demonstration (ACTD) (see chapter VIII). The Defense Science Board summer study also urged that prototype subsystems be developed as retrofit kits to upgrade existing equipment in the field—a concept that would become a key element of the Army's experimentation and modernization strategy during the 1990s (see chapter XII).[27]

The Defense Science Board report aimed to counter the popular idea advocated by many, including the chairman of the Senate Armed Services Committee, Sam Nunn of Georgia, that technology should be developed as far as the prototype stage and then put "on the shelf" until needed. Early on, Aspin, too, supported the on-the-shelf concept, suggesting in March 1990 that by continuing weapons R&D, "in effect, we could create a technology stockpile." However, Perry, long an advocate of building prototypes, recognized that if not produced right away the technology itself would probably become unusable after a year or two. "I am a skeptic about putting designs on the shelf. It is easy to put them on. It is just very difficult to take them off when you want them."[28]

Thinking in parallel, Aspin and Perry—who would soon serve together as secretary and deputy secretary of defense—came to the conclusion that the main purpose of continually performing research and building prototypes was not to develop technology but to keep the design teams actively employed. "The idea," said Perry,

> is that you maintain a pool of capable design teams, capable engineers, and capable scientists. To maintain that pool and keep them adequately trained, they have to go [to] this next step; they have to go to building the models and testing them. . . . The reserve that we are maintaining is not the reserve of designs on the shelf. It is the reserve of technical talent, the design teams, the engineers [*sic*] teams.

When the prototyping project was completed it would likely be shelved and the design team would move on to a new one.[29]

Aspin, too, began to focus less on the technology than on the design teams developing it. By fall 1990 his thoughts had evolved into a concept he called Rollover. It involved the continual upgrade of technology prototypes through multiple generations, with the knowledge and experience being "rolled over" into the next iteration, until a production decision was made or the technology was discarded. This was similar to an idea discussed in OSD called "hover," in which systems that were neither canceled nor approved for production were made to hover in place for an indefinite time. This approach would have the advantage of keeping design teams assembled and busy practicing their profession. Aspin later refined the concept as Rollover-Plus, which added manufacturing technology and operational testing. Under Rollover-Plus, a system could not be approved for production until it had been demonstrated to be fully successful, was required by an urgent threat, or represented a major, JSTARS-like breakthrough in battlefield operations. It also had to be tested rigorously and produced in a way that allowed manufacture if desired; it could not be simply a concept demonstration. The Office of Technology Assessment, a research arm of Congress, put forward a very similar proposal it called "Prototyping-Plus."[30]

These various proposals had several features in common. They called for boosting R&D spending with a corresponding reduction in procurement. In addition, they sought a more flexible acquisition system that could study experimental concepts more efficiently and could transition them to production and deployment more expeditiously. Usually they also involved the use of technology demonstrators and prototypes in some form. And they would establish strict criteria for approving production, including an urgent military need, and proof, through demonstrations and prototypes, that the technology was ready.

THE "NEW APPROACH" TO ACQUISITION

OSD paid close attention to the proposals for acquisition coming out of these several studies. The USD(A) staff looked favorably on Gold and Wagner's paper and the Institute for Defense Analyses report but panned Aspin's rollover theory as impracticable. What resonated so well in the secretary's office about these ideas was their focus on research and development. Early in the administration, OSD had decided to deemphasize production in favor of R&D. Cheney held the line on R&D spending even as the procurement budget was declining. Whereas RDT&E funding averaged 30 percent of procurement during 1982–1985 and 43 percent during 1986–1988, from 1989 to 1992 it was up to 51 percent, and Cheney's budget proposal for 1993 would push it even higher, to 72 percent. By 1992 OSD was calling its emphasis on R&D over production a "new approach" to acquisition.[31]

Cheney was especially interested in furthering the Defense Department's investment in long-term science and technology (S&T) research. "Look, this [Operation Desert Storm] was not done with technology that was developed in [t]his administration," he told Director of Defense Research and Engineering Victor H. Reis in spring 1991. "This was technology that was developed many years ago—10, 15, 20 years ago." Cheney said he wanted his legacy to be similar technological development that would form the basis of a new generation of weapons, so if the country were to fight another Desert Storm in 15 years people would look back and say, "Secretary Cheney didn't do such a bad job either in producing that level of technology." Within the department's RDT&E budget, he raised the proportion devoted to the science and technology program, which included research, exploratory development, and technology demonstrators (see figures 8-1 and 8-2), from an average of 21.3 percent in 1986–1988 to 26.3 percent in 1989–1992 and 30.5 percent in FY 1993. When the Perry Panel called for strengthened management of the Defense Department's S&T program, OSD obliged by assigning the DDR&E full responsibility for it within the department and giving that official commensurate authority—one more example of the centralization of power in OSD, a continual theme of Cheney's tenure at the Pentagon.[32]

At Deputy Secretary Atwood's direction, and armed with the new authority granted him, Reis set out in the latter part of 1991 to establish a strategy to reshape and redirect the S&T system to meet the needs of the "new paradigm" of the post–Cold

War world. He assembled a group of technologists and warfighters from the services, the Strategic Defense Initiative Organization, DARPA, and the Joint Chiefs of Staff, who met for six weeks at 6 a.m.—hence they were known as the Breakfast Club—to discuss the problems the U.S. military might face in 15 years and the capabilities it would need to deal with them. The group ultimately came up with seven primary "thrust areas" where the department would focus its efforts, such as precision strike and advanced land combat. Reis also reorganized his office to enable his staff to work more closely with the S&T organizations in the services and the defense agencies.[33]

Victor Reis's Seven Thrust Areas for DoD Science and Technology

1. Global surveillance and communications
2. Precision strike
3. Air superiority and defense
4. Sea control and undersea superiority
5. Advanced land combat
6. Synthetic environments
7. Technology for affordability[I]

While Reis was remaking the S&T system, Atwood was doing the same for acquisition as a whole. As early as February 1990, he suggested "a more proper approach would be to continuously develop and demonstrate new technology, but only commit to full scale development when factors such as changes in the threat, agency equipment and significant technological advances make it prudent to modernize the forces"—essentially the concept Aspin had unveiled the previous month. That was why OSD repeatedly proposed shutting down the production line of one system before the follow-on system was ready, as in the cases of tank and fighter production. Atwood and other Defense Department officials judged that the "dead zone" in production would constitute an acceptable risk. They were confident the plants could reopen without too much difficulty if and when necessary—say, if a new global threat emerged or a next-generation weapon was required.[34]

As a general rule, OSD favored the use of prototypes in the acquisition process. Some observers blamed the failure of the Navy's A–12 program on the lack of a prototype, which boosted support for the concept within DoD. In accordance with the Packard Commission recommendations, the Defense Management Report, and the 1991 revision of DoD's 5000 series, acquisition policies had mandated the use of prototypes and prescribed two kinds: technology demonstrators that preceded program specific prototyping and were used to evaluate the viability and usefulness of new technologies; and prototypes that were part of an acquisition program and used to test a system, assess cost and performance trade-offs, and provide a basis for choosing between two designs. However, OSD was cautious about calls for a fast-track acquisition system that would develop and deploy fieldable prototypes outside of the pipeline.[35]

Cheney and Atwood unveiled their new approach at a press conference on the FY 1993 Defense budget in January 1992. They said the collapse of the Soviet Union just a month before gave DoD time to develop weapons more carefully, eliminate concurrency, reduce risk, and mature component technologies before sending the program into production. The department would also continue its emphasis on R&D, with the government paying the full cost of research and development by shifting from fixed-price to cost-reimbursement contracts. No longer would contractors be tempted to use their own money for that purpose in the hope of recouping those costs in production contracts, as the Bell Boeing team had done with the V–22. DoD would sponsor the technology demonstrators and prototypes. Meanwhile, the department would produce only the weapons needed, and only after reducing the technical, manufacturing, and operational risks to a minimum. It would also give preference to upgrading existing systems over new program starts.[36]

In testimony to the Senate Appropriations Committee in February, Atwood gave an example of how the policy would work. "We have 8,000 tanks," he explained, "proven just recently as the best tanks in the world."

> There is considerable life left in those tanks. With the downsized Armed Forces we have, those 8,000 advanced tanks are more than we need for any foreseeable contingency. Thus, there is no need to replace them. There is no need to rush into production on a block 2 [a major modification] or something further.
>
> Nevertheless, we continue the work on our prototypes and on our technology. We continue to work on new engines, new transmissions, new tracks, new armor, new fire control systems. We will build demonstrators and evaluate them, but not necessarily go into production until we are forced to.[37]

To support the department's contention that it was time to reduce defense spending, Cheney's FY 1993 budget sliced $8 billion from what Congress had approved for FY 1993 the previous year, and more than $50 billion from the FY 1992–1997 Future Years Defense Program. As procurement continued its dramatic drop, from $62.9 billion (current dollars) in FY 1992 to $52.8 billion in FY 1993, RDT&E rose from $36.6 billion to $38 billion. To everyone's surprise, Cheney announced the termination or sharp reduction of 10 major programs, including some for which he had fought in previous years: the B–2 bomber, the *Seawolf* submarine class, the Comanche helicopter, the Midgetman Small ICBM, and various armor and missile programs. Over half of the $42.1 billion saved by cutting these programs came from the B–2 ($14.5 billion) and the *Seawolf* class ($17.5 billion). In accordance with the new policy, some programs were slowed to reduce risk.[38]

In spring 1992, after a delay of several months and considerable outside pressure and criticism—"long on rhetoric and short on details," was how one critic described the plan—OSD fleshed out its much-touted new approach in speeches and in testimony to Congress by Deputy Secretary Atwood and in a set of white papers released by Yockey explaining the new policy on science and technology management, acquisition, and industrial base issues. OSD reaffirmed that it was cutting production. The force structure would decline by 25 percent to the Base Force within three years and would have a much-reduced need for additional weapons and equipment. The Defense Department would conduct studies of the industrial base to identify the sectors requiring additional support to maintain the health of the defense industry. It would also encourage companies to develop "dual-use" technologies and products that held commercial as well as military value, and it would rely more heavily on purchasing commercial items from nondefense firms. In other words, the government would move toward the integration of commercial and military production and reduce its reliance on costly military-unique technology—an approach that the Clinton Pentagon would make the centerpiece of its acquisition reform program.[39]

In a speech to industry executives, now-Under Secretary Yockey gave a blunt assessment of the likely consequences of the Defense Department's new policy. The defense industry, faced with overcapacity in manufacturing, would have to restructure itself through redirection, mergers, or bankruptcy. How it did so was not the government's concern. "Don't expect the DoD to choose the winners or losers," Yockey warned. "[T]he Defense Department will not—and should not—dictate who will survive and who will not."[40]

R&D, especially science and technology, was the central component of the new approach. In 1992 OSD institutionalized Reis's Breakfast Club as the Defense Technology Board, comprising the service acquisition executives and senior officials of OSD and the Joint Chiefs of Staff. With the help of the new board, Reis formulated a Defense Science and Technology Strategy focusing S&T efforts on his seven thrust areas. The S&T program would explore and promote new technology more aggressively, relying particularly on advanced technology demonstrations (ATDs). Unlike the prototypes developed as part of the acquisition process, ATDs were to demonstrate technological or tactical concepts but not entire systems. Because they were not officially acquisition programs and therefore not governed by the 5000 series documents, regulations, and statutes, they could be initiated without a validated military requirement. Program managers were to develop ATDs with the assistance of warfighters. The technology demonstrations would be made as realistic as possible, not in the field, but in "synthetic environments" created by advanced simulation systems and high-speed computer networks.[41]

Advanced technology demonstrations would not automatically go into systems development and production. For the typical new technology or design, the ATD would represent the end of the line. Only if the technology met certain stated and rigorous criteria—it had to be workable, producible, cost-effective, and with a clear and verified military need—would it enter the acquisition pipeline, at Milestone I (concept demonstration approval, the normal start of an acquisition program), or at Milestone IV (major modification approval) if a modification or upgrade. As the new technology program proceeded through the demonstration and development phases, it would continue to develop increasingly sophisticated prototypes as a show of its feasibility and value, but would move more deliberately through the pipeline than programs had during the Reagan years. Indeed, OSD hoped that by reducing risk and eliminating concurrency, this approach would help programs avoid delays and cost overruns.[42]

Throughout winter and spring 1992, the Defense Department faced questions about the new acquisition policy emphasizing R&D. During a press conference, Cheney responded to concerns "we were going to cancel all procurement" and the department was planning to put the prototypes "on the shelf." OSD worked hard to kill one rumor in particular: that the new policy represented a fast-track or rapid-prototyping strategy of the sort favored by defense commentators and reformers. Some OSD acquisition officials believed prototypes and even technology demonstrators could be deployed. Others, however, feared that the rush to field prototypes would cause costly systems integration problems, which ran counter to the new emphasis on reducing risk; and that the various requirements for testing, logistics, and the copious documentation specified in the 5000 series guidance would be ignored. OSD argued that advanced technology demonstrations were not prototypes, were not meant to be fielded, and at best represented preludes to regular acquisition programs that later would build prototypes—which were also not meant to be fielded. Indeed, OSD downplayed the use of the term prototype because it connoted an early but usable version of an operational system. An internal document accompanying one draft of the white paper insisted the terms "demonstrator" and "demonstration" were preferred over prototype, while the term fieldable prototype was not to be used at all, because "the concept has outlived its usefulness and should be dropped." When proposing to field a prototype as an urgently needed interim capability, the director of the Theater High Altitude Area Defense (THAAD) program, which was developing an antiballistic missile system, had to argue the case for seven months before the Defense Acquisition Board.[43]

OSD also pointed out that the new approach did not involve new procedures but hewed closely to the acquisition process laid out in the 5000 series documents. If a technology performed well as an advanced technology demonstration and addressed a validated need, it started its passage through the acquisition process at Milestone I. OSD intended the ATDs to support, not bypass, the regular acquisition system and it employed system prototypes to reduce technological risk, not provide a test bed for new tactical and operational concepts. The new policy was a different method of allocating resources, not a reform of the process itself, although it was expected to improve acquisition outcomes. OSD planned no significant change to the 1991 guidance.[44]

The new policy satisfied almost no one outside OSD. Industry was apprehensive about how it would be applied, and opposed the de-emphasis on lucrative production and the newly stringent program evaluations. Although fully funding research and development meant industry no longer had to invest its own money in R&D to "buy in" to a program, the profits from such work would still be far less than from a good production run. Buying in involved underestimating cost, technical difficulty, or time to complete in order to gain support for a proposed program or win a contract. Industry also doubted Defense Department optimistic claims that the industrial base could be restored easily and production lines reopened if a global threat appeared. Business leaders and analysts pointed out that many skilled workers could be lost, and in some sectors the vendor base supplying the large prime contractors could be wiped out. For example, the policy would threaten submarine construction, a particularly high-profile industrial sector. Roger E. Tetrault, corporate vice president of General Dynamics' Electric Boat Division, warned Congress that canceling the two follow-on submarines to *Seawolf* would cause a break in production lasting seven to eight years before work was started on the next class. During that production gap, a large portion of the workforce, much of it skilled, would be lost, as would submarine designers, who took three to five years to train. Many of the company's 5,000 subsystem and component suppliers would go out of business, with the loss of competition and perhaps access to the needed technology altogether. Already, 22 of 33 sole-source suppliers of critical components such as turbines, generators, and condensers were at financial risk because of the low workload. Without those two follow-on boats, Tetrault warned, "we have no confidence that we can remain as a fully capable shipyard." Even more ominously, he predicted a net loss of 27,000 jobs in southeastern New England by 1997.[45]

The services, too, feared the new policy's impact on their respective industrial bases. The Navy worried about the effects of shutting down submarine production with the launch of the last *Seawolf*-class submarine. The Army had particular reason to worry. Its "Big Five"—the M1 Abrams tank, the M2 Bradley Fighting Vehicle, the AH–64 Apache helicopter, the UH–60 Black Hawk helicopter, and the MIM–104 Patriot air defense system—had performed well during the Gulf War and the Army had a large inventory of them, so the administration was disinclined to fund further production, existing system upgrades, or replacement systems. "My concern is that R&D without procurement doesn't put any capability in the hands of the soldier," Assistant Secretary of the Army for Research, Development, and Acquisition Stephen K. Conver told a Senate panel. "We need to get ideas out of the laboratory and into the hands of our soldiers." Conver was blunter in a draft working paper on the industrial base he prepared in fall 1992. Raising the specter of Task Force Smith—the notoriously ill-equipped American force that the North Koreans routed and hounded in the opening weeks of the Korean War—he warned: "The lesson here is clear—technological superiority is necessary, but it is not sufficient to guarantee quick and decisive combat victory with minimum casualties. Future wars are likely to be 'come as you are' affairs; the existence of superior technology in the laboratories will be of no use in winning in those engagements."[46]

Finally, legislators of both parties were skeptical about the meaning and significance of the new approach to acquisition, which some derided as a "retread of familiar policies." On the Senate Armed Services Committee, normally friendly to the Pentagon, Senator Malcolm Wallop (R-WY), a strongly pro-defense conservative, sneered, "What is really new?" while Senator Carl Levin (D-MI) complained, "The prototype acquisition strategy leaves more questions than answers." Congressional critics expressed particular confusion about why the Comanche helicopter and similar programs were being restructured but not the F–22 stealth fighter, which seemed a prime candidate for it under the new policy.[47]

Members of Congress especially disliked the plan's insistence on reducing procurement. The Hill was loath to close production lines, to a large extent because of lost jobs. Congress heard estimates that the Bush plan would put as many as two million civilian and uniformed personnel out of work. The chairman of the Senate Appropriations Committee, Daniel K. Inouye (D-HI), explained, "We are faced with two realities." One was the end of the Cold War. Electoral politics was the other: "At this moment there is a primary in South Dakota. There will be another set of those a week from now. The front-page headline is the closing of factories by General Motors. The lead stories on all television programs have been, for the last 48 hours, how many people are going to be laid off."[48]

One of the few in Congress to speak in favor of the Pentagon's reduced emphasis on production in favor of R&D was Aspin, whose Rollover-Plus plan was similar. However, Aspin parted ways with the Defense Department over its laissez-faire attitude toward the industrial base, which he considered dangerous. By 1992 Aspin had come to believe national security required targeted procurement programs to protect critical facilities and industries, most notably in two key sectors: shipbuilding and the production of heavy combat vehicles, such as tanks. In response to Cheney and Atwood's plan, Aspin in February unveiled what he called a "comprehensive resource strategy." It involved four elements. First, the country would "selectively upgrade" key weapons to allow modernization without the expense of buying a new system and to keep the production lines open. Aspin cited the Abrams tank upgrade, the M1A2, as an example. Second, some weapons would continue to be procured at a low rate even if not needed, for the sole purpose of protecting the industrial base, including manufacturing facilities, suppliers, and trained workforces. Aspin pointed to the shipbuilding industry as a prime candidate for this approach, as well as the F–16. The third element was Rollover-Plus, to keep defense technology up-to-date, keep the design teams in practice, and improve manufacturing technologies. Aspin named the Army's Block III tank, the follow-on to the Abrams, as a possible candidate. Work could proceed on designing and developing the Block III without actually manufacturing it, because no new tank would be needed for the foreseeable future. And finally, Aspin advocated what were called "silver bullet procurements," in which the Defense Department acquired a few highly capable and expensive systems that could have a disproportionate impact on operations even in small numbers. He cited the F–117 stealth fighter's performance in the Persian Gulf as such a "silver bullet."[49]

Congress made only minor cuts to the president's Defense budget request and put money back into continued production of the F–16 fighter, the *Seawolf*-class submarine, and other systems. The defense authorization conference committee looked for every opportunity to fund weapons production: "In each case, proponents of the chosen option cited a post–Cold War need for the particular weapon," noted the *Congressional Quarterly*. "Taken collectively, however, the decisions suggested that—in an election year with the economy in trouble and the defense industry contracting rapidly even under Bush's program—it was easier for the conferees to agree on ways to give out money than on ways to cut off money." The new approach, intended to give R&D priority over production, had met determined resistance.[50]

RETHINKING ACQUISITION REFORM

By the time it left office in January 1993, the George H. W. Bush administration, supported and sometimes prodded by Congress, had made numerous significant reforms to defense acquisition. The Defense Management Report, implementing the recommendations of the Packard Commission, had established a more streamlined acquisition organization clearly delineating the chain of command and the authority and responsibilities of various officials. Additionally, OSD had identified obstacles in the way of managing stable programs and had established policies and procedures intended to achieve stability, including the use of program baselines, milestone authorizations, and multiyear funding. OSD had also eliminated or combined redundant organizations, condensed the Defense Federal Acquisition Regulation Supplement, and revised the 5000 series documents that spelled out the new acquisition policies and procedures. Meanwhile, to bolster the quality of the workforce, the services had created specialized acquisition corps under pressure from OSD, and Congress had passed the Defense Acquisition Workforce Improvement Act, a dramatic overhaul of acquisition training and career management.[51]

These changes notwithstanding, acquisition did not appear to many to have made enough progress in correcting its long standing deficiencies. Major weapon system program scandals—mismanagement in the A–12 and corrupt practices in the C–17 (see chapter XI)—captured congressional and public attention. Reports and studies by government bodies and independent observers warned about what one called "the widely perceived crisis in defense acquisition." This alarm stemmed in part from continuing problems in the acquisition process. Program costs—and cost overruns—were still climbing; system cycle times, from conception to fielding, had grown to an average 16.5 years; and systems were often fielded with technology already obsolete by commercial standards. The General Accounting Office, after reviewing its own analyses of the acquisition system and weapon programs going back 15 years, concluded in December 1992 that major faults persisted in spite of numerous reform efforts. "Over the years," the report stated, "we have observed that, while a small number of systems reach the field as unqualified successes and a small number are canceled, most weapons reach the field but cost more, take longer, and are harder to produce and support than expected." The GAO found, for example, that technical problems and schedule stretchouts caused 32 programs it had reviewed to require an average of almost two years longer to field than planned, an increase of nearly 24 percent over their initial schedules. By 1992 development of the V–22 Osprey was three years behind schedule and the Tri-Service Standoff Attack Missile had fallen behind four years and was eventually canceled in 1994. The strategic Short-Range Attack Missile II had also been delayed four years by the time of its cancellation in 1991. Other systems encountered difficulties in production or in the field, where they performed poorly and failed to meet their stated requirements. Even when the weapons worked as intended, they often duplicated to a large degree existing systems or those being developed by other services.[52]

Behind the scenes some would have agreed with these negative assessments. A point paper that crossed the secretary's desk in summer 1992, unsigned but generated internally, said simply, "It's Broken." There was "no definition of or progress towards solving major impediments" to effective acquisition, and improvements were "only at the margin," it said. Furthermore, there was "no confidence among key players" that OSD truly intended to make the acquisition system "work." The paper painted a portrait of a dysfunctional top-level acquisition organization in OSD, citing a "We/They mentality," a lack of firm leadership that resulted in inconsistent and unreliable decisions, and a shortage of acquisition expertise.[53] Even the department's senior leadership, while publicly proclaiming all was at least almost well, were coming to the conclusion that the Packard Commission reforms were not sufficient. In 1992, with their blessing, a select five-member team of OSD staff led by Deputy Director for Cost Management Gary Christle developed a plan for radical overhaul of the Defense Department's acquisition organization based on the belief that too many management layers and parochial influences undermined weapon programs. The plan would have abolished the upper echelons of the service acquisition structures and assigned all program managers to a single organization under the authority of the under secretary for acquisition. Although completed in October 1992, the plan was shelved when Bush was defeated the next month.[54]

Why had reforms failed to take hold and prevent acquisition programs from getting into trouble? For Bush administration officials, the answer was reform had not been accompanied by effective enforcement of the rules and procedures governing the acquisition process. During its last two years in office, the Defense Department's leadership had focused on enforcing acquisition regulations and policies and demanding "realism" in planning and budgeting. Discipline—ensuring that everyone followed the rules—was what was needed to improve acquisition outcomes.[55]

By the end of the Bush administration, however, other analysts and critics had begun to point in an entirely different direction—to find the reasons for failure in systemic and cultural features of the acquisition system. One of the earliest of these analyses came from within the Pentagon itself. In his 1990 report on the A–12 program's collapse, Chester Paul Beach, the Navy's principal deputy general counsel, concluded that the existing acquisition culture, one not unique to the A–12 or to the Navy Department, encouraged participants to suppress information that might cast programs in a bad light. Changing the culture, not just demanding adherence to established procedures, would be required to address the acquisition system's problems (see chapter III).

In a 1991 study of cycle times prepared for the Defense Science Board's Acquisition Streamlining Task Force, the Logistics Management Institute identified systemic and cultural barriers to implementing acquisition reforms. Prominent among them were obstacles arising from the nature of the acquisition system itself, which tended to be compartmentalized and bureaucratic. The various participants—technical specialists and engineers, bookkeepers, managers, overseers, special advocates, and so on—worked in separate spheres with little direct connection to each other. This "stovepipe" system resisted attempts to integrate its various elements, the goal of many reform efforts. Cultural barriers to reform included the potential hostility or indifference of those involved in acquisition to reform goals and methods. Key personnel may have felt threatened by changes that could result in uncertainty and a loss of power or influence. Many acquisition officials and workers, especially at the lower levels, had no role in formulating reforms, had little stake in them, and lacked incentives to try new approaches.[56]

The General Accounting Office, highlighting the underlying cultural problem, also believed acquisition's ongoing difficulties were not attributable simply to lack of discipline but were pervasive, fundamental, and deeply embedded. The system functioned as it did because, in one way or other, it met the needs of all of its participants from the White House and Congress to production line workers. Participants acted out of self-interest, not necessarily for selfish personal reasons but in the parochial belief that what they were doing was in the national interest. For example, service warfare communities (e.g., submariners in the Navy, tankers in the Army, or fighter pilots in the Air Force) advocated systems reflecting their warfare specialty out of a sincere belief that the weapon system would be critical for the defense of the country. The acquisition process consisted of a constant jockeying among the participants, resulting in compromises that in the end usually satisfied everyone's basic needs and interests, regardless of whether it produced effective, timely, and cost-effective weapons.[57]

What skewed the process and made it so hard to reform, according to the General Accounting Office, were the incentives and rewards built into the system. Generally, an acquisition program was hailed as a success if it eventually fielded a weapon system, regardless of how long it took and how much it cost. Conversely, a program was deemed to be a failure if it was canceled prior to production and deployment. This widespread attitude exerted tremendous pressure on officials and organizations to act in subtle and not-so-subtle ways to ensure the survival of as many programs as possible. For example, it accounted for the tendency toward excessive optimism about the degree of a system's technological risk, its expected cost and capabilities, its operational suitability, and the availability of future funding for the program. As the A–12 scandal demonstrated, strong incentives existed for program advocates—including program managers whose careers might depend on the success of the project—to put the best possible face on a bad situation. As the program progressed through oversight reviews, each management level approving it became its de facto advocate as well, ensuring that bad news continued to be downplayed or hidden. Understanding this dynamic, program advocates used various techniques to manipulate the process, such as "buying in." In this way, the GAO stated, each program took on "a life of its own."[58]

In theory, OSD acted as a disinterested gatekeeper, evaluating programs with clarity and objectivity. Yet, as the General Accounting Office pointed out, the Pentagon's leadership faced pressures from the services, the White House, Congress, and industry that influenced its decision-making. Congress, for example, was particularly vulnerable to manipulative techniques such as "political engineering," the strategy of lining up subcontractors and dispensing contracts as early and as widely as possible to build political support for a program, even before the Defense Acquisition Board had approved production (see chapter IV and below). When OSD sought to terminate underperforming or unnecessary programs, as Cheney had tried to do, Congress would often overturn the decision, preferring to underfund two programs than fully fund only one. Conversely, the Pentagon sometimes continued programs questioned by Congress, which might signal its displeasure by demanding reports and other information, applying restrictions, and reducing funding. The results were not surprising. Programs were stretched out, production quantities reduced, and fielding dates delayed. Consequently, unit costs rose and total program costs mushroomed over the long term. Individual programs suffered instability, but that appeared to be the price for their survival. The GAO noted that despite the dramatic rise and decline of acquisition funding from 1977 to 1993, the overall number of programs remained relatively stable.[59]

The GAO identified other endemic problems, most of which were connected in some way to the struggle for programming self-preservation: parochialism in the requirements generation process; short tenures of acquisition system participants, with a resulting preference for short-term solutions to problems; the use of concurrency to rush programs into production, when they would become virtually unstoppable; resistance to constructing prototypes and to independent operational testing, both of which could reveal serious technical flaws in a system; and the tendency to begin more programs than could reasonably be funded over the long term. Various reform efforts had tried to tackle these problems separately through "management reforms," but they achieved only limited success because they were in effect only addressing the symptoms. They failed, or were unable, to deal with the root cultural problem, the problem of incentives and rewards, from which flowed all acquisition actions and results.[60]

Franklin C. Spinney. *(DoD)*

Other critics of defense acquisition rendered harsher, essentially polemical judgments that portrayed a politically and morally corrupt system. Franklin C. "Chuck" Spinney, an OSD analyst and outspoken advocate for reform throughout the 1980s, argued that the broader problems of acquisition policy, and indirectly many problems with the process, such as overly complex weapon systems, unstable budgets, and stretched-out programs, stemmed from the "defense power games" played by the Pentagon and the defense industry. The primary "power games" were "front-loading" and "political engineering." Front-loading was what Spinney called a form of bait and switch, in which advocates downplayed the future costs of a program in order to obtain sufficient funds to get it going. By presenting tempting but financially unrealistic acquisition plans, the Pentagon initiated and perpetuated a cycle of underfunding, cutbacks, and political pressure to feed the acquisition system at the expense of current operations and maintenance. Actions and reactions by the Defense Department and Congress reinforced each other to create a downward spiral of reduced readiness, slowing modernization, aging inventory, and a shrinking force size.[61]

Front-loading started the money flowing and caused the department to launch more programs than it could afford. Political engineering, however, locked the spigot open, according to Spinney. It linked the procurement of weapons to the wide distribution of jobs, making it extremely difficult to kill underperforming, overly expensive, or unnecessary programs—as Cheney had discovered. The B–2, for example, involved 3,000 contractors and 53,000 workers in 46 states and 383 congressional districts. The C–17 program was supplied by 2,000 vendors employing 20,000 workers in 44 states. When the Senate Committee on Armed Services supported Cheney's bid to halt production of the F–16, the aircraft's manufacturer, General Dynamics, distributed a "political atlas" of F–16 vendors, who numbered 3,216 in 47 states and 390 congressional districts (see figure 5-1). The atlas showed how much contract money went to each state and listed each district and the name of its representative, the number of vendors in that district, and the dollar value of their contracts.[62]

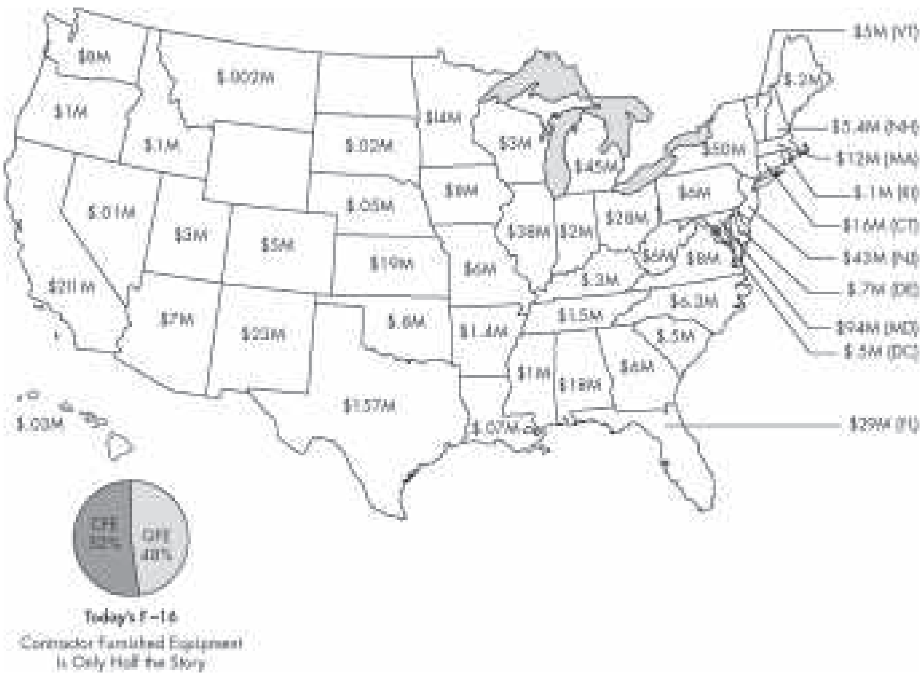
In 1993 a retired Air Force officer, Col. James G. Burton, published a severe indictment of the acquisition system based largely on his experience in operational testing of the Army's Bradley Fighting Vehicle and 14 years' service in the Pentagon. Burton described in detail the bureaucratic maneuvers, political battles, and manipulations of the acquisition process involving the Bradley. His account provided a concrete illustration of trends that the General Accounting Office described in the abstract, such as distrust, avoidance, and, when all else failed, the rigging of operational tests by the services. Like the GAO, Burton pointed to systemic faults in acquisition: "Because the incentives and rewards favor successful advocacy, there is seldom a serious attempt by the acquisition community to cancel its own programs." But for Burton, the system was also shot through with moral and ethical corruption. "All the legislation in the world," he wrote, "will not, in itself, reform the Pentagon. Congress cannot legislate integrity, character, and honesty."[63]


James G. Burton. *(Courtesy of James Burton)*

Although their assessments offered sometimes sharply different perspectives, critics of the acquisition system had one message in common. Achieving lasting change meant more than passing a few laws, fiddling with organization charts, and tweaking the process. Effective reform required an overhaul affecting not just organizational structure, procedures, and oversight, but the culture embedded in the system. Changing the culture demanded that tens of thousands of people—uniformed and civilian leaders and policymakers, industry executives and politicians, watchdogs and overseers, program managers and technicians, planners and bookkeepers—alter their individual and collective behavior. This behavioral modification would require training, ongoing education, and ready access to information concerning new ideas, approaches, and procedures. And it would call for measures to change the incentive structure, promote innovation, and lead toward the goal of buying quality products on time and within budget.

Figure 5-1: Political Atlas of the F–16 Falcon

GD/FW 1991 Purchases by Dollars (CFE)
($892M from 47 states)



GD/FW – General Dynamics/Fort Worth
CFE – Contractor Furnished Equipment
GFE – Government Furnished Equipment

Figure 5-1: Political Atlas of the F–16 Falcon *continued*

GD/FW 1991 Economic Impact, New York

Senators: Daniel Patrick Moynihan (D)
Alfonse M. D'Amato (R)

The $49,792,835 in General Dynamics, Fort Worth, purchases was divided among the 34 New York congressional districts as indicated.

DISTRICT	REPRESENTATIVE	NO. OF VENDORS	DOLLARS
1	George J. Hochbrueckner (D)	11	1,793,734
2	Thomas J. Downey (D)	25	12,903,880
3	Robert J. Mrazek (D)	10	4,506,618
4	Norman F. Lent (R)	17	5,471,575
5	Raymond J. McGrath (R)	3	905,344
6	Floyd H. Flake (D)	–	–
7	Gary L. Ackerman (D)	–	–
8	James H. Scheuer (D)	3	29,302
9	Thomas J. Manton (D)	4	434,598
10	Charles E. Schumer (D)	1	783
11	Edolphus Towns (D)	1	444
12	Major R. Owens (D)	–	–
13	Stephen J. Solarz (D)	1	3,024
14	Susan Molinari (R)	–	–
15	Bill Green (R)	1	803,184
16	Charles B. Rangel (D)	–	–
17	Ted Weiss (D)	3	13,054,566
18	Jose Serrano (D)	–	–
19	Eliot Engel (D)	–	–
20	Nita M. Lowey (D)	10	1,119,621
21	Hamilton Fish Jr. (R)	4	907,121
22	Benjamin A. Gilman (R)	2	47,475
23	Michael R. McNulty (D)	1	15,382
24	Gerald B.H. Solomon (R)	2	116,400
25	Sherwood L. Boehlert (R)	5	2,425,201
26	David O'B. Martin (R)	3	12,016
27	James T. Walsh (R)	5	266,166
28	Matthew F. McHugh (D)	10	902,343
29	Frank Horton (R)	2	4,749
30	Louise McIntosh Slaughter (D)	2	15,111
31	Bill Paxon (R)	7	1,293,304
32	John J. LaFalce (D)	7	439,102
33	Henry J. Nowak (D)	5	2,800,714
34	Amo Houghton (R)	3	131,078
	TOTAL	148	49,792,835

Source: Adapted from Franklin Spinney, "Anatomy of Decline," briefing, 27 Jan 1996, pt. 1, sec. C, slides 12, 14, copy in author files, OSD/HO.

* * * * *

The rapid and successful fielding during the Gulf War of advanced technology systems still under development reinforced thinking then underway about the relationship between R&D and production—R&D should be viewed primarily as a product with its own inherent value rather than as a step in the traditional process of producing systems in quantity. Such a conception provided support for Secretary Cheney's decision to favor technology development in the form of advanced technology demonstrations and prototypes over production. However, with its focus on efficiency and budget reduction, this approach to acquisition overlooked political realities and longer-term ramifications, such as maintaining the ability of the industrial base to produce weapons in the future. Ultimately, the Pentagon leadership's misjudgments about the importance of politics in an election year led to the defeat of the new approach. Moreover, despite the substantial changes resulting from the Defense Management Report, critics argued that the Cheney Defense Department was leaving acquisition in no better, if not worse, shape than it had been when the Bush administration took office. Program costs were still too high, acquisition cycles too long, and performance frequently falling short of expectations. In their view, the department's emphasis on greater discipline—demanding more effective enforcement of the rules and procedures governing acquisition—was a wrongheaded approach to correcting the system's deficiencies. Their solution was to fundamentally change acquisition's culture. Rather than rewarding program continuation for the sake of its stakeholders, they argued for policymakers to design incentives that would value program effectiveness.

Endnotes

1. Memo, Yockey for distribution, 23 Aug 1990, subj: Support for Operation Desert Shield, box 8, Acc 330-94-0006, OSD Records, WNRC; memo, DirAP&PI for USD(A), 10 Oct 1990, attached to ibid.

2. Memo, DepDDR&E(TWP) for DepSecDef, 10 May 1991, subj: Defense Science Board Task Force on Desert Shield Technology, box 3, Acc 330-94-0007, OSD Records, WNRC; memo, Yockey for Chairman, Defense Science Board, 17 Oct 1990, subj: Terms of Reference—Defense Science Board Task Force on High Leverage Technology Support for Operation Desert Shield, attached to ibid.

3. John E. Longhouser, OUSD(A), memo for record, 10 Aug 1990, subj: SAE Meeting Minutes, attached to routing slip, Col. Philip W. Bruce, USAF, Senior MilAsst to PDUSD(A), to Gene Porter, OUSD(A), Acquisition Policy and Program Integration (AP&PI), 20 Aug 1990, box 3, Acc 330-96-0008, OSD Records, WNRC; Joanne S. Schoonover, *Accelerated Air Force Acquisition Processes: Lessons Learned from Desert Storm*, Air University Research Report AU-ARI-92-11 (Maxwell Air Force Base [AFB], AL: Air University Press, Aug 1994), 12–15; Michael G. Anderson, *The Air Force Rapid Response Process: Streamlined Acquisition during Operations Desert Shield and Desert Storm*, Project AIR FORCE Analysis of the Air War in the Gulf, RAND Note N-3610/3-AF (Santa Monica, CA: RAND, 1992), 3–8, 10.

4. Schoonover, *Lessons Learned From Desert Storm*, 15, 17–29.

5. DoD, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, DC: DoD, Apr 1992), 738–739. Under Secretary of Defense for Policy Paul Wolfowitz oversaw preparation of DoD's

official report on the Gulf War. Directed by his deputy, I. Lewis "Scooter" Libby, the yearlong effort involved hundreds of individuals.

6. Kenneth P. Werrell, *Chasing the Silver Bullet: U.S. Air Force Weapons Development from Vietnam to Desert Storm* (Washington, DC: Smithsonian Books, 2003), 239. Originally designed to be an antiaircraft weapon, the Patriot system received a limited antiballistic missile capability in 1988. With respect to its actual performance during the Gulf War, the Patriots hit very few—and possibly no—incoming Scuds, which tended to break up on their own in flight. For the debate over the effectiveness of the Patriot missiles, see GAO, *Operation Desert Storm: Project Manager's Assessment of Patriot Missile's Overall Performance Is Not Supported*, GAO/T-NSIAD-92-27 (7 Apr 1992); GAO, *Operation Desert Storm: Data Does Not Exist to Conclusively Say How Well Patriot Performed*, GAO/NSIAD-92-340 (Sep 1992); GAO, *Postol's Video Analysis*, GAO/NSIAD-93-22R (Sep 1992); "Postol/Lewis Review of Army's Study on Patriot Effectiveness," *Inside the Army*, 5 Oct 1992, 10–12; Steven Hildreth, "Evaluation of U.S. Army Assessment of Patriot Antitactical Missile Effectiveness in the War Against Iraq," prepared for the House Government Operations Subcommittee on Legislation and National Security by CRS, 7 Apr 1992; Frank N. Schubert and Theresa L. Kraus, eds., *The Whirlwind War: The United States Army in Operations DESERT SHIELD and DESERT STORM* (Washington, DC: CMH, 1995), app. A, 238; Jeremiah D. Sullivan et al., "Technical Debate over Patriot Performance in the Gulf War," *Science & Global Security* 8, no. 1 (1999): 40–97; Robert M. Stein, John P. Kantelis, and Peter D. Zimmerman, "Response to *Science & Global Security* Article 'Technical Debate over Patriot Performance in the Gulf War,'" *Science & Global Security* 8, no. 2 (1999): 218–260.

7. Werrell, *Chasing the Silver Bullet*, 263–264.

8. Ibid., 262–264; Hallion, *Storm Over Iraq*, 233, 297; Schoonover, *Lessons Learned from Desert Storm*, 32–34; Barry Miller, "GPS Proves Its Worth in Operation Desert Storm," *Armed Forces Journal International* 128, no. 16 (Apr 1991): 16–20; Stephen A. Bourque, *Jayhawk! The VII Corps in the Persian Gulf War* (Washington, DC: Department of the Army, 2002), 96, 373; DoD, *Conduct of the Persian Gulf War*, 569–570. Werrell states that by the end of the war the U.S. military had 4,500 commercial and 840 military GPS receivers, and the coalition allies possessed 2,000. See Werrell, *Chasing the Silver Bullet*, 263. Hallion gives the figure 10,000. See Hallion, *Storm Over Iraq*, 313.

9. Hallion, *Storm Over Iraq*, 310–311; Charles D. Lloyd, "A Technological Success Story: Joint STARS and Operation Desert Storm," *Air Power History* 38 (Fall 1991): 28–32; Schoonover, *Lessons Learned from Desert Storm*, 29; U.S. News and World Report, *Triumph Without Victory*, 347. With the creation of the post of under secretary of defense for acquisition in 1986, the position of under secretary of defense for research and engineering reverted to its former title, director of defense research and engineering, with its occupant reporting to the under secretary of defense for acquisition.

10. Werrell, *Chasing the Silver Bullet*, 255–256; Leonard J. Samborowski, "The Joint Surveillance Target Attack Radar System: Can Procedures Be Developed to Support the Requirements of the Land and Air Component Commanders?" (Master of Military Art and Science thesis, U.S. Army Command and General Staff College, 1992), 4; SCA, *Department of Defense Appropriations Bill, 1990: Report [to accompany H.R. 3072],* 101st Cong., 1st sess., 14 Sep 1989, S. Rep. 101-132, 282–283.

11. Martin S. Kleiner, "Joint STARS Goes to War," *Field Artillery*, HQDA PB6-92-1 (Feb 1992): 25; Lloyd, "Joint STARS," 31–32; Samborowski, "Joint Surveillance Target Attack Radar System," 4–5; Tom Clancy, with General Fred Franks Jr., *Into the Storm: A Study in Command* (New York: G. P. Putnam's Sons, 1997), 169; HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1993: Hearings*, 102d Cong., 2d sess., 4 Mar 1992, pt. 1:536 (quote); U.S. News and World Report, *Triumph Without Victory*, 347–348. Werrell argues that pressure from Army Chief of Staff Carl E. Vuono and Congress also played a role in the decision to deploy JSTARS. See Werrell, *Chasing the Silver Bullet*, 256.

12. HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1993: Hearings*, 4 Mar 1992, pt. 1:536 (quote).

13. Kleiner, "Joint STARS," 26–27; Joris Janssen Lok, "J-STARS Gulf Role Detailed," *Jane's Defence Weekly* 15 (29 Jun 1991), 1169; Lloyd, "Joint STARS," 32; Peter Grier, "Joint STARS Does Its Stuff," *Air Force Magazine* 74, no. 6 (Jun 1991), www.airforcemag.com/MagazineArchive/

Pages/1991/June%201991/0691stars.aspx, accessed 27 Aug 2014; Schoonover, *Lessons Learned from Desert Storm*, 30–32.

14. Kleiner, "JSTARS," 27–29; Lloyd, "Joint STARS," 32–34; Hallion, *Storm Over Iraq*, 220–221; Werrell, *Chasing the Silver Bullet*, 257–258 (quote); U.S. News and World Report, *Triumph Without Victory*, 348–349; DoD, *Conduct of the Persian Gulf War*, 710–711. For a detailed description of JSTARS operations, see Samborowski, "Joint Surveillance Target Attack Radar System," 73–110.

15. Carlo Kopp, "Raytheon/Texas Instruments GBU–28 Bunker Buster," Technical Report APA-TR-2005-0501, updated Apr 2012, *Air Power Australia*, www.ausairpower.net/GBU-28.html, accessed 27 Aug 2014.

16. Ibid.; Schoonover, *Lessons Learned from Desert Storm*, 43–44; "How TTR Helped the Air Force Ready a New Bomb," *Sandia Lab News*, 26 Jul 1991, www.serve.com/mahood/nellis/ttr/sln4.htm, accessed 27 Aug 2014.

17. Kopp, "GBU–28."

18. James D. Evans, "Air Force Buys Support," *The Military Engineer* 83 (Nov-Dec 1991): 28–29.

19. Larry Doton, "Integrating Technology to Reduce Fratricide," *Acquisition Review Quarterly* 3 (Winter 1996): 10–11; Bradford G. Washabaugh, "Friendly Fire: Time for Action," *Marine Corps Gazette* 76, no. 9 (Sep 1992): 37–39.

20. Schoonover, *Lessons Learned From Desert Storm*, 25–26, 31, 59, 60; DoD, Acquisition Law Advisory Panel, *Streamlining Defense Acquisition Laws: Report . . . to the United States Congress* (Washington, DC: DoD, Jan 1993), I-6.

21. Memo, Yockey for Atwood, 16 Jan 1991, subj: DESERT SHIELD Battle Damage Assessment (quote), box 1; memo, Atwood for Service Secretaries, 31 Jan 1991, subj: Operations DESERT STORM and DESERT SHIELD Technical Performance Assessments, attached to ibid.; memo, Yockey for Service Secretaries, 12 Feb 1991, subj: Operations DESERT STORM and DESERT SHIELD Technical Performance Assessments, box 1; memo, Acting USD(A) Colin McMillan for Atwood, 2 Jul 1991, subj: Operations Desert Shield and Desert Storm Technical Databases, box 5: all in Acc 330-94-0007; memo, Yockey for Atwood, 9 Sep 1992, subj: DESERT SHIELD/STORM Technical Performance Assessments, box 7, Acc 330-95-0057, OSD Records, WNRC.

22. Air Force Instruction 63-14 (Rapid Response Process), 5 May 1994.

23. Donna Cassata, "Aspin Calls for Delays in Some High-Tech Weapons," *Associated Press*, 18 Jan 1990 ("develop and buy" and "real research and development"), AP News Archive, www.apnewsarchive.com/1990/Aspin-Calls-for-Delays-in-Some-High-Tech-Weapons/id-98a3dbfafdc812ba1e4fb5248c0bdb2f, accessed 27 Aug 2014; ltr, Theodore S. Gold and Richard L. Wagner to Capt. Jerry Murphy, OUSD(A), 1 Feb 1990 ("but not deploy"), attached to memo, Christie for DDR&E, 19 Mar 1990, subj: Technical Seminar, box 1, Acc 330-96-0008.

24. Ted Gold and Rich Wagner, "Long Shadow and Virtual Swords: Managing Defense Resources in the Changing Security Environment," Jan 1990, printed in SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1991: Hearings . . . on S. 2884*, 101st Cong., 2d sess., 17 May 1990, S. Hrg. 101-986, pt. 1:1216–1228 (1223, quote).

25. Ashton B. Carter and William J. Perry, *New Thinking and American Defense Technology,* Report of the Carnegie Commission on Science, Technology, and Government, Task Force on National Security (New York: The Commission, 1990), 13 (quote), 21.

26. Paul H. Richanbach et al., *The Future of Military R&D: Towards a Flexible Acquisition Strategy*, IDA Paper P-2444 (Alexandria, VA: IDA, Jul 1990), 3–4 ("filters and valves," "technology and acquisition options"), 16 ("old argument against prototyping"); John E. Krings, "Just-In-Time Weapons," n.d., printed in SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1991: Hearings . . . on S. 2884*, 17 May 1990, pt. 1:1230–1231.

27. Defense Science Board, *Research & Development Strategy for the 1990s, Executive Summary of Defense Science Board 1990 Study* (Washington, DC: OSD, Oct 1990), 16, 39–42, https://dsb.cto.mil/reports/1990s/R&D-STRATEGYforthe1990S-EXECUTIVESUMMARY-FOUO.pdf, accessed 29 Mar 2021. A "brassboard configuration" was defined officially as "an experimental device . . . used

to determine feasibility and to develop technical and operational data. It normally will be a model sufficiently hardened for use outside of laboratory environments to demonstrate the technical and operational principles of immediate interest. It may resemble the end item, but is not intended for use as the end item." See Acquisition Policy Department, DSMC, *Glossary: Defense Acquisition Acronyms and Terms*, 5th ed. (Fort Belvoir, VA: DSMC, Sep 1991), B-10.

28. HCAS, Defense Policy Panel, *Building a Defense That Works for the Post-Cold War World: Hearings*, 101st Cong., 2d sess., 21 Mar 1990, HASC No. 101-83, 199–200 (Aspin quote); Perry's prepared statement for the HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement,* 30 Apr 1992, 357 (quote). For Perry's support of prototyping, see Packard Commission, *Quest For Excellence*, 50–51, 55–57; ltr, Perry and David Packard, to Cheney, 3 Apr 1989, folder 400.14, box 75, Acc 330-91-0095, OSD Records, WNRC; Carter and Perry, *New Thinking*, 23.

29. SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1991: Hearings . . . on S. 2884*, 24 May 1990, pt. 1:1253–1254 (quote, 1253). See also HCAS, Procurement of Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006* . . . , 30 Apr 1992, 357–358.

30. "Scenario for 'Rollover' Discussions," unpublished paper attached to memo, Col. Royle P. Carrington III, OUSD(A) Acquisition Planning, for Gene Porter, OUSD(A), AP&PI, 26 Sep 1990, subj: "Rollover" Paper, box 3, Acc 330-96-0008; Aspin, "Tomorrow's Defense From Today's Industrial Base: Finding the Right Resource Strategy for a New Era" (paper presented to the American Defense Preparedness Association, Washington, DC, 12 Feb 1992), 15–17; U.S. Congress, Office of Technology Assessment [OTA], *Building Future Security: Strategies for Restructuring the Defense Technology and Industrial Base*, OTA-ISC-530 (Washington, DC: GPO, Jun 1992), 51–75. For "hover," see Charles B. Cochrane, "DoD's New Acquisition Approach," *Program Manager* 21, no. 4 (Jul–Aug 1992): 39–40.

31. Memo, Christie for DDR&E, 19 Mar 1990, subj: Technical Seminar; memo, Gene Porter, Principal Deputy AP&PI, for Christie, 20 Jul 1990, subj: IDA Acquisition Policy Paper, box 2; memo, Porter for Carrington, 3 Oct 1990, subj: Re: Rollover, with attachments, box 3: both in Acc 330-96-0008; "RDT&E Trends," 25 Feb 1992, folder 400.112, box 60, Acc 330-95-0014, OSD Records, WNRC. Although a departure from the Cold War approach to acquiring weapons, the emphasis on R&D over production was not unprecedented. Between World War II and the Korean War, the Army, flush with a large inventory of new weapons and facing slashes in procurement funding, concentrated on R&D of advanced subsystems and components." See Converse, *Rearming for the Cold War*, 152.

32. "Technology Base Programs/DARPA," in HCAS, Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Research, Development, Test, and Evaluation*, 102d Cong., 2d sess., 1 Apr 1992, HASC No. 102-44, 267 (quotes); "RDT&E Trends," 25 Feb 1992; Carter and Perry, *New Thinking*, 19–21; memo, Atwood for Service Secretaries, 12 Aug 1991, subj: Strengthening Technology and Acquisition Functions, box 2, DepSecDef Signer's Copies 1991, Acc 330-93-0002, OSD Records, WNRC; DSB, *Research & Development Strategy for the 1990s*, 1:22–25.

33. HCAS, Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Research, Development, Test, and Evaluation*, 1 Apr 1992, 267–271.

34. SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1991: Hearings . . . on H.R. 5803/S. 3189*, 101st Cong., 2d sess., 20 Feb 1990, S. Hrg. 101-936, pt. 1:54, 82–83; "Atwood: 'Dead Periods' Ahead for Some Weapon Production Lines," *Aerospace Daily*, 28 Dec 1989, 487. See also chapter XIV in this volume.

35. Cheney, *Defense Management*, 18–19; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 5, secs. C and D; memo, John Christie, Director AP&PI, for USD(A) Don Yockey, 22 Jan 1992, subj: Acquisition Initiative Definitions, attached to memo, Col. Michael C. Mushala, MilAsst to USD(A), for Col. John Rhodes, MilDep to

DepSecDef, 24 Jan 1992, subj: Definitions Used in the Acquisition Initiative, folder 400.13, box 60, Acc 330-95-0014; James Kitfield, "Conventional Wisdom Revisited," *Government Executive* 23 (Aug 1991): 19–21; DSB, *Research & Development Strategy for the 1990s*, 1:39–40.

36. "A New Approach to Defense Acquisition," paper attached to memo, Atwood for Cheney, 22 Jan 1992, subj: Explanation of the New Approach to Defense Acquisition, folder 400.112, box 60, Acc 330-95-0014; OASD (PA) Press Release 26-92, "DoD to Slow Pace of Modernization, Cut Strategic Nuclear Arsenal While Maintaining Essential Forces," n.d., 2–4; Cheney, Atwood, and Powell, press briefing, Pentagon, 29 Jan 1992, *Cheney Public Statements 1992–1993*, 1:159, 160, 161–162, 166–167; SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearings . . . on S. 3114*, 102d Cong., 2d sess., 31 Jan 1992, S. Hrg. 102-833, pt. 1:42.

37. Robert Atwood, testimony before the SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1993: Hearings*, 102d Cong., 2d sess., 25 Feb 1992, S. Hrg. 102-636, pt. 1:20 (quote).

38. HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006 . . . on Authorization and Oversight,* 102d Cong., 2d sess., HASC No. 102-41, 55–57; SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1993: Hearings*, 25 Feb 1992, pt. 1:42–43, 54–57; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8.

39. HCAS, Procurement and Military Nuclear Systems Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . .* , 28 Apr 1992, HASC 102-42, 143–209; "Impact of the Defense Build-Down on the Ability of the U.S. Industrial and Technology Base to Meet National Security Requirements," in SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearing . . . on S. 3114*, pt. 5: *Defense Industry and Technology*, 4 Jun 1992, 476–483; "Defense Acquisition," "Defense Industrial Base," "Defense Science and Technology Strategy," and "Science and Technology Management and Oversight," DoD white papers, attached to memo, USD(A) Donald Yockey for Secretaries of Military Departments et al., 20 May 1992, subj: Defense Acquisition, box 4, Acc 330-95-0057.

40. Text of speech by USD(A) Don Yockey to Aerospace Industries Association (AIA) Board of Governors Meeting, Williamsburg, VA, 21 May 1992 (quotes), attachment D to memo, Yockey for SecDef, 21 May 1992, subj: *Wall Street Journal* Article (May 21), folder 400.13, box 60, Acc 330-95-0014.

41. "Defense Science and Technology Strategy" and "Science and Technology Management and Oversight," DoD white papers; "A Revised Approach to Defense Acquisition," draft white paper, 3–7, attached to DUSD(A) Donald Fraser, memo for distribution, 4 Mar 1992, box 2, Acc 330-95-0057; Director of Defense Research and Engineering, *Defense Science and Technology Strategy* (Washington, DC: DoD, Jul 1992), sec. I, 8–19; DDR&E Victor H. Reis, testimony before the HCAS, Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Research, Development, Test, and Evaluation*, 1 Apr 1992, 271–272.

42. Atwood, written statement before the HCAS Subcommittees on Research and Development and Procurement, 28 Apr 1992, 8–10, copy attached to memo, Yockey for SecDef, 21 May 1992; "A Revised Approach to Defense Acquisition," draft white paper, 7–10; unsigned paper, "Issues & Clarifications: Revised Acquisition [Approach] to Defense Acquisition," 4–5, attached to memo, Col. John E. Rhodes for DUSD(A), 20 Apr 1992, filed under 31 Mar 1992, folder 400.13, box 60, Acc 330-95-0014; SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and Future Years Defense Program: Hearings . . . on S. 3114,* 4 Jun 1992, pt. 5:481.

43. Cheney, Atwood, and Powell, press briefing, 29 Jan 1992, *Cheney Public Statements 1992–1993*, 1:160, 167 (Cheney quotes); "New Strategy Calls for Longer Development Time," *Defense Week*, 6 Apr 1992, 1; memo, Director AP&PI John Christie for the USD(A), 22 Jan 1992, subj: Acquisition Initiative Definitions, attached to buckslip, Col. Michael A. Mushala, Military Attache, to the USD(A), to Colonel Rhodes, MilAsst to DepSecDef, 24 Jan 1992, subj: Definitions Used in the Acquisition Initiative, folder 400.13, box 60, Acc 330-95-0014; Stephen C. LeSueur, "DoD's Buying Regulations to Remain in Place under New Acquisition Strategy," *Inside the Pentagon*, 8, no. 15 (9 Apr 1992): 1, 6–7; Andrew Weinschenk, "Pentagon Acquisition Policy: Round and Round It Goes," *Defense Week*, 27 Apr 1992, 3; "Issues & Clarifications," attached to memo, Rhodes for DUSD(A), 20 Apr 1992, 1–2 (quote);

Kevin A. Moss, "Changing the Acquisition Process for a New World Order," Executive Research Project S58 (Washington, DC: Industrial College of the Armed Forces, NDU, 1993), 13.

44. Proposed SecDef responses to *Wall Street Journal* assertions, attached to memo, Yockey for SecDef, 21 May 1992; Yockey speech to AIA Board of Governors, 7, attached to ibid.; draft of portion of Atwood testimony attached to memo, Gene Porter for Yockey, 23 Apr 1992, subj: DepSecDef Testimony, folder 4000.13, box 60, Acc 330-95-0014.

45. Melissa Healy, "Pentagon to Call for Freeze on New Arms Production," *Los Angeles Times*, 23 Jan 1992, 1; Richard W. Stevenson, "Arms Makers Criticize Plan that Puts Focus on Research," *New York Times*, 24 Jan 1992, A1; "DBP: Pentagon's 'Fly but Wait to Buy' Strategy 'a Disaster,'" *Aerospace Daily*, 28 Jan 1992, 5; Bruce B. Auster, with Tim Zimmermann, "The Pentagon's Big Gamble," *U.S. News and World Report*, 10 Feb 1992, 31; Graham Warwick, "Prototyping Pitfalls," *Flight International*, 18 Feb 1992, 9; "Industry Officials Call DoD's Industrial Base Forecast Unrealistic," *Defense Daily*, 6 Mar 1992, 9; Charlotte Adams, "DoD's Acquisition Policy Ignites Fears in Industry," *Military & Aerospace Electronics* 3, no. 3 (Mar/Apr 1992): 22; David Silverberg, "Atwood Rebuts Industry Concerns Over Buying Strategy," *Defense News*, May 1992: all in author files, OSD/HO; ltr, James R. Hogg, President National Security Industrial Association, to Yockey, 20 Aug 1992, attached to ltr, DUSD(A) Fraser to Hogg, 8 Oct 1992, box 7, Acc 330-95-0057; Charles W. Sieber, "Industry Responses to the New DoD Technology and Acquisition Approach," Executive Research Project RS5 (Washington, DC: Industrial College of the Armed Forces, NDU, Apr 1993), 7–12; Roger E. Tetrault, statement in "Submarine and Nuclear Propulsion Industrial Base," SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearing . . . on S. 3114*, 1 Apr 1992, pt. 1:448–463 (quote, 450).

46. "Acquisition Plans and Policies and the Impact on the Industrial Base," in SCAS, Subcommittee on Conventional Forces and Alliance Defense, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program . . . on S. 3114,* pt. 4: *Conventional Forces and Alliance Defense*, 3 Apr 1992, 11 ("hands of the soldier"); Frank Varnado, "The Effects on Weapon Systems' Producibility of Suspending System Development After Advanced Technology Demonstration" (master's thesis, Naval Postgraduate School, Mar 1993), 20 (Conver, "technological superiority is necessary").

47. "New Acquisition Strategy Really a Retread – Senators," *Defense Daily*, 6 Apr 1992, 33 (quote); Andy Pasztor, "Arms Purchase Policy Changes Appear Stalled," *Wall Street Journal*, 21 May 1992, A14; SCAS, Subcommittee on Conventional Forces and Alliance Defense, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program . . . on S. 3114,* pt. 4:3, 4 (quotes); SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearings . . . on S. 3114*, pt. 1:399–400; memo for record, 21 Feb 1992, subj: SAC Staff Questions on Acquisition Strategy, folder 400.13, box 60, Acc 330-95-0014; HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1993: Hearings*, pt. 6:272–273.

48. SCA Subcommittee, *Department of Defense Appropriations for Fiscal Year 1993: Hearings,* 25 Feb 1992, pt. 1:29 (quote); Pamela Fessler, "Economic Reality May Limit Hill's Urge to Outcut Bush," *CQ Weekly Report* 50 (1 Feb 1992): 253.

49. "Aspin Plan Backs Arms Production," *CQ Weekly Report* 50 (15 Feb 1992): 359; Aspin, *Tomorrow's Defense*, 13–18. For analyses of Aspin's plan, see Roy W. L'Heureux, "The Aspin Plan: A Resource Allocation Strategy for Today," USAWC Military Studies Program paper (Carlisle, PA: U.S. Army War College, 15 Apr 1993), and Alan T. Nacke, "Analysis of 'Rollover-Plus': An Acquisition Strategy Undefined," research report (Maxwell Air Force Base, AL: Air War College, Air University, Apr 1994).

50. *CQ Almanac 1992*, 483, 492.

51. GAO, *Weapons Acquisition: A Rare Opportunity for Lasting Change*, GAO/NSIAD-93-15 (Dec 1992), 13–14, 27, 58, 67–68; memo, Yockey and ASD(PA&E) David Chu for SecDef, 12 Jan 1993, subj: GAO Report on Weapons Acquisition, folder 12 Jan 1993, box 1, Acc 330-97-0030, OSD Records, WNRC. See also, Frederick P. Biery, "The Effectiveness of Weapon Acquisition Reform Efforts," *Journal of Policy Analysis and Management* 11, no. 4 (Fall 1992): 644.

52. Carter and Perry, *New Thinking*, 13 ("widely perceived crisis"); Jacques S. Gansler, *Defense Conversion: Transforming the Arsenal of Democracy* (Cambridge, MA: MIT Press, 1995), 9–10; GAO, *Weapons Acquisition*, 15–34, 60 (quote), 74–75. The Logistics Management Institute, in a report prepared for the Defense Science Board's Acquisition Streamlining Task Force, which OSD chartered in 1990, reviewed 150 acquisition programs initiated between 1943 and 1983, and found that programs initiated in the 1940s and 1950s generally took six years to develop, those initiated in the 1960s about seven years, and those begun in the 1970s and 1980s eight years. The average cycle time was increasing at an annual rate of 1.2 percent per year. For some types of systems, the rate was growing much faster. While the time required for developing new missiles was growing 1.3 percent per year, the time for modifying existing missile systems was increasing at 5.5 percent per year—doubling every 13 years. See Myron G. Myers et al., *Acquisition Streamlining: Barriers to Implementation of Prior Recommendations; A Report to the Defense Science Board's Acquisition Streamlining Task Force*, vol. 1, Report RE001R1 (Bethesda, MD: Logistics Management Institute, Jan 1991), 3-1–3-5, 4-1–4-7.

53. Point paper, "Acquisition Reform," date-stamped 3 Aug 1992 (but filed under Sep 1992), folder 400.13, box 60, Acc 330-95-0014. The point paper cited "Don and David" as the key offenders; the context suggests Under Secretary Yockey and Assistant Secretary of Defense for Program Analysis and Evaluation David Chu.

54. Gary Christle, interview by members of Defense Acquisition History Project, 21 May 2008, 19–21, CMH, Fort Lesley J. McNair, DC; *Defense Acquisition: Consolidating Defense Acquisition Organizations & Functions*, ver. of 20 Nov 1992, copy in author files. Christle stated that the study was completed in October but postdated to November. That Under Secretary Yockey would approve such a plan is curious given that OSD had long opposed the centralization of acquisition on the grounds it would further separate the acquirers from the users. Just that February, Yockey had objected to a bill introduced by Sen. William V. Roth (R-DE) that would have created just such an organization within the under secretary's office. See memo, Yockey for Atwood, subj: Roth Bill, S. 2057, to Establish a Central Acquisition Agency, folder 3 Feb 1992, box 1, Acc 330-95-0057.

55. GAO, *Weapons Acquisition*, 13; DoD IG, *Advisory Report on Major Weapon System Acquisitions*, Audit Report 92-047, (Washington, DC: DoD, 14 Feb 1992), and chap. III in this volume.

56. Myers et al., *Acquisition Streamlining*, vol. 1, chaps. 4–5.

57. The GAO defined the "acquisition culture" as "the collective behavior of the various participants in the acquisition process . . . and the forces that motivate their behavior." GAO, *Weapons Acquisition*, 35.

58. Ibid., 35–39, 45–47 ("life of its own," 46).

59. Ibid., 38–40.

60. Ibid., 21–27, 38, 41–44, 51–57. See also Burton, *Pentagon Wars*, 111–115.

61. Franklin C. Spinney, *Defense Power Games* (Washington, DC: Fund for Constitutional Government, Oct 1990), 7–9, 36. For more on the defense power games, see Spinney's briefing, "Anatomy of Decline," 27 Jan 1996, copy in author files.

62. Spinney, *Defense Power Games*, 7; Spinney, "Anatomy of Decline," pt. 1, sec. C, slides 10–15. See also GAO, *Weapons Acquisition*, 45–47.

63. Burton, *Pentagon Wars*, 8, 66–67, 111 ("seldom an attempt"), 112, 170, 238 ("All the legislation in the world").

I. HCAS, Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Research, Development, Test, and Evaluation*, 1 Apr 1992, 267–271.

CHAPTER VI

The Clinton Administration, Congress, and Acquisition Reform, 1993–1997

As the Clinton administration prepared to take office in January 1993, critics from within and outside government continued to express dissatisfaction with defense acquisition. Although previous reform efforts sought to correct some problems, weapon system program outcomes stubbornly refused to improve. Unit costs continued to rise, cycle times to lengthen, and faulty systems to progress through the acquisition pipeline until it was almost too late to do anything about them. The uncertain nature of the emerging international order, the steady reductions in the Defense budget, especially in procurement appropriations, and the drawdown in force structure added a sense of urgency to addressing acquisition's problems. Defense leaders saw reform as necessary so the system could continue producing the advanced weapons that had afforded the United States a technological edge over its opponents since the late 1940s. Reform impulses would come from three sources: the Defense Department, the White House, and Congress. While these initiatives differed in some respects, all shared the view that an entirely new approach to the problem was required, one directed at acquisition's perceived systemic and cultural weaknesses.

PENTAGON ACQUISITION LEADERSHIP AND REFORM AGENDA

DoD's new leaders, Secretary of Defense Les Aspin and Deputy Secretary William Perry, had strong backgrounds in defense acquisition, especially technology development. As chairman of the House Armed Services Committee, Aspin had spent much time with acquisition issues, authorizing and monitoring individual weapon system programs. From this experience, he had developed a "comprehensive resource strategy" intended to guide the Defense Department's acquisition program, especially in promoting the use of high-technology systems, such as the precision-guided munitions that had been so effective during the Persian Gulf War. When he became secretary of defense, however, Aspin relied on Bill Perry to lead the department's acquisition reform program.

William Perry, deputy secretary of defense, 1993–1994; secretary of defense, 1994–1997. *(OSD/HO)*

William J. Perry

If anyone was prepared to initiate and direct acquisition reform it was Bill Perry. When he became deputy secretary of defense in March 1993, four decades of experience with defense weaponry in both the private sector and in government had readied him for the task.

Born in 1927 in Vandergrift, Pennsylvania, Perry served in the Army Corps of Engineers after World War II and then attended Stanford University where he received B.S. and M.S. degrees in mathematics. In 1954 he went to work for Sylvania/GTE, rising to be director of its Electronic Defense Laboratories and earning a doctorate in mathematics from Pennsylvania State University. Ten years later Perry went out on his own, founding and leading ESL Incorporated, an electronics firm. In 1977 he entered government service as director of defense research and engineering (later an under secretary position), where he managed DoD weapon system R&D and procurement, formulated the "offset strategy" that relied on advanced technologies to counter the Soviet Union's numerical advantage in weaponry, and promoted the development of stealth aircraft technology. With the end of his term in the Pentagon in 1981, Perry returned to the private sector to be executive vice president of Hambrecht and Quist, an investment banking firm specializing in high-technology companies, and then, in 1985, chairman and CEO of another California-based firm, Technology Strategies and Alliances. During these years he was also a part-time member of the Stanford faculty and a leading advocate of comprehensive acquisition reform, first as a member of the Packard Commission and then as a member of the Carnegie Commission on Science, Technology, and Government.

When Les Aspin resigned in February 1994, Perry became secretary of defense, holding the post through the end of Clinton's first term. He then returned to California and rejoined the Stanford faculty. For the next 20 years, as a professor and as a senior fellow at the Freeman Spogli Institute, Center for International Security and Cooperation, and at the Hoover Institution, and as director of the Preventive Defense Project (all at Stanford), he explored ways to reduce the dangers posed by nuclear weapons.[1]

Perry had been a key figure in defense acquisition since the 1970s, even during the years in which he did not occupy a top position in the Pentagon. When he was under secretary of defense for research and engineering during the Carter administration he had not initiated major acquisition reforms, but when David Packard, chairman of President Reagan's Blue Ribbon Commission on Defense Management, asked him to lead the commission's acquisition task force in 1985, Perry made the most of the opportunity. *A Formula for Action*, the commission's report on defense acquisition, became a highly influential reform document; Perry considered it a "blueprint for transforming the acquisition system." He was subsequently disappointed by what he saw as the Defense Department's halfhearted efforts to implement the reform agenda, complaining later that under Secretary of Defense Caspar Weinberger a formula for action became "a formula for inaction." Perry, however, believed Secretary of Defense Dick Cheney's Defense Management Report made significant progress in achieving its stated goal of implementing the Packard recommendations but thought the work was incomplete. Reforms had not yet touched what Perry considered to be the heart of *A Formula for Action*: the greater use of commercial products and business practices.[1]

Perry arrived at the Pentagon in 1993 determined to see the Packard reforms carried through. "[M]y passion for this goal was my principal reason for returning to DoD," he explained to the Business Executives for National Security, an industry group. Perry's first action after being confirmed as deputy secretary of defense "was to pull [the Packard] blueprint off the shelf and use it to lay out the department's plan of action for acquisition reform." However, his thinking went further, in light of the changes that had occurred since 1986, especially the ongoing consolidation of the defense industry and weaknesses in the industrial base. At his confirmation hearing in February 1993, Perry told the Senate Armed Services Committee he intended to initiate "an even bolder plan of acquisition reform than was recommended by the Packard Commission." He went so far as to describe his agenda as "radical reform." He wanted to tear down barriers between the commercial market and defense-oriented industry.[2]

Perry took the lead in assembling the DoD acquisition team. "We needed a team that was experienced in defense acquisition, not real estate agents, not lawyers, not brain surgeons," he said. Perry also emphasized personal integrity, because "this is a business where if you get a whiff of scandal or a whiff of corruption, you just completely undermine the effectiveness of doing what you're trying to do." Perry's handpicked candidates for the top acquisition positions—the under secretary for acquisition (before the end of the year renamed the under secretary for acquisition and technology) and the three service acquisition executives, all assistant secretaries in their respective departments—possessed backgrounds in acquisition, had worked in the Pentagon, and included three Republicans. Perry called it "the strongest acquisition team the Pentagon has ever seen" and "an acquisition 'dream team.'" Under Secretary for Acquisition John Deutch led the group. Like Perry, he had served in the Pentagon during Democratic administrations and had advised the department during Republican administrations. A physical chemist, Deutch had been a systems analyst in DoD in the early 1960s and under secretary of energy during Carter's

John Deutch, under secretary of defense for acquisition and technology, 1993–1994; deputy secretary of defense, 1994–1995. *(NARA)*

John M. Deutch

In the half century after World War II, scientists from the American academic community moved back and forth between their universities and the Department of Defense and other U.S. government departments and agencies concerned with national security. At the time of his appointment as the under secretary of defense for acquisition in April 1993, John Deutch's career epitomized that pattern.

Born in Brussels, Belgium, on 27 July 1938, Deutch and his family escaped Nazism for the United States soon after World War II started. In 1961 he received a B.A. in history and economics from Amherst and a B.S. in chemical engineering from MIT. His association with MIT would span most of the remainder of his professional career: a doctorate in physical engineering in 1965; associate professor and professor of chemistry, chairman of the chemistry department, dean of science, provost; and finally, beginning in 1997, the institution's highest academic rank, Institute Professor.

Although he remained anchored at MIT, Deutch took time out to serve in several government posts. From 1961 to 1965, he was a systems analyst in OSD (one of Secretary of Defense Robert S. McNamara's "whiz kids"). During the Carter administration, he worked with the U.S. nuclear arsenal in positions at the Department of Energy, eventually becoming its under secretary in 1979. Both as an MIT faculty member and executive branch employee, Deutch served on numerous government advisory bodies, including the Army Scientific Advisory Board, the Defense Science Board, the President's Nuclear Safety Oversight Committee, and the White House Science Council. His knowledge and high-level government ties also made him attractive to business and industry, landing him seats on the boards of directors or advisory boards of such companies as CMS Energy Corporation, Citicorp, TRW Inc., and United Technology Corporation.

Deutch's tenure at the Defense Department did not last long. He was under secretary for less than a year, moving up to become deputy secretary in March 1994. Just over a year later, however, he left the Pentagon to run the CIA, serving as its director through December 1996 when he returned to MIT as an Institute Professor.[II] presidency. The top-level leadership team worked well together. Aspin, Perry, and Deutch were all alumni of the Aspen Strategy Group, a nonpartisan gathering of defense thinkers and policymakers hosted by the Aspen Institute in Colorado. Perry and Deutch were also business partners and were particularly close—"kindred souls," according to one veteran reporter on defense issues.[3]

Paul Kaminski, under secretary of defense for acquisition and technology, 1994–1997. *(DoD)*

Paul G. Kaminski

On 3 October 1994 Paul Kaminski became under secretary of defense for acquisition and technology—the sixth person to hold that office in eight years. Like his superiors in the Defense Department, he was committed to acquisition reform. His relatively long tenure in the position, more than two and a half years, would enable him to oversee much of the reform agenda.

Kaminski's career, in both the public and private sectors, focused on the application of scientific knowledge to the development of advanced technology military systems. Graduating from the U.S. Air Force Academy in 1964 with a B.S. in engineering science, he later earned an M.S. in electrical engineering and an M.S. in aeronautical and astronautical engineering from MIT, and then, in 1971, a Ph.D. in aeronautics and astronautics from Stanford. During his 20 years in the Air Force, Kaminski held a variety of technology development and program management positions that included work on Minuteman missile guidance components, a tour as a special assistant to Bill Perry in DDR&E from 1977 to 1981, and a final assignment as director for low observables technology—stealth aircraft—at Air Force headquarters from 1981 to 1984.

After retiring from military service, Kaminski joined Perry at Technology Strategies and Alliances, eventually succeeding his former boss as chairman and CEO of the company. Just prior to becoming under secretary, Kaminski chaired the Defense Science Board and was a member of the Defense Policy Board. When he left his Pentagon post in 1997, he returned to the private sector as chairman and CEO of Technovation Inc., a consulting firm concentrating on the development of business and investment strategies for applying advanced technology to defense. During the next two decades at Technovation, he again chaired the Defense Science Board (2009–2016), was chairman of RAND's Board of Trustees (2009–2013), and also board chairman of HRL Laboratories and Exostar, both for-profit enterprises. In 2006 President George W. Bush awarded Kaminski the National Medal of Technology and Innovation.[III]

The pattern of close cooperation continued when Perry became secretary of defense in early 1994, and Deutch moved up to the deputy secretary position. To replace Deutch as under secretary for acquisition and technology, Perry recruited another longtime friend, professional associate, and business partner, Paul G. Kaminski. Kaminski had a strong background in systems acquisition, including the development of the most advanced technologies, such as stealth aircraft and satellite systems. During the 1970s he formed a bond with Perry, who had brought Kaminski to the Pentagon to work as his special assistant when Perry was under secretary for research and engineering. Subsequently, the two became business partners when they founded Technology Strategies and Alliances, which provided venture capital to technology start-up companies. When he became under secretary in 1994 Kaminski cultivated a close relationship with the service acquisition executives; indeed, he had a role in choosing them. Every two weeks they met for a well-publicized lunch with Kaminski who also developed personal relationships with the uniformed service chiefs to help ensure that he and they understood each other's concerns.[4]

During 1993 Perry and Deutch continued to direct acquisition reform, encouraging OSD staff and the service acquisition executives in the effort and providing high-level backing for reform initiatives. A reform program on the scale they envisioned, however, required a full-time supervisor unencumbered by the wider responsibilities of the deputy secretary and the under secretary. For this task, they turned to Colleen A. Preston. A longtime staff member of the House Armed Services Committee and a lawyer, Preston crossed the Potomac with her boss on the committee, Les Aspin, when he became secretary of defense. She possessed an ideal blend of Pentagon and congressional experience with a strong background in acquisition that would work to her advantage when she became Deutch's deputy under secretary of defense for acquisition reform in May 1993.[5]

The acquisition team assembled by Perry had often combined their education and research experience in the hard sciences and engineering with careers in business management and public service. They were comfortable dealing with the complex problems of defense acquisition, particularly those involving advanced technology. For a time during the first Clinton administration, the top three officials in the Pentagon held doctorates and had served on the Defense Science Board. A few military leaders also shared the reformers' vision of a reorganized acquisition system better able to exploit advanced technology, including Army General Gordon Sullivan and Admiral William Owens.[6]

Some of the new leaders had participated in the debates over acquisition reform before, mostly in background roles. Now they were at center stage. They were self-confident and at times self-righteous, believing they had a mission to bring about change they considered not only necessary but inevitable. "We were on a crusade," recalled Preston. To the reformers, the old industrial age principles and rules no longer applied in the information age. They envisioned new ways of doing things in the changed context, from routine administration to R&D and production to military operations.[7]

On 9 February 1994, only six days after succeeding Aspin as secretary of defense, Perry presented the broad outlines of the department's acquisition reform program in a paper delivered to the House Armed Services Committee. *Acquisition Reform: A Mandate for Change* laid out the themes that by now were familiar to those who knew Perry's views. Referring to the Bottom-Up Review, DoD's vision for the U.S. armed services announced the previous fall (see chapter I), Perry stated flatly, "DoD will not be able to carry out this blueprint, without dramatic changes in its acquisition processes—from determining what the Department needs, to logistics support and reutilization requirements." Change, he declared, "is imperative." He argued that the department was losing access to the state-of-the-art technology essential to fulfill its mission because it could not easily buy from commercial enterprises. This limitation made the department's cost of doing business too high. By the 1990s commercial firms were producing most of the latest technology. Consequently, Defense Department officials began looking for ways to break down the barriers that prevented or deterred private firms from selling to the government. By modernizing its business practices and easing up on costly regulatory burdens imposed on its contractors, DoD could obtain the latest technologies and ultimately reduce costs for both government and industry.[8] The reformers' program constituted a new relationship with industry, one that sought to integrate the commercial and defense-oriented sectors of the economy.

INTEGRATING THE DEFENSE AND CIVILIAN INDUSTRIAL BASES

Although the status of the defense industrial base had received considerable public attention throughout the Cold War, its health had become the subject of growing concern since at least the 1970s. By the late 1980s government, industry, and independent analysts were warning with increasing urgency of the defense industry's declining ability to meet acquisition needs. With the Defense budget dropping and DoD's inventory bulging with weapons, there were simply too few procurement dollars and major contracts to support a significant number of competing firms, not just the top prime contractors but also smaller companies in the industrial base, the subcontractors who produced subsystems and components and the suppliers who provided critical parts and materials. The defense industry had already begun an intensive restructuring that included mergers and sell-offs, which reduced the number of companies competing for contracts. Seeking new markets, the survivors sought to sell their military products overseas or diversify into commercial products. Many subcontractors and parts suppliers, especially in high-technology industries, abandoned the defense business altogether to focus on commercial markets, where profit margins were higher and regulatory burdens less onerous. Meanwhile, overseas competitors were dominating key industrial sectors, especially in high technologies like electronics, creating fears that American weapon systems would be dependent on foreign suppliers for critical components and parts. In other cases, foreign firms actively sought to acquire important U.S. companies, raising the specter of foreign control of defense industries. The Clinton administration believed it needed to take more active measures to support the industrial base than the laissez-faire policies of its predecessor (see chapter XIV).

From its perspective, industry had long maintained the government had to reduce the cost of doing business with it. Private-sector defense executives claimed federal laws, regulations, procedures, and specifications and standards, imposed to ensure honesty, fairness, high quality, and reasonable prices, were instead impeding innovation, raising costs, and lengthening development times. A survey of members of the American Defense Preparedness Association concluded in 1992 that government statutory and regulatory requirements added 30–50 percent—and in some cases as much as 100 percent—to the cost of doing business with the Defense Department. Not surprisingly, deregulation and a loosening of oversight ranked high on industry's agenda.[9]

By the end of the 1980s, however, some reformers had a more ambitious plan than deregulation for dealing with the problems of acquisition and industry. They argued that the defense-oriented industrial base had to be integrated with commercial-market industry to create a "national" industrial base capable of meeting the needs of both the Defense Department and the civilian market. The leading proponent of this concept, known as "civil-military integration," was Jacques Gansler, a vice president of The Analytic Sciences Corporation and a leading expert on the defense industry. Gansler was advocating the idea by 1989, and two years later cochaired a panel for the Center for Strategic and International Studies (CSIS) that issued an influential report, *Integrating Commercial and Military Technologies for National Strength*, laying out the case for civil-military integration. Gansler and CSIS continued to promote the concept; later, as the acquisition under secretary during the second Clinton administration, Gansler would work to apply it (see chapter X).[10]

Civil-military integration required the government to encourage companies that had once depended entirely on defense contracts to make and sell products for the civilian market. This change would not only benefit the national industrial base but would also prevent wholesale layoffs of highly skilled defense workers should major defense-oriented companies fail. At the same time, the government had to entice nondefense-oriented firms to sell their products to the Defense Department, especially already-available systems, subsystems, and components (commercial off-the-shelf items) and particularly products not requiring further development (non-developmental items).[11]

The accessibility of the country's technology base, which supplied the ideas and cutting-edge technologies essential to producing advanced weapon systems, was a closely related issue.[12] Until the late 1980s, government funding and efforts by defense organizations, such as the Defense Advanced Research Projects Agency, had been responsible for much of the progress in advanced weapon system technology. By then, however, years of declining government science and technology funding and a booming commercial market meant that the locus of innovation, especially in electronics ranging from microprocessors and memory chips to data networks to high-resolution displays, had switched to private businesses producing for civilian markets.

In such an environment, designing and producing militarily unique technologies was inefficient and expensive. This did not mean civilian technologies could always meet the military's requirements or the government should stop sponsoring defense-oriented R&D. On the contrary, the reformers believed the government should boost R&D funding and promote the development of dual-use technologies by its own labs and contractors, which could then be applied to military systems and also sold on the civilian market. In this way, the government could contribute to the national technology base and boost the civilian economy. (For DoD's effort to pursue dual-use technologies, see chapter XIV.)

As the reformers understood, however, achieving civil-military integration was not simply a matter of announcing new policies. They faced a large number of barriers including many embedded in the laws, regulations, and procedures governing acquisition. The Center for Strategic and International Studies panel identified four obstacles in particular: incompatible accounting systems, rigid military specifications and standards, the government's claim to own the technical data resulting from the work, and unique contract requirements. First, government accounting standards differed so significantly from those in the private sector that commercial firms doing business with the government could expect to maintain two separate accounting systems—even two separate business units—one for defense work and one for commercial work. Second, when seeking bids from industry for military work, the Defense Department provided precise specifications for the products it wanted. These so-called MILSPECs detailed the materials to be used; the product's shape, form, and function; and the exact capabilities to be achieved (see chapters VII, XI, and XII). DoD further required contractors to adhere to military-unique design and manufacturing standards while performing the work, a condition that effectively prevented companies from offering their own know-how and off-the-shelf products to achieve better or cheaper results. Third, the government asserted it owned the data derived from any product, technology, process, or innovation developed or purchased with federal funds. This type of ownership enabled the government to find a second supplier or reopen a production line more easily. But from a private firm's perspective, developing and selling a product to the government meant handing over the rights to data that might include proprietary secrets, possibly acquired at great effort and expense, and risking their disclosure to a competitor. Fourth, companies bidding on government contracts had to meet numerous legislative mandates and requirements. For example, a contractor might have to award women- or minority-owned businesses a certain percentage of its subcontracts, or use only American-made products and materials. Certifying compliance with these requirements, enshrined in a complex web of procurement legislation and federal acquisition regulations and policies, demanded from private firms considerable time and substantial legal staffs. Undeterred by these formidable barriers standing in the way of integrating defense-oriented and commercial-only industries, the Clinton administration reformers set about overcoming them.[13]

Facing such wide-ranging obstacles, the reformers who took office in 1993 adopted a broad definition of acquisition reform, which extended beyond the management of weapon system acquisition. It aimed at restructuring the defense industrial and technology base by promoting the conversion of defense industries to civilian production, enticing commercially oriented firms to sell their products to the government, and encouraging the development of dual-use technologies. To accomplish their objectives, the reformers sought to change fundamentally the way government procured goods and services. This effort would go beyond the Defense Department and involve the entire federal government. Indeed, acquisition reform would be part of an ambitious effort to reinvent the government itself.

REINVENTING GOVERNMENT

President Clinton and Vice President Albert A. Gore Jr. came to the White House seeking to improve the productivity of the executive branch by applying management concepts and new technologies originating in the private sector. The president's National Performance Review (NPR) set the tone—and provided both a philosophy and approach—for acquisition reform. The Defense Department, which recognized the need for change if it was to acquire state-of-the-art weaponry with reduced budgets, embraced the effort.

The National Performance Review was an outgrowth of the trend in the corporate world in the 1980s that saw companies reexamine and "reengineer" their organizations and business processes in accordance with the ideas of noted management experts such as W. Edwards Deming, Peter F. Drucker, and Thomas J. "Tom" Peters. Government officials subsequently tried to apply these ideas to the public sector. For example, two of the first three Pentagon acquisition under secretaries, Robert Costello and Jack Betti, came out of the automobile industry, which had been among the first to adopt Deming's concept of total quality management; both were devotees of TQM and worked hard to implement it in the Defense Department. The new administration, however, wanted a broader, more encompassing effort that would not just reform government, but reinvent it.

David Osborne and Ted Gaebler, leading proponents of public-sector reform, popularized the phrase "reinventing government." They studied the initiatives tried in various government organizations and the ideas of management experts as well as those of political and social theorists such as Robert B. Reich, Alvin Toffler, and James Q. Wilson. They distilled the lessons and principles in a book entitled *Reinventing Government*. Osborne and Gaebler argued, "The kind of governments that developed during the industrial era, with their sluggish, centralized bureaucracies, their preoccupation with rules and regulations, and their hierarchical chains of command, no longer work very well."

The duo did not believe reformers should look to the corporate world as a model, on the assumption that government could be run "like a business," because government operated under different rules and incentives. Instead, the authors advocated what they called "entrepreneurial government," which would operate by empowering government employees, focusing on missions and goals instead of rules and regulations, and measuring an organization's performance in achieving goals. It would also promote decentralized authority, competition among service providers, market solutions over bureaucratic mechanisms, and cooperation with the commercial and nonprofit sectors to address local problems without dictating the solutions. Government-industry partnerships, which became a centerpiece of Defense Department acquisition reform, were in keeping with the idea of entrepreneurial government.[14]

Clinton had instituted a statewide total quality management program as governor of Arkansas, and he came to the White House intending to initiate something similar for the federal government. Upon taking office, he immediately set into motion an ambitious and expansive reform of the executive branch, starting with a review of its operations. On 3 March 1993 the president announced the National Performance Review and asked for a report in six months. Vice President Gore took charge of the effort and released the review's first report, *From Red Tape to Results*, in September. Declaring, "Government is broken, and it is time to fix it," the report condemned bureaucratic inefficiency, inflexibility, and failure to respond to the needs of the public. The vice president's call for a more entrepreneurial government echoed Osborne and Gaebler, as did the fundamental principles for successful government that he enunciated: restrictive regulations and procedures should be reduced to a minimum; government employees should be accountable for producing results, not just following rules; agencies should focus on satisfying their "customers," the

President Bill Clinton (left) with Vice President Al Gore during the National Performance Review Awards for the Reinventing Government initiative in Washington, D.C., 1 June 1994. *(FEMA Media Library)* taxpayers (in DoD, the warfighters); authority within the bureaucracy should be decentralized, with lower-level employees given much more autonomy and freedom to experiment; and the government must do more with less by eliminating wasteful and obsolete practices and embracing new technologies that would promote efficiency.[15]

Gore's emphasis on deregulation, decentralization, and empowerment of employees had a precursor in the Defense Department. In 1978 Air Force General William L. Creech took over the Tactical Air Command (TAC), then suffering from low productivity, a low mission-capable rate for the aircraft, and low pilot retention. With the support of Air Force Chief of Staff General David C. Jones, and against vigorous resistance from the Office of the Secretary of Defense and within the Air Force itself, Creech decentralized the command, allowing base and squadron commanders and even maintenance personnel (whom he organized into autonomous teams) to make decisions once reserved for central authorities. Through this and other initiatives, Creech executed the celebrated "TAC turnaround" that made the command into a first-rate combat organization, as demonstrated during the Gulf War. After retiring, Creech wrote a book on total quality management.[16]

Creech's activities came to the attention of OSD's deputy assistant secretary for installations and housing, Robert A. Stone, who in 1982 proposed to centralize all military installations under a single agency within OSD. He soon changed his mind after receiving a briefing on Creech's approach and seeing it in action. Stone's conversion to the concept of decentralization was completed the following year when he read a book on this theme coauthored by Tom Peters. In 1984, with Creech's help, Stone applied what he had learned in an initiative he called the Model Installation Program, which allowed selected facilities to waive regulations and exercise more local autonomy. The successful program won the enthusiastic endorsement of Defense Department leaders, who ordered its concepts applied to all department installations. The Model Installation Program influenced David Packard, who mentioned the approach in his foreword to the Packard Commission's final report, and to Osborne and Gaebler, who met with Stone at the Pentagon and later described the Model Installation Program in *Reinventing Government*. After Clinton's announcement of the National Performance Review, Stone, Osborne, and other like-minded reformers met with Gore, who adopted their ideas (and apparently also the name Reinventing Government) and appointed Stone to be the NPR project director.[17]

Also at Stone's suggestion, Gore made the model installation concept the basis for what he called Reinvention Labs. In April 1993, while the review was still in its early stages, the vice president authorized departments and agencies to designate two or three existing programs or organizations as "laboratories for reinventing government." The object was "to pick a few places where we can immediately unshackle our workers so they can re-engineer their work processes to fully accomplish their missions—places where we can fully delegate authority and responsibility, replace regulations with incentives, and measure our success by customer satisfaction." The department and agency heads were authorized to waive rules and regulations upon request by a lab. About 185 labs were active by early 1995, including 54 in DoD.[18]

Determined that the National Performance Review report would not "just . . . gather dust in some warehouse"—"We have enough of them [such reports] already," Clinton said—the reviewers assembled a detailed list of changes—1,250 in 38 accompanying reports—to be made in each executive department and agency. These measures focused on reorganizing the departments and agencies, streamlining the bureaucracy, overhauling the procurement system, and promoting the use of the latest information technology throughout the government. Clinton immediately acted on some of the proposals, ordering each department and agency to eliminate one half of its internal regulations within three years; to prepare plans for streamlining their organizations through personnel cuts, empowerment, and deregulation; to establish a chief operating officer to implement the NPR and other reforms; and to adopt electronic acquisition systems.[19]

The National Performance Review reversed the focus of previous reform efforts, including the Defense Management Report, which sought to control the behavior of government employees through extensive regulation, oversight, and discipline. The new reformers believed overregulation and archaic bureaucratic procedures stifled creativity and innovation. Gore and others were convinced employees wanted to improve their work processes and performance, but were hamstrung by pointless rules. Like the December 1992 study on weapons acquisition by the General Accounting Office (see chapter V), the National Performance Review called for changing the culture of the bureaucracy by granting workers more authority and autonomy, by giving them a greater voice in decision-making, and by providing the training and information tools they needed to learn a new way of doing their jobs and to spread their ideas and experiences.[20]

Among the National Performance Review's 12 recommendations for the Defense Department were calls for it to "clarify policy directives and procedures to reduce administrative burden and unnecessary regulatory controls," create a "unified" Defense budget that gave more flexibility to commanders in the field, and purchase "best value" commercial supplies and services. On DoD's recommendation, the report also asked the department to establish a "defense quality workplace" that would encourage the use of total quality management concepts. The report's statement on defense acquisition reform was vague and unspecific: "The DoD acquisition system is large and extraordinarily complex. It needs to enable DoD to take advantage of the technological advances and efficient procurement practices of the commercial marketplace."[21]

The White House memorandum requiring all executive departments and federal agencies to prepare plans for streamlining their organizations and operations directed them to incorporate such goals as decentralization, cost savings, and "measures to simplify the internal organization and administrative processes" and to "raise the morale and productivity" of each department or agency. The Defense Department responded with a plan which included the promise that the under secretary would ensure "the Department continues supporting efforts to streamline acquisition practices, policies, and regulations to make the existing system function more effectively and efficiently." DoD was planning a comprehensive reform effort anyway, but those plans were far from complete. It did, however, indicate some basic goals: workforce downsizing ("rightsizing," the report called it), outsourcing departmental functions, and deregulation.[22]

Although Perry and his staff arrived at the Pentagon with an idea of what they hoped to achieve, the process by which they operated was influenced by the National Performance Review, especially the effort to change the culture of the workplace. The Defense Department used teams of workers to plan the substance and implementation of reform initiatives, highlight reform success stories, give awards to innovative workers and organizations, and maintain a communications center to provide information about reform goals and procedures. The reform goals also seemed to have been influenced by the NPR concept of government-industry partnership. Gore pushed the idea that government should see industry as a partner in areas such as public safety, health, and the environment. The Department of Defense adopted the language and spirit of "partnership" with its contractors.

CONGRESS AND REFORM

In addition to Perry's Defense Department and the White House, another acquisition reform impulse emanated from Congress. It focused on overhauling the laws governing acquisition and culminated in a series of reform statutes, most notably the Federal Acquisition Streamlining Act of 1994 (FASA). This legislation sprang from the January 1993 report of the Advisory Panel on Streamlining and Codifying Acquisition Laws, which, as noted in chapter II, Congress had chartered as part of Section 800 of the FY 1991 National Defense Authorization Act to perform a comprehensive review of the laws relating to acquisition.

The Section 800 Panel as it was known comprised 13 military and civilian legal experts backed by a task force drawn from DoD agencies and the military services, especially the Defense Systems Management College. According to the act that created it, the panel was to recommend for elimination any laws "unnecessary for the establishment of buyer and seller relationships in procurement"; to ensure the "continuing financial and ethical integrity" of defense procurement programs; and to "protect the best interests of the Department of Defense." It was then to offer an alternate code of acquisition laws.[23]

Although not expected to conduct its own analysis of acquisition problems, the panel was to provide recommendations based on the principles outlined by previous studies, in particular the Packard Commission and the Defense Management Report. But the drawdown of the armed forces, the continuing decline in the Defense budget, and the contraction of the defense-industrial base led the panel to study the impact of acquisition laws on post–Cold War defense and technology policy. Any new legislation was supposed to promote cost reduction and the restructuring of the industrial base. With respect to the latter, the Section 800 Panel was particularly concerned with reducing the barriers that were impediments to integrating the commercial and defense-oriented industrial bases; its report would be a crucial step in untangling the regulatory web behind those barriers. Although not responsible for regulations per se—the FAR and DFARS, the 5000 series documents, and military specifications and standards all fell under the purview of the Defense Department or other executive agencies, not Congress—the panel noted that acquisition laws stood at the apex of a "cascading pyramid" of rules and restrictions that in many cases implemented congressional wishes. Change the laws, and the regulations would follow suit.[24]

After seeking input from acquisition experts and from military, government, and industry leaders, the panel agreed on a set of principles that, in addition to the congressionally mandated goals, would guide its review. The first, a criticism of congressional micromanagement, was a general statement that acquisition laws should identify broad policy objectives and fundamental requirements; details and methodology of implementation should be left to the regulations formulated by the executive agencies themselves. Other principles called for reducing the barriers to commercial purchasing, enabling the integration of commercial and defense-unique production within a single business organization, promoting the transfer of technology between the government and the commercial sector, preserving the industrial base, and encouraging acquisition personnel to use their own professional judgment in making decisions.[25]

The panel identified 889 laws that appeared to relate to acquisition. It focused on those affecting the buyer-seller relationship and excluded those relating to Defense Department organization, the commissary system, traditional supply operations, and finances and budgeting. It also excluded laws relating to the acquisition workforce. The Defense Acquisition Workforce Improvement Act had been enacted in 1990 at the time the panel was beginning its work. Six working groups representing major functional areas—contract formation, contract administration, service-specific and major system statutes, socioeconomic requirements, small business, and simplified acquisition—then tackled the remaining 600 laws, largely based on separate sections of the U.S. Code (primarily Title 10). The Section 800 Panel studied both the congressional intent behind each law and the legislation's subsequent effect on the acquisition system. It then recommended whether the law should be retained, repealed, modified, or reorganized, and provided alternate wording if appropriate. In one instance, concerning defense trade and cooperation with foreign nations, the panel recommended adding an entirely new chapter to Title 10.[26]

The panel's report contained two major initiatives. The first proposed to streamline the acquisition process by reducing the number and complexity of acquisition laws and granting the Defense Department more flexibility in applying them. It recommended simplifying the department's reporting requirements to Congress by eliminating duplicative or unnecessary reports and by allowing the defense secretary to determine their form and content, within congressional guidelines. Similarly, the panel would permit the secretary to specify the content of acquisition program baselines and cost and personnel estimates. It proposed giving DoD greater flexibility in determining the nature and schedule of operational tests, although it acknowledged "testing is a contentious subject with strong advocates in each camp" and therefore sought a balance between flexibility and thoroughness. The panel recognized the value of competitive prototyping but concluded that building prototypes might be too expensive in an era of tight budgets. It therefore recommended eliminating the on-again, off-again statutory requirement for the development of two or more prototypes for each acquisition program in favor of allowing the defense secretary to decide case-by-case.[27]

The second initiative took on those aspects of the procurement process that dissuaded companies engaging exclusively in the civilian economy from entering the defense market or that stood in the way of DoD increasing its purchases of commercial products. In its analysis, the panel was greatly influenced by the Center for Strategic and International Studies' 1991 report on integrating commercial and military technologies and accepted the four major barriers the report had identified: accounting requirements, military specifications and standards, technical data rights, and military-unique contract requirements. The panel tried to cut through the confusing Gordian Knot of laws, regulations, and procedures and to offer some practical solutions. It clarified the definition of "commercial item." It proposed ways to grant both the government and industry more flexibility in negotiating contracts and sales. And it recommended replacing the "small purchase threshold" of $25,000—the level at which procurement actions became subject to the most stringent regulations—with a "simplified acquisition threshold" of $100,000.[28]

Throughout its deliberations and in its recommendations, the panel was aware there could be no single ideal code governing acquisition. Acquisition necessarily required striking a workable balance among diverse interests that included sellers, buyers, overseers, and users (DoD, the services, Congress, and other government agencies)—in other words, the stakeholders in the acquisition process. These interests were sometimes divergent, competing, and even irreconcilable. The panel recognized that the acquisition process must be not only efficient but also fair, allowing full and open access to the procurement system. At the same time, acquisition had to promote the socioeconomic policies deemed to be in the national interest, because "the requirements of the common defense have always been balanced by the necessity to promote the general welfare." Furthermore, the very nature of the federal government as an enormous, taxpayer-supported institution precluded it from behaving like a typical commercial buyer; many government-unique rules and practices could not be eliminated, however onerous.[29]

Finding a balance proved to be difficult on some key issues, such as technical data rights. For years the Defense Department had tried unsuccessfully to develop a data-rights policy acceptable to all concerned parties, one that balanced the government's need for access with industry's need to protect intellectual property and private investment. The Section 800 Panel, too, failed to find a satisfactory solution. "Reconciling these competing needs has proven to be a formidable task and may never be possible in any perfect sense," it observed. The panel's report proposed an approach that guaranteed the government access to the technical data but only when necessary and only as much as necessary.[30]

The Section 800 Panel report provided an important guide for DoD, which announced it would use the findings "as the starting point" for its own reform efforts. However, the report was directed at Congress and focused on acquisition statutes, not regulations. Much of the subsequent legislative reform activity involved acquisition across the federal government and avoided detailed prescriptions for the process of acquiring major weapon systems—the accusations of congressional micromanagement in the 1980s were still fresh.[31]

With DoD in the process of putting its leadership team in place early in 1993 and yet to submit proposed acquisition legislation, members of Congress put forward several reform bills of their own. Democratic Representatives John Conyers Jr. of Michigan and Ronald Dellums of California, chairmen of the House Government Operations and Armed Services committees, respectively, introduced the most important of these, the Federal Acquisition Improvement Act, in May 1993. The legislation sought to encourage commercial product acquisition, enhance competition, strengthen the bid protest process, streamline and simplify small purchases, and promote small business. The bill was not comprehensive, however. It left out most of the Section 800 Panel recommendations regarding the acquisition of commercial products. Perry described it as "a modest, useful step" but still only "a small step in the direction we want to go."[32]

The Defense Department, White House, and Senate all wanted a broad reform package that would apply to the entire federal government. The Section 800 Panel report, though directed at defense acquisition laws, became the basis of such legislation. Immediately after receiving the report in January 1993, a bipartisan group of reform-minded senators and the staffs of three Senate committees—Governmental Affairs, Armed Services, and Small Business—met weekly for nine months in an intensive effort to assemble a comprehensive reform package. The resulting bill, S. 1587, the Federal Acquisition Streamlining Act, was largely complete by September and unveiled late the following month. For the next nine months an extensive debate over the proposed legislation took place, both within the Clinton administration and in Congress; in both cases the battle was between those who thought the bill went too far in the direction of reform and those who thought it did not go far enough. Finally, after the administration resolved its own internal differences and reached a compromise with Congress, the Senate approved the bill in August 1994 and the House, two months later. President Clinton signed it into law on 13 October 1994.[33] The primary thrusts of FASA were to promote the use of commercial products and to simplify the process of awarding and managing contracts in the hope more firms would enter the defense market. For example, the act broadened the definition of commercial items, reduced the requirements placed on companies offering such items, and raised the threshold for the use of simplified acquisition procedures from $25,000 to $100,000. One of the most important changes amended the Truth in Negotiations Act (1962) to relax the requirement for bidders to reveal cost and pricing data for their products. The Federal Acquisition Streamlining Act also required the government to increase its use of electronic commerce and electronic data interchange and created the Federal Acquisition Network. These measures sought to level the playing field for small businesses by giving them easier access to the acquisition system.[34]

While much of the act concerned small purchases or the procurement of commodities, some provisions dealt with the acquisition of major systems. Title 3 reduced reporting requirements and modified the statutes regarding independent cost and personnel estimates, baseline descriptions, and other elements of the acquisition process. It also repealed the statutory requirements to use competitive prototypes and to provide for competitive alternative sources in major system programs, although the House-Senate conference committee expressed its hope that DoD would voluntarily continue these practices. Title 5 directed the Defense Department to adopt "performance based management" that established cost, schedule, and performance goals for acquisition programs and incentives to encourage the workforce to pursue those goals. The department was to report annually whether its acquisition programs were achieving an average of 90 percent of their cost, schedule, and performance goals, and whether it was succeeding in reducing the time required to field new technology by 50 percent.[35]

Although pleased with most of these provisions—Colleen Preston, the deputy under secretary for acquisition reform, later told Congress that FASA gave the Defense Department "95 percent" of what it needed to reengineer its business processes—the department did not get everything it wanted. It did not, for example, receive blanket waivers of some statutes that it believed raised the cost of acquisition, such as the Davis Bacon Act (1931), which required companies doing business with the government to pay prevailing wage rates where the work was being performed. It also failed to obtain the changes it wanted regarding operational test and evaluation. The original Senate bill would have given the Pentagon the right to waive existing testing requirements if the secretary of defense certified "that such testing would be unreasonably expensive and impracticable, cause unwarranted delay, or be unnecessary because of the acquisition strategy for that system." The reformers in the Senate, who dubbed this provision the "Mack-truck loophole" because "it would have opened a loophole large enough to drive a Mack truck through," rebelled. Although the final bill allowed the secretary to waive live-fire testing under certain circumstances, it reaffirmed the independence of the director of operational test and evaluation and left the operational testing requirements largely intact.[36]

The Federal Acquisition Streamlining Act was a landmark piece of legislation—some in Congress called it the most important acquisition legislation since the 1983 Competition in Contracting Act. Senator Sam Nunn, chairman of the Senate Armed Services Committee, described it as the "second installment on major changes in the Department of Defense" begun by the Goldwater-Nichols legislation of 1986. The effort was bipartisan—FASA passed the House by a vote of 425-0. Steven Kelman, who as head of the Office of Federal Procurement Policy played a key role in working out the disagreements within the administration and between the White House and the Senate over FASA, later reflected that the legislation "accomplished less than the rhetoric surrounding it suggested." Even so, he also wrote, the act "sent people on the front lines a thundering message . . . that change was underway."[37]

The preparation and passage of acquisition reform legislation continued even after the control of Congress passed to the Republicans. In February 1996, after a bitter fight between reformers and their opponents, Congress passed the Federal Acquisition Reform Act (FARA) and the Information Technology Management Reform Act as part of the FY 1996 National Defense Authorization Act. The two were subsequently designated the Clinger-Cohen Act of 1996, after the legislation's cosponsors, Representative William F. Clinger Jr. (R-PA) and Senator William S. Cohen (R-ME). FARA gave an additional boost to commercial purchasing and softened the procurement integrity laws that restricted employment after government service. It also eliminated the General Services Board of Contract Appeals, which adjudicated bid protests in computer procurements. Chapter IX describes the far-reaching changes in DoD information technology procurement and management mandated by Clinger-Cohen.[38]

* * * * *

To produce the advanced weapon systems the nation required, Defense Department reformers sought to strengthen the U.S. industrial and technological base by integrating the commercial and defense-oriented sectors, thus enabling the government to access the most advanced technologies at the least cost. Achieving that integration meant breaking down barriers between the two, including the differences between government and industry accounting systems, rigid military specifications and standards, the government's insistence that it owned technical data resulting from defense work, and strict contract requirements not found in the private sector. Overcoming these obstacles would result in a government-industry partnership beneficial to both, a concept of the relationship between government and industry that was also central to the White House's program for reinventing government through the National Performance Review and a key element of Congress's acquisition reform legislation.

NPR's principles provided a guide for the Defense Department effort to bring about fundamental change in acquisition culture. They emphasized decentralization of authority, deregulation, and empowerment of government employees. When applied to the acquisition workplace, these prescripts meant changing the previous emphasis on enforcing strict adherence to established rules and procedures to hold managers and workers accountable for program outcomes. Under the reformers' new approach, acquisition workers would be given a greater voice in decision-making and the freedom to take actions on their own. A system of incentives would reward success, measured by user satisfaction. Support for such fundamental change from the White House and Congress boded well for Defense Department reformers as they went to work to reengineer the acquisition system.

Endnotes

1. Ashton B. Carter and William J. Perry, *Preventive Defense: A New Security Strategy for America* (Washington, DC: Brookings Institution Press, 1999), 180–183; William J. Perry, interview by Alfred Goldberg and Roger Trask, Arlington, VA, 22 Oct 1998, 9, 10, OSD/HO; Perry, interview by Alfred Goldberg and Roger Trask, Arlington, VA, 6 Oct 1998, 3–4 ("formula for inaction," 3), OSD/HO; *Nominations Before the Senate Armed Services Committee, Second Session, 103d Congress*, 2 Feb 1994, S. Hrg. 103-873, 66. See also Packard Commission, *A Formula for Action*.

2. Ltr, Perry to "Friends" [Business Executives for National Security Inc.], 12 Apr 1994, copy in author files, OSD/HO; Perry, quoted in J. Ronald Fox, *Defense Acquisition Reform, 1960–2009: An Elusive Goal* (Washington, DC: CMH, 2011), 152; Senate Committee on Governmental Affairs and Committee on Armed Services, S. 1587, *Federal Acquisition Streamlining Act of 1993: Joint Hearings*, 103d Cong., 2d sess., S. Hrg. 103-849, 19; Perry interview, 6 Oct 1998, 11; Carter and Perry, *Preventive Defense*, 183–184 (Packard's blueprint quote); *Nominations Before the Senate Armed Services Committee, First Session, 103d Congress*, 25 Feb 1993, S. Hrg. 108-414, 292, 345 ("even bolder plan of acquisition reform").

3. Charles L. Beck Jr., Nina Lyn Brokaw, and Brian A. Kelmar, *A Model for Leading Change: Making Acquisition Reform Work*, Report of the 1996–1997 DSMC Military Research Fellows (Fort Belvoir, VA: DSMC Press, Dec 1997), chap. 5:2; Dana Priest, "Pentagon's Latest Acquisition: Private-Sector Purchasing Practices," *Washington Post*, 2 May 1996 ("whiff of scandal"), https://www.washingtonpost.com/archive/politics/1996/05/02/pentagons-latest-acquisition-private-sector-purchasing-practices/3a38d13a-e006-4a3f-b19e-097b0ffb37aa/, accessed 18 Feb 2020; Carter and Perry, *Preventive Defense*, 184–185 ("acquisition 'dream team'"); Perry interview with reporters, 21 Dec 1994, *Public Statements of William J. Perry, Secretary of Defense, 1994*, 4:2626, OSD/HO; Nick Kotz, "Mission Impossible," *Washingtonian Magazine,* Dec 1995, 63, 66, 134–136; Eric Schmitt, "Washington at Work: Pal, Teacher and Now Powerbroker," *New York Times*, 22 Sep 1993, 22; Schmitt, "An Energetic Deputy Helps Remake the Pentagon," *New York Times*, 24 Jul 1994, 30 ("kindred souls").

4. Paul G. Kaminski, interview by Alfred Goldberg and Richard Hunt, Fairfax Station, VA, 14 Jun 2000, 1:2–6, 25, 37–38, OSD/HO; Kaminski, interview by Stuart Rochester and Richard Hunt, Fairfax Station, VA, 24 Jan 2001, 2:6, 11, OSD/HO.

5. Colleen A. Preston, interview by J. Ronald Fox et al., CMH, Fort Lesley J. McNair, DC, 26 Mar 2008, 18, OSD/HO.

6. Secretary Perry, Deputy Secretary Deutch, and Under Secretary Kaminski held doctorates.

7. Preston interview, 18.

8. William J. Perry, *Acquisition Reform: A Mandate for Change* (Washington, DC: DoD, 9 Feb 1994), 1–18, attached to memo, SecDef Perry for Secretaries of Military Departments et al., 15 Mar 1994, subj: Acquisition Reform, copy in author files.

9. HCAS, Investigations Subcommittee, *DoD Military Specifications and Standards: Hearing*, 102d Cong., 2d sess., 22 Jul 1992, HASC No. 102-75, 30–32; Gansler, *Defense Conversion*, 125.

10. Gansler, *Affording Defense*, 273–282; Center for Strategic and International Studies, *Integrating Commercial and Military Technologies for National Strength: An Agenda for Change; Report of the CSIS Steering Committee on Security and Technology* (Washington, DC: CSIS, Mar 1991); Gansler, "Strengthening America's Defense Industrial Base in an Era of Declining Defense Budgets," in House Committee on Banking, Finance, and Urban Affairs, Subcommittee on Economic Stabilization, *Defense Production Act: Hearings*, 102d Cong., 1st sess., 5 Jun 1991, Serial No. 102-43, 294–309; Gansler, *Defense Conversion*, esp. 87–99.

11. The material in this and the next two paragraphs is largely based on the following: Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, OTA-ISC-420 (Washington, DC: GPO, Apr 1989), 5–6, 161–187; Herschel Kanter and Richard H. Van Atta, *Integrating Defense into the Civilian Technology and Industrial Base*, IDA Paper P-2801 (Alexandria, VA: IDA, Feb 1993); Mark A. Lorell et al., *Cheaper, Faster, Better? Commercial*

Approaches to Weapons Acquisition, RAND Report MR-1147-AF (Santa Monica, CA: RAND, 2000), xvii–xxiii, 1–4, 13–44.

12. Congress's Office of Technology Assessment referred to the technology and industrial bases together as the "Defense Technology and Industrial Base," which consisted of three components: R&D, production, and maintenance. See OTA, *Building Future Security: Strategies for Restructuring the Defense Technology and Industrial Base*, 4.

13. Gansler, *Defense Conversion*, 119–146; CSIS, *Integrating Commercial and Military Technologies*, 16, 29–36, 41–50, 53–62, 65–69; HCAS, Investigations Subcommittee, *DoD Military Specifications and Standards*, 28–29, 206–223; Gansler, *Affording Defense*, 191–193; Center for Strategic and International Studies, *Road Map for Milspec Reform: Integrating Commercial and Military Manufacturing: The Report of the Working Group on Military Specifications and Standards* (Washington, DC: CSIS, 1993), 7–8. For a defense of the use of MILSPECs in commodities, see Gansler, "How the Pentagon Buys Fruitcake," *Air Force Magazine* 72, no. 6 (Jun 1989): 94. Strictly speaking, MILSPECs refers only to military specifications, but the term is often used generically to cover military standards as well and will be applied that way here.

14. David Osborne and Ted Gaebler, *Reinventing Government: How the Entrepreneurial Spirit Is Transforming the Public Sector* (Reading, MA: Addison-Wesley, 1992), 11–12 (quote), 22.

15. President William Jefferson Clinton, "Remarks Announcing the National Performance Review," 3 Mar 1993, *Public Papers of the Presidents of the United States: William J. Clinton, 1993* (Washington, DC: NARA, 1994), 1:233–235; Al Gore, *From Red Tape to Results: Creating a Government That Works Better and Costs Less: Report of the National Performance Review* (Washington, DC: GPO, 1993), 1–6 (quote, 6), 7–9 (hereafter Gore, *Red Tape*).

16. Bill Creech, *The Five Pillars of TQM: How to Make Total Quality Management Work for You* (New York: Truman Talley Books/Dutton, 1994), 115–147; James C. Slife, *Creech Blue: Gen Bill Creech and the Reformation of the Tactical Air Forces, 1978–1984* (Maxwell AFB, AL: Air University Press, 2004), 79–100.

17. Bob Stone, *Confessions of a Civil Servant: Lessons in Changing America's Government and Military* (New York: Rowman & Littlefield, 2003), 23–69; Creech, *Five Pillars*, 147–156; Packard Commission, *Quest For Excellence,* xii; Osborne and Gaebler, *Reinventing Government*, 8–11.

18. GAO, *Management Reform: Status of Agency Reinvention Lab Efforts*, GAO/GGD-96-69, (Mar 1996), 12–22.

19. Clinton, "Remarks Announcing the National Performance Review," 234 (quotes); *A Brief History of Vice President Al Gore's National Partnership for Reinventing Government during the Administration of President Bill Clinton, 1993–2001* (n.p., Jan 2001), 2, https://govinfo.library.unt.edu/npr/whoweare/historyofnpr.html, accessed 11 Jun 2020; Executive Order 12861 (Elimination of One-Half of Executive Branch Internal Regulations), White House, 11 Sep 1993, www.archives.gov/federal-register/executive-orders/pdf/12861.pdf, accessed 8 Aug 2014; Presidential memo for Heads of Departments and Agencies, 11 Sep 1993, subj: Streamlining the Bureaucracy, www.gpo.gov/fdsys/pkg/WCPD-1993-09-20/pdf/WCPD-1993-09- 20-Pg1738.pdf, accessed 8 Aug 2014; Presidential memo for the Heads of Executive Departments and Agencies, 1 Oct 1993, subj: Implementing Management Reform in the Executive Branch, http:// govinfo.library.unt.edu/npr/library/direct/memos/2552.html, accessed 8 Aug 2014; Presidential memo for the Heads of Executive Departments and Agencies, 26 Oct 1993, subj: Streamlining Procurement Through Electronic Commerce, www.gpo.gov/fdsys/pkg/WCPD-1993-11-01/pdf/ WCPD-1993-11-01-Pg2174.pdf, accessed 8 Aug 2014.

20. Gore, *Red Tape*, 2, 68.

21. Ibid., 136–137.

22. Clinton memo on Streamlining the Bureaucracy; *Department of Defense Plan for Streamlining the Bureaucracy*, Dec 1993, 32 (quote), www.dod.mil/pubs/foi/administration_and_Management/other/797.pdf, accessed 8 Aug 2014.

23. Acquisition Law Advisory Panel, *Streamlining Defense Acquisition Laws: Report*, vii, ix; Introduction, 1–2, 9–10.

24. Ibid., 5.

25. Ibid., Intro., 4–9.

26. Ibid., Intro., 9–12; chap. 7:10–12.

27. Ibid., chap. 3:74 (quote).

28. Ibid., chap. 4:9–14; chap. 8:1 –32.

29. Ibid., Intro., 9; chap. 4:1; chap. 8:32.

30. Ibid., chap. 5:1–7.

31. "Acquisition Reform Starts with 'Section 800 Panel' Report, Says Reform Chief," *Inside the Pentagon* 9, no. 22 (3 Jun 1993), 5.

32. U.S. Congress, 103d Cong., 1st sess., S. 554, *Solicitation Enhancement Act of 1993*; S. 555, *Procurement Protest Clarification Act of 1993,* and S. 556, *A Bill to Amend Chapter 35 of Title 31, United States Code, To Improve the Procurement Protest System*; H.R. 2238; Rep. John Conyers Jr., extension of remarks on the Federal Acquisition Improvement Act of 1993, 103d Cong., 1st sess., *Congressional Record* 139 (24 May 1993): E1337; Perry, testimony before the HCAS, *Acquisition Reform: Fact or Fiction: Hearing*, 103d Cong., 1st sess., 15 Jun 1993, 14.

33. *Congressional Record* 139 (26 Oct 1993): S14384, S14426, S14697; P.L. 103-355 (13 Oct 1994), 108 Stat. 3243. For the debate in the administration and in Congress, see Sen. William V. Roth Jr. (R-DE), statement before the Senate, 103d Cong., 1st sess., *Congressional Record* 139 (23 Oct 1993): S14376–S14377; S. 1598, *The Department of Defense Management Reform Act of 1993*, 103d Cong., 1st sess., introduced 28 Oct 1993; Stephen C. LeSueur, "DoD Acquisition Reform Plan Stalls," *Defense News*, 25 Oct 1993, 1; and Steven Kelman, "Implementing Federal Procurement Reform," Occasional Paper 1-97, Innovations in American Government Program (Cambridge, MA: John F. Kennedy School of Government, Harvard University, Spring 1998), 11–12.

34. *Federal Acquisition Streamlining Act of 1994*, secs. 1201–1252, 4001–4203, 8001–8003, 9001–9004.

35. The requirement to report whether acquisition programs were achieving 90 percent of their cost, schedule, and performance goals had already been imposed by U.S. Code, Title 10, sec 2435 See GAO, *Acquisition Reform: Implementation of Title V of the Federal Acquisition Streamlining Act of 1994*, GAO/NSIAD-97-22BR (31 Oct 1996), 11.

36. Preston, testimony before the House Committee on Government Reform and Oversight [HCGRO], Subcommittee on Government Management, Information, and Technology, *Simplifying and Streamlining the Federal Procurement Process: Hearing*, 104th Cong., 1st sess., 28 Feb 1995, 14 ("95 percent"); S. 1587, *Federal Acquisition Streamlining Act of 1993*, introduced 26 Oct 1993, sec. 3013 ("unreasonably expensive and impracticable"); Sen. David H. Pryor, statement before the Senate, 103d Cong., 2d sess. *Congressional Record* 140 (8 Jun 1994): S6587 ("Mack-truck loophole"); Federal Acquisition Streamlining Act of 1994, Title III, secs. 3011–3015. For the wage rate requirements of the Davis-Bacon Act (U.S. Code, Title 40, sec. 276a), see HCGRO, *Oversight of Implementation of Federal Acquisition Streamlining Act of 1994*, 104th Cong., 1st sess., 21 Feb 1995, 36–37 (hereafter HCGRO, *Implementation of FASA*).

37. Senate Committee on Governmental Affairs and Committee on Armed Services, S. 1587, *Federal Acquisition Streamlining Act of 1993: Joint Hearings*, 103d Cong., 2d sess., 6; Final Vote Results for Roll Call 425 [FASA], 20 Sep 1994, http://clerk.house.gov/evs/1994/roll425.xml, accessed 12 Feb 2020; Steven Kelman, *Unleashing Change: A Study of Organizational Renewal in Government* (Washington, DC: Brookings Institution Press, 2005), 136; Kelman, "Implementing Federal Procurement Reform," 12.

38. *Federal Acquisition Reform Act of 1996*, Div. D of the *National Defense Authorization Act for Fiscal Year 1996; Information Technology Management Reform Act,* Div. E of the *National Defense Authorization Act for Fiscal Year 1996*, P.L. 104-106 (10 Feb 1996); Kelman, *Unleashing Change,* 137; Kathleen Day, "Streamlining Procurement Begins Phase 2," *Washington Post*, 9 Feb 1996, 19.

I. "Nomination of William J. Perry To Be Secretary of Defense," *Nominations Before the Senate Armed Services Committee, Second Session*, *103d Congress*, 26 Jan 1994, 1, 137–140; "William J. Perry," Center for International Security and Cooperation, Freeman Spogli Institute, Stanford

University, www.cisac.fsi.stanford.edu/people/william_j_perry, accessed 12 Feb 2020; William J. Perry website, http://www.wjperryproject.org, accessed 18 Feb 2020. For a short account of Perry's tenure as secretary of defense, see https://history.defense.gov/Multimedia/Biographies/Article-View/Article/571282/william-j-perry/, accessed 12 Feb 2020.

II. "Nomination of John M. Deutch To Be Under Secretary of Defense for Acquisition," *Nominations Before the Senate Armed Services Committee, First Session, 103d Congress*, 30 Mar 1990, S. Hrg. 103-414, 469, 526–530; "John M. Deutch, Institute Professor," Department of Chemistry, MIT website, http://web.mit.edu/chemistry/deutch/biography.html, accessed 12 Feb 2020.

III. "Nomination of Dr. Paul G. Kaminski, To Be Under Secretary of Defense For Acquisition and Technology," *Nominations Before the Senate Armed Services Committee, Second Session, 103d Congress*, 14 Sep 1994, 1019, 1062–1065; Kaminski interview, 14 Jun 2000, 1:1–3, 25, 37–38; Paul Kaminski, Linkedin, https://www.linkedin.com/in/paul-kaminski-963a16b; "Paul G. Kaminski, 2006, National Medal of Technology and Innovation," National Science and Technology Medals Foundation, https://www.nationalmedals.org/laureates/paul-g-kaminski, accessed 12 Feb 2020.

CHAPTER VII

Reformers "Reengineer" Acquisition, 1993–1997

The consensus among the Defense Department, the White House, and Congress that acquisition reform was necessary and would require systemic and cultural changes created a climate favorable for action. DoD's principal reform leaders—Perry, Deutch, Kaminski, and Preston—began the task guided by their years of experience in defense acquisition and the management concepts embodied in the Clinton administration's initiative to reinvent government. Their reform plans aimed at changing *how* the department acquired products and *what* products it purchased. Reforming the *how* referred to employing new organizational forms—collaborative, multidisciplinary teams—that represented all of a system's stakeholders and to adopting new acquisition processes that took into account every phase of a system's life cycle. Changing the *what* meant replacing military specifications with commercial standards. The development of the Joint Direct Attack Munition, a standard gravity bomb equipped with a guidance system, demonstrated that the new reforms could yield improved weapons at a lower cost, with a faster time from conceptualization to fielding. By early 1997, as the first term of the Clinton administration drew to a close, the Defense Department had made significant progress in reengineering the acquisition system.

BUSINESS PROCESS REENGINEERING

If the principles of total quality management and reinventing government provided a philosophical approach to reform, the concept of business process reengineering identified tools for achieving it. Business process reengineering emerged at the start of the decade as a way to transform business enterprises to make them more competitive in the information age. It concentrated on the processes by which a business provided products and services to its customers—handling invoices, for example, or scheduling production runs on the factory floor. The concept called upon businesses to eliminate inefficient processes and to redesign those remaining from scratch to improve performance. These changes required managers to obtain workers' support and to shift the organization's culture from one dominated by rules and regulations to one that encouraged innovation. To compare themselves with their competitors, businesses engaged in benchmarking by setting up performance measures or metrics.[1]

New information technologies such as inexpensive personal computers, databases, simulators, and communications networks were central to business process reengineering. Its proponents, notably Michael Hammer, a computer scientist turned management consultant, believed information technology both created the opportunity for reengineering and made it imperative for business survival. His 1990 article, "Reengineering Work: Don't Automate, Obliterate," is generally credited with launching the reengineering movement. He argued that the rules, habits, and organizational structures of the industrial age were outdated and ineffective and had to be replaced. Reengineering meant abandoning unnecessary processes or practices and, if necessary, dismantling and rearranging entire organizations. Unsettling as it was, this course was inevitable, Hammer maintained. Most firms had no choice if they wanted to avoid being dragged down by their "antiquated processes."[2]

Despite the difficulties and expense, companies fearful of being left behind in the information age embraced reengineering. Hammer's book, *Reengineering the Corporation,* coauthored with James Champy and published in 1993, remained on the *New York Times* bestseller list for 41 weeks. In 1996 *Time* magazine would name Hammer one of the 25 most influential people in America. Peter Drucker and other leading management theorists endorsed the concept. One survey found that 41 percent of business executives claimed to be doing some sort of reengineering, while another reported that the average corporate chief information officer was engaged in four or more reengineering projects.[3]

Governments, under pressure to provide more services with less money, also became interested in business process reengineering. The concept resonated well with the Clinton administration's effort to reinvent government reflected in the National Performance Review led by Vice President Gore. With respect to procurement reform, a major impetus came from the Office of Federal Procurement Policy, which worked for the White House through the Office of Management and Budget. The procurement policy office's director, Steven Kelman, a Harvard academic who had taught public management at the John F. Kennedy School of Government, had written about the federal bureaucracy and the procurement system and was familiar with the difficulties of reform. Kelman advocated the increased use of commercial items; the adoption of best commercial practices (the management methods used by exceptional private-sector firms); and, with respect to contractor relations, the use of past performance data, best value contracting (evaluating factors in addition to price when comparing competing offers), and streamlined procurement procedures. He chose a high-profile strategy for implementing change that included getting agencies to make voluntary pledges to undertake specific reform activities. Kelman also sought early successes to generate momentum for change within the bureaucracy. He reached out to the workforce, a significant proportion of which he believed supported reform. And, he employed the new medium of the personal computer to conduct some of his outreach, such as organizing online chatrooms in which he would pose questions and study the responses. Kelman's views and methods reinforced and influenced the acquisition reformers who were taking over the Pentagon.[4]

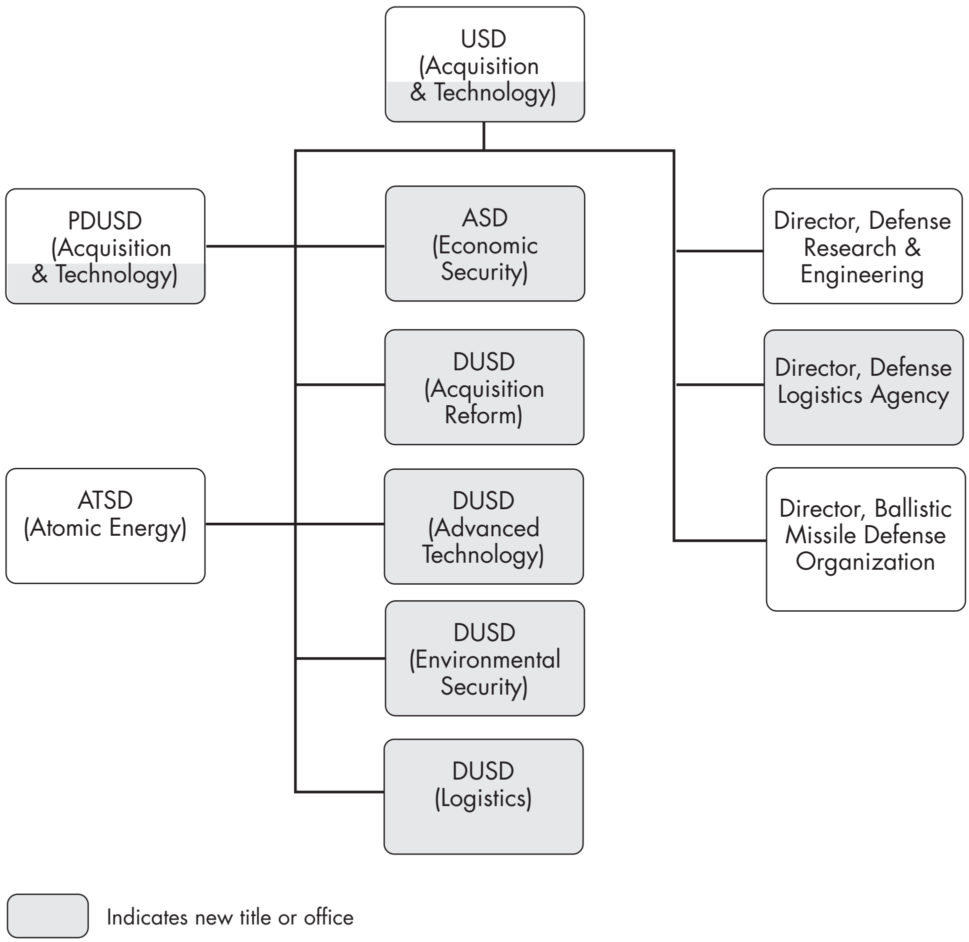
ORGANIZING FOR ACQUISITION REFORM

The Office of the Under Secretary of Defense for Acquisition underwent significant reorganization within a year of the new Pentagon leadership's taking control (see figure 7-1). The changes reflected their acquisition priorities. As noted in the previous chapter, "technology" was added to the under secretary's title (and to that of his principal deputy). A new position, the assistant secretary of defense for economic security would be responsible for industrial base issues. The portfolios of four new deputy under secretaries would include advanced technology, acquisition reform, logistics, and environmental security, respectively. Additionally, the assistant secretary of defense for command, control, communications, and intelligence was detached from the under secretary's office to report directly to the secretary of defense, and the Office of the Assistant Secretary of Defense for Production and Logistics was eliminated altogether, its functions parceled out to other elements of the under secretary's office, including that of the new deputy under secretary of defense for logistics.[5]

On 14 May 1993 Under Secretary Deutch established the Office of the Deputy Under Secretary of Defense for Acquisition Reform with Colleen Preston as its head. When she came to the Pentagon earlier in the year, and despite her familiarity with acquisition, Preston had anticipated appointment to one of the Defense Department's legal posts. She initially stood in for the not-yet-appointed DoD general counsel, with the title of special assistant for legal affairs, tasked with shepherding appointees, starting with Perry, through the confirmation process. She expected an appointment of her own as the general counsel for one of the services. But she so impressed Perry and Deutch, who found in her "one of the toughest, most informed, and most committed professionals we know," that they tapped her for the acquisition reform post. For her part, Preston was taken by Perry's and Deutch's commitment to reform, and would later say "despite the admonitions of many who said that this [reform] was a thankless task to take on, and that so many had tried and not succeeded, why would anyone want to do this, I decided that the leadership we had would make this come true."[6]

While Perry and Deutch laid out the broad acquisition reform program and established the short- and long-term priorities and goals, Preston formulated specific initiatives, devised plans for executing them, and oversaw their implementation. She worked with individuals and offices across the Defense Department, other executive

Figure 7-1: OSD Acquisition Organization, May 1994



ASD – Assistant Secretary of Defense
ATSD – Assistant to the Secretary of Defense
DUSD – Deputy Under Secretary of Defense
PDUSD – Principal Deputy Under Secretary of Defense
USD – Under Secretary of Defense

Source: Memo for correspondents, 20 May 1993, with attached memo, Deutch for Secretaries of Military Departments et al., 19 May 1993, subj: Reorganization of OUSD (Acquisition and Technology), file VII-A, OSD/HO.

departments and agencies, and the White House. Interagency coordination was an essential part of acquisition because many of the relevant regulations originated from non-DoD organizations such as the Office of Federal Procurement Policy. Similarly, Preston worked with Congress to formulate and enact the necessary legislation, a job for which her congressional background was invaluable. She had no significant budget of her own and no direct authority to enforce her guidance. To get anything done she had to obtain voluntary support from the various organizations she dealt with. Preston therefore spent much of her time negotiating, cajoling, and persuading her colleagues to support the acquisition reform agenda.[7]

Preston owed much of her influence to a high-level advisory body, the Acquisition Reform Senior Steering Group that she chaired. Comprising 14 senior OSD and service officials, it advised Preston as she planned and implemented the

Colleen Preston, deputy under secretary of defense for acquisition reform, 1993–1997. *(DoD)*

Colleen A. Preston

When Colleen Preston became deputy under secretary of defense for acquisition reform in June 1993, she possessed a solid background in acquisition gained over the course of 15 years as a Defense Department lawyer and as a congressional staffer.

After receiving a law degree from the University of Florida and working for a short time for an Orlando law firm, in 1979 Preston came to the Pentagon as an attorney in the Office of the Air Force General Counsel, advising on contracting, particularly defense contractor bid protests, and other acquisition matters. In 1983 she joined the House Armed Services Committee staff, eventually becoming its general counsel. During 10 years with the committee (for several years chaired by Les Aspin), she dealt with key pieces of acquisition legislation, including the Competition in Contracting Act of 1984, three Defense Department procurement reform acts, and the Defense Acquisition Workforce Improvement Act of 1990. She was a leading proponent of the effort to catalog and overhaul acquisition statutes and helped to establish the Section 800 Panel (the advisory panel set up by Congress to streamline acquisition laws) for which she was an adviser and liaison with the Armed Services Committee. Preston returned to the Pentagon when Aspin became secretary of defense, initially assisting both Bill Perry and John Deutch through the nomination process. After she formally proposed to Perry an office focused solely on acquisition reform, the new deputy secretary chose her to head it.

Following the end of her tenure in January 1997 as deputy under secretary, Preston founded Preston & Associates, a consulting firm focusing on the federal acquisition process and on business process reengineering. From 2007 to 2009, she was employed by two nonprofit, industry trade associations, first as senior vice president for public policy for the Contract Services Association, and then as executive vice president for policy and operations for the Professional Services Council.[1]

reform agenda, disseminating information and speeding up interoffice coordination. Preston later stated she included as members of the group the major stakeholders whose support she used to circumvent the normal, cumbersome coordination process. She even invited the DoD inspector general because, she said later, it was "better to have them knowing what we're doing at the outset."[8]

Preston's office—which she called "Team AR" (Acquisition Reform)—was small. She had asked for 20 billets but received only 13 positions. Permitted to recruit whomever she wanted to staff her team, she looked for bright, energetic people with significant knowledge of acquisition. Most of her recruits were already Defense Department employees, but two came from outside the department as special appointees. Both had worked for the Section 800 Panel, a particularly useful background given that the panel's report formed the basis of the early DoD reform initiatives. In addition to her office staff, Preston supervised the president of the Defense Acquisition University and the commandant of the Defense Systems Management College.[9]

Preston's role diminished some when Paul Kaminski arrived in fall 1994. The new under secretary became very active in the reform program. Indeed, Kaminski, like Perry and Deutch, had returned to the Pentagon with acquisition reform as his top priority. He talked about it in scores of speeches, interviews, and roundtable discussions; he sponsored conferences and workshops; and he hosted off-site meetings on the subject. He gave speeches on reform to service leaders, program executive officers and program managers, other DoD acquisition officials and workers, industry executives, and Congress. However, Kaminski was not content simply to make speeches. He worked hard to guide the formulation of reform initiatives and shepherd their implementation. In pursuing reform he drew on his own acquisition background, which had taught him, among other things, the importance of having stable funding for programs, a streamlined oversight process, and integrated product teams (IPTs). He never had to consult Perry about the reform agenda because, he would say, they were "connected at the hip" on the issues and goals, having worked together for many years.[10]

PLANNING ACQUISITION REFORM: PROCESS ACTION TEAMS

The most important task of Preston's staff was to supervise the work of process action teams (PATs) preparing the reform initiatives and implementation plans. The teams were each made up of 25 to 50 members drawn from OSD, the services, and other Defense Department components. Each group received a charter to tackle a particular issue and then disbanded upon completing its report. The two PATs chartered in 1993 worked on the use of electronic commerce tools in acquisition and on military specifications and standards. By the end of 1995 four more teams had issued reports covering the acquisition process, oversight and review, contract administration, and the automation of acquisition information. By 1996, 12 process action teams were at work or had issued their reports. Preston firmly believed reform should proceed from the bottom up by experienced people with an intimate, working-level understanding of acquisition; senior OSD officials were too isolated from the front lines to design practicable changes. In addition to relying on their own knowledge, team members received assistance from research and support staff and could also call on experts and officials from within and outside the Defense Department. Working with other acquisition practitioners broadened individual perspectives. The report of the Procurement Process Reform PAT highlighted this aspect of the team environment: "Many PAT members with 15, 20, or more years of experience on the front lines of procurement who thought they had pretty much done it all or at least mostly seen it all had their eyes opened by the experiences of others." Along with direct supervision from Preston's staff, a board of advisers or "directors" comprising senior Defense Department officials provided oversight for process action team initiatives.[11]

Preston did not intend the process action teams to perform their studies de novo. She liked to describe her staff as "the world's best plagiarizers" because, she said, "our goal in life is to take everyone else's great ideas and see if we can share them, or help get them implemented." For example, the charter for the team studying military specifications and standards—a subject to which Perry had given much thought—explained exactly what the secretary of defense wanted to accomplish and what the plan should look like. Each process action team followed a 15-step sequence for analyzing an issue, deciding on what actions to take, and preparing a proposal for approval and implementation. It had 60 to 90 days to complete its work and submit a report that included policy proposals, the actions required to implement them, the agency or office responsible for carrying them out, a timetable for implementation, and an estimate of the cost and resources required. The under secretary reviewed the report and decided whether to accept the recommendations.[12]

The services were responsible for implementing the reform program, and each formed an acquisition reform office and an executive advisory group for that purpose. These offices worked closely with Preston's, relaying OSD directives and translating them into policies and procedures appropriate to the particular service. Each service had its own set of initiatives: The Air Force's were known as "Lightning Bolts," the Navy's as "Cardinal Points," and the Army's as "Thrust Areas." The establishment of the reform offices and the selection of pro-reform acquisition officials in the military departments provided a measure of uniformity throughout the Defense Department and helped to reduce resistance to the reform program. (For service reform programs, see chapters XI, XII, and XIII.)

Kaminski wanted input from the government's acquisition practitioners and from industry. He and his staff studied the results of surveys and listened to the questions and comments from participants at various internal and external forums. He especially sought the advice of program executive officers and commanders of the service systems commands (SYSCOMs). During summer 1994 the Defense Manufacturing Council, composed of OSD and service officials and chartered to encourage use of modern manufacturing practices throughout the department, proposed solutions to several acquisition problems. These suggestions were passed to a select group of service acquisition officials and to industry. In March 1995 the council hosted a gathering of all PEOs and SYSCOM commanders to provide further input. This gathering turned into a semiannual event that came to be called the PEO/SYSCOM Commanders' Conference. Participants listened to speeches, briefings, and panel discussions on the general state of defense acquisition as well as on particular problems and proposed policies. The conferees formed working groups responsible for commenting on the policies and suggesting solutions to the problems. Kaminski always considered this advice carefully and assigned follow-up actions to the appropriate office. These conferences provided a two-way exchange of information, with service officials learning about the latest acquisition policies and initiatives while Kaminski and other senior DoD officials gained a valuable perspective from them on acquisition problems and issues.[13]

The PATs and the PEO/SYSCOM Commanders' Conferences reflected one of the central features of OSD's reform program: active participation by the acquisition community. The reformers believed the community's involvement was crucial to formulating and implementing changes to the department's acquisition system.

CHANGING "HOW WE BUY": INTEGRATED PRODUCT TEAMS AND INTEGRATED PRODUCT AND PROCESS DEVELOPMENT

The reformers made the teaming concept embodied in the process action teams an integral part of the acquisition process from top to bottom. Kaminski's experience in the Air Force stealth aircraft programs had taught him the value of multidisciplinary teams, later called integrated product teams. Soon after he took office, Kaminski assigned the Defense Manufacturing Council to study possible changes to acquisition oversight, including the use of such teams. The council discussed these changes with industry and, after the first PEO/SYSCOM Commanders' Conference in early 1995, recommended their adoption throughout the department. Meanwhile, at the end of August 1994, Perry had chartered the Acquisition Reform Process Action Team to produce "a comprehensive plan to reengineer the oversight and review process for systems acquisition, in both Components and OSD, to make it more effective and efficient, while maintaining an appropriate level of oversight." The team had a mandate to suggest radical changes, and it did not disappoint. Its report, issued in December, made 33 recommendations covering program milestones and phases, oversight organization and documentation, management of joint programs, and workforce issues. A separate volume provided detailed plans for implementation. The team recommended a simplified review process that placed less emphasis on formal reviews in favor of monitoring programs continuously by a hierarchy of integrated product teams to identify problems early. Because this approach would diminish the role of milestone reviews, the report recommended reducing their number to three;

it also cut the number of phases from five to three, representing concept exploration, development, and production. The process action team proposed other measures to ease the oversight burden on the program offices and contractors, such as reducing the documentation required of the programs, restricting the ability of the Defense Contract Management Command and the DoD inspector general to perform independent investigations and audits, and allowing well-performing contractors to oversee themselves with reduced government involvement.[14]

Kaminski approved the recommendations with only a few exceptions; he did not approve the changes to the milestones and phases or the limitation on independent investigations. He replaced the Defense Acquisition Board committees with integrated product teams, with the highest level of oversight performed by a so-called overarching IPT. "Rather than checking the work of the program office beginning six months prior to a milestone decision point," he directed that "the OSD and Component staffs shall participate early and on an on-going basis with the program office teams, resolving issues as they arise, rather than during the final decision review." There should be no surprises, Kaminski noted, because the overarching integrated product team would have been closely involved with the program from the start. He described this new policy as a shift from "after-the-fact oversight" to "early-and-continuous insight," a formula that would often be reduced to the slogan, "Insight, not oversight."[15]

Kaminski also called for program officials to prepare the minimum number of documents necessary for him to reach a decision and to tailor each document to the specific program. He further ordered a study on how to "reengineer the entire acquisition management information and reporting system" to ensure program managers were not creating data for reporting purposes but only capturing management data that already existed. Kaminski likewise reduced the oversight of contractors. "Once a contractor has demonstrated a system of stable, compliant processes leading to performance as contracted," he ordered, "the Government shall rely almost exclusively on contractor self-governance, rather than Government inspectors, auditors, and compliance monitors."[16]

Integrated product teams were useful for more than just oversight. As the stealth programs had demonstrated, they were also effective management tools. Program offices were already starting to adopt and organize such teams to help execute their programs. Program-level integrated product teams were structured differently from those performing oversight. At the program level, the teams were integrated horizontally, comprising functional specialists in design engineering, manufacturing, systems engineering, test and evaluation, subcontracts, safety, quality assurance, training, finance, suppliers, customers, and so on. They could include both government and contractor personnel. Each member was empowered to make decisions on the spot, without referring to his or her parent organization. The teams were a significant commitment; they met frequently and worked together for a long time. This helped the members learn to trust each other and gain a thorough understanding of the relevant issues. An integrated product team managed and supervised the entire program, but smaller teams often addressed particular problems or technical issues, such as the integration of hardware and software or the development of a subsystem or a component.[17]

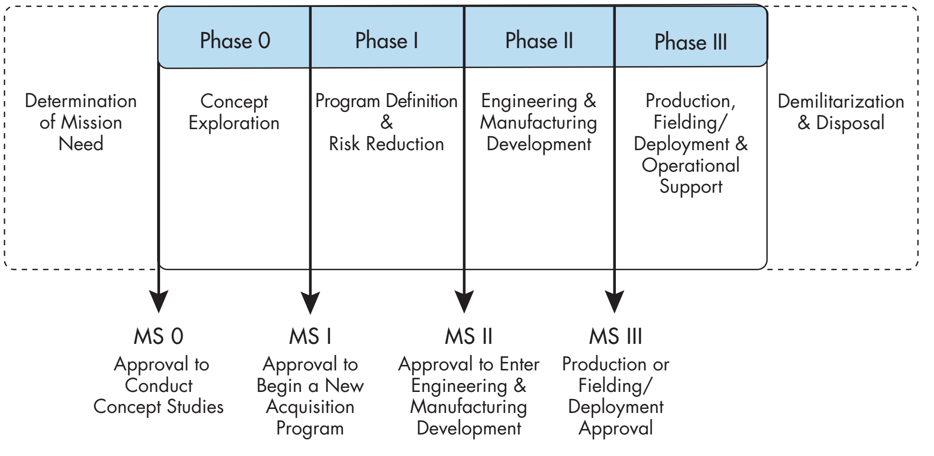
Integrated product teams represented a significant cultural change, as functional and technical personnel who were accustomed to interacting only within their own organization now had to learn to cooperate and communicate with workers from other organizations and disciplines. The empowerment of team members to make decisions on the fly was not readily accepted in organizations that had long been rigidly hierarchical. To overcome this obstacle, the Acquisition Reform PAT and Kaminski emphasized training workers and managers. The Defense Department published guidebooks and instructions, held workshops and seminars, and produced videotaped lessons transmitted by satellite to win acceptance of the new approach. Kaminski himself sponsored a special off-site meeting at the Defense Systems Management College in July 1995 to explain the integrated product team concept to acquisition officials in the services. The effort to win broad acceptance of integrated product teams was successful. In surveys conducted in 1996 and 1997, an overwhelming majority of workers considered the concept useful and effective, although they indicated it was often implemented improperly and special training was necessary for effective participation and direction of the teams.[18]

These organizational and cultural changes were also the foundation for another change of equal significance: integrated product and process development (IPPD). This management approach integrated program activities from product concept through production and field support, with teams that included a product's stakeholders—manufacturers, trainers, logisticians, and other technical and functional experts, as well as service acquisition officials and users. Instead of the program participants proceeding serially through the development process, each performing their tasks in sequence, in IPPD they worked from the start as an integrated product team. These teams could address early on the issues that typically arose later during a program's life cycle—such as a system's ease of manufacture or its training requirements. If neglected during the design phase, these and other considerations might require a costly and time-consuming reengineering of the product.[19]

Integrated product and process development grew out of an industry concept called concurrent engineering, an element of total quality management. Not to be confused with the acquisition strategy of concurrency, in which production activities overlapped development, concurrent engineering involved the simultaneous and integrated design of a product and the related processes encompassing its development, manufacture, and subsequent logistics support. By the late 1980s at least nine major defense contractors were using concurrent engineering in weapon system programs. Reports from the Institute for Defense Analyses and the Defense Science Board recommended that the Defense Department adopt it as policy. In 1991 Under Secretary of Defense for Acquisition Robert Costello, a TQM advocate, followed the recommendation. The services had also been studying the concept. The Air Force expanded it from a technical design method into a broader management approach called integrated product development (IPD) and made it a key element of the service's integrated weapon system management (IWSM) philosophy in 1992 (see chapter XI). Because integrated product development, like concurrent engineering, included the simultaneous and coordinated design of both products and processes, it began to be called "integrated product and process development" by 1993, when a Defense Science Board report promoted the concept. On 10 May 1995, Defense Secretary Perry directed the adoption of integrated product teams and integrated product and process development throughout the acquisition system "to the maximum extent practicable."[20]

The revision of the 5000 series documents released on 15 March 1996 codified the changes to defense acquisition organization and processes. The stark contrast in style and management philosophy between the Bush and Clinton administrations was clearly evident in the differences between the 1991 and 1996 versions of these documents. The 1991 guidance was contained in three documents totaling almost 900 pages and including 50 figures and charts and 36 pages of tables. The documents discouraged tailoring both the oversight and review process and the documentation. They appeared to require lockstep movement through the process. In all, the emphasis was on discipline. The 1996 version had a very different look and feel. Contained in two documents comprising only 140 pages, it emphasized flexibility. This revision sought to reflect the themes of the acquisition reform program: teamwork, a tailored process and organization to suit each program's particular circumstances, empowerment of program managers and frontline acquisition workers, cost control, purchase of commercial products, and adoption of best practices. The documents also adjusted the milestones and phases. The new guidance provided at Milestone III the option to approve fielding/deployment as well as production and eliminated Milestone IV (approval for major modification) and Phase IV, adding the latter's operations and support to Phase III.[21] (See figures 7-2 and 2-4, chapter II.)

Figure 7-2: Acquisition Milestones and Phases, 1996



Source: Joseph H. Schmoll, *Introduction to Defense Acquisition Management,* 3d ed. (Fort Belvoir, VA: DSMC Press, Jun 1996), 45.

The new approach to management embodied in the 5000 series revision of 1996 represented a historic change in the Defense Department's traditional practices, the most significant since the adoption of a standard acquisition oversight process in the early 1970s. Integrated product and process development and integrated product teams required the workforce to adopt a new mindset and learn new skills. In terms of their impact, institutionalization, and acceptance by the workforce, they represented some of the most successful acquisition reform initiatives of the Perry years.

CHANGING "WHAT WE BUY": MILITARY SPECIFICATIONS AND STANDARDS REFORM

Reform of the acquisition system's organizational structures and procedures would help provide the Defense Department with superior weapons on time and at acceptable cost. In Perry's view, the collection of military specifications and standards used to define nearly all of the products DoD purchased stood in the way of achieving these two objectives because they hindered the integration of the commercial and the defense-oriented industrial bases that would give the department access to advanced technologies and other products at lower costs. Acquisition reformers had long sought to reduce dependence on MILSPECs; many studies had examined the problem over the years, and Congress had weighed in from time to time. Since the 1980s, however, the department had met with little success in its efforts to cut through the tangle of MILSPECs. Detailed specifications for commonplace items such as fruitcakes, chocolate syrup, and dog combs had elicited public amusement and ridicule, but of greater consequence, many analysts believed the overuse of MILSPECs was adding significantly to the cost of products and preventing firms from offering innovative technology to the Pentagon. For example, in 1994 a study by Coopers & Lybrand/TASC (The Analytic Sciences Corporation, a defense contractor) branded the department's MIL-Q-9858 quality management system standard as the top single cost driver, claiming it increased the cost of defense acquisition by 18 percent—that one specification alone was said to account for 10 percent of the Defense Department's cost premium.[22]

In August 1993 Preston chartered a process action team to prepare a reform plan for MILSPECs. The following March, the team released its report, *Blueprint for Change*, which drew on previous studies of the subject and proposed a broad range of changes, including sharp restrictions on the use of MILSPECs in favor of commercial specifications (specifications used widely in civilian industry) and performance-based specifications (specifications that defined the expected performance but not the way that performance was to be achieved). A second team followed up with an implementation plan.[23]

On 29 June 1994, in "Specifications and Standards: A New Way of Doing Business," Perry's first major acquisition reform memorandum, the secretary "wholeheartedly" accepted the process action team's recommendations and ordered them implemented throughout the Defense Department. He prohibited the use of military specifications and standards in any acquisition except as "a last resort," and even then required a waiver for their use. Otherwise, performance specifications were preferred, with nongovernmental specifications as the second choice. Whereas previously program managers were required to seek permission to use commercial standards, now they had to obtain permission not to. "[W]e are . . . turning the present system upside down," he told reporters. Perry considered his memo on MILSPEC reform, rather than *A Mandate for Change*, to be the beginning of the acquisition reform program.[24]

Some of these policies were hardly new. The Defense Department had preferred performance specifications for several years. Yet, as Perry himself recognized, cultural change was required. He wanted to shock the system and get its attention. Severely restricting the use of MILSPECs achieved that objective. It was a bold and challenging move that would be difficult to implement. Perry himself noted that "the problem of unique military systems does not begin with the standards. The problem is rooted in the requirements determination phase of the cycle."[25]

The restrictions on the use of military specifications and standards, however, only applied to new contracts. Existing programs were exempted. This meant a company performing both old and new contracts might have to use multiple manufacturing and management processes in one facility. At one factory, for example, a defense contractor was forced to use eight different soldering specifications, including five for the government and three for commercial clients. The workers had to be trained on all eight soldering and inspection techniques, and the company had to maintain eight different types of production documentation. This drove up costs and made plant managers reluctant to adopt new processes while still committed to the old.[26]

In response, in December 1995 the Defense Department established the Single Process Initiative, also known as the Block Change Initiative because it allowed companies to make "block changes" to their contracts, shifting all of them to a single process at each facility. With this policy, the contractor cited in the above example could change all five of the military contracts to allow the use of a single soldering specification, eliminating the burden of adhering to multiple specifications. Contractors were encouraged to submit proposals to the government's on-site contracting officer for review and approval. The government was even willing to pay for the changes if contractors could demonstrate that they would produce significant long-term savings.[27]

The Defense Department signed the first two block change agreements with Texas Instruments Defense Systems and Electronics. Within nine months, 103 contractors had submitted 341 proposals covering 426 process changes; DoD accepted 349. OSD considered this approach critical to the success of MILSPEC reform and ultimately for integrating the private sector and defense markets. It also came to view the initiative as a primary vehicle for introducing best commercial practices among the department's contractors.[28]

The department maintained the Single Process Initiative through the rest of the decade, periodically adjusting and reinforcing it. By May 1997, 180 contractors had proposed 862 block changes; the department approved 429, for an estimated savings of over $100 million. In 1996 DoD signed what Kaminski called "the mother of all block changes" with Raytheon, covering 884 contracts and 16 separate facilities. He was so pleased with progress on this initiative by January 1997 that he sent a copy of the latest quarterly report to the White House to show the vice president its value for reinventing government. Kaminski considered it to be one of the most important of his initiatives and was anxious to have the program continue even after he left his post. His office issued instructions on the subject several times during his last weeks at DoD, including on his last day. Of the 30,000 specifications and standards, by February 1997 the Defense Department had canceled 5,104, replaced 555 detail specifications with performance specifications, and adopted 1,784 additional nongovernmental standards. In fall 1996 the department canceled MIL-Q-9858, governing contractor quality assurance programs, and replaced it with ISO 9000, a widely used commercial standard.[29]

After restricting the use of MILSPECs in favor of commercial standards and performance specifications, the next step was to mandate the use of open systems, a design concept emphasizing common, nonproprietary standards. When applied to interfaces and operating systems, the open systems approach allowed civilian-oriented firms to sell components and subsystems to the Defense Department that could readily be installed without having to adapt them to military standards. The department expected that employing such standards would expand its supplier base because firms could avoid incurring the expense of converting their commercial products and practices to government specifications. When used in conjunction with concepts such as modularity and functional partitioning—self-contained functional components to build systems—DoD anticipated the open systems approach would reduce costs and make technology upgrades easier. Technology upgrades and modular add-ons could also be quickly swapped into the larger system.[30]

Five months after Perry issued his specifications and standards memorandum, Kaminski took the first steps toward adopting the open systems approach by ordering its application to the acquisition of weapon system electronics. He also established the Open Systems Joint Task Force, with members drawn from OSD and DoD components, "to promote and oversee the enactment of this policy, identify opportunities for implementing open systems architectures, develop training and education programs, and coordinate the identification and selection of open systems specifications and standards." In March 1996 the newly revised 5000 series documents expanded this order to cover all weapon system components. After a workshop late that spring studied the practical aspects of implementing the policy, Kaminski ordered the service acquisition executives to adopt the open systems approach and report their progress regularly.[31]

DEFENSE ACQUISITION PILOT PROGRAM

Early on, DoD leaders decided to test their ideas for acquisition reform using pilot programs. They would be similar in concept to the earlier Defense Enterprise Programs (see chapter II). Established by Congress in 1986, enterprise programs could waive department policies, regulations, directives, and established administrative procedures, with the hope of achieving streamlined management. However, they were still required to follow the Federal Acquisition Regulation, or FAR; the Defense FAR Supplement, or DFARS; and existing procurement statutes. Believing that enterprise programs were more trouble than they were worth and that ongoing reforms were providing the same regulatory relief anyway, the Defense Department showed little enthusiasm for the initiative and allowed it to lapse by 1990. Instead, for a small number of "major defense acquisition pilot programs," Defense Secretary Cheney sought authority to waive laws and regulations governing certain procurement requirements for oversight, acquisition management, test and evaluation, and reporting. Congress agreed but insisted that Cheney obtain its approval for the programs he selected and the statutes he intended to waive. It also limited the experiment to one year, through the end of FY 1991; subsequently Congress extended the waiver authority through September 1995, the end of FY 1995. Evidently these conditions did not sit well with the secretary because he did not nominate any programs for pilot status as provided for by the act.[32]

Perry and his staff, however, saw value in the pilot program concept. Pilot programs would be a useful test bed for some of the acquisition innovations they had in mind, especially the application of commercial practices. The programs could provide useful lessons about the problems and benefits of those innovations as the Defense Department began to implement acquisition reforms across the board. By demonstrating practical results, the pilots would act as "change agents," providing encouragement to advocates of reform, quieting the objections of skeptics, and presenting models for other programs. Furthermore, they could jump-start acquisition reform by allowing the department to move forward while awaiting congressional action on broader reform legislation. In this way, acquisition reform could build up the early momentum that would help reformers bring the various acquisition organizations on board.[33]

At DoD's urging, Congress amended the pilot program legislation, deleting the limit of six programs (Perry had seven in mind at the time) and requiring the department to collect and analyze data on contractor performance. The law also recommended some specific measures dealing with contracting, program management, and workforce incentives that applied to one or more of the pilot programs. Additionally, it called for the Defense Department to use the lessons learned to reduce acquisition management and administrative costs by at least 25 percent by October 1998. These provisions were suggestions only and were not binding. The department generally received a free hand in managing the pilot programs but, as with the restrictions in place under Cheney, it had to obtain approval from Congress not only for each program selected but also for every statute to be waived.[34]

Perry wanted the pilot programs approved and launched as quickly as possible. For this reason, choosing the candidate programs, assembling the nomination packages for Congress, and submitting suggested legislation to the White House Office of Management and Budget became Preston's top priorities. She looked for programs that had an approved requirement, were still early in their cycle, were assured of relatively stable funding, and represented low technological risk. Additionally, the prospective pilot programs had to involve some aspect of acquisition reform, with preference for those that could satisfy their military requirement using commercial off-the-shelf or non-developmental items. Finding and selecting the programs proved difficult. Program managers of prospective pilots had to prepare an acquisition strategy, identify laws and regulations to be waived, and justify the waivers—generally in terms of dollars saved—and at the same time prepare a conventional acquisition strategy in the event the application for pilot program status was rejected. Furthermore, the Defense Department had to obtain the approval of OMB and other federal agencies with an interest in the socioeconomic-related statutes to be waived, including the Departments of Labor and Veterans Affairs, NASA, and the Small Business Administration. The first pilot programs included the Commercial Derivative Engine, a standard jet turbine intended for use on the C–17 airlifter; a Non-Developmental Airlift Aircraft conceived to provide a competing design for the C–17; the Joint Primary Aircraft Training System, featuring the T–6A Texan II propeller-driven aircraft for training Air Force and Navy entry-level student pilots; and the Joint Direct Attack Munition (JDAM).[35]

Preston hoped to have the nomination packages ready by summer 1993 to include in the National Defense Authorization Act for the next fiscal year. However, the proposal became controversial within the administration—every agency except NASA objected to waiving the statutes within its jurisdiction—so she was unable to submit the candidate programs until October, the day the Federal Acquisition Streamlining Act was introduced in the Senate. Congress folded the measure into the act, which delayed the program for another year. In the meantime, DoD had begun the pilot programs, but until the acts were passed it could only waive internal regulations, not statutory or FAR and DFARS requirements. The Defense Acquisition Pilot Program did not fully begin until December 1994, when Kaminski formally designated approved programs and waived the statutes as authorized by the Federal Acquisition Streamlining Act.[36]

THE SEARCH FOR REFORM METRICS

The pilot programs provided a test bed for developing metrics, objective yardsticks with which reformers could track and measure the progress of reform initiatives. The Government Performance and Results Act of 1993, the first among the Clinton administration's initiatives to promote efficiency and accountability in government, lay behind the push to create suitable metrics. The act required federal agencies to prepare strategic plans identifying long-term goals, to link those goals to short-term goals in annual performance plans, and to issue annual reports on the progress made toward meeting the goals. Although most agencies, including the Defense Department, were not required to present their strategic plans until September 1997 and their performance plans until 2000, the deadlines added to the pressure to devise suitable metrics for measuring the progress of acquisition programs and to ensure the means were in place to collect and evaluate the necessary data. Furthermore OSD, facing a declining Defense budget, needed to know as early as possible how the department's effort to streamline processes was affecting the ability of the acquisition system to fulfill its mission.[37]

OSD had organized an ad hoc group in 1993 to prepare the strategic and performance plans, at the same time it was putting together the pilot program initiative. In March 1994 Preston superseded the ad hoc group with the Defense Acquisition Pilot Program Consulting Group. It included members from OSD offices, DoD components, and the Defense Systems Management College. Led by Preston's director of international and commercial systems acquisition, William E. Mounts, it was to work with and oversee the pilot program offices to ensure that the metrics they were developing were conceptually sound and adequately supported by the data collected from the programs. It would also advise the program offices and resolve disputes regarding baselines and measurements. Metrics development burdened managers who were struggling to launch their programs, but by fall 1994 three pilot program offices had signed initial metrics agreements with the consulting group. The group then tracked the progress of the pilot programs according to these metrics and reported the results to Preston annually.[38]

To develop metrics for all DoD acquisition programs, in April 1995 the Defense Standards Improvement Council formed a "tiger team" of specialists to work on the problem. The team proposed 23 Strategic Outcome Metrics divided into four categories—cost, schedule, training, and performance—and included algorithms for calculating them. Preston superseded the tiger team with the Acquisition Reform Benchmarking Group in September 1995. After reviewing the metrics practices within the Defense Department, in other federal agencies, and in the commercial sector, the group devised its own hierarchy of metrics. This complex framework included three levels: "enterprise" metrics, which assessed the efficiency gains of the total acquisition process in the categories of cost, schedule, training, and performance; "subordinate," or "process" metrics, which measured the underlying tasks or elements contributing to enterprise metrics; and "program" metrics, which measured factors relating to specific acquisition programs.[39]

Thanks to the work of the benchmarking group, in July 1996 OSD announced a program that established six (later seven) enterprise-level metrics for measuring improvement in terms of cost, schedule, and performance. The metrics applied to all acquisition programs. Each metric was assigned a "champion," a DoD organization responsible for collecting, assembling, and reporting all relevant data and baselines to the Acquisition Reform Benchmarking Group. The baseline group coordinated the effort, published the results, and ensured that the metrics continued to be appropriate and useful.

Identifying accurate and meaningful metrics proved elusive. In December 1996 Kaminski worried that "while we are making good progress with our acquisition reform initiatives, there are few good measures of that progress." Connecting goals with statistics that could be collected and assessed was challenging, especially when a goal was imprecise. Other difficulties included conceiving standardized metrics that could be applied across programs and measuring the progress of a program or initiative while it was underway, a far more challenging task than analyzing the results after the fact. The inability to develop appropriate and useful metrics remained a significant drawback to implementing acquisition reform for the rest of the decade.[40]

THE JDAM PILOT PROGRAM

Within the Defense Department a small cohort had pushed to include a military-unique system as one of the first pilot programs, arguing that the new acquisition reforms were not worth doing if they could not be applied to an actual weapon program. The Pentagon's acquisition leadership eventually agreed, granting pilot program status to the Joint Direct Attack Munition in April 1994.[41]

JDAM's concept developed out of the success of precision-guided munitions during the 1991 Gulf War. The majority of these weapons in service at the time were laser-guided, a method undermined by weather and other environmental conditions. Even before the war, the Air Force and Navy had projects underway to develop a technology that would overcome the limitations of laser-guided systems. In 1991 DoD merged the two efforts into a joint program office, with the Air Force as the lead agency. Terry Little, a reform-oriented Air Force acquisition official, took over as program director in 1993.[42]

The JDAM system program office sought to produce an affordable, all-weather smart bomb by attaching a GPS guidance package and a set of control fins to a standard unguided gravity bomb. After issuing a request for proposal in April 1994, the Air Force awarded engineering and manufacturing development contracts to two competing design teams, one led by Martin Marietta (which would merge with Lockheed in 1995), and one led by McDonnell Douglas. Though a modular approach to the weapon's design seemed promising, JDAM's estimated unit cost rose from $40,000 to $68,000 in only a few years. Unlike other pilot program technologies, precision munitions were not available commercially. The challenge for Little and the competing design teams was to find cheaper, equivalent commercial components and then assemble them into an effective weapon system.[43]

Reformers expected the pilot programs to achieve savings in similar ways through the application of private-sector concepts and techniques. In support of this goal, the Defense Department waived dozens of regulations, mostly related to procedure and compliance, granting much greater flexibility to managers and easing their paperwork burden considerably. In JDAM's case, Little focused on commercial bidding and product development practices. He reissued the program's statement of work, cutting the document from 137 to 2 pages. During the bidding phase JDAM also employed integrated product teams. The teams consulted potential users on how best to tailor the product to their needs. This organizational innovation also enabled the use of a "rolling down-select" method, in which the program management team delivered feedback continuously before the final submission of designs, permitting a more iterative process.[44]

By waiving regulations, the JDAM program office attempted to reorder incentives between government and manufacturer, providing more freedom in some areas but making greater demands in others. For instance, the office realigned the system's requirements to focus on only a few critical factors, such as cost, while permitting designers to make trade-offs with lower-level objectives in order to achieve the most important requirements. The program managers also avoided issuing specifications for how to build the product, placing the responsibility and risk on the contractor. While the manufacturers had much greater freedom to choose their own specifications, the JDAM program also demanded a commercial-grade warranty of up to 20 years in the event the manufacturer's design failed to live up to its promises.[45]

McDonnell Douglas submitted the winning proposal with an average unit cost of less than $20,000 and a 20-year warranty. These figures far surpassed reformers' expectations and narrowly beat Lockheed Martin's proposal. According to Little, one of the main reasons the program succeeded in driving the price down was the government's hands-off approach to specifications and design, giving manufacturers more freedom to be creative. McDonnell Douglas succeeded in identifying high-volume commercial substitutes for most major components, including the GPS receiver, main processor chip, actuators, and inertial measurement unit. As the JDAM program began to demonstrate success, reformers accelerated it. The weapon skipped the final phases of developmental test and evaluation and went into low-rate initial production in 1997, more than a year ahead of schedule. JDAM's success gained the program office a measure of credibility that allowed it to engage in concurrency despite the significantly increased risks of that approach.[46]

The success of individual pilots would not necessarily confirm the validity of the concepts that underpinned the larger pilot program. Partly for this reason, the Defense Department dedicated considerable resources to developing metrics for determining exactly how much money individual factors had saved pilot programs against base cases using traditional acquisition methods. In the absence of control groups, however, settling on valid metrics could be quite difficult. Instead, programs would have to compare themselves against historical norms and averages, similar programs, previous expectations, or some combination of the three. For the most part, pilot programs compared themselves to their pre-Defense Acquisition Pilot Program baselines, including estimated cost, schedule, and staffing. By 1998 most pilot programs appeared to be successful, JDAM especially so, reducing source selection, bid and proposal costs, staffing, and unit costs by half or more.[47]

Crew members from Attack Squadron 145 prepare to load a JDAM on an F/A–18C Hornet on board USS *Harry S. Truman* (CVN 75) during Operation Enduring Freedom, February 2003. *(U.S. Navy)*

JDAM was also an operational success. The weapon officially entered service in December 1998 and was employed the next year with great effect by B–2 bombers, flying in combat for the first time during Operation Allied Force, the NATO air campaign against Serbia. The Air Force assessed that more than 80 percent of the 652 JDAMs released by B–2s during those operations hit their targets. During the opening months of Operation Enduring Freedom in Afghanistan in 2001, JDAMs, accounted for nearly 60 percent of the precision munitions expended and were the "guided weapon of choice" for the Air Force and Navy.[48]

Terry Little left JDAM in 1998 for a related project intended to extend and apply the principles he had demonstrated with the guided-bomb program—the Joint Air-to-Surface Standoff Missile (JASSM), a next-generation medium-range cruise missile with low-observable radar characteristics. Designed as a self-contained munition with its own propulsion, rather than as a "kit" to attach to a gravity bomb, the standoff missile was a far more sophisticated system than JDAM. Air Force and Navy leaders directed the program office to make the greatest use possible of commercial components and methods, however, and to apply the lessons of the Defense Acquisition Pilot Program. Unlike JDAM, JASSM was beset with problems so pervasive the program was suspended while the main contractor, Lockheed Martin, remedied numerous quality and design problems. The system's estimated cost jumped considerably thereafter, prompting the Navy to withdraw from the program. After a long development period, JASSM eventually entered the inventory, recording its first operational use in strikes on targets in Syria in April 2018.[49]

The legacies of other pilot programs are similarly mixed. The Commercial Derivative Engine was relatively successful, making it into the C–17 with an expansive warranty and substantial life-cycle savings due to common logistics with other engines. Development of the aircraft for the Joint Primary Aircraft Training System held out the promise of combining several Air Force and Navy aircraft into a single, commercially available design, but conflicts between the two services loaded the trainer with numerous expensive design changes, all of which occurred after source selection. The aircraft entered production in 2000 and subsequently experienced more than 25 percent cost growth. In November 1995 the Defense Department canceled the Non-Developmental Airlift Aircraft in favor of the C–17, claiming the threat of competition had been sufficient to spur McDonnell Douglas to find cost reductions and solve the C–17's development problems (see chapter XI). The pilot programs initially claimed substantial cost savings, but DoD metrics show that the majority of the savings came from reductions in cycle time and in program office staffing. Only JDAM could lay claim to substantial reductions in the actual cost of the contract. The Joint Primary Aircraft Training System also claimed substantial reductions, but subsequent overruns negated any savings that might have occurred early in the contract.[50]

As much as JDAM is touted as a successful weapon program, it was also a relatively uncomplicated system. Almost all of its major components had been produced for commercial use for years. Most major weapon systems, by contrast, possessed extensive software and military-specific components that could not be bought or sold in commercial markets. Even while JDAM was still a pilot program, informed observers openly questioned whether any of the lessons learned from it could apply to a sophisticated, state-of-the-art system like the F–22 stealth fighter.[51]

ACQUISITION REFORM THROUGH CLINTON'S FIRST TERM

By the time William Perry stepped down as secretary in January 1997, Kaminski believed the Defense Department had made great strides in reforming the acquisition system. According to one count, as many as 51 initiatives had been established since January 1993—most of them since Kaminski came to office the following year. The reduction in the number and use of military specifications and standards was underway as were steps toward reforming acquisition regulations and statutes. The department actively supported the enactment of the Section 800 Panel recommendations as the Federal Acquisition Streamlining Act in 1994, the Federal Acquisition Reform Act in 1995, and the Clinger-Cohen Act in 1996 and worked to implement those reforms. For example, it was implementing FASA's provisions regarding commercial purchasing and major systems acquisition, and was in the process of overhauling its acquisition of information technology in accordance with the Clinger-Cohen Act. The department helped rewrite Federal Acquisition Regulation, part 15, governing source selection and contract negotiation. Meanwhile, DoD revisions to its own acquisition guidance, the 5000 series directives and instructions, streamlined the acquisition process, reduced the documentation and oversight burden, promoted the tailoring of the acquisition process to the needs of the individual program, and instituted the use of integrated product teams.[52]

Many other acquisition reform measures were initiated during the first four years of the Clinton administration. There were changes pertaining to source selection, such as the use of contractor data on past performance; the handling of contract awards, protests, and contract administration; changes in audit and inspection procedures; new policies to encourage the use of commercial products; and increased use of e-commerce systems and data interchanges. In a major effort to teach the new way of doing things to the workforce, OSD acquisition leadership held reform days and town hall meetings, produced training videos and satellite broadcasts, made numerous public appearances, and developed a digital reference tool, the Defense Acquisition Deskbook, which helped frontline workers sort through the new regulations and differentiate between mandatory and optional procedures (see chapter XV). Beyond workforce education, however, acquisition leaders understood they had to change the culture that influenced how workers did their jobs.[53]

There was evidence that new and ongoing acquisition programs were adopting various reforms. In June 1996 Kaminski's office cited a number of programs that had reduced their reliance on military specifications and standards, including the Mark 48 torpedo, which slashed the number of MILSPECs in its solicitation from 103 to 5; the LPD 17 *San Antonio*-class amphibious ship, which went from 710 MILSPECs to 149; and the AH–64D Longbow Apache helicopter modification, which reduced the number of MILSPECs from 47 to 1, the number of data requirements from 117 to 15, and the contract's statement of work from 113 pages to 25. The services had also employed the open systems approach to systems engineering—the use of open, preferably commercial standards in lieu of propriety standards—in numerous programs: the Navy's UGM–133 Trident II Submarine-Launched Ballistic Missile, the New Attack Submarine (the *Virginia* class), LPD 17, modifications to the *Blue Ridge* (LCC 19) amphibious command ship, and Navy Area Theater Ballistic Missile Defense; the Army's Crusader artillery system and Intelligence and Electronic Warfare Common Sensor; the Air Force's F–15E; the Marine Corps' Advanced Amphibious Assault Vehicle and AV–8B Harrier; and, finally, the E–8 Joint Surveillance Target Attack Radar System and the F–35 Joint Strike Fighter.[54]

Perhaps the most successful initiatives were the application of integrated product teams and, more broadly, the employment of integrated product and process development. Programs adopting these reforms included the LPD 17, the F/A–18E/F Super Hornet, the RAH–66 Comanche helicopter, the MIM–104 Patriot Advanced Capability–3 missile defense system, the F–22 Raptor, and the Joint Strike Fighter.[55]

Surveys of government acquisition workers conducted by the services showed mixed results regarding the reforms. Workers believed the acquisition system had made real improvements, but significant obstacles to continued reform remained, ranging from lack of awareness and training deficiencies to management resistance. In a survey of Navy acquisition workers in 1997, about 30 percent agreed that acquisition reform had improved how they did their jobs and the products and services their organizations produced, and 75 percent reported they saw moderate to significant improvements in the acquisition process.[56]

For its part, industry also reported that although considerable progress had been made, much remained to be done before reforms achieved full implementation. In October 1997 Coopers and Lybrand surveyed 10 major defense contractors concerning awareness, implementation, and impact of reform measures. The survey revealed a "moderate" level of both awareness and implementation (2.6 and 2.9 on a 0-4 point scale, respectively). Although reform application was limited, many of the survey's industry participants "cited numerous instances where the government has been successful in effecting cycle time reductions or cost savings or avoidance." Positive outcomes in both areas resulted from eliminating MILSPECs and using the open systems approach, performance-based requirements, rapid prototyping in software development, and commercial standards for cost or pricing data.[57]

One of the main purposes for acquisition reform was to reduce the cost of acquisition. MILSPEC reform was estimated to save or avoid $90 million on the KC–135 Stratotanker's avionics upgrade, $236 million on the MILSTAR satellite communications system, and $300 million on the Joint Primary Aircraft Training System. The Army's Intelligence and Electronic Warfare Common Sensor was projected to avoid $35 million in R&D costs, $532 million in production costs, and $436 million in operations and support costs through the use of open systems. Overall, the services estimated $29 billion in cost reduction just in the two-year period from December 1993 through December 1995, with 63 programs each reporting amounts from $0 to $5.3 billion. The Air Force claimed reductions of $14.9 billion, over half of the total, followed by the Navy with $8.9 billion, and the Army with $5.2 billion. Nine programs reported savings of at least $1 billion, led by the C–17 ($5.4 billion), the F/A–18E/F ($3 billion), and JDAM ($2.9 billion).[58]

Some of these estimates, however, were questionable or at least unverifiable because they would not be realized until as late as 2002, or they were not reflected in any budget reduction. The General Accounting Office noted in an October 1997 report that the costs of the 33 programs it reviewed rose 2 percent and concluded that the estimated cost reductions were offset by cost increases elsewhere in the programs, or were reinvested within the programs. What the cost increases would have been without acquisition reform is unknown and probably unknowable. Even the GAO made the point that the estimates were difficult to verify. In other reports, the GAO lauded Defense Department efforts and approved of many initiatives but indicated that lasting, meaningful reform was unlikely to occur without fundamental changes in the acquisition culture and the incentives driving it.[59]

Meeting in spring 1997, focus groups comprising senior acquisition officials found much in the reform program to improve, for example, a better system of metrics for measuring reform. Even so, most thought acquisition reform was well underway and the Defense Department should be doing more with it, not less.[60]

As he approached the end of his time in office, Kaminski often compared DoD to a runner "who is just beginning the third lap of a four lap race." He had a sense of unfinished business, especially the ongoing instability in the acquisition program budgets that was playing havoc with their costs and schedules. Leaving this aside, however, Kaminski was satisfied with what the reform program was achieving. To strike the right balance between sober realism and confident optimism, he chose as the theme of the first acquisition reform stand-down day Winston Churchill's assessment of the British victory at El Alamein in November 1942: "This is not the end, or even the beginning of the end, but it is, I believe, the end of the beginning."[61]

Endnotes

1. Raymond L. Manganelli, "It's Not a Silver Bullet," *Journal of Business Strategy* 14, no. 6 (Nov-Dec 1993): 45; Thomas A. Stewart and Joyce E. Davis, "Reengineering: The Hot New Managing Tool," *Fortune* 128, no. 4 (23 Aug 1993): 41–48; Jill Vitiello, "Reengineering: It's Totally Radical," *Journal of Business Strategy* 14, no. 6 (Nov-Dec 1993): 44–47.

2. Michael Hammer, "Reengineering Work: Don't Automate, Obliterate," *Harvard Business Review* 68, no. 4 (Jul-Aug 1990): 104–105, 107–108, 112; Thomas H. Davenport and James E. Short, "The New Industrial Engineering: Information Technology and Business Process Redesign," *Sloan Management Review* 31, no. 4 (Summer 1990): 11–13, 16; Bristol Voss et al., "Setting a Course for Radical Change," *Journal of Business Strategy* 14, no. 6 (Nov-Dec 1993): 52; Vitiello, "Reengineering," 44; Tim R. Furey, Jennifer L. Garlitz, and Michael L. Kelleher, "Applying Information Technology to Reengineering," *Planning Review* 21, no. 6 (1 Jun 1993): 22–23; Richard Heygate, "Immoderate Redesign," *McKinsey Quarterly* (1993, Issue 1): 73–87; Subashish Guha, William J. Kettinger, and James T. C. Teng, "Business Process Reengineering: Building a Comprehensive Methodology," *Information Systems Management* 10, no. 3 (Summer 1993): 13; Peter Homa, "Business Process Re-engineering: Theory- and Evidence-Based Practice," *Business Process Re-Engineering & Management Journal* 1, no. 3 (1995): 10–30; Stewart and Davis, "Reengineering," 41–48; Dan Rasmus, "'Reengineering,' or Evolution Through Violent Overthrow," *Manufacturing Systems* 10, no. 9 (Sep 1992): 52. Hammer and James Champy claimed to have invented the concept of business process reengineering, but others argued it was based on an old idea; see Homa, "Business Process Re-engineering."

3. Michael Hammer and James Champy, *Reengineering the Corporation: A Manifesto for Business Revolution* (New York: Harper Business, 1993); "*Time's* 25 Most Influential Americans," *Time*, 17 Jun 1996, 52–73; Stewart and Davis, "Reengineering"; D. Lance Revenaugh, "Business Process Re-engineering: The Unavoidable Challenge," *Management Decision* 32, no. 7 (Oct 1994): 16; Walter Hamscher, "AI in Business-Process Reengineering," *AI Magazine* 15, no. 4 (Winter 1994): 71; Vitiello, "Reengineering"; Russ Linden, "Business Process Reengineering: Newest Fad, or Revolution in Government?" *Public Management* 75, no. 11 (Nov 1993): 9.

4. Steven Kelman, "White House-Initiated Management Change: Implementing Federal Procurement Reform," in *The Managerial Presidency*, ed. James P. Pfiffner, 2d ed. (College Station: Texas A&M University Press, 1999), 244, 246–254; Kelman, *Unleashing Change*, 82–107; various discussion threads from Acquisition Reform Net Electronic Forum, copies in author files, OSD/HO.

5. Memo for correspondents, 20 May 1993, with attached memo, USD(A) John Deutch for Secretaries of Military Departments et al., 19 May 1993, subj: Reorganization of OUSD (Acquisition and Technology), file VII-A, OSD/HO. The under secretary's principal deputy would oversee the Defense Acquisition Board process and some of the major functional divisions within OUSD(A&T): Strategic and Space Systems, Tactical Systems, Test and Evaluation, Acquisition Program Integration, Defense Procurement, and Computer-aided Acquisition and Logistic Support and Electronic Data Interchange.

6. Preston interview, 26 Mar 2008, 10–12, 15; Preston (remarks at the Heroes of Reinvention Hammer Award Ceremony, Arlington, VA, 20 Sep 1996) (hereafter Preston, Hammer Award remarks); ltr, Perry to "Friends," 12 Apr 1994 ("toughest, most informed"); memo, Deutch for Director, Administration and Management, 14 May 1993, subj: Establish Deputy Under Secretary of Defense for Acquisition Reform, Acker Library, Defense Acquisition University (DAU), www.library.dau.mil/DoD_MemoDepUnderSec.pdf, accessed 5 Feb 2015. Preston claimed to have originated the idea of an office dedicated to reform and wanted to name it "Business Process Engineering," but Deutch thought that sounded insufficiently aggressive.

7. Preston interview, 26 Mar 2008, 13–14.

8. Beck, Brokaw, and Kelmar, *Model for Leading Change*, chap. 5:3–5; Preston interview, 26 Mar 2008, 26. The Acquisition Reform Senior Steering Group included the JCS vice chairman; the DoD general counsel; the DoD comptroller; the DoD inspector general; the directors of defense research and engineering, program analysis and evaluation, defense procurement, and acquisition program integration in OSD; the assistant secretary of defense for command, control, communications, and intelligence; the director of the Defense Contract Audit Agency; the service acquisition executives; and the director of the Defense Logistics Agency (Perry, *Mandate for Change*, 14–15). Preston had initially wanted a broader membership that included members of Congress, officials of other executive branch offices, and industry CEOs. See draft memo, DepSecDef for Secretaries of Military Departments et al., n.d., subj: Strategic Plan for Acquisition Reform, attached to Preston to DepSecDef, 27 May 1993, subj: Proposed Strategic Plan to Pursue Acquisition Reform (hereafter DUSD[AR], Proposed Strategic Plan), folder 28 May 1993, Acc 330-97-0030, OSD Records, WNRC.

9. DUSD(AR), Proposed Strategic Plan; Preston interview, 26 Mar 2008, 12–13.

10. Kaminski interview, 24 Jan 2001, 3–6, 11, 17, 22; Kaminski interview, 14 Jun 2000, 41–45, 52–53 ("connected at the hip," 52), 55–56.

11. The report of the Contract Administration Reform PAT listed almost 200 individuals from DoD and industry as "contributors." See *Final Report of the Contract Administration Reform Process Action Team to the Under Secretary of Defense for Acquisition and Technology* (Washington, DC: DoD, Feb 1995), xi–xv. For the Procurement Process Reform PAT quotes, see *Final Report of the Procurement Process Reform Process Action Team to the Under Secretary of Defense for Acquisition and Technology* (Washington, DC: DoD, Jan 1995), iv, x–xii.

12. Preston, Hammer Award remarks; memo, Preston for Perry (through USD[A]), 1 Sep 1993, subj: PAT on Mil Specs and Standards—Information Memorandum, Acc 330-97-0030; Process Action Team on Military Specifications and Standards, *Blueprint for Change: Report of the Process Action Team on Military Specifications and Standards* (Washington, DC: OUSD[A&T], Apr 1994), app. A.

13. Memo, Kaminski for Secretaries of Military Departments et al., 11 Apr 1996, subj: Stand-Down – Acquisition Reform Acceleration Day; Defense Acquisition University, *Acquisition Reform Acceleration Day Summary Report*, 23 Jul 1996, 2–54; Kaminski, "Acquisition Reform Day Feedback," videotaped remarks, 10 Oct 1996; "AR Day Feedback," document dated 21 Nov 1996 ("Final Version"); "DoD Electronic Commerce AR Day #1 Action Item Status," briefing presented to the ARSSG, 11 Feb 1997; Alan Gregory, "Status Report on Acquisition Reform Education & Training," briefing presented to ARSSG, 25 Feb 1997; memo, Acting DUSD(AR) for USD(A&T) and PDUSD(A&T), 27 Feb 1997, subj: Synopsis of AR Day 1 Action Items – INFORMATION: copies of all in author files. See documents relating to the Defense Manufacturing Council offsite and the first PEO/SYSCOM Commanders' Conference (Mar 1995) in file DAE/AAE Offsite Mar 95, box Ac Corps, PEO Days: copies in author files. For the Defense Manufacturing Council, see DoD News Release 666-94, 29 Nov 1994.

14. Kaminski interview, 14 Jun 2000, 20; Kaminski interview, 24 Jan 2001, 8–9; "Paul Kaminski on Acquisition Reform," *Program Manager* Special Issue 26, no. 1 (Jan-Feb 1997): 7; Acquisition Reform Process Action Team, *Reengineering the Acquisition Oversight and Review Process: Final Report to the Secretary of Defense* (Washington, DC: DoD, 9 Dec 1994), 1:1, 4–57; John S. Caldwell Jr., "Reengineering the Oversight and Review Process for Systems Acquisition," *Program Manager* 24, no. 3 (May-Jun 1995): 3–5.

15. Memo, Kaminski for Secretaries of Military Departments et al., 28 Apr 1995, subj: Reengineering the Acquisition Oversight and Review Process; Kaminski, statement prepared for the SCAS, Subcommittee on Acquisition and Technology, 20 Mar 1996, 31: copies of both in author files.

16. Kaminski memo, Reengineering the Acquisition Oversight and Review Process, 28 Apr 1995.

17. Descriptions of the roles of "working-level" or "program" IPTs can be found in DSMC, *Systems Engineering Fundamentals* (Fort Belvoir, VA: Defense Acquisition University Press, Jan 2001), 172–174; Anthony R. DiTrapani and Jonathan D. Geithner, *Getting the Most Out of Integrated Product Teams (IPTs)*, CRM 96-49.10 (Alexandria, VA: Center for Naval Analyses, Oct 1996), 17–19; *Integrated Program Team Manual Update: Guidance for Program Teams and Their Subsets* (n.p.: [Naval Air Systems Command], Dec 1996), 3–5, 11–12.

18. Paul R. Popick and Sarah A. Sheard, "Ten Lessons Learned from Implementing Integrated Product Teams," *CrossTalk: The Journal of Defense Software Engineering* 9, no. 7 (Jul 1996), n.p., https://web.archive.org/web/19991010020706/http://www.stsc.hill.af.mil/CrossTalk/1996/jul/tenlesso.asp, accessed 12 Feb 2020; Susan Page Hocevar and Walter E. Owen, "Team-Based Redesign as a Large-Scale Change: Applying Theory to the Implementation of Integrated Product Teams," *Acquisition Review Quarterly* 5, no. 2 (Spring 1998): 158–160, 162–163; Joe Ferrara and Collie Johnson, "Institutionalizing Integrated Product Teams: DoD's Commitment to Change," *Program Manager* 24, no. 6 (Nov-Dec 1995): 2–5; memo, I. N. Blickstein, Director, Acquisition Program Integration, for USD(A&T) Staff Meeting Participants, 23 Jun 1995, subj: "All-Hands" Meeting on IPPD/IPT Reform – OSD's Commitment to Change, folder OSD IPT Offsite 20 Jul 1995, box Ac Corps, PEO Days; proceedings of the DoD IPT Offsite, DSMC, Fort Belvoir, VA, 20 Jul 1995; memo, Kaminski for Secretaries of Military Departments et al., 14 Aug 1995, subj: Questions and Answers from the DoD Offsite Conference: "Institutionalizing IPTs: DoD's Commitment to Change": copies of all in author files; USD(A&T) and the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (C3I), *Rules of the Road: A Guide for Leading Successful Integrated Product Teams* (DoD, Nov 1995, and revision 1, Oct 1999); ODUSD(AR), *OIPT-WIPT Information Guide* (n.p., DoD, Mar 1996); Richard Engel, "Overarching Integrated Product Team—Working Integrated Product Team Process," *Program Manager* Special Issue 26, no. 1 (Jan-Feb 1997): 48–49; [Richard Engel,] "OIPT-WIPT Process: A Status Report" (presentation, 3d PEO/SYSCOM Commanders/PM Conference, Fort Belvoir, VA, 26 Mar 1996), box Ac Corps PEO Days, copy in author files; Skip Hawthorne, *"AR Week/IPT Survey Feedback,"* undated briefing in author files.

19. *DoD Guide to Integrated Product and Process Development*, ver. 1.0 (Washington, DC: OUSD[A&T], 5 Feb 1996), chap. 1:1–10.

20. Robert I. Winner et al., *The Role of Concurrent Engineering in Weapons System Acquisition*, IDA Report R-338 (Alexandria, VA: IDA, Dec 1988), 1–49; memo, USD(A) Costello for Secretaries of Military Departments, 9 Mar 1989, subj: Concurrent Engineering—A Total Quality Management Process, box 3, Acc 330-92-0136, OSD Records, WNRC; U.S. Air Force, *Air Force Materiel Command Guide on Integrated Product Development* (n.p., 25 May 1993), 4–10, 95–106; Defense Science Board, *Report of the Defense Science Board Task Force on Engineering in the Manufacturing Process* (Washington, DC: OUSD[A], Mar 1993), chap. 1:1–13; memo, Perry for Secretaries of Military Departments et al., 10 May 1995, subj: Use of Integrated Product and Process Development and Integrated Product Teams in DoD Acquisition, copy in author files; DoD News Release 264-95, "Department of Defense Announces Bold Reform for Major Systems Oversight and Review," 16 May 1995.

21. DoD Directive 5000.1 (Defense Acquisition), 23 Feb 1991; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991; DoD 5000.2-M (Defense Acquisition Management Documentation and Reports), 23 Feb 1991; DoD Directive 5000.1 (Defense Acquisition), 15 Mar 1996; DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs [MDAPs] and Major Automated Information System [MAIS] Acquisition Programs), 15 Mar 1996; Charles B. Cochrane, "Defense Acquisition Policy—A More Flexible Management Approach," *Program Manager* 25, no. 4 (Jul-Aug 1996): 16; memo for the Defense Acquisition Community, USD(A&T) Kaminski, Philip Coyle, Director, Operational Test and Evaluation, and ASD(C3I) Emmett Paige Jr., 15 Mar 1996, subj: Update of the DoD 5000 Documents, copy in author files.

22. GAO, *Acquisition Reform: DoD Begins Program to Reform Specifications and Standards*, GAO-NSIAD-95-14 (Oct 1994), 4–5, 21; Gansler, "How the Pentagon Buys Fruitcake," 94; HCAS, Investigations Subcommittee, *DoD Military Specifications and Standards: Hearing*, 102d Cong., 2d sess., 22 Jul 1992, HASC No. 102-75, 1–29, 106–111, 206–223; CSIS, *Integrating Commercial and Military Technologies*, 41–52; Sanders, *Road Map for Milspec Reform*; Coopers & Lybrand/TASC, "The DoD Regulatory Cost Premium: A Quantitative Assessment" (briefing prepared for DoD, Dec 1994), 20–20a.

23. DepSecDef Perry to Jacques Gansler, 17 Sep 1993, attached to memo, ASD(ES) Walter B. Bergmann for Perry, 1 Sep 1993, subj: Report on Military Specifications and Standards, box 7 (filed under date 13 Sep 1993); memo, Preston for Perry, 1 Sep 1993, subj: PAT on Mil Specs and Standards—Information Memorandum, box 7: both in Acc 330-97-0030; Process Action Team on Military Specifications and Standards, *Blueprint for Change*; GAO, *Acquisition Reform . . . Specifications and Standards*, 4–5; *Implementation Plan for the Process Action Team Report on Specifications and Standards*, version 1.0 (Washington, DC: OASD [Economic Security], 23 Jun 1994). Performance specifications told contractors what performance was required but not how to achieve it. According to the Defense Standards Improvement Council, "A performance specification states requirements in terms of the required results with criteria for verifying compliance, but without stating the methods for achieving the required results. A performance specification defines the functional requirements for the item, the environment in which it must operate, and interface and interchangeability characteristics. Defense Standardization Program SD-15, *Performance Specification Guide* (Washington, DC: Office of the Assistant Secretary of Defense for Economic Security, 29 Jun 1995), 6.

24. Perry memo, 29 Jun 1994, subj: Specifications & Standards; Thomas E. Ricks, "Pentagon, in Streamlining Effort, Plans to Revamp Its Purchasing Procedures," *Wall Street Journal*, 30 Jun 1994, 1 ("upside down"); Carter and Perry, *Preventive Defense*, 185.

25. Walter B. Bergmann II, "Message from Chairman, Defense Standards Improvement Council," *Standardization Newsletter*, Special Edition (Oct 1994): 1; "Chairman's Message: Waiver Requests—A Matter of Balance," *Standardization Newsletter*, Fall Edition (Oct 1995): 2; GAO, *Acquisition Reform . . . Specifications and Standards*, 4–11; Perry memo, Specifications & Standards, 29 Jun 1994 (Perry quote).

26. Kaminski (speech, Lockheed-Martin Common Processes Conference, Arlington, VA, 18 Jan 1996), copy in author files.

27. Memo, Perry for Secretaries of Military Departments et al., 6 Dec 1995, subj: Common Systems/ISO-9000/Expedited Block Changes; memo, Kaminski for Secretaries of Military Departments et al., 8 Dec 1995, subj: Single Process Initiative: copies of both in author files; DoD News Release 647-95, "Department of Defense Announces Policy on Single Process Initiative," 8 Dec 1995.

28. Robert W. Drewes, "SPI—Progress Made and Lessons Learned," *Program Manager* Special Issue 26, no. 1 (Jan-Feb 1997): 37.

29. Memo, USD(A&T) Jacques Gansler for Secretaries of Military Departments, 3 Jun 1998, subj: The Single Process Initiative—A Long Term Perspective; "Single Process Initiative Biweekly Report," 23 May 1997; Kaminski, statement before the House Committee on National Security, 26 Feb 1997; ltr, Kaminski to Dr. Elaine Kamarck, Senior Policy Advisor to the Vice President, 27 Jan 1997; memo, DUSD(A&T) R. Noel Longuemare for SAEs et al., 30 Apr 1997, subj: Single Process Initiative and New Contracts; memo, Kaminski for Secretaries of Military Departments et al., 1 May 1997, subj: Review and Approval of Single Process Initiative Proposals; memo, Kaminski for the SAEs et al., 16 May 1997, subj: Subcontractor Single Process Initiative (SPI): copies of all in author files; Office of the Under Secretary of Defense for Acquisition and Technology, *MilSpec Reform: Results of the First Two Years* (Washington, DC: DoD, Jun 1996). Gansler strongly supported the single process initiative as essential for integrating the private sector and defense markets. See Gansler, "The Single Process Initiative: Its Role in Civil/Military Integration" (remarks at the SPI Recognition Awards Ceremony, Defense Logistics Agency, Fort Belvoir, VA, 29 Sep 1998), copy in author files; LeAntha Sumpter, "Gansler Endorses Single Process Initiative Throughout DoD-Industry," *Program Manager* 27, no. 5 (Sep-Oct 1998): 2–3.

30. For descriptions of the open systems approach, see Matt Gillis, "Open Systems Joint Task Force Gets the Word Out," *Program Manager* 28, no. 4 (Jul-Aug 1999): 44–47; Michael Hanratty, Robert H. Lightsey, and Arvid G. Larson, "Open Systems and the Systems Engineering Process," *Acquisition Review Quarterly* 7, no. 5 (Winter 1999): 47–58.

31. Memo, Kaminski for Secretaries of Military Departments et al., 29 Nov 1994, subj: Acquisition of Weapons Systems Electronics Using Open Systems Specifications and Standards; DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs [MDAPs] and Major Automated Information System [MAIS] Acquisition Programs), sec. 4.3.4 (quote); memo, Kaminski for the Assistant Secretary of the Army (RD&A) et al., 10 Jul 1996, subj: Open Systems Acquisition of Weapons Systems; Chien Huo, "Open Systems Policy Directions: The DoD 5000.2-R, Change 3," 11 Apr 1998; "Open Systems Policy in the DoD 5000.2-R, Change 4," 24 May 1999: copies of all in author files.

32. *National Defense Authorization Act for Fiscal Year 1991*, P.L. 101-510 (5 Nov 1990), sec. 809; *National Defense Authorization Act for Fiscal Year 1993*, P.L. 102-484 (23 Oct 1992), sec. 811; "Pentagon Can Waive Acquisition Regulations for Pilot Programs," *Inside the Pentagon* 7, no. 35 (29 Aug 1991): 13; 103d Cong., 1st sess., *Congressional Record* 139 (7 Oct 1993): S11547; HCAS, Military Acquisition Subcommittee, *Acquisition Reform: Fact or Fiction? Hearing*, 15 Jun 1993, 6.

33. HCAS, *Acquisition Reform: Fact or Fiction?* 6; Perry, *Mandate for Change*, 17; Secretary of Defense Les Aspin, *Annual Report to the President and the Congress*, Jan 1994, 110; *Congressional Record* 139 (7 Oct 1993): S11546.

34. *National Defense Authorization Act for Fiscal Year 1994*, P.L. 103-160 (30 Nov 1993), secs. 831–839.

35. Memo, Preston for Perry, 16 Jul 1993, subj: Status Report on Short Term Acquisition Reforms, folder 19 Jul 1993; memo, Deutch for Secretaries of Military Departments et al., 21 Jul 1993, subj: Defense Acquisition Pilot Programs, file 24 Jul 1993: both in Acc 330-97-0030; HCGRO, *Implementation of FASA*, 53; Brenda Forman, "Wanted: A Constituency for Acquisition Reform," *Acquisition Review Quarterly* 1, no. 2 (Spring 1994): 94. The initial pilot programs are described in sec. 5064 of *Federal Acquisition Streamlining Act of 1994*, P.L. 103-355 (13 Oct 1994), 108 Stat. 3359.

36. DUSD(AR), Proposed Strategic Plan; Senate Committee on Governmental Affairs and Committee on Armed Services, S. 1587*, Federal Acquisition Streamlining Act of 1993*, 446–448; Colleen Preston, statement before the SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1994 and the Future Years Defense Program: Hearings . . . on S. 1298,* pt. 5: *Defense Technology, Acquisition, and Industrial Base*, 103d Cong., 1st sess., 28 Jun 1993, 449; DoD Press Release 517-93, "DoD's Acquisition Reform Recommendations to 800 Panel Report," 28 Oct 1993; Preston, "Acquisition Reform: Making It a Reality," *Acquisition Review Quarterly* 1, no. 1 (Winter 1994): 10; Forman, "Wanted," 94; *Congressional Record* 139 (26 Oct 1993): H8505, S14380; *Federal Acquisition Streamlining Act of 1994*, sec. 5064; memo, Kaminski for Secretaries of Military Departments and Under Secretary of Defense (Comptroller), 15 Dec 1994, subj: Defense Acquisition Pilot Programs Designation and Statutory Relief, in Pilot Program Consulting Group, *Interim Report* (n.p.: Deputy Under Secretary of Defense for Acquisition Reform, Fall 1994), tab C.

37. P.L. 103-62 (3 Aug 1993), sec. 4b; Senate Committee on Governmental Affairs, *Government Performance and Results Act of 1993*, 103d Cong., 1st sess., 16 Jun 1993, S. Rep. 103-58, 28–29; "GPRA Spurs Efforts to Measure Results," *Acquisition Reform Today* 2, no. 4 (Jul/Aug 1997): 1, 7; "AR's Benchmarking Initiative," *Acquisition Reform Today* 3, no. 1 (Jan/Feb 1998): 1. A metric was any concrete measurement of data over time to indicate a trend. Examples of metrics included unit procurement or life-cycle costs, the length of the acquisition cycle from program start to production, contractor overhead, and production lead time from contract award to delivery. Any statistic that could be calculated, input into a database, and displayed on a spreadsheet or chart could conceivably be used as a metric. There were essentially three kinds of metrics. The first were "go/no-go" metrics that simply recorded whether an event had occurred—whether a report had been issued, for example, or a particular developmental milestone was passed. The second were "activity" metrics that determined the extent to which an activity was taking place, such as the use

of commercial or non-developmental items in the development of a given system. The third were "effectiveness" metrics that measured whether the actions being taken were leading to the desired results. See *Final Report of the Contract Administration Reform Process Action Team to the Under Secretary of Defense for Acquisition and Technology*, Feb 1995, chap. 3:21.

38. Pilot Program Consulting Group, *Interim Report Prepared for the Deputy Under Secretary of Defense for Acquisition Reform*, Fall 1994, tab 1:1–3, 8–9; tab 2; Pilot Program Consulting Group, *1995 Interim Report* (n.p., n.d.); Pilot Program Consulting Group, *1996 Report* (n.p., n.d.); Pilot Program Consulting Group, *1996 Compendium of Pilot Program Reports* (n.p., n.d.); Pilot Program Consulting Group, *1997 Report: Celebrating Success: Forging the Future* (n.p., n.d.); Pilot Program Consulting Group, *PPCG 1997 Compendium of Pilot Program Reports* (n.p., n.d.); Pilot Program Consulting Group, *Compendium of Defense Reform Performance: Affordable Defense for the 21st Century* (n.p.: Apr 1999): copies of all in author files. OSD representatives on the Defense Acquisition Pilot Program Consulting Group were from the DoD comptroller's and the DoD inspector general's offices; component representatives came from the Defense Contract Audit Agency and the Defense Contract Management Command.

39. "Acquisition Reform: Tiger Team on Metrics, April 1995–August 1995," briefing, 19 Sep 1996, copy in author files; Aron Pinker, Charles G. Smith, and Jack W. Booher, "Selecting Effective Prosecution Metrics," *Acquisition Review Quarterly* 4, no. 2 (Spring 1997): 191–192, 206; memo, Preston for Secretaries of Military Departments et al., 3 Sep 1996 [sic, 18 Sep 1995?], subj: Acquisition Reform Benchmarking Initiative Charter; Acquisition Reform Benchmarking Group, *1997 Final Report*, 30 Jun 1997, chap. 1, copy in author files (hereafter ARBG, *1997 Final Report*); Joseph Kevin Pope, "Measuring the Effect of the Defense Acquisition Workforce Improvement Act" (thesis, Naval Postgraduate School, Monterey, CA, Jun 1997), 35–56; Curtis K. Munechika, "Acquisition Reform: 'This, Too, Shall Pass . . . ?'" (research paper, Air Command and Staff College, Air University, Maxwell AFB, AL, Mar 1997), 55–60. Secretary Perry established the Defense Standards Improvement Council in June 1994 to coordinate DoD's specifications and standards program. The council comprised representatives from OSD, the services, and the Defense Logistics Agency and reported to the assistant secretary of defense for economic security. See memo, Perry for Secretaries of Military Departments et al., 29 Jun 1994, subj: Specifications & Standards—A New Way of Doing Business, copy in author files.

40. ARBG, *1997 Final Report*, app. A; memo, DUSD(A&T) Longuemare for Secretaries of Military Departments et al., 16 Jul 1996, subj: DoD Enterprise Acquisition Metrics Program; "DoD Enterprise Metrics Program, 30 Aug 1996," briefing; Munechika, "Acquisition Reform," 55; memo, USD(A&T) Kaminski for PDUSD(A&T) et al., 3 Dec 1996, subj: Metrics for Measuring Acquisition Reform: copies of all in author files; Defense Science Board, *Report of the Defense Science Board Task Force on Acquisition Reform Phase IV* (Washington, DC: OUSD[A&T], Jul 1999), 1–11.

41. Cynthia Ingols and Lisa Brem, *Implementing Acquisition Reform: A Case Study on Joint Direct Attack Munitions* (Fort Belvoir, VA: DSMC, Jul 1998), 3–5, 9.

42. Barry D. Watts, *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects* (Washington, DC: Center for Strategic and Budgetary Assessments, Mar 2007), 214–216.

43. Ibid., 213–214; Ingols and Brem, *Implementing Acquisition Reform*, 1–2, 5–6; Dominique Myers, "Acquisition Reform: Inside the Silver Bullet – A Comparative Analysis – JDAM versus F–22," *Acquisition Review Quarterly* 9, no. 4 (Fall 2002): 314.

44. Pilot Program Consulting Group, *Compendium of Pilot Program Reports* (Washington, DC: Deputy Under Secretary of Defense for Acquisition Reform, 1997), 5–13.

45. Pilot Program Consulting Group, *1997 Report: Celebrating Success*, 3, 4, 11, 29.

46. Ingols and Brem, *Implementing Acquisition Reform*, 10-12. For testing schedule and GAO objections, see memo, Louis J. Rodrigues, Director, Defense Acquisitions Issues, GAO, for Secretary of the Air Force Sheila E. Widnall, subj: Joint Direct Attack Munition: Low-Rate Initial Production, GAO/NSIADD-97-116R (17 Mar 1997). For the list of commercial components, see Pilot Program Consulting Group, *Compendium*, 5.

47. For concerns about developing metrics, see memo and attachment, William Mounts, Pilot Program Consulting Group, for Program Manager, Joint Direct Attack Munition, subj: Pilot Program Consulting Group (PPCG) Issues on JDAM Metrics (Washington, DC: OUSD[AR], 4 Dec 1994). For success by these metrics, see Pilot Program Consulting Group, *Compendium*, 7–13.

48. Watts, *Six Decades of Guided Munitions*, 217 (quote), 222–223.

49. Pamela Bowers, "Judy Stokley and Terry Little Lead Acquisition Reform," *CrossTalk* 13, no. 11 (Nov 2000): 4–7. For JASSM's problems, see "JASSM/No Ma'am – Which Will it Be?" *Defense Industry Daily*, 12 Oct 2005, http://www.defenseindustrydaily.com/jassm-no-maam-which-will-it-be-01326/, accessed 21 Nov 2013; Tony Capaccio, "Lockheed $6 Billion Missile Program May Be Killed, U.S. Says," *Bloomberg News*, 30 Jun 2009, http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aaH6VKOIUXUs, accessed 21 Nov 2013; and Gayle S. Putrich, "$68M plan to fix JASSM gets the OK," *Air Force Times*, 20 Jul 2007, http://www.airforcetimes.com/article/20070720/NEWS/707200336/-68M-plan-to-fix-JASSM-gets-the-OK, accessed 21 Nov 2013; AFCENT Public Affairs, Combined Air Operations Center, United States Air Forces Central Command, "AFCENT Airpower Summary: Multinational Strikes on Syrian Chemical Weapons Production Facilities," 30 Apr 2018, https://www.afcent.af.mil/Portals/82/Documents/Airpower%20summary/Airpower%20Summary%20-%20April%202018%20(Final%20and%20Corrected).pdf?ver=2018-05-21-052403-213, accessed 14 Mar 2019.

50. In terms of savings from cycle time, contract cost, and program staffing, respectively, DoD estimated cost reductions of 35, 50, and 30 percent for JDAM; 0, 49, and 47 percent for the Joint Primary Aircraft Training System; and 60, 4, and 42 percent for the Commercial Derivative Engine. Sources of savings and details on the Commercial Derivative Engine are in Pilot Program Consulting Group, *1997 Report*, 3, 7, 29–30. For the joint aircraft trainer, see DoD News Release 401-07, "Department of Defense Releases Selected Acquisition Reports," 9 Apr 2007, http://www.defense.gov/releases/release.aspx?releaseid=10714, accessed 21 Nov 2013.

51. See Myers, "Acquisition Reform: Inside the Silver Bullet," 313–321.

52. Coopers & Lybrand LLP, "Acquisition Reform Implementation: An Industry Survey" (briefing prepared for Service Acquisition Executives, Coopers & Lybrand LLP, Oct 1997), Exhibit 1; Christopher H. Hanks et al., *Reexamining Military Acquisition Reform: Are We There Yet?* (Santa Monica, CA: RAND Arroyo Center, 2005), 97–99; DoD IG, *Purchasing Commercial Products*, Audit Report 97-145 (Washington, DC: DoD, 23 May 1997); GAO, *Acquisition Reform: Implementation of Title V of the Federal Acquisition Streamlining Act of 1994*, GAO-NSIAD-97-22BR (Oct 1996).

53. "Institutionalizing Cultural Change: Colleen Preston on Acquisition Reform," 24–26. For a broader discussion of the problem of cultural change, see Beck, Brokaw, and Kelmar, *Model for Leading Change*. For cultural change throughout the federal government, see Anne Laurent, "Cultural Revolution," *Government Executive* (1 Jul 1997), https://www.govexec.com/magazine/1997/07/cultural-revolution/5743/, accessed 13 Oct 2020.

54. OUSD(A&T), *MilSpec Reform*, 16–17; Trish Bryan, "Open Systems—Fielding Superior Combat Capability Quicker," *Program Manager* 27, no. 1 (Jan-Feb 1998): 50–51; Open Systems Joint Task Force, "Using Open Systems for Weapons," briefing, n.p. & n.d., https://apps.dtic.mil/dtic/tr/fulltext/u2/a402572.pdf, accessed 20 Feb 2020; Defense Science Board Open Systems Task Force, *An Open Systems Process for DoD, Final Report* (Washington, DC: OUSD[A&T], 25 Sep 1998), 20; Lockheed Martin press release, "Fleet Ballistic Missile Trident Open System Architecture Team Earns DoD Acquisition Reform Award," 2 Oct 2001.

55. Larry Griffin and Robert I. Winner, *Integrated Product/Process Development in Upgrade and Mod Programs* (Hopkinton, MA: R. Winner & Associates, Feb 2003), chap. 1:10–11; Winner, *Integrated Product/Process Development in the New Attack Submarine Program: A Case Study*, 2d ed. (Washington, DC: USD[AT&L], Feb 2000); Howard Fireman et al., "LPD–17 on the Shipbuilding Frontier: Integrated Product & Process Development" (paper delivered at the Association of Scientists and Engineers 35th Annual Technical Symposium, 17 Apr 1998); Christina M. Patterson and Karen J. Richter, *Integrated Product and Process Development (IPPD) Case Examples*, IDA Document D-2223

(Alexandria, VA: IDA, Dec 1998); Beth Springsteen et al., *Integrated Product and Process Development Case Study: Development of the F/A–18E/F*, IDA Document D-2228 (Alexandria, VA: IDA, Jun 1999).

56. "Acquisition Reform Week III: Department of the Navy Survey Results," briefing, Navy Department, 1998, copy in author files. The briefing reported the results of the 1998 survey but also included the results of the 1997 survey; the 1997 report has not been found.

57. Coopers and Lybrand, "Acquisition Reform Implementation: An Industry Survey," 3, 5, 5a, 9, 9a, 17 (quote).

58. OUSD(A&T), *MilSpec Reform*, 17; Open Systems Joint Task Force, *Case Study of the U.S. Army's Intelligence and Electronic Warfare Common Sensor (IEWCS)* (Alexandria, VA: OSJTF, 15 Nov 1996), 31–33, A.2-1–A.2-4; GAO, *Acquisition Reform: Effect on Weapon System Funding*, GAO/NSIAD-98-31 (Oct 1997), 2, 4–5, 18–20.

59. GAO, *Effect on Weapon System Funding,* 2; GAO, *Acquisition Reform: Efforts to Reduce the Cost to Manage and Oversee DoD Contracts*, GAO/NSIAD-96-106 (Apr 1996); GAO, *Acquisition Reform: DoD Faces Challenges in Reducing Oversight Costs*, GAO/NSIAD-97-48 (Jan 1997); GAO, *High-Risk Series: Defense Weapon System Acquisition*, GAO/HR-97-6 (Feb 1997); GAO, *DoD High-Risk Areas: Eliminating Underlying Causes Will Avoid Billions of Dollars in Waste*, GAO/T-NSIAD/AIMD-97-143 (1 May 1997).

60. "Acquisition Reform Executive Focus Group, March 31, 1997: Final Report," and "ODUSD-AR Acquisition Reform Focus Group, Performance Based Service Contracting Executive Group II, May 5, 1997: Final Report": copies of both in author files.

61. Kaminski, "Sustaining the Momentum: Full Speed Ahead" (speech, Acquisition Reform Day Kick-off Ceremony, Washington, DC, 17 Mar 1997) ("third lap of a four lap race"); Kaminski, "The End of the Beginning" (speech, Acquisition Reform Day, Pentagon, Washington, DC, 31 May 1996) ("end of the beginning"): copies of both in author files.

I. "Institutionalizing Cultural Change: Colleen Preston on Acquisition Reform," *Program Manager* 26, no. 1 (Jan-Feb 1997): 24; Preston interview, 26 Mar 2008, 1–6; Professional Services Council, "Statement of Colleen A. Preston . . . Before the Subcommittee on Government Management, Organization, and Procurement of the Committee on Oversight and Government Reform, U.S. House of Representatives, H.R. 5712, April 15, 2008," 11, copy in author files; Colleen Preston, Linkedin, https:/www.linkedin.com/in/colleen-preston-4192136, accessed 3 Mar 2020.

CHAPTER VIII

The Technology Imperative

The new Pentagon leadership, as noted in chapter VI, made acquisition and deployment of new technology a high priority and a significant goal of acquisition reform. They viewed advanced technology as the solution to many problems in weapons acquisition and the conduct of military operations. Both Secretaries of Defense Les Aspin and William Perry had played a critical role in acquiring the advanced weaponry that performed so impressively in the Gulf War in 1991, and both believed the results vindicated their faith in new technology. Both, too, were convinced that the end of the Cold War did not lessen the importance of high technology in defense systems—quite the opposite. Globalization and the rise of high technology now raised the danger that other states, even small ones with no global ambitions, could acquire advanced weaponry that could tip the balance of power in regions of vital concern to the United States. But reduced defense spending and force structure meant the nation would have to confront the new threats with smaller, lighter forces. Technology could act as a force multiplier, making smaller expeditionary forces and their weapons much more effective than before.[1]

Some of the highest priority and most imaginative technology initiatives involved transforming technology originating within the department and from commercial sources into advanced weapon systems and putting them into the hands of warfighters. These initiatives included fast-track prototype demonstrations known as advanced concept technology demonstrations, or ACTDs. Unmanned aerial vehicles were among the first of these programs. The Office of the Secretary of Defense considered their acquisition so important that it took control of them from the services and created a new organization, the Defense Airborne Reconnaissance Office (DARO) to oversee their development. The Joint Advanced Strike Technology (JAST) program to identify technologies for a low-cost multiservice fighter was another initiative designed not only to maximize technological development but also to employ acquisition reform measures to reduce costs. These programs had a mixed record. The RQ–1 Predator UAV would survive a highly unconventional development process to become the most transformational weapon system to emerge from the 1990s. JAST's successor, the Joint Strike Fighter program, produced the F–35, which represented a major leap in technology, but became infamous for cost overruns and technical failures that delayed the aircraft's development and deployment.

THE PROBLEM OF TECHNOLOGY TRANSITION

Ideally, transitioning technology from the laboratory to the field should be both timely and cost-effective. Perry and others believed one way to achieve these objectives was through the aggressive use of prototypes that would smooth technology's transition into usable systems. Perry had long advocated "fly before you buy," which called for rigorously and thoroughly testing aircraft prototypes before committing to a major production run. However, he argued that prototyping should not be limited to completed systems—production prototypes—but should also be used throughout development to reduce technological risk and long-term costs. In this respect, Perry thought along the same lines as David Packard. As deputy secretary of defense in the early 1970s, Packard had mandated a prototyping strategy involving a more informal technology development process characterized by strict cost caps, reduced paperwork, minimal design specifications, and increased flexibility for the contractors.[2]

Not surprisingly, the Packard Commission had emphasized prototyping. The commission argued that new technology could be used to reduce acquisition costs, both directly by reducing unit costs and indirectly by improving the reliability, operability, and maintainability of military systems. Technology could also extend the life and improve the performance of existing systems, as occurs with avionics upgrades for older aircraft. However, since the adoption of state-of-the-art technology carried inherent risks, its use was expected only when the benefits were clear and outweighed the risk. Prototypes were to be tested extensively as early as possible in the acquisition process, before the decision to proceed with full-scale development. Therefore, the commission recommended the Defense Department place "a high priority on building and testing prototype systems to demonstrate that new technology can substantially improve military capability and to provide a basis for realistic cost estimates prior to a full-scale development decision."[3]

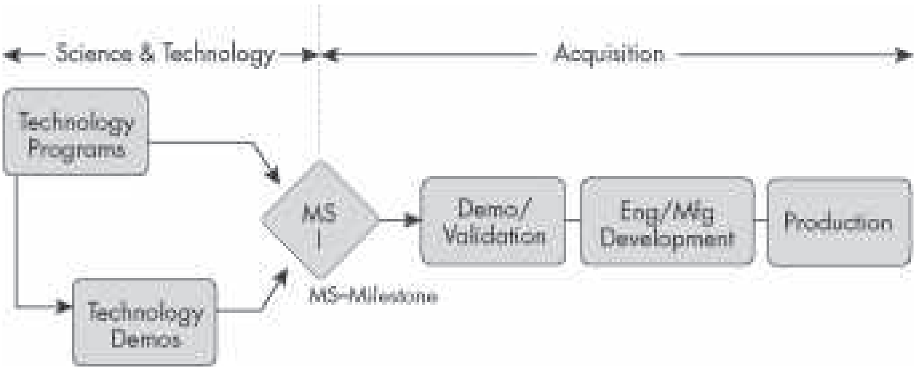
The testing of developmental prototypes was hardly a new idea, but the Packard Commission went well beyond this, calling for a new process for the early stages of R&D similar to the one Packard had outlined the previous decade. "The early phase of R&D should follow procedures quite different from those of approved production programs, in order to complete the entire prototyping cycle in two or three years," the commission said. Streamlined contracting procedures would speed up the process of evaluating new ideas; as development progressed, the emphasis would shift to "an informal competition of ideas and technologies." Significantly, the commission called for operational as well as developmental testing, even at these early stages. In other words, the prototypes would be tested not only in an experimental or developmental setting to make sure they functioned technically, but also under operational conditions to show how well they performed in the field.[4]

In April 1989, three years after the commission issued its report, Packard and Perry wrote jointly to the new secretary of defense, Dick Cheney, stressing the importance of prototyping and complaining the Packard Commission's recommendation on the subject "has not been properly implemented." They argued for a three-phased acquisition process consisting of a demonstration of feasibility, full-scale development through low-rate initial production, and full-scale production. In the first phase, prototypes would show proof-of-principle and reduce technical uncertainty. They would be "pushed" by the technology rather than "pulled" by military requirements. Technical opportunity would guide prototype development and eliminate the need for a formal statement of requirement from a military service. Tests of the prototype would demonstrate its military utility. In the second phase, full-scale development, the production design would be established. Testing under operational conditions would provide solid cost and performance data that the Defense Department could use to decide whether to proceed to quantity production. Cheney did not adopt these ideas, although the 1991 revision of the 5000 series documents and the abortive "new approach" to acquisition, discussed in chapter V, did mandate the use of prototypes in various forms.[5]

When Perry came back to the Pentagon in 1993, his thoughts returned to the transition of technology into system development programs. Many new technologies were becoming available or, if they already existed, were improving rapidly. Among them were stronger and lighter composites and other materials; all-weather, high-resolution sensors; high-bandwidth data networks that could transmit text, images, and video; devices that could process the data at high speeds; and miniaturized electronics and more sophisticated integrated circuits, especially advanced microprocessors, which promised to revolutionize nearly all classes of weapon systems.

Much of this new technology was not finding its way into defense systems. Part of the problem lay in the division of defense R&D into two communities representing generic science and technology and weapons acquisition (see figures 8-1 and 8-2). S&T—category 6.1 and 6.2 programs, in the arcane language of Pentagon budgeting—fell under the authority of the director of defense research and engineering. The system programs—categories 6.4 through 6.6—were the responsibility of the Defense Acquisition Board or its service equivalents. The dividing line fell within the 6.3 category of programs. The director of defense research and engineering oversaw advanced technology development (6.3A) programs while the Defense Acquisition Board was responsible for demonstration/validation (6.3B) programs. "The distinction between 6.3A money and 6.3B money is what has separated the two communities over the years," one observer noted. "It marks the far boundary of generic research and the near boundary of systems development, and that boundary is porous . . . [and] operates erratically." Paul Kaminski, under secretary of defense for acquisition and technology in the first Clinton administration, later explained, "[W]e always had this big gap in acquisition. We had military users who were supposed to be developing requirements that often didn't have the foggiest idea what the technology offered. And we had our technologists off pushing the edge of technology, sometimes having a very poor idea of how this stuff was actually going to be used in the field." As a result, many advanced research and early development projects failed to make the transition from S&T to the acquisition side of the R&D portfolio.[6]

Figure 8-1: Relationship Between S&T and Acquisition



Source: Adapted from V. Larry Lynn, statement before the SCAS, Subcommittee on Defense Technology, Acquisition, and Industrial Base, 8 Mar 1994, *Department of Defense Authorization for Appropriations for Fiscal Year 1995 and the Future Years Defense Program: Hearings*, S. Hrg. 103-765, pt. 5:27.

Figure 8-2: RDT&E Budget Categories

Science & Technology	6.1	Basic Research
	6.2	Exploratory Development
	6.3A	Advanced Technology Development
Acquisition	6.3B	Demonstration/Validation
	6.4	Engineering & Manufacturing Development
	6.5	Management Support
	6.6	Operational System Development (includes initial operational testing)

Source: DoD Regulation 7000.14-R (Financial Management Regulation), Jun 1993, vol. 2B, chap. 5.

DoD leadership created the position of deputy under secretary of defense for advanced technology (later renamed advanced systems and concepts) in 1993 to help break down that institutional barrier. The new deputy under secretary's office straddled the boundary, overseeing all 6.3A and 6.3B efforts except for formal acquisition programs that had passed concept demonstration/approval (Milestone I), which remained under Defense Acquisition Board supervision. The deputy under secretary was responsible for shepherding promising technologies across the boundary and into military systems "through an informal but comprehensive process," and to prioritize the various research projects to speed up the transition of the high-leverage technologies at the expense of those less critical. The first to hold the position, Verne L. "Larry" Lynn, devised a process for accomplishing this transition. The result was the advanced concept technology demonstration, an initiative that OSD described as being "at the foundation of the DoD acquisition reform process."[7]

ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS

The ACTD concept, unveiled in Aspin's annual report in January 1994, incorporated ideas the Packard Commission and the Defense Science Board had recommended for improving user-developer interaction to facilitate cost-performance trade-offs early in a program's development. ACTDs would demonstrate prototypes of new technologies and evaluate their usefulness and suitability for military operations. They were outside the standard acquisition process and therefore not governed by the procedures laid out in the 5000 series documents. The idea was to take a mature technology or set of technologies—some advanced concept technology demonstrations involved integrating existing technologies and systems to create new or expanded capabilities—and find out if they had military value by building a few prototypes and letting the end-users, the warfighters, test and experiment with them. The systems were not to be laboratory exercises but would undergo operational testing in the field, ideally in actual military operations. Thus advanced concept technology demonstrations represented the fieldable prototype idea that Cheney's Defense Department had firmly rejected.[8]

Not all advanced concept technology demonstrations focused on transitioning technology to the warfighters. A small number of the programs sought to investigate a new strategy or process for acquiring and fielding technology. The Joint Logistics ACTD, charged with creating a network of workstations to promote rapid logistics planning, was to apply "evolutionary acquisition," an innovative approach calling for programs to seek limited capabilities at first, then improve systems incrementally until they achieved full capability. (For more on evolutionary acquisition see chapters IX and X.) The Defense Advanced Research Projects Agency, which had charge of the High Altitude Endurance UAV ACTD, applied many of its own streamlined management approaches. Among these was the so-called other transaction authority Congress had granted the agency for "advanced research projects" in 1989 and then extended to prototype projects in 1993. Other transaction authority allowed DARPA extraordinary freedom to manage its programs, including signing cooperative agreements with industry in lieu of the usual contracts, waiving most laws and regulations, and reducing oversight. One project, the Low Life-Cycle Cost, Medium Lift Helicopter ACTD, had nothing to do with cutting-edge military technology at all—quite the opposite: It explored the feasibility of using leased or purchased civilian helicopters for Navy resupply.[9] (For DARPA's initial use of other transaction authority, see chapter XIV.)

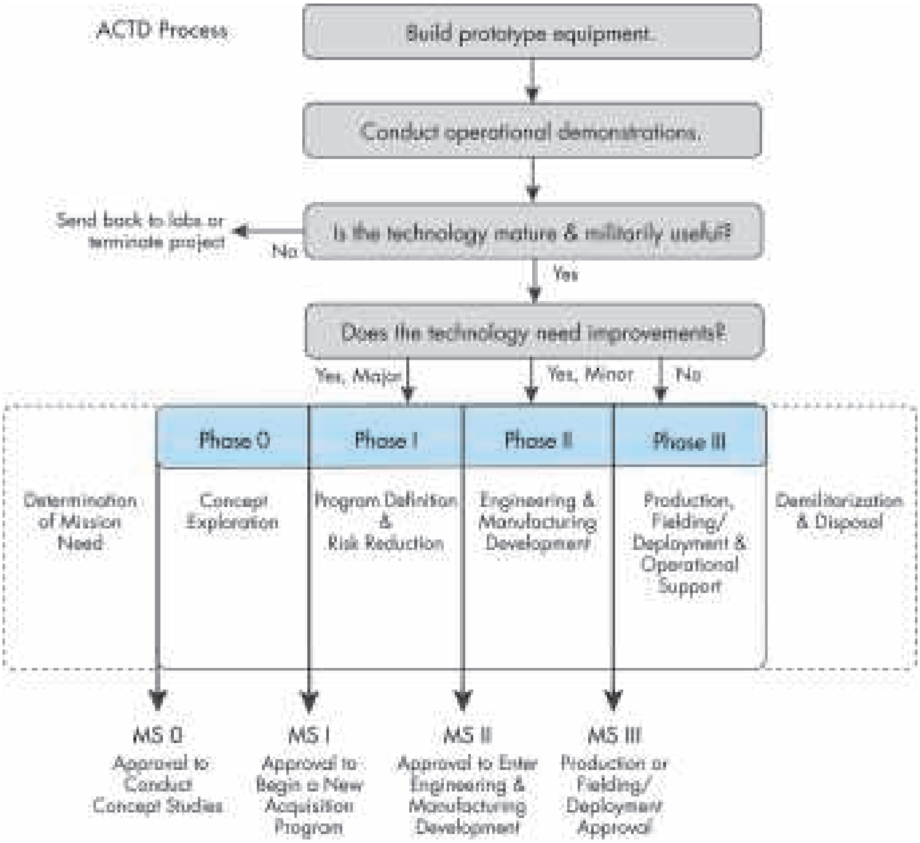
An advanced concept technology demonstration had to address a clear military need but not a specific military requirement, so the users might not know initially how to apply it effectively. Through experiments and operational deployments, users could decide the specific characteristics they wanted in the system and begin refining its operational concepts. Even if the ACTD was found wanting and terminated, experimentation itself could encourage the search for more suitable technology and operational concepts and create a requirements pull for a related technology. Kaminski considered serving as "a catalyst for stimulating innovation" to be the ACTD's most important attribute. The fielding of advanced concept technology demonstrations and their projected role in the development of military concepts distinguished them from advanced technology demonstrations, or ATDs, prominently featured in Cheney's new approach to acquisition discussed in chapter V. The Defense Department continued to conduct those demonstrations and in fact expected them to provide candidates for the ACTD program. The difference lay in the former's emphasis on the technology itself while the latter emphasized the operational concept.[10]

Only a few units of each advanced concept technology demonstration were to be produced, just enough to allow the system to perform as needed. Demonstrations might last only a few months, but typically they were expected to continue for two to four years. The first year or two would be spent integrating component technologies, building prototypes, and planning the demonstration, which was usually incorporated into regularly scheduled exercises held by a regional command. This phase of the project could take up to two years. At the end of the demonstration the system could follow one of three courses: It could go directly into production, it could enter the acquisition system (usually in Phase II, engineering and manufacturing development, or EMD) for additional development, or it could be terminated (see figure 8-3). Even with the last option, however, the user would retain a "residual operational capability"—leftover equipment—with which to continue testing, experimentation, and operational employment. The operating forces might in fact need only a small number of units of a certain technology, such as a command and control system, in which case no follow-on action was expected.[11]

Unlike other technology prototyping approaches, in which the scientists and engineers essentially controlled the test and evaluation and the users were relegated to the status of observers, in an advanced concept technology demonstration program the users were in control and would ultimately decide the system's future. The rules governing the ACTD initiative emphasized "that the interests of the warfighter are paramount and that 'guidelines' regarding ACTDs are flexible." A user, usually a unified command—the warfighters who would take the systems into battle—sponsored the advanced concept technology demonstration. A service or defense agency organized a demonstration program office to manage the effort. The sponsors and the developers were expected to work closely together. After 1997 the deputy under secretary for advanced technology designated a lead service for the demonstration of each system. Ideally, the program would extend beyond service boundaries and emphasize the development of joint capabilities and equipment interoperability, thereby promoting joint operations. Allies participated as well. By 1998 the United Kingdom had contributed $7 million for two projects, while Israel spent $64.7 million on another, the Tactical High-Energy Laser. By 2006 at least eight countries and NATO had participated in 29 advanced concept technology demonstrations.[12]

At first, ACTD selection was performed informally, but by 1997 it involved more formal procedures with several levels of review. Generally speaking, the process began when a user organization such as the Joint Staff, a unified command, or one of the services formed a partnership with a developer and proposed a candidate program.

Figure 8-3: How ACTDs Fit Into the Acquisition Process



Source: Adapted from Congressional Budget Office, *The Department of Defense's Advanced Concept Technology Demonstrations*, Sep 1998, 3; Schmoll, *Introduction to Defense Acquisition Management*, 3d ed., 45.

The program had to address a clear user need and offer a reasonable prospect of filling that need. "*Military utility* is the heart and soul of an ACTD—its defining characteristic," a RAND study declared. The program also had to use mature or nearly mature technology involving little technical risk. The emphasis was to be on demonstration, not development; schedule slips were to be avoided. The technology had to constitute an ongoing technology development project judged to be ready for demonstration. If the deputy under secretary for advanced technology believed the program had potential—usually only one-third to one-half of all candidates made the cut—the proposal went to a senior advisory group known as the Advanced Technology Breakfast Club. Next, the Joint Staff took a look at it. The deputy under secretary compiled a list of likely candidates for the Joint Requirements Oversight Council, which ranked them in order of priority. The deputy under secretary in concert with the vice chairman of the Joint Chiefs of Staff made the final selection.[13]

Upon approval of a candidate technology, the user and developer organizations and other key parties signed an implementation directive and an ACTD management plan, the equivalent of the acquisition strategy and baseline required of a formal acquisition program. DoD strongly encouraged the use of streamlined acquisition and management processes along with other acquisition reform initiatives, such as the use of commercial and non-developmental items. Two officials directed each ACTD program—a demonstration manager in charge of development and an operations manager to organize the user activities. They received guidance from an oversight group consisting of representatives of participating organizations. Management of the programs tended to be flexible and informal, in contrast to the formality of standard acquisition programs. The managers enjoyed a large degree of freedom to run their programs, unfettered by the regulations, procedures, military specifications, and documentation governing the activities of a normal program office.[14]

The advanced concept technology demonstrations received Defense Department funding, but only to cover the costs of system integration, the fabrication of one or more operational units, technical support for extended user field tests, and support for the program for the two-year follow-on phase. Otherwise, funding for most development activities continued to come out of existing program budgets, usually provided by the services or defense agencies. Before acceptance as an ACTD, a candidate program had to identify and commit the required funding for the entire demonstration period. This freed managers from spending their time seeking funds or worrying about perturbations in their budgets. The fact that advanced concept technology demonstrations relied entirely on R&D funding, especially from science and technology accounts, made them particularly attractive to DoD because they offered the possibility of deploying usable capabilities without consuming production dollars.[15]

The Defense Department initiated the first six ACTD programs in April 1994 with five more following by the end of FY 1995. The Advanced Joint Planning ACTD focused on providing command and control technologies tailored to the needs of the various regional commanders in chief. The Joint Countermine ACTD integrated Army, Navy, and Marine Corps technologies for countering land and sea mines and evaluated whether they reduced the risk to joint amphibious operations. The Synthetic Theater of War–97 ACTD demonstrated distributed simulation technologies that could enhance the ability to conduct joint training and the rehearsal of planned operations. Others included an improved munitions targeting system, ballistic and cruise missile defenses, and UAVs. In FY 1996, DoD added 12 more advanced concept technology demonstrations for a total of 23 since the program began. Among these were demonstrations to evaluate the military value of, and develop operational procedures for, the ability to detect biological warfare attacks on ports and airfields; to improve capabilities for identifying friend from foe, thus reducing fratricide on the battlefield; to determine the benefits of a program to enhance the survivability of the M1 Abrams tank; and to evaluate a high-energy laser, a commercial off-the-shelf helicopter for the Military Sealift Command, and capabilities for preventing enemy use of satellite navigation and for destroying sites that housed weapons of mass destruction.[16]

Through FY 2001, the number of ongoing or completed advanced concept technology demonstrations stood at 82. The programs fell into three categories: information systems, especially software systems that ran on commercial workstations; traditional weapon systems or sensors; and systems of systems that involved the integration of multiple technologies into a larger whole. In the first four years of this relatively inexpensive initiative, the Defense Department spent $3.2 billion on 46 advanced concept technology demonstrations, an average of $800 million per year, which represented about 10 percent of the department's S&T budget and only 2 percent of its entire R&D budget during that period. Of that $3.2 billion, the deputy under secretary for advanced technology's share grew from 2 percent in FY 1995 to about 15 percent in FY 1998. The services and defense agencies provided the rest. The projects were relatively large in FY 1995, the first year of the initiative, averaging $230 million in total costs, in 1998 dollars, but they soon became smaller; the FY 1998 projects averaged only $50 million. The three largest projects of 1995 cost three times as much as all nine projects begun in 1997.[17]

The ACTD initiative suffered from a number of serious and unanticipated difficulties. One of its problems was political. Congress sought assurances that the demonstrations, designed to help streamline and even transform the acquisition process and produce useful military capabilities along the way, would not transition to full-blown acquisition programs. In public pronouncements Defense Department officials declared that advanced concept technology demonstrations were not acquisition programs but "*pre*-acquisition" programs. The reason is clear: Congress, which often praised the idea of streamlined acquisition in the abstract, nonetheless watched closely to ensure the department did not try to evade laws, regulations, and congressional oversight by using S&T money for acquisition activities. Even so, streamlined ACTD programs employed relatively informal organizations and procedures and produced much less documentation, making outside oversight particularly difficult. On one occasion, Congress, suspicious of the decision to convert the Joint Tactical UAV program into a demonstration, accused the Defense Department of "using the ACTD program to circumvent acquisition requirements, rather than to demonstrate new technologies on a limited basis."[18]

In another expression of congressional doubts about ACTD programs, the House Appropriations Committee criticized the Army's planned procurement of 256 antitank Enhanced Fiber Optic Guided Missiles for the Rapid Force Projection Initiative ACTD, although only 44 missiles were needed for testing. "This program . . . is essentially a multiyear procurement program incrementally funded in the Army's science and technology (S&T) research budget," the committee wrote scathingly. It noted that the Army planned to use research money to procure and field the missiles, launch vehicles, and command vehicles "without independent operational testing and evaluation . . . , formal milestone review, or many of the other fundamental acquisition requirements in place to ensure DoD only procures safe, cost effective, operationally suitable, and supportable weapon systems." The committee went on to report that because program funding was buried in a generic R&D budget line, neither Congress nor OSD could track the annual costs and quantities as it could in a traditional procurement program, and that the Army had awarded a multiyear contract without congressional approval. "Abuse of so many basic acquisition and financial policies," it noted, "jeopardizes the Committee's support of the ACTD 'leave behind' principle [to provide the user with a two-year residual capability with which to continue testing after the completion of the demonstration program]." The committee ordered the Defense Department to procure the minimum amount of equipment necessary to support the advanced concept technology demonstrations and to prohibit use of R&D funds for items not needed for testing. The department, demonstrating a much different view of the purpose of the "leave behind" principle, grumbled it needed the additional missiles to keep the weapon systems operational after the official end of the demonstration program, because "without missiles there is no residual capability."[19]

The DoD inspector general also expressed misgivings about the ACTD initiative, asserting in a 1997 report that the criteria for the program's candidates, especially military need and technological maturity, were unclear and perhaps arbitrary. Five of the nine projects reviewed in the report, including one of the unmanned aerial vehicle projects, were "questionable" because they did not meet OSD criteria for ACTD programs, namely that they involve mature technologies and satisfy a military need. Additionally, the inspector general objected that at least two projects were expected to last longer than the two-to-four-year limit set by OSD for a demonstration. Finally, the inspector general report criticized the department for poorly documenting the project selection process. OSD vigorously disputed these charges. Under Secretary Kaminski defended both the projects and the project selection process, arguing that the four-year limit was not hard and fast but more of a guideline. He did agree, however, that some criteria appeared ambiguous and not well explained, and accepted the recommendation to form a working group to systematize the process and produce new instructions.[20]

A more fundamental problem with the ACTD initiative lay in the conflicting goals of the demonstration programs. One astute observer, Maj. Devin L. Cate, an Air Force officer with extensive experience in acquisition, identified a critical issue: "The prototyping initiatives of the early 90s failed to yield results in the arena of large, complex weapons systems, because they attempted to solve too many problems at the same time. Although all the goals of the initiatives were valid, they, by their nature, could not all be accomplished, because they tended to work against each other." As an example, Major Cate noted that the requirement for prototypes to be fully operational conflicted with the requirements to reduce the time and cost of prototype development. Rendering a system operational, even in a rudimentary way, meant endowing it with features and characteristics one would normally not find in a prototype, such as means to transport it or safety features, thus adding to the expense and time required to produce the system. Such a compromise did not in itself void the value of a demonstration, but it did introduce stresses on the program that had to be carefully managed. Furthermore, the larger and more complex the system, the more expensive its operational testing, a cost perhaps beyond the reach of a demonstration program.[21]

The structure of the planning and budgeting process drove the advanced concept technology demonstrations, and in fact all technology demonstrations that aspired to become full acquisition programs, toward the so-called valley of death—the time between the end of the demonstration and its transformation into an acquisition program. Defense Department officials hoped successful demonstrations could go directly into engineering and manufacturing development, or even production, "without any loss of momentum." Yet to win funding for EMD and production a program had to go through a large number of steps. First, it had to wend its way through the programming process in order to be included in a service's funding wish list, the Program Objective Memorandum, then maneuver through the DoD Planning, Programming, and Budgeting System to gain OSD approval and win a place in the budget and the Future Years Defense Program. Along the way the advanced concept technology demonstration, like any other acquisition program, had to prepare documents, satisfy legal and other regulatory requirements, and provide or obtain required certifications. Indeed, the advanced concept technology demonstration had to work extra hard to catch up to traditional programs at the same stage in their development cycle because the demonstration program had to prepare all of the documentation it had previously skipped. This process took time—usually a minimum of 18 months to two years—and staff, which many advanced concept technology demonstrations lacked, because they operated with a lean program office. So if the service withheld the decision to proceed until it had evaluated the final results of the demonstration, the program would then have to wait up to two additional years before funding would again flow. The Predator UAV program, for example, waited 14 months between the end of its ACTD status and its transition to low-rate production.[22]

If the services wanted to start a program immediately, they could carve out some money from the budgets of other programs, but this could complicate their budget submissions and lead to political infighting in which Congress might become involved. The services rarely resorted to this practice. The other alternative—to get an early start on the budgeting process in order to reduce or close the funding gap—however, meant the program office had to guess the eventual costs of and schedule for development and production. Meanwhile, the services would have to predict if a system would be practicable and desirable and what its final configuration would be without seeing the benefits of a demonstration. Ultimately, the services had to decide whether to commit to acquiring a potentially deficient or flawed technology they had not yet evaluated and were not sure they wanted—exactly the situation the ACTD initiative was designed to avoid. The services were expected to cover the gap. They at least tried: the Army, through its Warfighting Rapid Acquisition Program (see chapter XII); and the Air Force, with its similarly named Warfighter Rapid Acquisition Program (see chapter X). OSD could provide money to support the technology for two years after the end of the advanced concept technology demonstration. Still, the program would only be marking time until it was approved for engineering and manufacturing development or production, and it ran the risk of losing key personnel and vendors in the meantime.[23]

Another problem stemmed from differences in management approaches between demonstrations and traditional acquisition programs. The streamlined organization and processes used by ACTD programs to avoid costly overhead and bureaucratic delays—small staffs, flexible processes, informal procedures, and minimal reporting requirements—were incompatible with the extensive requirements of the 5000 series acquisition policy documents, and deliberately so. If and when the program entered the acquisition system, however, it had to conform to the same rules and procedures it had previously avoided. A program that had spent more than four years following one management approach inevitably found it difficult to adjust to the other. The closer the advanced concept technology demonstration had adhered to the streamlined ideal, the greater the shock of transition. The demands of an acquisition program differed greatly from those of a small demonstration. The demonstration lacked the time and resources to devote to considerations such as long-term logistics support. But when it came time to transition, the former ACTD program suddenly discovered it had to address those issues in a hurry. Thus the paradox: The more a demonstration program streamlined the initial process and saved time and money, the greater the risk of lengthy delays and demands for funds before it could be procured.[24]

One solution to the dilemma was to prepare for transition well in advance. For example, the deputy under secretary for advanced technology required ACTD programs to form a team to prepare transition plans at an early stage and to draw up a draft Operational Requirements Document (ORD) that would be updated and revised as the demonstration proceeded. Such a document, which explained the military need for the weapon, was essential for an acquisition program—none could enter the acquisition system without it—and by having a draft well underway, the program could save considerable time. However, preparing for transition in advance was a balancing act, because, again, the advanced concept technology demonstration could ill afford to expend resources on tasks that were not critical to its objective. The more the program did to ready itself for transition, the more it began to look like a regular acquisition program.[25]

The ACTD initiative was not designed to transform the acquisition system as a whole. In his annual report in 1995, Secretary Perry pointed out that the program was not "intended to be a substitute for the formal acquisition system required to introduce large, complex weapon systems such as ships, tanks, or aircraft" or "to support acquisition of new systems such as vehicles or munitions, which may be procured in large numbers and over a number of years." The initiative began with a specific purpose: to move technology out of laboratories and into the field to provide the warfighters with capabilities they would not otherwise have. In this respect, advanced concept technology demonstrations compiled a respectable record. Of the 154 demonstrations initiated by 2004, 80 programs had been completed, of which 19 had been returned to the technology base or terminated early, 25 had been converted to a full-fledged acquisition program, and 36 had ended but had left "residual products" that continued to provide useful capabilities in the field. Many ACTD programs provided products that were used in military operations in Kosovo, Afghanistan, Iraq, and elsewhere. Given this record, the ACTD program could be considered a successful and worthwhile endeavor. It demonstrated the military utility of advanced technologies and weeded out those that were unneeded or unworkable before they reached the system development level.[26]

UNMANNED AERIAL VEHICLE ACTDs

The benefits and pitfalls of advanced concept technology demonstrations could be seen in unmanned aerial vehicle programs. UAVs—also called drones or remotely piloted vehicles—were among the earliest and highest profile ACTDs. Four of these systems, which included not just the aircraft but ground stations, controllers, and communications and other support equipment, were accepted into the ACTD program, three in 1994, the first year of the initiative. UAV programs reflected the importance Defense Department leaders placed on such systems and their frustration with the course of UAV development up to that time. Since the 1950s, U.S. intelligence agencies such as the National Reconnaissance Office (NRO) and the Central Intelligence Agency (CIA) had been using highly classified UAVs for strategic reconnaissance. The Air Force, which made the vehicles for the NRO and the CIA, also developed versions for tactical operations and employed drones extensively in the Vietnam War. The other services took note of this and began to develop their own systems after Vietnam. Even so, by the early 1990s, the services had little to show for their 20 years of effort.[27]

UAV programs encountered many obstacles. Although drone development proved to be more technically challenging than expected, the primary problems were institutional and political. Vehicles intended for strategic reconnaissance faced heavy competition from, and were eventually entirely supplanted by, increasingly sophisticated satellites. By the 1970s the National Reconnaissance Office relied on satellites almost exclusively and ceased funding UAV development. In the Air Force, UAVs for tactical operations also competed with more sophisticated, manned stealth aircraft and, at least temporarily, lost out to them. UAVs had a low priority within the services, which considered them to be novelty products. They did not know what to do with them, and they had few senior officials willing to champion them. Military sponsors and Congress expected the pilotless vehicles to be an inexpensive substitute for manned aircraft and were quick to cancel the projects when their costs exceeded expectations. The problem stemmed from overly optimistic sales pitches by UAV developers and other advocates and by the services' tendency to demand increased capabilities and technological enhancements—so-called requirements creep and gold plating—often after development had begun. The instability of requirements caused costs to balloon and schedules to stretch. Such problems were hardly unique to UAVs, but they were particularly deadly to the programs, given their low priority. Nearly every military UAV program initiated during the 1970s and 1980s was ultimately canceled. The significant exception was the Navy's RQ–2 Pioneer, which the Israelis had largely developed and which saw service in the Persian Gulf War. But even that system suffered significant deficiencies and never fulfilled its stated requirements in spite of the Navy's $50 million effort to fix it. "[F]or all the positive technological developments of the [1980s]," one study has noted, "the great failing was the inability to deploy those technologies in the Services to support forces in the field."[28]

Concerned about this poor record and believing there was too much duplication among the services, Congress in 1987 required all UAV programs to be multiservice, and the following year created a joint program office within the Navy to manage them. Yet, duplication grew worse under the multiservice approach. As with other systems, the services each had their own requirements, many of them incompatible with those of the other services. Not surprisingly the Army wanted short-ranged craft that would support ground operations and "see over the next hill," while the Air Force wanted vehicles that could fly higher and loiter longer to locate antiaircraft defenses and other targets for airstrikes. The Navy and Marine Corps had their own peculiar technical requirements, such as the need for shipborne UAVs to take off and land vertically and to burn the heavier fuel used by all Navy aircraft to reduce the risk of fire. The differing service requirements often conflicted with each other and increased the cost of the systems, reduced their capabilities, and added to the technical challenges. These problems were insurmountable, at least through the standard acquisition process. None of the UAVs the joint program office managed ever saw service.[29]

The Clinton administration was determined to reverse this record of failure. After Pioneer performed limited but useful service in the Persian Gulf War, acquiring UAVs became a higher priority in the Pentagon. Proponents of the revolution in military affairs, which then included OSD, saw them as valuable components in the networks of sensor and shooter systems they believed would dominate future warfare. Roaming the battlefield, the drones would locate targets, guide munitions to them, and investigate the resulting damage to help determine if a follow-up air or artillery strike was needed.

RQ–2 Pioneer unmanned aerial vehicle. *(U.S. Navy)*

(The idea of arming the aircraft themselves, the logical next step in their evolution, would not be seriously considered until the late 1990s.) UAVs could also deny such capabilities to the enemy by locating and targeting radar sites, communications centers, and command and control facilities. Thus they could be a part of the increasingly popular concept of information warfare. Advocates of peacekeeping and humanitarian intervention considered them particularly useful for reconnoitering and surveilling large and relatively inaccessible areas in war zones such as the former Yugoslavia. The aircraft could confirm the targets before a strike and detect the presence of civilians. And drones could do all of these things without putting pilots at risk, an important consideration to the casualty-averse Clinton administration.[30]

Furthermore, the advance of technology made the early 1990s seem a propitious time to renew efforts to develop unmanned aerial vehicles. GPS navigation made it possible to know the exact location of the aircraft at any time, solving a critical problem that had long bedeviled UAVs. Miniaturized electronics, especially microprocessors, as well as high-resolution sensors and lightweight composite materials, allowed more cameras and radars to be mounted on smaller airframes. High-bandwidth communications systems and satellite relays enabled the drones to provide their operators and the warfighters they supported with real-time imaging and made it easier to fly them remotely, even from thousands of miles away. Defense leaders believed a new generation of more capable unmanned aerial vehicles could be built, given the proper acquisition strategy and management approach.[31]

By 1993, however, neither the Defense Department leadership nor Congress had faith that the services could successfully manage UAV acquisition programs. In November 1993, with congressional support, the deputy secretary of defense established the Defense Airborne Reconnaissance Office within the Office of the Deputy Under Secretary of Defense for Advanced Technology. Responsible for the acquisition of manned and unmanned reconnaissance systems, in what was called the Defense Airborne Reconnaissance Program, DARO became the OSD focal point for all aspects of airborne reconnaissance, including policies, standards, budgets, program management, and oversight. The office was to ensure that all UAV efforts employed streamlined acquisition approaches and used common components such as ground stations and a common technical "architecture" that allowed systems such as communications equipment to "interoperate" (work with each other and other service systems). DARO's director was to work with the services, the Joint Chiefs of Staff, the regional commanders in chief, and especially the assistant secretary of defense for command, control, communications, and intelligence, whose staff would supply the organization's deputy director.[32]

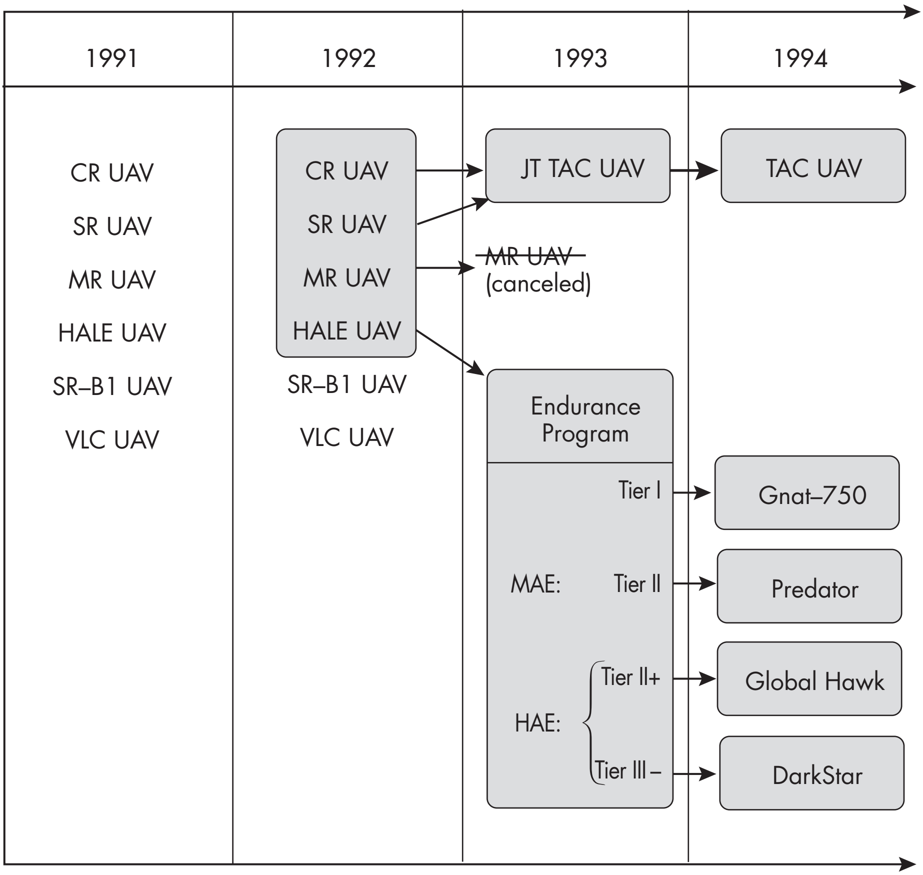
To some, DARO's control of an entire class of weapon systems represented a challenge to the services' Title 10 mandate to "organize, train, and equip" their forces. One observer called it "a grand experiment in civilian intervention and centralized control" and "one of the most substantial civilian incursions into major military system acquisition management since the establishment of the National Reconnaissance Office in 1961"—which was the model for DARO. Surprisingly, the Air Force, Navy, and Marine Corps, normally quick to defend their Title 10 prerogatives, accepted this move quietly. Perhaps not coincidentally, all were ambivalent about the use of drones at this particular time. Only the Army, which was coming to see reconnaissance capabilities as critical to its future operations, openly fought the creation of DARO. The Army considered the new organization to be an extension of the Air Staff, and with good reason: Although service representation in DARO was officially supposed to be balanced, the Air Force dominated, providing the director (Maj. Gen. Kenneth R. Israel) and occupying more leadership positions than the other services combined. The Army, which held only one of the top slots, had long doubted the Air Force commitment to joint operations and believed its own interests and concerns would be ignored. This stance was something of a self-fulfilling prophecy since the Army refused to fill four of the six positions reserved for it in the joint-service organization.[33]

The Army wanted control of its own reconnaissance programs, because it feared losing the freedom to make changes to its systems to suit Army requirements if DARO priorities superseded its own. For example, DARO's intent to make reconnaissance systems interoperable among the services conflicted with the Army's plan to make them interoperable with other Army systems, which required different standards. (The low priority the services assigned to joint interoperability is discussed in chapter IX.) The Army's position reflected reasons the Defense Airborne Reconnaissance Office was created in the first place: to prevent the services from making budget-busting changes to their systems and to promote joint interoperability. The Army won at least a partial victory, keeping control of two programs that were well along in development: the RC–12 Guardrail Common Sensor, an airborne system that collected signals intelligence, and the EO–5C Airborne Reconnaissance Low-Multifunction intelligence-gathering aircraft.[34]

The evolution of UAV classification in the late 1980s and early 1990s, promulgated by the joint program office in its quest to define requirements for a family of vehicles, was complex. Essentially, by 1993, requirements called for four categories of vehicles representing increasing ranges and capabilities: "close-range," "short-range," "medium-range," and "endurance" vehicles (see figure 8-4). The first two were intended to provide immediate support to ground and aircraft carrier battle group commanders. Endurance vehicles were to have the ability to loiter for at least 24 hours on station, not only to perform reconnaissance missions but also to conduct longer-term area surveillance and provide strategic intelligence. The medium-range vehicle fell somewhere in between. Confusing matters further, the endurance category was itself divided into three "tiers," again corresponding to different capabilities (primarily flight altitude), with a separate UAV system planned for each tier. The Defense Airborne Reconnaissance Office reclassified the four categories into two programs, joint tactical (later tactical), representing both the close- and short-range systems, and endurance. It dropped the medium-range designation along with the vehicle it represented, a failed joint Army-Navy program that was canceled in October 1993. Endurance vehicles were classified as either medium altitude or high altitude (see figure 8-5).[35]

In addition to the already fielded Pioneer, the joint tactical program consisted of three systems, the Army's RQ–5 Hunter and two variants, one for the Navy and one for close-in battlefield coverage. Under development since 1989, Hunter was in low-rate initial production and undergoing testing at Fort Huachuca, Arizona, so DARO turned its attention to the endurance vehicles. At first it planned to acquire two systems, a medium altitude UAV and a high altitude UAV, but in 1994 DoD added another high altitude endurance vehicle with stealth characteristics. The

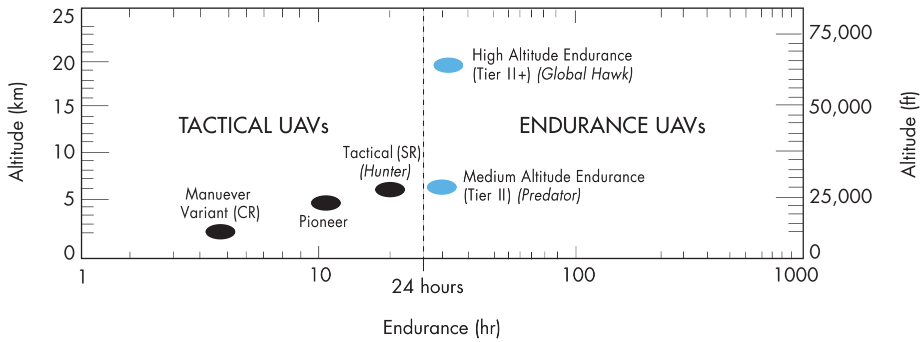
Figure 8-4: The Tangled Evolution of MR UAV



CR – Close Range
SR – Short Range
MR – Medium Range
HALE – High Altitude Long Endurance
SR–B1 – Short Range Block I
VLC – Very Low Cost
JT TAC – Joint Tactical
TAC – Tactical
MAE – Medium Altitude Endurance
HAE – High Altitude Endurance

Source: Richard Thirtle, Robert V. Johnson, and John L. Birkler, *The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process* (Santa Monica, CA: National Defense Research Institute, RAND Corp., 1997), 10.

Figure 8-5: Major DARO UAV Programs, April 1994



Major Defense Acquisition Program (MDAP) or Fielded
System Concept Demo

Note: The Tier III High Altitude Endurance UAV (DarkStar) is not shown.

CR – Close Range
SR – Short Range

Source: Defense Airborne Reconnaissance Office, *Unmanned Aerial Vehicles (UAV) Program Plan*, Apr 1994, ES-2.

development of the two vehicles as well as a common ground control station was managed as a single program.[36]

From the start, the Defense Airborne Reconnaissance Office planned to run the endurance programs as advanced concept technology demonstrations. Indeed, UAV programs seemed ideal for that initiative. They integrated apparently mature technology that could be demonstrated in far-flung crisis zones, providing capabilities to peacekeepers in relatively low-stress environments with no major combat. The demonstrations would be largely isolated from the regular service acquisition systems and free from the pressures and influences that had sunk

Maintenance specialists with Northrop Grumman prepare an RQ–5 Hunter UAV for its first flight. *(DIMOC)*

UAV programs in the past. They could be hurried through development before gold plating could begin. Once new prototypes were in the field and being flown in exercises and other military operations, their uses would become clearer, their strengths and vulnerabilities more evident, and their operational concepts better defined. The process had the potential to make requirements creep less of a problem for future UAV programs following the standard acquisition path. And, of course, the demonstrations would also help developers identify flaws in the design, fix them, and think of ways to improve the vehicles.

Initially only the three endurance systems were accepted as advanced concept technology demonstrations: the medium-altitude endurance UAV, Predator, in 1994, and the two high-altitude endurance UAV systems, Global Hawk and DarkStar, the following year. At the end of 1995 a fourth program, the Tactical UAV, was added, a result of the early 1996 decision to end production of Hunter, the centerpiece of joint tactical programs and the system the Army was counting on for battlefield support. (As it turned out, Hunter's termination, prompted by technical problems and several crashes, was premature: The Army continued to fly and improve the existing vehicles.)[37] In December 1995, on the eve of Hunter's anticipated demise, the under secretary for acquisition and technology approved a Tactical UAV advanced concept technology demonstration. The following May, Alliant Techsystems won a $57 million contract to develop its RQ–6 Outrider as the system.[38]

Not only was Predator the first UAV selected as an advanced concept technology demonstration, it was also the first ACTD and therefore the prototype for the program. After a competition among four designs, the Navy awarded a contract on behalf of the joint program office to General Atomics Aeronautical Systems Inc. for 10 Predators in January 1994, just as the demonstration initiative was being announced. Predator was an upgrade of an existing General Atomics product in service with the CIA, called the Gnat–750, which had evolved from a DARPA-funded vehicle named Amber, so the technology was considered mature. The Navy's program executive officer for Cruise Missiles and Unmanned Aerial Vehicles managed the development of the system through the joint program office, while the U.S. Atlantic Command represented the users. DARO provided the funding. Because Predator was the first advanced concept technology demonstration, OSD created a special oversight panel comprising representatives from the participating organizations to make sure the program fulfilled the ACTD vision and followed OSD policies and procedures.[39]

The Predator medium-altitude endurance UAV program met a demanding 30-month schedule that included developing and manufacturing 10 Predators to be ready for the system's first flight in six months and first operational demonstration in 18 months. In spring 1995, the UAV took part in the Roving Sands Exercise in Texas and New Mexico, where it flew 25 reconnaissance sorties and provided real-time imagery on simulated Scud-type ballistic missiles in the desert. In July, Predator deployed to the Balkans to take part in Operation Nomad Vigil in Bosnia, where

Table 8-1: Unmanned Aerial Vehicle Characteristics

CHARACTERISTIC	PIONEER (RQ–2)	PREDATOR (RQ–1)	HUNTER (RQ–5)	GLOBAL HAWK (RQ–4)
Wingspan	16.9 ft	55 ft	34.25 ft	130.9 ft
Length	14 ft	27 ft	23 ft	47.6 ft
Max takeoff weight	416 lbs	2,250 lbs	1,950 lbs	32,250 lbs
Payload	75 lbs	450 lbs	280 lbs	3,000 lbs
Max speed	110 kts	118 kts	110 kts	340 kts
Operational radius	100 nm	500 nm	108 nm	5,400 nm
Endurance	5 hrs	24 hrs	18 hrs	28 hrs
Ceiling	15,000 ft	25,000 ft	18,000 ft	60,000 ft
Deployed	1986	1995	1996	2001

Note: After initial deployment, subsequent performance upgrades and other modifications changed the characteristics of several UAVs. Data in the table reflect those changes. Additionally, when UAVs took on new roles (e.g., munitions delivery), system designations changed. Thus, the RQ–1 Predator and RQ–5 Hunter became the MQ–1 and the MQ–5, respectively ("M" for "multirole").

Sources: Defense Airborne Reconnaissance Office, *UAV Annual Report, FY 1996* (n.p., 6 Nov 1996), 30–31; Department of Defense, *FY 2009–2034 Unmanned Systems Integrated Roadmap* (n.p., 2009), 63, 65, 73; U.S. Navy Fact File, "RQ–2A Pioneer Unmanned Aerial Vehicle (UAV)," updated 9 Sep 2013, http://www.navy.mil/navydata/fact_display.asp?cid=1100&tid=2100&ct=l, accessed 19 Nov 2015; U.S. Air Force Fact Sheet, "MQ–1B Predator," 23 Sep 2015, http://www.af.mil/AboutUs/FactSheets/tabid/131/Search/predATOR/Default.aspx, accessed 2 Nov 2015.

it provided reconnaissance and surveillance support to U.S. peacekeeping forces until November when it returned to the United States for upgrading. After two more exercises in the United States, in March 1996 Predator redeployed to Europe to support Bosnian operations, remaining until February 1997.[40] Predator received high marks from users, who valued its capability, but as expected, the deployment revealed defects in the system, including a poor video link to ground stations, and weather vulnerabilities, such as wing icing in cold temperatures. During their first Balkan deployment, two of the three Predators crashed, at least one was downed by enemy fire. Of the 315 missions assigned to Predator from March 1996 to April

A Predator unmanned aerial vehicle passes near the nuclear-powered aircraft carrier USS *Carl Vinson* (CVN 70) during a simulated Navy reconnaissance flight, December 1995. *(NARA)*

1997, 60 percent were scrubbed because of the weather or technical issues. Of the missions launched, half were subsequently aborted, usually because of weather (65 percent), but almost a third (29 percent) because of technical problems.[41]

The Predator demonstration program ended in June 1996, and the UAV began the transition into the acquisition system. The Air Force lobbied to control the program, and in April 1996 Secretary Perry named it the lead service for Predator. Full control followed in 1998. The Air Force then transformed the rickety prototype vehicle into a sturdy, reliable machine that was ready for quantity production with enhanced and, in some cases, entirely new capabilities.[42]

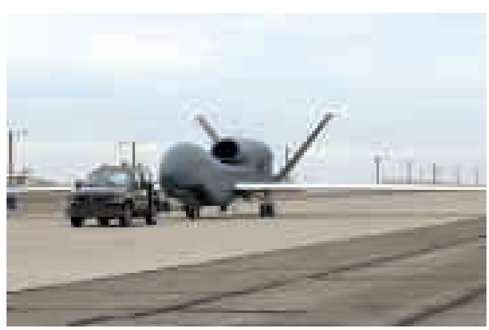
Predator's transition to a formal acquisition program was not easy, especially since it was the first ACTD to make the leap. The program office had made no preparations for post-demonstration activities, failing, for example, to assemble the required documentation. With no prior involvement in the program before taking control, the Air Force was unfamiliar with its management and surprised at how much it would cost to finish Predator's development. To ease the shock of transition, the service assigned Predator to Big Safari, a unique Air Force organization that specialized in rapid acquisition, a streamlined approach similar to that of the advanced concept technology demonstration. The Predator system also continued to be unreliable; even five years after the ACTD ended, doubts and criticism of it persisted. Nonetheless, the Air Force stuck with Predator and Big Safari turned it into an effective reconnaissance system. Meanwhile, DoD studied

Predator's experience and derived useful lessons for the conduct and transition of future ACTDs, such as the importance of designating the lead service early in the demonstration process and planning for the transition in advance.[43]

The other unmanned aerial vehicle ACTDs had mixed records. Of the high altitude endurance UAVs, Global Hawk made the transition into an acquisition program and was fielded. Cost growth and major technical problems, however, led to DarkStar's cancellation in 1999. Outrider, the Tactical UAV, suffered similar problems and, while not canceled outright, was terminated at the end of the ACTD.[44]

The ACTD concept proved its value during the wars of the early 21st century and continued 20 years later in the form of Joint Concept Technology Demonstrations. The Defense Airborne Reconnaissance Office, however, lasted just five years. During that time it achieved success with Predator but had alienated the services, which had little influence on the organization. Improved UAV performance led the Air Force to decide that drones would be critical to its future and the service should control acquisition of its own systems. DARO also roused the enmity of Congress by its strident advocacy of drones, a threat to proponents of manned reconnaissance aircraft such as the venerable U–2. With the change in Pentagon leadership in 1997, DARO lost its top-level support. That year, with the encouragement of the services, especially the Air Force, Congress took away DARO's management and budgeting responsibilities, turning the organization into a weak oversight body. The following year, with "few allies, almost no senior advocates, and only one very shaky operational UAV to show for its efforts," writes strategist Thomas P. Ehrhard, Secretary of Defense William Cohen disbanded it.[45]

During its five-year life, DARO made great strides toward creating a joint architecture for UAV development. However its demise—partly a response to service reaction to those efforts and to its failure to work with them more closely—demonstrated the difficulty of that task. Ehrhard concludes, "The meteoric rise and fall of centralized UAV management provided strong evidence that 'pluralism and untidiness' indeed may be the only way for the US military to achieve weapon system innovation with the UAV." He argues that a service must possess "substantial autonomy" in developing a system. This freedom enables it to adapt the system to the service's distinctive operating



RQ–4 Global Hawk. *(U.S. Air Force Fact Sheet)* environment and for service members to adapt to the system by developing appropriate doctrine, operating procedures, and training methods.

By equipping Predator with the AGM–114 Hellfire air-to-ground missile in 2002, the Air Force turned the UAV into a weapon as well as a reconnaissance vehicle. Yet the Defense Airborne Reconnaissance Office first developed Predator, which did not originate in any service, and even Ehrhard acknowledges the drone "would never have been built under the service-centric approach."[46]

Predator UAV with a Hellfire air-to-ground missile mounted under the right wing. *(U.S. Air Force Fact Sheet)*

JAST AND THE ORIGINS OF THE F–35 JOINT STRIKE FIGHTER

Although not an advanced concept technology demonstration, at its outset in 1994 the Joint Advanced Strike Technology program shared many of the characteristics and purposes of that initiative with respect to technology development. JAST and its successor, the Joint Strike Fighter (JSF) program, which began in 1996, also exemplified the Clinton Pentagon's approach both to technology development and to acquisition reform. The programs incorporated the most popular reform ideas of the mid-1990s, including greater reliance on commercial methods and off-the-shelf products, extensive prototyping, an emphasis on affordability, and the use of cost as an independent variable (CAIV) in setting program cost and performance objectives. The Joint Advanced Strike Technology program emerged at a time when the Clinton administration was faced with the dual consequences of the collapse of the Soviet Union: significantly less money to spend on defense and an absence of consensus as to the nature of the future international order, including potential opponents and likely operating environments. Since modernization of the U.S. tactical air fleet would have to take place amid fiscal constraints and geopolitical uncertainty, it became a focal point for acquisition reformers. At the heart of JAST was a desire to reconcile the dual objectives of greatly improving both performance and affordability in a tactical aircraft. Its experience in that regard is central to understanding the course subsequently taken by the Joint Strike Fighter program.

In 1993 most U.S. tactical aircraft, having been introduced in the 1960s and 1970s, were nearing the end of their operational lives. This cohort included systems as varied as the Navy A–6E Intruder, the Air Force A–10 Thunderbolt II and F–16 Fighting Falcon, and the Marine Corps AV–8B Harrier. Each would reach the end of its planned operational life around the same time in the late 1990s and early 2000s.

The services initially dealt with the retirement and impending replacement of these aircraft systems in isolation, but they were soon overwhelmed by cost projections and congressional opposition to this approach. Even under optimistic assumptions, replacing these systems simultaneously would have created a "bow wave" of costs cresting between 2000 and 2015 and crowding out most other acquisition efforts. Factoring in development time and inevitable delays, unless replacement programs began soon, a serious gap of unknown duration could develop in U.S. capabilities, as old age forced some aircraft into retirement and significantly increased the maintenance costs and decreased the readiness of others.[47]

Requirements aimed at incorporating the latest technological advances drove cost projections for individual programs. Stealth aircraft and precision-guided munitions attracted great attention during Operation Desert Storm, but these capabilities were only available on a limited number of systems. The Navy felt the shortage of stealth aircraft most acutely, as it had no such systems during Desert Storm, and its program to acquire one, the A–12 Avenger II, met its ignominious end only days before hostilities began. In contrast, the Air Force took an aggressive lead in stealth and precision weapons, foreseeing these capabilities would be essential in meeting the demands of future wars. But the Air Force effort to develop and incorporate them into new systems lacked coherence. Leading into 1993, the service pursued a mishmash of programs—many expensive and ill-defined, with few likely to receive an enthusiastic reception from Congress.[48]

Five acquisition programs existed for tactical aircraft at this time. Two of the programs were well into development and had received high-level support from their services: the Air Force F–22 Raptor, intended to replace the F–15 Eagle in the air superiority role; and the Navy F/A–18E/F Super Hornet, nominally an upgrade of the original F/A–18 Hornet, but meant to replace the F–14 Tomcat in the fleet air defense mission. Because of their stages of development and service support, neither was likely to be canceled. In addition to the F–22 and the F/A–18E/F, each service was pursuing a program for an advanced tactical aircraft. After the A–12 debacle, the Navy embarked on a search for a medium-range attack aircraft under the banner of the Advanced Fighter–Experimental program, or A/F–X. The Air Force considered signing on to this program but ultimately chose a different path, preferring a cheap, capable design, the Multi-Role Fighter (MRF), to fulfill the "low" role in the "high/low" mix, then performed by the F–16, to complement the high-role F–22. Neither the A/F–X nor the MRF were well defined, leaving both vulnerable to cancellation.[49]

The fifth tactical aircraft acquisition program was less controversial and consisted of the Marine Corps effort to replace the venerable but temperamental AV–8B Harrier, whose distinguishing characteristic was its ability to take off from short, unimproved runways and to land vertically. Through the Defense Advanced Research Projects Agency, the Advanced Short Takeoff/Vertical Landing (ASTOVL) program mainly focused on identifying better and more reliable

STOVL lift technologies, rather than developing an entire aircraft, in the hope these technologies would pair with another program as production neared.[50]

The authors of the Defense Department's 1993 Bottom-Up Review grappled with these various programs, examining a number of ways to meet tactical aircraft requirements in time to prevent major gaps in capability. Sensing the danger to A/F–X and MRF, the Navy and Air Force preempted external attempts to control costs by merging their programs with a plan to build a single aircraft, the Joint Attack Fighter (JAF), and even held out the possibility of developing a STOVL variant for the Marine Corps. In the services' telling, the joint development of a single design would cut research and development costs almost in half. Moreover, a base design could be built on a single production line in greater numbers, maximizing economies of scale. Despite the services' arguments, the proposed program met immediate and overwhelming opposition, especially from Congress.[51]

Critics of the proposed Joint Attack Fighter program cited the problems in developing the multiservice F–111 fighter-bomber three decades earlier. Secretary of Defense Robert McNamara had initiated the F–111 program in 1961 over the objections of the Navy. What ensued was one of the most costly and divisive acquisition battles of the 1960s. McNamara ordered the services to develop a single design for a tactical fighter-bomber. He expected the combined program to reduce development and production costs substantially, but it faced several obstacles. A joint acquisition program could work if the services were planning similar missions for the aircraft, but in the case of the F–111, they were not. Whereas the Air Force wanted a supersonic long-range platform for delivering conventional or nuclear weapons, the Navy sought a fleet defense interceptor with relatively long endurance. The Navy's unique requirements for reinforced landing gear, a heavier, less volatile fuel, and a tailhook for landing on aircraft carriers further differentiated the two variants of the aircraft. After years of development and cost overruns, the Navy's variant never went into production. The Air Force had more success with the F–111; it purchased over 500, including 76 of a strategic bombing version. Although not entirely negative, the F–111 experience was enough to dissuade the defense community from any serious attempt at joint fighter development for the next 30 years.[52]

The services sought to distinguish the Joint Attack Fighter from the F–111 in several ways. To assuage concerns that the services' unwillingness to compromise might lead to expensive, subpar systems, the Navy announced it had dropped its traditional demand for a two-engine design, greatly increasing commonality and reducing the aircraft's projected weight. Moreover, unlike the F–111 experience, the services undertook the Joint Attack Fighter on their own initiative, proactively responding to a constrained fiscal environment rather than begrudgingly acceding to it. Furthermore, the idea of pursuing commonality in aircraft design to cut costs did not belong exclusively to the services. By mid-1993 it was clear that the Bottom-Up Review was likely to recommend the approach as one of several cost-saving strategies. Additionally, the FY 1993 National Defense Authorization Act ordered the Defense Science Board to provide "an assessment of the ways that current aircraft, upgrades to current aircraft, and new design aircraft can be modified or otherwise adapted so that a single aircraft type can be used by both the Air Force and the Navy in parallel missions."[53]

These arguments held little sway, however. The services' plan for the Joint Attack Fighter lacked specificity, and their protestations to the contrary could not overcome the ingrained congressional skepticism regarding joint development with a common airframe. In assessing tactical aircraft options for the future, the Congressional Budget Office (CBO) projected the program would not save any money. In a conference report on Defense Department authorizations, Congress stated that JAF proponents lacked a "plausible concept" of how they would reconcile the Navy's demand for high-end performance and the Air Force's requirement for low cost. Even the Defense Science Board, when tasked with analyzing the problem, concluded that the Joint Attack Fighter was not "sufficiently defined . . . to allow meaningful analysis," and "it does not appear likely that the capabilities described by the Navy and the Air Force are likely to be achieved in a single, common airframe."[54]

In the face of such opposition, the Joint Attack Fighter quietly exited the scene. As the Defense Department prepared its Bottom-Up Review in 1993, a consensus developed among both senior civilian and uniformed DoD officials that JAF's flaw was not joint development or a common airframe per se, but the pursuit of these objectives in the framework of a traditionally large acquisition program. Imbued with the technological optimism of the 1990s, the services and OSD instead turned to a much more open-ended program concept to identify, validate, and "mature" the technologies that were necessary to achieve radical increases in affordability for the next generation of tactical aircraft. This was not a formal acquisition program though; it would not produce an aircraft design intended for production. Instead, it would construct limited, but functional technology demonstrators to mature the technologies and ready them for integration into the engineering and manufacturing development phase of a formal acquisition program, but with a much lower risk.[55]

Extensive staff work aimed at developing a consensus preceded the Defense Department's formal announcement of the program known as JAST in September 1993. Two months earlier the Defense Science Board had provided the final report of its task force to review the draft recommendations of the Bottom-Up Review with regard to tactical aircraft. Paul Kaminski, then chairman and CEO of Technology Strategies and Alliances and a Defense Science Board member, headed the task force; its conclusions closely aligned with his priorities when he became under secretary of defense for acquisition and technology in 1994. The board criticized the concept underpinning the Joint Attack Fighter and stated it would be risky and counterproductive to try to build a medium-range attack aircraft and a low-cost air superiority fighter on a single airframe. The task force did not abandon commonality altogether, but articulated an inverse vision of it. Instead of designing a shared airframe, the task force recommended designing almost all of the aircraft's mechanical and electronic subsystems to be shared and capable of being installed on different airframes to accommodate different missions. These subsystems, avionics in particular, represented a large and growing proportion of development costs and could easily exceed the costs of an airframe design on any one program. To ensure that a dual-airframe approach did not spin out into two distinct programs, the report also recommended that future technology exploration programs assume responsibility for identifying manufacturing processes that would allow both airframes and all subsystems to be assembled on the same production line.[56]

The Bottom-Up Review embraced these recommendations with a few important differences. Unlike the Kaminski report, which assumed that the Advanced Fighter—Experimental and, to a lesser extent, the Multi-Role Fighter programs would continue or be put in mothballs, the Bottom-Up Review canceled both. The Joint Advanced Strike Technology program, as articulated in the review, did not rule out the idea of a common airframe, nor did it explicitly dedicate itself to a dual-airframe approach. Instead all forms of commonality were on the table and capable of being explored. Leaving decisions about commonality open may have been deliberate to limit opposition within the Defense Department. When explaining the program to the press, JCS Chairman General Colin Powell emphasized the unique and novel approach JAST represented, as well as the importance of commonality in subsystems, components, and parts to cost savings. But Powell also used the singular "aircraft" to describe the future design, conceding only that the "silhouette" of the variants might differ, sidestepping the airframe question entirely. While promoting JAST, Defense Secretary Aspin expanded on the program's mission without clarifying the ambiguity between the common airframe and the dual-airframe approach. The three main thrusts of the program were to explore the highest degree of commonality possible (aiming for 70 percent by cost), to develop new precision-guided munitions, and to build "demonstration aircraft" that could provide a proof of concept for specific new technologies. These demonstrators would be flight-capable but were not full prototypes, a distinction that would become consequential as DoD wrote JAST's charter and clarified its statutory authority.[57]

The Joint Advanced Strike Technology program's reception in Congress was scarcely better than the Joint Attack Fighter's. Less than two months after the release of the Bottom-Up Review and the announcement of JAST, the FY 1994 Conference Report on the National Defense Authorization Act adopted a skeptical tone, saying the program "appears to use technology rollover as a means of 'treading water' over several more years, and then leads only to a JAF of a different color. By the same token, the conferees would also resist any effort which becomes a 'science fair' project that has no hope of yielding any fully integrated aircraft for more than 20 years." The conferees focused mainly on the fact that JAST did not seem to answer, or seem interested in answering, the question of how both to meet and to afford the divergent mission requirements of the A/F–X, MRF, and ASTOVL programs. Fatefully, the conferees made clear that as a measure of progress, they expected any joint development effort to lead to working prototypes capable of meeting the Defense Department's stated requirements.[58]

Congressional skepticism could do little to slow down JAST once OSD canceled the Advanced Fighter–Experimental and the Multi-Role Fighter, however. The Defense Department immediately began writing a charter for the program, further defining its objectives. In addition to articulating OSD's vision for JAST, this process identified the statutory obligations that would apply to the program's activities. JAST's charter specifically stated it was not an "acquisition program," likely because of the bureaucratic rigidities this would entail, but also because OSD did not intend the program to produce a design for production. JAST's managers and supporters insisted that it also was not a technology development program, but rather a demonstration program designed to identify, validate, and mature technologies in preparation for inclusion in the engineering and manufacturing development phase of a separate acquisition program. The program office officially opened January 1994, and within a year Congress significantly expanded the office's purview by placing the ASTOVL program under its jurisdiction as well.[59]

Comparing the rhetoric surrounding the ambitious goals for the Joint Advanced Strike Technology program at its inception in 1993–1994 and the Joint Strike Fighter design that eventually became the F–35 is a study in discontinuity. From the start JAST set out a number of specific areas of exploration from aviation technology to program management, all of them heralded as significant contributions to "affordability." But over the course of the next two years, JAST's explorations gradually elided the question of whether these technologies contributed to affordability, instead simply certifying that they could, until most of the priorities distinguishing JAST from conventional acquisition efforts vanished.

The dual pursuit of modularity and commonality in the Joint Advanced Strike Technology program produced a tension that was never resolved. Upon announcing JAST, DoD spokespersons touted lofty goals of 70 percent to 80 percent cost commonality, but expressed this in terms of parts, components, and subsystems. The purpose of commonality, as articulated by JAST's promoters and conventionally understood, was to cut costs by maximizing economies of scale, and to a lesser extent to save on maintenance and other logistics costs by having a common pool of supplies and spares. Assuming the program would produce three variants (as it eventually did for the Air Force, Navy, and Marine Corps), pursuing this goal would minimize the number of variations from one service to another. Perversely, pursuit of this goal would encourage designers to engineer common subsystems, components, and parts to accommodate a wider variety of missions, driving up costs.

The Defense Science Board recommended identifying the subsystems that were most expensive to develop, such as avionics, radar, and jet engines, and to keep these in common across aircraft that would remain tailored to specific missions. "Modularity" meant designing these aircraft in coordination with each other, so that subsystems tailored to an aircraft's mission all shared a common physical and software interface. Instead of trying to accommodate divergent missions in a single slightly varied design, a modular architecture would make it cheaper and easier to tailor aircraft to specific missions from a common foundation. The JAST charter and subsequent evaluations of the program's effectiveness bowed to modularity by emphasizing the goal of developing technology "building blocks" for inclusion in future designs. But by pursuing airframe and manufacturing commonality above all else, the resulting design bore more resemblance to a single building block with limited modular elements. Unsurprisingly, then, at the close of the concept exploration phase in March 1995, the program reported that fulfilling the needs of the Air Force, Navy, and Marine Corps was possible with a "family of aircraft," with not just a common engine and avionics suite but also with a common airframe.[60]

Evidence of this design philosophy cropped up elsewhere. One of JAST's key initiatives was the exploration of completely integrated avionics, making the Joint Strike Fighter only the second such fighter, after the F–22, to do so. One of the main reasons for pursuing software integration was the Navy's decision to abandon its traditional preference for dual-seat aircraft. This choice held out the promise of considerable weight savings and, therefore, cost reduction. But in the absence of a weapons and radar officer sitting behind the pilot, the Navy insisted on a user interface that provided the same degree of situational awareness to the now unassisted pilot. Achieving this objective required merging the inputs from a variety of sensors and other systems to a much greater degree than ever before. If done properly, this level of integration would save the weight and expense of dual-seat designs, while also opening up promising opportunities such as centralized self-diagnostics.[61]

Such complex and extensive software integration projects carried inherent risks, however. Large, centralized software projects can be devilishly hard to manage and to keep to an established schedule or budget. Furthermore, once written, such software is essentially customized to the exact configuration of the aircraft, making future upgrades to subsystems and components much more difficult. By contrast, the F/A–18E/F Super Hornet employed a federated architecture that delegated most processing to individual subsystems but utilized a common interface with some central processing capabilities to coordinate the aircraft's functions. This approach entailed a slight increase in aircraft weight over total integration, but also made maintenance and upgrades far simpler and easier to perform. It also flattened out software development responsibilities, reducing the impact of a delay in any one part of the project.[62]

Of course, not every avenue of research proved to be so problematic. Other technologies investigated by JAST included the use of advanced materials such as composites and innovative manufacturing techniques that could take multiple-component assemblies and package them into a single whole. Studying the feasibility of the lift fan, which was central to the STOVL variant of the F–35, was also one of the main projects funded by JAST, as were cost-saving commercial best practices like "lean manufacturing" in the production line for the final design.[63]

The Boeing X–32A/C conventional takeoff/landing and carrier prototype 2. *(JSF)*

The Boeing X–32B short take off/vertical landing prototype 3. *(JSF)*

The Lockheed Martin X–35C carrier prototype. *(JSF)*

As the Joint Advanced Strike Technology program transitioned from exploration to producing working models, a unique set of pressures and decisions clipped its wings. When DoD renamed JAST the Joint Strike Fighter program, the change was emblematic of the drift from the original JAST concept. The ideas of "fly before you buy" and competitive prototyping were deeply ingrained in the minds of defense reformers such as Under Secretary Kaminski and Secretaries of Defense Aspin and Perry. These concepts were also quite popular with Congress. When first announced, aircraft manufacturers expressed concern that JAST's explorations were too abstract to require building any aircraft, deferring important business opportunities to a follow-on program. Aspin quickly defused these concerns, assuring the defense industry that the demonstrators JAST planned to construct would include functioning aircraft. By not specifying how these demonstrators would fit into the program strategy, Aspin introduced a conceptual ambiguity that helped shift the program away from its original vision.[64]

When applied to aircraft, the term "demonstrator" is a flexible concept. As originally articulated, JAST's demonstrators likely would have tested only one or two new technologies at a time, confirming that a functioning aircraft with acceptable performance could be constructed while incorporating, for instance, a lift fan. Such a demonstrator could mitigate the technology risk to follow-on acquisition programs. Successful precedents existed for this strategy. For example, the Lockheed/DARPA/Air Force top-secret Have Blue project, proved that a functioning aircraft could be built with stealth features. Have Blue then transitioned to the F–117 stealth fighter program, managing a schedule and budget performance impressive for an advanced fighter development program.[65]

Demonstrators could also incorporate far more sophisticated concepts, a path aligned more closely with congressional expectations and JAST's eventual direction. Designers at times have used demonstrators to test the feasibility of broad operational concepts at the intersection of technology, design, and performance. The YF–16/YF–17 Light Weight Fighter program, which resulted in the F–16 and ultimately the F/A–18, employed two such demonstrators that came much closer to full-featured prototypes, so much so that program managers felt confident in combining the concept demonstration and fly-off competition into a single phase. Congress argued that JAST's original approach simply shifted the true technology risks into the EMD phase of the follow-on acquisition program. Concerned that the Joint Advanced Strike Technology program would waste years with "science fair" projects before engaging practical questions of how to design a combat aircraft, Congress from the start demanded that demonstrators, in effect, be prototypes. Furthermore, Congress insisted on a competitive prototyping process, implying that the winner would go on to build the airplane, an outcome contrary to JAST's original purpose. In view of congressional mandates, JAST's requirements for demonstrators had to incorporate as many technologies per design as possible, causing each manufacturer's submission to include some overlapping combination of available technologies, rather than just proving one or two concepts.[66]

OSD and JAST program managers did little to oppose this trend. The change in the program office's name implicitly accepted the shift in mission from exploration to producing a functioning aircraft design. At the time, observers such as the General Accounting Office noted that the traditional pressure to move high-profile projects into EMD seemed to underlie the push toward a traditional acquisition program, but other factors affected this decision as well. In November 1996 the Joint Strike Fighter program office selected the two prototype manufacturers, Boeing and Lockheed Martin, with fly-offs scheduled for 2000. This decision locked in the program's direction and limited the possibilities for design and functional variations in the future, regardless of who won the competition. This outcome was hardly surprising, as the formal acceptance of the "family of aircraft" concept presupposed the production of a single aircraft with three variants two years earlier. When the transition to full-featured prototypes seemed assured, the "fly before you buy"

The Air Force F–35A Lightning II variant of the Joint Strike Fighter. *(U.S. Air Force)*

predilections of civilian policymakers such as Kaminski overtook the original vision for a highly modular architecture for one or more aircraft. Once nearly functional aircraft were built, Congress was unlikely to approve any major deviations from those designs. In other words, building full-featured demonstrators in the name of "fly before you buy" implicitly meant "once you fly, you must buy."[67]

After competitive fly-offs in 2000 and 2001, Lockheed Martin's X–35 design won the contract over Boeing's X–32 for the production of all three variants of the Joint Strike Fighter. The program's subsequent history was dismal—cost overruns of 50 percent in real terms, delays, testing problems, and international partners threatening to withdraw. In view of this record, congressional warnings that JAST would simply produce a Joint Attack Fighter of a different color might seem prophetic had Congress itself not pushed for a process virtually guaranteeing such an outcome.[68]

The defense reformers of the Clinton administration believed technology was the path to affordability, even though in the history of defense acquisition some of the most affordable aircraft programs have been those pushing innovation and performance the least, such as the close air support A–10. Aspin and others who supported JAST promised a revolution that would lead to substantial performance gains at low costs. While enthusiasm levels varied over the course of the program, no major constituency saw JAST/JSF as a threat to its future or as an unacceptable compromise in its capabilities; indeed, this was the promise the program made at the very beginning. The result was that too often the Joint Advanced Strike Technology program failed to restrain requirements and ultimately supported technologies that made performance gains at a higher-than-anticipated cost.

To the program's credit, many of JAST's efforts proved worthwhile and undoubtedly saved money, such as the Navy's initial design compromises, the program office's commitment to cutting red tape and adopting paperless processing to the greatest extent possible, and advances in modeling, simulation, and computer-aided design. Even the use of cost-as-an-independent-variable budgeting, while ironic in view of a 50 percent increase in costs, initially pushed the services and program managers to be far more proactive in providing oversight and guidance to contractors with regard to costs, particularly in the early phases of development. But these were either incremental increases or the sort of policies that should have been instituted to prevent traditional programs from becoming too expensive. Applied to the Joint Strike Fighter and its forebears, they did no more than hold the cost to that of traditional programs. Unsurprisingly, the Joint Advanced Strike Technology program failed to achieve its goal of providing major increases in performance at a radically lower cost.

* * * * *

During the first Clinton administration the Pentagon launched a number of experiments to promote the fielding of advanced technology, including three discussed in this chapter: the advanced concept technology demonstration, to move promising technologies into the field rapidly; the Defense Airborne Reconnaissance Office, to lead a centralized effort to acquire unmanned aerial vehicles, relatively low-cost systems the administration considered critical to U.S. warfighting capabilities; and the Joint Advanced Strike Technology program, which sought to find the technologies that would be necessary to develop an affordable tactical aircraft (the Joint Strike Fighter) with a common airframe.

The results were mixed. Advanced concept technology demonstrations could be seen as successful, because they provided the warfighter with otherwise unavailable capabilities and allowed for the termination of failed technologies before they were formally acquired or installed in a major weapon system where failures would have been costly. The Defense Airborne Reconnaissance Office failed, at least institutionally, and for the most part so did the centralized approach to UAV development. However, DARO did launch Predator, which changed attitudes about the value of unmanned vehicles among military and political leaders and initiated a revolutionary change in the conduct of warfare. Finally, the JAST experiment fell short of its original intent. The pressure to begin the acquisition of the multiservice fighter overwhelmed it; the resulting Joint Strike Fighter program developed impressive technology, but also exhibited the performance shortfalls, schedule delays, and cost overruns reformers had been trying to prevent in the first place.

Endnotes

1. Perry, "Desert Storm and Deterrence," 78–82; Perry, "Defense in an Age of Hope," *Foreign Affairs* 75, no. 6 (Nov-Dec 1996): 64–79.

2. Devin L. Cate, "Where Have All the Prototypes Gone? The Failure of the Prototyping Initiatives of the 1990s" (research paper, Air Command and Staff College, Air University, Maxwell AFB, AL, Mar 1997), 7–8.

3. Packard Commission, *Quest for Excellence*, 55–57 (quote, 55).

4. Ibid., xxvi, 56.

5. Ltr, Perry and Packard to SecDef Cheney, 3 Apr 1989, folder 400.14, box 75, Acc -330-91-0095, OSD Records, WNRC; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 5, sec. D.

6. A. D. Van Nostrand, *Fundable Knowledge: The Marketing of Defense Technology,* Rhetoric, Knowledge, and Society Series (Mahwah, NJ: Lawrence Erlbaum Associates, 1997), 95 ("operates

erratically"); Paul G. Kaminski, interview by Philip Shiman, Fairfax Station, VA, 8 Sep 2004, 21–22 (quote), OSD/HO.

7. Memo, USD(A) John Deutch for Secretaries of Military Departments, et al., 14 Oct 1993, subj: Defense Advanced Development, with attached draft memo, 28 Jun 1993, subj: Relationships Between DDR&E, Director of Tactical Systems, Director of Strategic and Space Systems, DUSD (Advanced Technology), (quote), box 8, Acc 330-97-0030, OSD Records, WNRC; RDT&E Budget Item Justification Sheet (R-2 Exhibit), Defense-wide/BA-3, program element 0603750D8Z, "Advanced Concept Technology Demonstrations," Feb 1999, sec. A, http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2001/budget_justification/pdfs/03_RDT_and_E/volume3.pdf, accessed 8 Aug 2014.

8. Les Aspin, *Annual Report to the President and the Congress*, Jan 1994, 137; Defense Science Board, *Report of the Defense Science Board 1991 Summer Study on Weapon Development and Production Technology* (Washington, DC: OUSD[A], Nov 1991), 27, 42. Information on the advanced concept technology demonstrations in this section is drawn primarily from Secretary of Defense William J. Perry, *Annual Report to the President and the Congress*, Feb 1995, 107–110; Perry, *Annual Report to the President and the Congress*, Mar 1996, 84–86; SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1995 and the Future Years Defense Program: Hearings . . . on S. 2182,* pt. 5: *Defense Technology, Acquisition, and Industrial Base*, 103d Cong., 2d sess., 8 Mar 1994, S. Hrg. 103-765, 19–29; Director, Defense Research and Engineering, *Defense Science and Technology Strategy* (Washington, DC: DoD, Sep 1994), 17–18; ACTD website archived 5 Jun 1997, https://web.archive.org/web/20160303231029/https://acc.dau.mil/CommunityBrowser.aspx?id=37609&lang=en-US, accessed 13 Oct 2020; and Kaminski, "Advanced Concept Technology Demonstrations: Challenges and Opportunities" (keynote address, ACTD Manager's Conference, DSMC, Fort Belvoir, VA, 10 Sep 1996): both in author files, OSD/HO; Congressional Budget Office, *The Department of Defense's Advanced Concept Technology Demonstrations* (Washington, DC: CBO, Sep 1998). One of the best descriptions and analyses of the ACTD program is in Matthew T. South, "Transitioning Advanced Concept Technology Demonstrations to Acquisition Programs" (master's thesis, Naval Postgraduate School, Monterey, CA, Dec 2003).

9. Alan E. Barrick and Henry C. Alberts, "Acquisition of State-of-the-Art Logistics Combat Support Systems: The Joint Logistics Advanced Concept Technology Demonstration Program," *Acquisition Review Quarterly* 4, no. 2 (Summer 1997): 352; Jeffrey A. Drezner, Geoffrey Sommer, and Robert S. Leonard, *Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial Vehicle Program: Phase II Experience*, MR-1054-DARPA (Santa Monica, CA: RAND National Defense Research Institute, 1999), 25–28; "Low Life Cycle Cost Medium Lift Helicopter," 5 Jun 1997, copy in author files; DoD IG, *Advanced Concept Technology Demonstration*, Audit Report 97-120 (Washington, DC: DoD, 7 Apr 1997), 28–29, 45–46; CBO, *Advanced Concept Technology Demonstrations*, 19, 27–30. For the evolution of other transaction authority legislation, see Office of the Under Secretary of Defense for Acquisition and Sustainment, *Other Transactions Guide*, Nov 2018, ver. 1.0, 4, app. B, https://aaf.dau.edu/aaf/ot-guide, accessed 2 Aug 2020.

10. Kaminski, keynote address, 10 Sep 1996, 2, 4 (quote). See also V. Larry Lynn, testimony before the SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1995 and the Future Years Defense Program*, 8 Mar 1994, 55.

11. SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1995 and the Future Years Defense Program*, 8 Mar 1994, 25–27 (quote, 25); CBO, *Advanced Concept Technology Demonstrations*, 5–6.

12. "ACTD Initiation and Approval Process," *ACTD Guidelines*, 1 (quote); "International Participation in ACTDs," *ACTD Times*, Oct 1996, 1; CBO, *Advanced Concept Technology Demonstrations*, 28, 30; Office of the Deputy Under Secretary for Advanced Systems and Concepts, "Joint Capability Technology Demonstration (JCTD): Program Overview," briefing, 14 Oct 2006, slide "Coalition Participation in ACTDs/JCTDs": copies of all in author files. In fall 1994 the new DoD science and technology strategy described ACTDs as "user-oriented, even user-dominated." See DDR&E, *Defense Science and Technology Strategy*, 17.

13. CBO, *Advanced Concept Technology Demonstrations*, 2, 4; "Introduction to the ACTD Process," 5 Jun 1997 ("good judgment"), copy in author files; Michael R. Thirtle, Robert V. Johnson, and John L. Birkler, *The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process*, RAND Report MR-899-OSD (Santa Monica, CA: RAND, 1997), 4 (emphasis in original); *Advanced Concept Technology Demonstrations (ACTDs) Master Plan* (1996), www.fas/org/spp/military/docops/defense/actd_mp/index.html, accessed 25 Aug 2014; DoD IG, *Advanced Concept Technology Demonstration*, 22–23. The Advanced Technology Breakfast Club included the deputy under secretary of defense for advanced technology; the director of defense research and engineering; the deputy assistant secretary of defense for command, control, communications, and intelligence; and representatives from the Joint Staff, the Ballistic Missile Defense Organization, the Advanced Research Projects Agency, and service scientific and technical (S&T) and operations/requirements offices. Judging the maturity of the technologies was very difficult and would prove to be a significant problem. At the start of the program, DoD did not have an effective way to evaluate the maturity of technology; each service had its own definition. See DoD IG, *Advanced Concept Technology Demonstration*, 9–10, 31–33, 38–44, 47–52; CBO, *Advanced Concept Technology Demonstrations*, 19–21; CBO, *Options for Enhancing the Department of Defense's Unmanned Aerial Vehicle Programs*, CBO Papers (Washington, DC: CBO, Sep 1998); GAO, *Defense Acquisition: Advanced Concept Technology Demonstration Program Can Be Improved*, GAO-NSIAD-99-4 (Oct 1998), 4–5. By the end of the century, however, DoD adopted a scale of technology readiness levels, or TRLs, which helped alleviate the problem.

14. "Guidelines for ACTD Management Plans," *ACTD Guidelines*; Thirtle, Johnson, and Birkler, *Predator ACTD*, 72–75.

15. House Committee on National Security [HCNS], Military Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1998—H.R. 1119 . . . Title II–Research, Development, Test, and Evaluation*, 105th Cong., 1st sess., 27 Feb 1997, 83; RDT&E Budget Item Justification Sheet, Feb 1999, "Advanced Concept Technology Demonstrations," sec. A; John M. Bachkosky, "The Contribution of ACTDs to Acquisition Reform," *Program Manager* 26 (Jan–Feb 1997): 55; South, "Transitioning Advanced Concept Technology Demonstrations," 47–48.

16. For detailed descriptions of the ACTDs selected for FY 1995 and FY 1996, see "ACTD Descriptions," archived webpage, 6 Jun 1997, copy in author files.

17. For brief descriptions of the ACTDs selected through FY 2002, see South, "Transitioning Advanced Concept Technology Demonstrations," 31–32 and app. B; CBO, *Advanced Concept Technology Demonstrations*, 8–12, 27–30. OSD's share of the costs began to rise as the individual projects became smaller and as more became ready for demonstration, which OSD was underwriting.

18. *National Defense Authorization Act for Fiscal Year 1997: Conference Report to Accompany H.R. 3230*, 104th Cong., 2d sess., 30 Jul 1996, H. Rep. 104-724, 651.

19. HCAS, *Department of Defense Appropriations Bill, 1998: Report*, 105th Cong., 1st sess., 25 Jul 1997, H. Rep. 105-206, 25 Jul 1997, 168 (quotes); CBO, *Advanced Concept Technology Demonstrations*, 21–22. DoD's comments were in response to the GAO's criticisms of the purchase of Enhanced Fiber Optic Guided Missiles and Line-Of-Sight Antitank Missiles for the following year. See GAO, *Advanced Concept Technology Demonstration Program Can Be Improved*, 7–8, 17 (quote).

20. DoD IG, *Advanced Concept Technology Demonstration*, 5–15, 38–53.

21. Cate, "Where Have All the Prototypes Gone?" 25–28 (quote, 25).

22. Reasons for delay in the Predator program may have been because it was the first to make the transition, had no guide to follow, and had done nothing to prepare for the change. South, "Transitioning Advanced Concept Technology Demonstrations," 49–51; Mark H. Mol, "Advanced Concept Technology Demonstrations (ACTD): Are They Relevant in Today's Acquisition Environment?" (master's thesis, Air Command and Staff College, Air University, Maxwell AFB, AL, Apr 1998), 27–28; Thirtle, Johnson, and Birkler, *Predator ACTD*, 30–49, 62–75.

23. South, "Transitioning Advanced Concept Technology Demonstrations," 46–51.

24. Mol, "Advanced Concept Technology Demonstrations," 14–16. For an extreme example of this problem, see also Thirtle, Johnson, and Birkler, *Predator ACTD*, 30–49, 62–75.

25. South, "Transitioning Advanced Concept Technology Demonstrations," 52–53; Mol, "Advanced Concept Technology Demonstrations," 14, 16–18, 42–44. For an excellent case study of the Global Hawk's transition from an ACTD to a full acquisition program, see Jeffrey A. Drezner and Robert S. Leonard, *Innovative Development: Global Hawk and DarkStar: Transitions Within and Out of the HAE UAV ACTD Program*, RAND Report MR-1476-AF (Santa Monica, CA: RAND Corporation, 2002).

26. Perry, *Annual Report*, 1995, 109–110; Trey Carson, "Advanced Concept Technology Demonstration: Defense Acquisition University ACTD Funding Process," undated briefing, slide: "ACTD Statistics"; South, "Transitioning Advanced Concept Technology Demonstrations," app. B. See also GAO, *Defense Acquisitions: Factors Affecting Outcomes of Advanced Concept Technology Demonstrations*, GAO-03-52 (Dec 2002), 5.

27. Thomas P. Ehrhard, *Air Force UAVs: The Secret History* (n.p.: Mitchell Institute Press, Jul 2010), 5–46.

28. Ehrhard, *Air Force UAVs*, 4, 11–12, 16–21, 24, 31, 36–38; Richard H. Van Atta et al., "Unmanned Aerial Vehicles," in Richard H. Van Atta et al., *Transformation and Transition: DARPA's Role in Fostering an Emerging Revolution in Military Affairs*, vol. 2: *Detailed Assessments*, IDA Paper P-3698 (Alexandria, VA: IDA, 2003), chap. 6:1–26; Drezner, Sommer, and Leonard, *Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial Vehicle Program*, 4–7; Louis J. Rodrigues, statement before the HCNS, Subcommittees on Military Research and Development and Military Procurement, in GAO, *Unmanned Aerial Vehicles: DoD's Acquisition Efforts*, GAO-NSIAD-97-138 (9 Apr 1998), 1–3, 6–7; DARO, *Unmanned Aerial Vehicle's (UAV) Master Plan* (Washington, DC: DARO, Apr 1994), 2, 1–3; Barak J. Carlson, "Past UAV Program Failures and Implications for Current UAV Programs" (research report, Air Command and Staff College, Air University, Maxwell AFB, AL, Apr 2001), 5–10, 16. The quote is in Van Atta et al., "Unmanned Aerial Vehicles," 6:24. For a list of the key UAV programs and their results, see CBO, *Options*, x; Rodrigues statement, 2–3.

29. Ehrhard, *Air Force UAVs*, 41–42.

30. CBO, "*Options*," 4–8; "UAVs and the Revolution in Military Affairs," "Contributions of UAVs to Future Military Operations," and "Contributions of UAVs in Other Operations," in Defense Airborne Reconnaissance Office, *UAV Annual Report*, Aug 1995, www.fas.org/irp/agency/daro/uav95/toc.html, accessed 25 Aug 2014.

31. Ehrhard, *Air Force UAVs*, 47.

32. House of Representatives, *National Defense Authorization Act for Fiscal Year 1994: Conference Report* . . . 103d Cong., 1st sess., 10 Nov 1993, H. Rep. 103-357, 444, 597–598; DoD Directive 5134.11 (Defense Airborne Reconnaissance Office [DARO]), 5 Apr 1995, 2–6 (quotes); DARO, *Unmanned Aerial Vehicles (UAV) Program Plan* (Washington, DC: DUSD [Advanced Technology], Apr 1994), 1, 2–6; Ehrhard, *Air Force UAVs*, 46–48.

33. Ehrhard, *Air Force UAVs*, 46 (quote); Darell G. Lance, "Army Participation in the Defense Airborne Reconnaissance Program," Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, 1996), 1–5, 26; DARO listings in Department of Defense telephone books from Aug 1995 to Apr 1998, all on O-3.

34. Lance, "Army Participation," 16–19, 22.

35. Thirtle, Johnson, and Birkler, *Predator ACTD*, 6-7; [Unmanned Aerial Vehicle Joint Program Office] *Unmanned Aerial Vehicles 1994 Master Plan* (n.p., n.d.), app. A, 1–2 (hereafter *1994 Master Plan*); DARO, *1994 Program Plan*, Executive Summary, 2, 2-3–2-6, 3-1–3-10. For the failure of the Medium Range UAV, see UAV JPO, *1994 Master Plan*, 3–29; Rodrigues statement, GAO, 3.

36. DARO, *Program Plan*, 4-1–4-4, 6-1–6-4.

37. The Army deployed its seven Hunter systems with eight support vehicles each to the Balkans from 1999 to 2002, by which time, according to a 2003 OSD report, the once unreliable Hunter had become "the standard to which other UAVs are compared in reliability." The Army restarted production, which ended in 2005. As of 2011, 45 Hunters were still in operation. For Hunter, see

Office of the Secretary of Defense, *Unmanned Aerial Vehicles Roadmap, 2002–2027* (Washington, DC: DoD, Dec 2002), 7; Elizabeth Bone, *Unmanned Aerial Vehicles: Background and Issues for Congress*, CRS Report RL31872 (Washington, DC: CRS, 25 Apr 2003), 28–29; Jeremiah Gertler, *U.S. Unmanned Aerial Systems*, CRS Report R42136 (Washington, DC: CRS, 3 Jan 2012), 42–43; Office of the Secretary of Defense, *Unmanned Aerial Vehicle Reliability Study* (Washington, DC: DoD, Feb 2003), 14–17 (quote, 16).

38. DARO, *UAV Annual Report, FY 1996* (n.p., 6 Nov 1996), 16–17.

39. Thirtle, Johnson, and Birkler, *Predator ACTD*, xiv, 7–9, 12, 19–20, 27–30; Ehrhard, *Air Force UAVs*, 20–22; Van Atta et al., *Transformation and Transition*, vol. 2, 6:18–19, 6:22–23, 6:29–30, 6:35–36; CBO, *Options*, 28–29. For background on the Predator vehicle and program, see Richard Whittle, "The Drone Started Here," *Air & Space* 28, no. 1 (Apr/May 2013): 28–33; Ehrhard, *Air Force UAVs*, 49–50.

40. Thirtle, Johnson, and Birkler, *Predator ACTD*, 20–26; "Medium Altitude Endurance UAV, Predator," in *ACTD Master Plan*, 1996, copy in author files.

41. Mol, "Advanced Concept Technology Demonstrations," 26–27; Director of Operational Test and Evaluation, "Predator Unmanned Aerial Vehicle (UAV)," annual reports, FY 1996 and FY 1997, copies in author files; OSD, *Unmanned Aerial Vehicle Reliability Study*, 7.

42. Richard Whittle, *Predator's Big Safari*, Mitchell Paper 7 (n.p.: Mitchell Institute Press, Aug 2011), 11.

43. Ehrhard, *Air Force UAVs*, 50–51; memo, Acting USD(A&T) Noel Longuemare for Secretaries of the Army, Navy, and Air Force, 18 Aug 1997, subj: Predator Unmanned Aerial Vehicle (UAV) Acquisition Decision Memorandum, copy in author files; Mol, "Advanced Concept Technology Demonstrations," 27–28; Thirtle, Johnson, and Birkler, *Predator ACTD*, 31–49; Rojan J. Robotham, "Predator Acquisition Program Transition from Rapid to Standard Processes" (Masters of Military Art and Science thesis, U.S. Army Command and General Staff College, Fort Leavenworth, KS, 2012), 9–10, 19–20; Roxana Tiron, "Despite Doubts, Air Force Stands by Predator," *National Defense*, Dec 2001, www.nationaldefensemagazine.org/archive/2001/December/Pages/Despite_Doubts4155.aspx, accessed 25 Aug 2014; James Dao, "A Nation Challenged: Technology; U.S. Is Using More Drones, Despite Concern Over Flaws," *New York Times*, 3 Nov 2001, www.nytimes.com/2001/11/03/world/nation-challenged-technology-us-using-more-drones-despite-concern-over-flaws.html, accessed 25 Aug 2014; HCNS, Military Research and Development Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1998—H.R. 1119*, 77, 81; Whittle, *Predator's Big Safari*, 7–32.

44. Ehrhard, *Air Force UAVs*, 53–54; Van Atta et al., *Transformation and Transition*, chap. 2:31–32.

45. Ehrhard, *Air Force UAVs*, 48–49 (quote, 49), 56; *Intelligence Authorization Act for Fiscal Year 1998*, H.R. 1775 (as passed the House, 9 Jul 1997), 105th Cong., sec. 608; House Permanent Select Subcommittee on Intelligence, *Intelligence Authorization Act for Fiscal Year 1998*, 105th Cong., 1st sess., 18 Jun 1997, H. Rep. 105-135, pt. 1:36–37; HCNS, *National Defense Authorization Act for Fiscal Year 1998: Report*, 105th Cong., 1st sess., 16 Jun 1997, H. Rep. 105-132, 398; House of Representatives, *National Defense Authorization Act for Fiscal Year 1998: Conference Report*, 105th Cong., 1st sess., 23 Oct 1997, H. Rep. 105-340, 783–785; *National Defense Authorization Act for Fiscal Year 1998*, P.L. 105-85 (18 Nov 1997), sec. 905 (111 Stat. 1855–1856).

46. Ehrhard, *Air Force UAVs*, 49, 52, 56–57 (quotes, 57, 52); U.S. Air Force Fact Sheet, "MQ–1B Predator," 23 Sep 2015, http://www.af.mil/AboutUs/FactSheets/tabid/131/Search/predATOR/Default.aspx, accessed 2 Nov 2015.

47. On the "bow-wave" phenomenon, see CBO, *Options for Fighter and Attack Aircraft: Costs and Capabilities*, CBO Staff Memorandum (Washington, DC: CBO, May 1993), 8–10. See also Defense Science Board, *Report of the Defense Science Board Task Force on Aircraft Assessment* (Washington, DC: OUSD[A], 1993), 7.

48. Relevant congressional committees bristled at the multiplying modernization programs, demanding a number of affordability assessments and alternatives studies in the FY 1993 budget. See *National Defense Authorization Act for Fiscal Year 1993*, P.L. 102-484 (23 Oct 1992), sec. 902.

49. The high/low mix was a concept originated by proponents of the F–16 program in the 1970s. The program sought to develop a cheap, single-engine day fighter to prove a number of

operational and fiscal concepts, but wanted to avoid conflict with Air Force leaders who viewed the F–16 as a threat to the highly advanced and expensive F–15. For the high/low mix concept and the origins of the F–16, see Coram, *Boyd*, passim.

50. See CBO, *Options for Fighter and Attack Aircraft*, 1–4.

51. See John D. Morrocco, "Reports Cast Doubts on Joint Attack Fighter," *Aviation Week & Space Technology* 138, no. 20 (May 1993): 63.

52. Ibid. For a short description and analysis of the F–111's acquisition, see Walter S. Poole, *Adapting to Flexible Response, 1960–1968*, vol. 2 of *History of Acquisition in the Department of Defense* (Washington, DC: OSD/HO, 2013), chap. VII; for a full account, see Robert Coulam, *Illusions of Choice: The F–111 and the Problem of Weapons Acquisition Reform* (Princeton, NJ: Princeton University Press, 1977).

53. *National Defense Authorization Act for Fiscal Year 1993*, P.L. 102-484, sec. 902(d)(1) (quote). On the Navy dropping its demand for a two-engine fighter, see Introduction, Joint Strike Fighter Program History, http://web.archive.org/web/20050305170804/http://www.jsf.mil/History/History_Intro.htm, accessed 7 Nov 2013.

54. Defense Science Board, *Report of Defense Science Board Task Force on Tactical Aircraft Bottom-Up Review* (Washington, DC: OUSD[A&T], 1993), 2 (quote). CBO estimate in *Options for Fighter and Attack Aircraft*, 14–18. See also *National Defense Authorization Act for Fiscal Year 1994: Conference Report to Accompany H.R. 2401*, 103d Cong., 1st sess., 10 Nov 1993, H. Rep. 103-357, 592.

55. *Conference Report to Accompany H.R. 2401*, 592 (quote); Aspin, *Report on the Bottom-Up Review*, 35–38.

56. *Report of Defense Science Board Task Force on Tactical Aircraft Bottom-Up Review*, 2, 4.

57. Aspin, *Report on the Bottom-Up Review*, 35–38; Colin Powell, News Briefing, Office of the Assistant Secretary of Defense (Public Affairs), 1 Sep 1993, 1325; Aspin, "Prepared Remarks: Future Effective, Affordable Air Power Plans," *Defense Issues* 8, no. 59, 15 Sep 1993, 1464.

58. *Conference Report to Accompany H.R. 2401*, 592–593.

59. *Charter for the Joint Advanced Strike Technology (JAST) Program*, www.dod.mil/pubs/foi/joint_staff/jointStaff_jointOperations/795.pdf, accessed 7 Nov 2013, 3–4; Maj. Gen. George K. Mueller, USAF, "Statement of Joint Advanced Strike Technology Program Director Before the Subcommittee On Airland Forces of the Senate Armed Services Committee on Tactical Aviation," 3 Mar 1995, http://web.archive.org/web/19970131071457/http://www.jast.mil/testimony/sasc_tstmny.html, accessed on 7 Nov 2013, 5.

60. *Report of Defense Science Board Task Force on Tactical Aircraft Bottom-Up Review*, 2, 4; *Charter for the Joint Advanced Strike Technology*, 2, 4; "Statement of Joint Advanced Strike Technology Program Director," 3 Mar 1995, 7, 9, 10.

61. Centralized self-diagnostics refers to the idea that different aspects of an aircraft would "know" their expected service life, and the central computer would be capable of detecting where and when a breakdown has occurred or a piece of software has been corrupted and therefore is in need of repair. If not for the development costs and integration requirements such a system would entail, the capability could provide considerable cost savings in logistics, including maintenance, and downtime. "F–35 Jet Fighters to Take Integrated Avionics to a Whole New Level," *Military & Aerospace Electronics*, 1 May 2003, www.militaryaerospace.com/articles/print/volume-14/issue-5/features/special-report/f-35-jet-fighters-to-take-integrated-avionics-to-a-whole-new-level.html, accessed 7 Nov 2013. See also John D. Morrocco, "JAST to Be Single Seat/Engine Design," *Aviation Week & Space Technology* 142, no. 6 (Feb 1995): 22; GAO, *Tactical Aircraft: Opportunity to Reduce Risks in the Joint Strike Fighter Program with Different Acquisition Strategy*, GAO-05-271 (Mar 2005), 5; Defense Science Board, *Report of the Defense Science Board Task Force on Joint Advanced Strike Technology (JAST) Program* (Washington, DC: OUSD[A&T], 1994), 22.

62. Norman Friedman, *Naval Institute Guide to World Naval Weapon Systems*, 5th ed. (Annapolis, MD: Naval Institute Press, 2006), 181; CBO, *A Look at Tomorrow's Tactical Air Forces* (Washington, DC: GPO, 1997), 44, 47, 49.

63. For a list of technologies under consideration or investigation, see *Report of the Defense Science Board Task Force on Joint Advanced Strike Technology (JAST) Program*, ES-3. Lean

manufacturing was a quality and efficiency standard the Toyota Corporation pioneered that experienced widespread popularity in commercial industry at the time.

64. "Aspin says JAST Prototypes will Fly," *Aviation Week & Space Technology* 139, no 12 (20 Sep 1993): 33.

65. The Defense Science Board and external reports almost insisted on this approach. See Defense Science Board, *Report of the Defense Science Task Force on Tactical Air Warfare*, 1993 Summer Study (Washington, DC: OUSD[A&T], Nov 1993), app. D, 2; David C. Aronstein and Albert C. Piccirillo, *Comments and Observations on Flight Demonstrator Programs* (Arlington, VA: ANSER [Analytic Services Inc.], 1994), 1–4, 14–17, 54–56.

66. Aronstein and Piccirillo, *Flight Demonstrator Programs*, 11–14, 54–56. For congressional pressures, see HCA, *Department of Defense Appropriations Bill, 1996: Report of the Committee on Appropriations together with Dissenting Views [to accompany H.R. 2126]*, 27 Jul 1995, H. Rep. 104-150, 208; SCA, *Department of Defense Appropriations Bill, 1996, Report [to accompany S. 1087]*, 28 Jul 1995, S. Rep. 104-124, 167; and *Conference Report to Accompany H.R. 2401*, 593.

67. GAO, *Joint Strike Fighter Program*, 13. For the prototype manufacturer selection and fly-off, see James Fallows, "Uncle Sam Buys an Airplane," *The Atlantic Monthly*, Jun 2002, https://www.theatlantic.com/magazine/archive/2002/06/uncle-sam-buys-an-airplane/302509/, accessed 12 Mar 2020.

68. Fallows, "Uncle Sam Buys an Airplane." For problems since the fly-off, see GAO, *Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time* 26, GAO-10-382 (Mar 2010); and GAO, *Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain*, GAO 13-690T (2013); Jim Wolf, "Price of Lockheed's F–35 fighter soars," *Reuters News Service*, 11 Mar 2010, https://www.reuters.com/article/lockheed-fighter/update-2-price-of-lockheeds-f-35-fighter-soars-idUSN1123180820100312, accessed 12 Mar 2020.

CHAPTER IX

Acquisition and the Computer Revolution

Of all the technologies developed since the end of World War II, none had affected society more profoundly by the end of the century than information technology, especially computers. In less than a single lifetime, digital computers evolved from special-purpose, one-of-a-kind machines, like the room-size ENIAC of 1945, to common, everyday devices integrated into nearly every aspect of modern life. In particular, the microprocessor, the brain behind every computer, and the software to run it, became ubiquitous and increasingly indispensable. The most obvious manifestation of the microprocessor's impact was the personal computer, first marketed in 1975. It steadily worked its way into the center of work and home life around the world. Annual sales grew from 48,000 units in 1977 to 125 million in 2001. By that time, more than half of American households had at least one personal computer.[1]

Information technology had significantly impacted all aspects of the military, especially on weapon systems. A manual on computer acquisition published by the Defense Systems Management College in 1988 observed that modern weapon systems "would not exist" without computers and the associated software. "Digital systems are now the heart and soul of all new weapon systems." By the time of Operation Desert Storm in 1991 nearly every weapon system depended on computers in one way or another.[2]

Information technology held two great attractions for the military. First, it promised capabilities military leaders had long dreamed about: to hit a target precisely on the first try; to have a complete view of the battlefield, including the location of both enemy and friendly forces; to always know one's exact location; to have instantaneous communication with anyone, anywhere; to provide forces with all necessary supplies, when and where they were required; and to link air, ground, and naval forces and systems so they could operate as one. Second, it promised to deliver these capabilities relatively inexpensively. Computer hardware was becoming more capable and cheaper; microprocessors, at one time high-priced and in short supply, were also becoming less expensive and were more readily available. Digital technology would also likely provide a lower-cost method of extending a system's life cycle. Inserting new hardware modules and rewriting the software were expected to cost less than the traditional approach of cutting apart the hull or airframe and reengineering the system. Additionally, the Defense Department anticipated that adopting open architectures, nonproprietary standards, and commercial off-the-shelf products, as well as new computerized tools for designing and testing weapons, would not only reduce acquisition costs but also shorten cycle times and increase interoperability of service systems.

By the turn of the century, information technology had fulfilled much of the military's vision of greatly enhanced capabilities. Desert Storm swept away doubts in the services about the efficacy of precision-guided munitions. Whereas they accounted for fewer than 10 percent of munitions delivered during that campaign, they represented almost 30 percent in Kosovo in 1999, more than 50 percent in Afghanistan in 2001–2002, and over 60 percent in Iraq in 2003. Computerized avionics and flight-control systems had made high-performance aircraft more maneuverable and easier to fly. Communications systems were more flexible and widespread. Commanders could see more than ever before. The battlefield picture provided by the Joint Surveillance Target Attack Radar System in 1991, though rudimentary by later standards, nonetheless stunned combat commanders with its detail. Operated from half a world away, unmanned aerial vehicles could send imagery, including video, to a third party on the ground for analysis. The services, using information technology, had also successfully upgraded numerous systems. For example, Army and Marine Corps units that invaded Iraq in 2003 were equipped largely with the same basic platforms, such as M1 Abrams tanks, they had used in Kuwait in 1991. In the period after Desert Storm, these vehicles had been upgraded with improved computer hardware and software that significantly increased their capabilities (see chapter XII).[3]

Although information technology demonstrably improved military capabilities, it did not realize the expectation that it would also save money. Problems with software frequently caused system shortfalls or even failures. In many instances the promise of shorter, more cost-effective development cycles actually resulted in increased acquisition and maintenance costs. Difficulties in developing software were the major reason for many acquisition programs falling behind schedule.

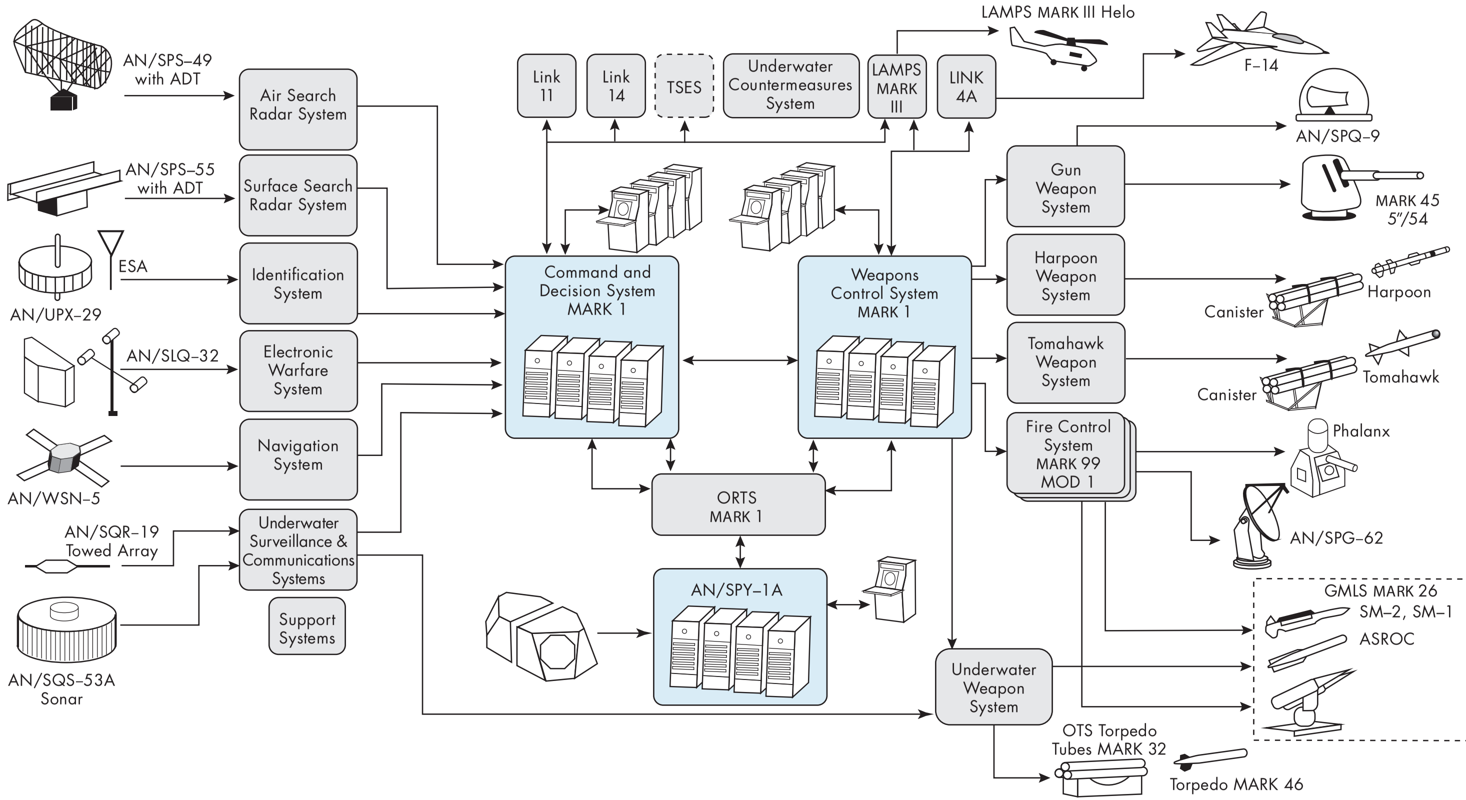
DEFENSE DEPARTMENT OVERSIGHT OF COMPUTER ACQUISITION

When the George H. W. Bush administration came into office in 1989, the Defense Department divided management of information technology acquisition by type of computer system. The first, automatic data processing equipment, was used for routine administrative tasks such as payroll and closely resembled or was identical to machines used in the private sector. The second type, "mission-critical computer resources," which included hardware, software, documentation, and personnel, was intended for uniquely military purposes. The divided oversight structure accorded with the separate legislation covering the two types of computer systems. Automatic data processing equipment was subject to the Automatic Data Processing Act of 1965, commonly known as the Brooks Act after its sponsor, Representative Jack Brooks (D-TX). The act placed restrictions on the acquisition of computer equipment by federal agencies, including a requirement that the General Services Administration conduct all such procurements.

Because the Brooks Act did not distinguish between computers for routine purposes and those for military-specific uses, the Defense Authorization Act for 1982 included a measure known as the Warner Amendment, which exempted mission-critical systems from the provisions of the Brooks Act. The exemption covered four classes of systems: those used for intelligence activities, those used for cryptologic activities related to national security, equipment that was an integral part of a weapon system, and other equipment "critical to the direct fulfillment of military or intelligence missions."[4]

Among the mission-critical systems, those that were an integral part of a weapon system predominated. These were commonly known as "embedded computers." But the term was something of a misnomer. These systems controlled a weapon system or operated in support of it. Some were physically embedded in the weapon, perhaps as circuit boards or individual microprocessors that were fully integrated into the system's electronics and might be virtually indistinguishable from the system's other hardware, except they required software to function. For example, sensors such as radar or infrared heat-seekers on missiles relied heavily on microelectronic devices to amplify signals, convert them from analog to digital form, and perform whatever other signal processing might be needed. However, some embedded systems had the appearance of a stand-alone computer, such as the Navy's Aegis Combat System, which controlled Aegis air defense operations (see figure 9-1). But as long as computers formed an integral part of the larger system and performed relatively focused, narrow functions, they were considered to be embedded.[5]

Figure 9-1: Embedded Computers: The Aegis Combat System



The Navy's Aegis Combat System was a highly integrated air defense system that could identify, track, and engage targets with or without human intervention. Several main computer systems (highlighted in blue) controlled the radar, analyzed the data, decided on courses of action (or presented options to the ship's captain), and directed the weapons. Almost every internal and external system shown in this diagram also incorporated embedded computer hardware and software.

Source: Adapted from Figure 1 (AEGIS Ship Combat System – Baseline), in Walter P. Warner and Richard E. Nance, *The Development of Software Engineers: A View from a User,* Technical Report CS81020-R (n.p., 15 Dec 1981), 4.

To exempt as many of its computers as possible from the Brooks Act, the Defense Department interpreted the Warner Amendment liberally. Thus, it classified as "integral parts of a weapon or weapons system" equipment for training, testing, maintaining, simulating, and even developing weapons. Because the department formally defined "embedded" as "integral to, from the design, procurement, and operations point of view," all such support systems, even computer-aided design tools, were considered to be embedded in the weapons. DoD described other systems with no connection to particular weapons, such as automatic data processing equipment used for war planning or military communications, as "critical to the direct fulfillment of missions." Later it added logistics systems providing direct support to operating forces or to maintenance of weapon systems.[6]

Mission-Critical Computer Systems Exempt from the Brooks Act

1. **Intelligence systems**
2. **Cryptologic systems related to national security**
3. **Command and control systems**
    a. The National Military Command System
    b. Worldwide Military Command and Control System
    c. Department of Defense component command and control systems
4. **Systems that are an integral part of a weapon system**
    a. Those that are physically a part of, dedicated to, or essential in real time to, performance of the mission of weapon systems
    b. Those used for specialized training, diagnostic testing and maintenance, simulation, or calibration of weapon systems
    c. Those used for research and development of weapon systems
5. **Systems that are critical to the direct fulfillment of military or intelligence missions**
    a. Those that will deploy as mission support in a combat environment
    b. War-planning systems
    c. Environmental systems supporting military missions, such as weather, oceanographic, or satellite systems
    d. Projects the existence of which are classified
    e. Warning, surveillance, reconnaissance, and electronic warfare systems
    f. Mapping, charting, and geodesy systems
    g. Airlift, sealift, and port facilities systems
    h. Military communications systems
    i. Logistics systems that provide direct support to operating forces or to maintenance of weapon systems, such as organic supply and software support facilities for weapon systems (but not including contracting, accounting, disbursement, and budgeting)[I]

Note: These categories include not only the systems themselves but also systems used for their research and development.

Within the Defense Department, different regulations and management structures governed mission critical systems. Embedded systems followed DoD Directive 5000.29 (Management of Computer Resources in Major Defense Systems), were overseen by the under secretary of defense for acquisition, and were reviewed by the Defense Acquisition Board as part of the department's weapons program. For example, avionics computers were reviewed as part of the specific aircraft program for which they were being developed. The acquisition of general-purpose data-processing equipment, including non-embedded types of Warner-exempted systems, followed a different set of regulations—DoD Directive 7920.1 (Life-Cycle Management of Automated Information Systems [AISs]) and DoD Instruction 7920.2 (Major Automated Information System Approval Process). Those systems also moved along a special development path similar to that for other major systems but one covering their entire life cycle, including maintenance and upgrades, which for information systems were seen as integral to the acquisition process because their functions and purposes continually evolved. Such systems even had their own special acquisition categories, with the designation of "major" being applied if their costs were expected to exceed $100 million over their life cycle, $25 million in a single year, or if the Office of the Secretary Defense so designated them. Major automated information systems fell under the purview of the Major Automated Information System Review Council, which reviewed those programs in much the same way the Defense Acquisition Board assessed the major defense acquisition programs. As senior official for information resource management, the Defense Department comptroller set policy for automated information systems, oversaw their acquisition, and chaired the Major Automated Information System Review Council.[7]

When Dick Cheney became secretary of defense, the management of both embedded computers and automated information systems was causing much alarm. At that time automated information systems suffered from cost overruns because of weak oversight and cost estimation procedures—eight information systems had collectively experienced 100 percent cost growth, including a Navy financial system that rose in cost from $33 million to $479 million, an increase of more than 1,400 percent. OSD had greatly reduced its role in the acquisition process by allowing the services to manage their own automated information systems during two crucial milestones, the decision to enter engineering and manufacturing development and the decision to deploy the system. The services were supposed to conduct their own oversight in parallel with the Major Automated Information System Review Council, but they rarely held the required reviews, and OSD made little effort to hold them accountable.[8]

One problem with the management of embedded systems was no one person or organization was in charge of their development. In theory, the under secretary for acquisition was responsible for acquiring embedded computers. In practice, various organizations in the under secretary's office shared it.[9]

Responsibility for addressing significant embedded-computing problems resided in the Defense Acquisition Board. Its committees discussed the computer development part of any program under their purview, and if the issue were not resolved at that level, it could be raised to the full board. However, such issues rarely reached the board because no single board official or committee had specific responsibility for them, and none would assume it. As OSD reported to the General Accounting Office, "senior DoD management," including Defense Acquisition Board members, lacked familiarity with information technology and were uncomfortable discussing it. The full board usually addressed the issues chosen by a committee and generally accepted its recommendations. One OSD official told the GAO "the best board meeting is one that just ratifies committee positions." Therefore, if the committee did not discuss computer issues, neither did the board. (In 1990 a longtime OSD official who had attended 200 meetings of the Defense Acquisition Board and its predecessor over 11 years recalled that issues regarding embedded computing came up only once.)[10]

Once in office, Cheney and Deputy Secretary Donald Atwood began to overhaul the management structure for overseeing the acquisition of information technology. For embedded systems, the revised 5000 series acquisition documents released in early 1991 canceled the governing directive (DoDD 5000.29) and incorporated its principles into DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures) as part of OSD's new emphasis on consolidating acquisition guidance. The instruction maintained the definition of embedded computer systems as those physically part of, dedicated to, or essential to the immediate mission performance of weapon systems, and those used for training on, testing of, and research and development of weapons. Such systems would continue to be managed as an integral part of the completed system. With respect to major automated information systems, the new documents maintained the separate procedures for overseeing those systems.[11]

The overhaul of information technology oversight involved several important organizational changes. OSD designated the Major Automated Information System Review Council as a committee of the Defense Acquisition Board. The council would continue to review major automated information systems programs—and in fact its review authority expanded as a result of General Accounting Office audits—but under the Defense Acquisition Board's authority and supervision. OSD also enlarged the authority of the assistant secretary of defense for command, control, communications, and intelligence (C3I). Congress had directed the position's establishment in 1984; it combined two functions and two separate communities with an abiding interest in information technology. One concerned itself with collecting and using the information, while the other focused more on acquiring the capabilities for doing so.[12]

As a result of the reorganization, Duane P. Andrews, the incumbent assistant secretary, took charge of automated information systems acquisition and management in the Defense Department, became chairman of the Major Automated Information System Review Council, and reported directly to Cheney and Atwood. Andrews also received control of several defense agencies, including the Defense Communications Agency, which was enlarged and renamed the Defense Information Systems Agency.[13]

Duane Andrews, assistant secretary of defense for command, control, communications, and intelligence (C3I), 1989–1993. *(NARA)*

Duane P. Andrews

When he became assistant secretary of defense for command, control, communications, and intelligence in November 1989, Duane Andrews had more than 20 years of military and civilian government service and a strong background in intelligence. As an Air Force officer from 1967 to 1977, he held intelligence analysis and resource/systems management positions. He then served as a staff member of the House of Representatives Permanent Select Committee on Intelligence from 1977 to 1989.

After leaving the assistant secretary post in January 1993, Andrews began more than 13 years with Science Applications International Corporation, holding several executive positions, including executive vice president, chief operating officer, and director. From 2006 to 2013 he was chief executive officer of QinetiQ of North America, a subsidiary of QinetiQ Group, an international defense and security company headquartered in London. During this period he was also chairman of the board of the Armed Forces Communications and Electronics Association.

A native of Florida, he earned a bachelor's degree from the University of Florida and later a master's degree in management and supervision from Central Michigan University.[II]

Additionally, Andrews assumed supervision of Corporate Information Management, an initiative that sought to reengineer the Defense Department's business processes. It involved redesigning information systems and standardizing equipment and protocols to allow the various systems to work with each other and share information. The program was assigned to the newly created post of the director of defense information. Paul A. Strassmann, its first occupant, was a highly respected retired Xerox executive who worked out of Andrews's office. He believed the logical goal of Corporate Information Management's effort to establish a unified information infrastructure was enhanced capabilities to support joint operations. Strassmann received a mandate to improve information technology acquisition, but it specifically excluded embedded systems and, to elicit JCS support for the Corporate Information Management program, also excluded C3I systems.[14]

Emmett Paige Jr., assistant secretary of defense for command, control, communications, and intelligence (C3I), 1993–1997. *(NARA)*

Emmett Paige Jr. (1931–2017)

In contrast to his predecessor's intelligence background, retired Army Lt. Gen. Emmett Paige came to the assistant secretary post in June 1993 with expertise in communications. Nearly all of his assignments in a 41-year Army career were in that field. After his promotion to brigadier general in 1976 (the first black general officer in the history of the Signal Corps), Paige commanded key Army information technology organizations: the Communications Systems Agency, the Communications-Electronics Engineering Installation Agency, the Communications Research and Development Command, and the Electronics Research and Development Command. In 1984 he took over the Army's newly formed Information Systems Command.

Following retirement from the Army in 1988 and before becoming assistant secretary, Paige was president and chief operating officer of OAO Corporation, an aerospace engineering and information systems company. After completing his service as assistant secretary in May 1997, he returned to OAO. When Lockheed Martin Corporation acquired that firm in 2001, he became vice president of Lockheed Martin Information Technology Company.

Born in Florida, Paige enlisted in the Army in 1947 where he earned a high school diploma, an undergraduate degree from the University of Maryland, and a master's degree from the University of Pennsylvania.[III]

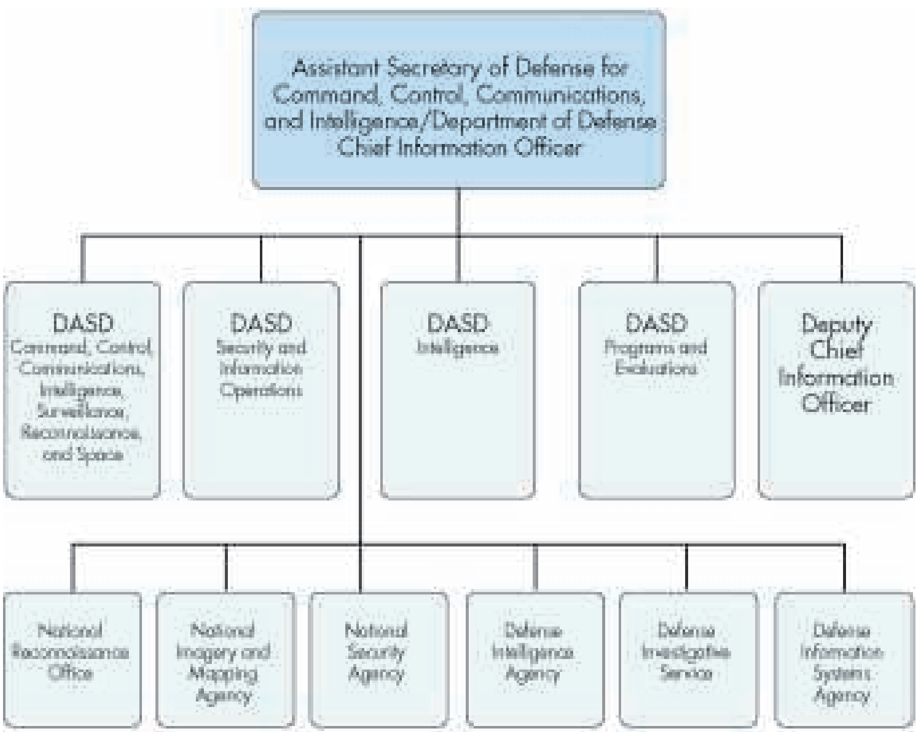
With the advent of the Clinton administration in 1993, retired Army Lt. Gen. Emmett Paige Jr. succeeded Andrews as assistant secretary. Coming into office with an administration that strongly supported computer technology, Paige expected to achieve the Corporate Information Management vision and rationalize the Defense Department's information resources. However, the ability of his office to initiate and carry through major elements of this vision proved to be limited. Recruited for the post by then-Deputy Secretary William Perry, Paige did succeed in creating some large-scale communications and intelligence networks, such as the Global Command and Control System and the Global Combat Support System, and in raising awareness of the vulnerability of information systems to attack. He later recalled the "fantastic support" he received from Paul Kaminski, the under secretary for acquisition and technology, and from Perry, who became secretary during Paige's tenure, and whose face he said lit up with pleasure when receiving a demonstration of the Global Command and Control System. Yet Paige's efforts to eliminate duplication in information systems and ensure interoperability often met with frustration. Paige discovered that his office, while strong on paper, was actually weak because it had few resources of its own and depended on the organizations it was overseeing—up to 60 percent of his personnel were borrowed from elsewhere. John J. Hamre, DoD comptroller during the first Clinton administration, later recalled Paige's frustration at his lack of power and funding: "Poor Emmett was sitting with a wreckage [*sic*] for a department." After what Paige would later describe as "the worst four years of my life," he left the Pentagon in May 1997. Almost two and a half years would pass before a successor, Arthur L. Money, was confirmed as assistant secretary.[15]

In addition to changes in the organization for oversight and review, changes in the acquisition process also affected information technology systems. In 1996 the publication of a new set of 5000 series acquisition documents and the passage of the Information Technology Management Reform Act, the Clinger-Cohen Act, eliminated the separate set of procedures for the acquisition of major automated information systems, including command and control systems. With respect to the process for developing weapons-oriented information technology, Clinger-Cohen had much greater impact than the revised acquisition guidance. Clinger-Cohen was not directed at the Defense Department alone but grew out of concern about information technology acquisition across the federal government. In October 1994, Senator (and future secretary of defense) William Cohen of Maine had issued a report condemning acquisition processes that created expensive, underperforming information systems. Although he did not single out the Defense Department, he criticized the Corporate Information Management program, which had failed to realize the savings promised for it. Cohen's findings were backed up by other reviews. The DoD inspector general conducted a detailed audit of the Defense Information Systems Agency and found it had lax acquisition oversight. Clinger-Cohen repealed the Brooks Act requirement that federal departments and agencies procure information technology through the General Services Administration, simplified the process for procuring information technology, especially with commercial off-the-shelf products, and reduced the burden of bid protests on acquisition programs. However, the Clinger-Cohen Act also imposed on federal departments and agencies requirements intended to ensure that their investments helped achieve the organization's functions and mission more cost-effectively and efficiently.[16]

Clinger-Cohen mandated a crucial change to the Defense Department's information technology management structure. The act required every executive department and agency, including OSD, the military departments, and the major military commands, to appoint a chief information officer to take charge of the organization's information technology resources. The chief information officer was expected to be an expert on the subject, hold a senior position in the organization, and focus on information technology procurement without the distraction of other duties. Many organizations did not follow the latter proviso. Rather than create a new position, OSD assigned the chief information officer duties to the assistant secretary of defense for command, control, communications, and intelligence (see figure 9-2). The services did likewise to comparable officials in their departments. Two years later, in 1998, Congress expanded the authority of chief information officers, requiring them to review budget requests, to ensure that all information systems were compatible and interoperable, and to establish and enforce the necessary standards.[17]

In addition to having authority over the organization's information systems, each chief information officer was the principal advisor on information technology to the agency head. The various chief information officers together formed a council that discussed issues of common concern. The DoD chief information officer chaired the department's Chief Information Officer Council, which was intended to be the principal forum for information technology and to act in both an advisory and coordinating capacity.[18]

Figure 9-2: Organization of the Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), 1999



DASD – Deputy Assistant Secretary of Defense

Source: Adapted from archived ASD(C3I) website, http://web.archive.org/web/19990506163414/http://www.c3i.osd.mil/org/index.html.

Clinger-Cohen explicitly excluded "National Security Systems"—those military systems exempted by the Warner Amendment—from some of its provisions but not from those relating to accountability and performance measurement. The chief information officer now had statutory authority over all computer acquisition. Based on this authority, OSD issued new instructions in 1997 for the acquisition of information technology, in particular for the oversight process.[19]

Once again the Department of Defense had a new, updated management structure and set of rules for information technology. As with defense acquisition in general, however, the question was, Would the management structure ensure that the rules were actually applied? More importantly, were the various reorganizations and policy changes at the top as consequential as the struggle to change habits and practices at the working level among those who developed the hardware and software and those who wrote the contracts and oversaw their execution? By the end of the decade, none of those changes had noticeably impacted the acquisition of information technology.

DIFFICULTIES IN HARDWARE AND SOFTWARE DEVELOPMENT

Computers largely consist of two fundamental elements: hardware and software. Hardware includes microprocessors, memory and other integrated circuits, devices for long-term storage of data, input/output mechanisms such as keyboards and monitors, and other peripherals, as well as the wiring, circuit boards, and other components. Software dictates the behavior of the system and comprises the basic machine instructions, operating systems, and application programs. Each of these elements has its own characteristics and development processes; difficulties with each complicated weapon system acquisition.

By the 1990s significant developments in the microprocessor, the major element of computer hardware, affected defense acquisition. First, since their invention, microchips had grown rapidly in capability while dropping sharply in price. Second, the development cycle for integrated circuits was only 18 months—a new generation every year and a half. And third, the government had become increasingly dependent on commercially designed microchips.

The explosive growth in the power of the microprocessor was due to the peculiar nature of the silicon-based transistor (the fundamental component of the integrated circuit) and major advances in tools and techniques for designing and fabricating microchips. Engineers were continually making the transistors smaller and packing more of them on the chip. Meanwhile, the chips dropped sharply in price as fabrication techniques improved and manufacturers sold more of them. Most remarkably, technological progress continued to follow Moore's Law, named after Gordon E. Moore, a physical chemist who had predicted the number of components on integrated circuits would double every 18 months. (It was later reformulated to say processing power would double every 18 months.) When Moore made his prediction in 1965, the microprocessor had not yet been invented and the largest existing integrated

Computer Terms

Architecture: The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time. (*DAU Glossary*, 16th ed., B-17)

Computer program: A combination of instructions and data definitions that enable computer hardware to perform computational or control functions; it consists of lines of code written by computer programmers. (*DAU Glossary*, 16th ed., B-41; PC Net, http://pc.net/glossary/print/software)

Hardware: The physical equipment that makes up computer systems, including integrated circuits, circuit boards (often called motherboards), hard drives, monitors, keyboards, mice, printers, scanners, terminals, and storage devices. (*DAU Glossary*, 16th ed., B-114; PC Net, http://pc.net/glossary/print/hardware)

Information Technology: The hardware or software used for government information, regardless of the technology involved, whether computers, communications, micrographics, or others. (DoD Directive 8000.1 [Defense Information Management Program], 27 Oct 1992. DoD definition is from OMB Circular A-130, reference [d].)

Integrated circuit: A small chip (microchip) usually made of silicon that can hold millions of transistors. It can function as a microprocessor, performing calculations and storing data using either digital or analog technology. (PC Net, http://pc.net/glossary/print/integratedcircuit)

Microprocessor: A microchip that performs a computer's calculations and stores its data according to instructions received from the computer's software. Also called the CPU—central processing unit. (PC Net, http://pc.net/glossary/print/processor, http://pc.net/glossary/print/cpu; Computer Hope computer terms, dictionary, and glossary, http://www.computerhope.com/jargon/c/cpu.htm)

Semiconductor: A solid substance, such as germanium or silicon, with electrical conductivity between that of a conductor and an insulator. A microchip is a semiconductor. (*Merriam Webster's Collegiate Dictionary*, 10th ed.)

Software: Computer programs, procedures, and associated documentation and data pertaining to the operation of a computer system. (*DAU Glossary*, 16th ed., B-42)

Transistor: An electronic device made up of a semiconductor such as germanium or silicon that controls the flow of electricity in electronic equipment. (*Merriam Webster's Collegiate Dictionary*, 10th ed.) It is the primary building block of all integrated circuits (microchips). (Computer Hope computer terms, dictionary, and glossary, http://www.computerhope.com/jargon/t/transist.htm; Tech Terms Computer Dictionary, http://techterms.com/definition/transistor) circuit held only 32 transistors. The first commercial microprocessor, introduced by the semiconductor manufacturer Intel in 1971, comprised 2,300 transistors. Less than 20 years later, in 1989, Intel marketed a microprocessor with over 1 million transistors; 17 years later, it announced a microprocessor with nearly 1.75 billion.[20]

The leap in computer processing capability fueled the Defense Department's growing hunger for more computing power. However, the speed with which the advance in capability took place caused significant problems for weapon system developers and maintainers, who had trouble keeping up. In an acquisition program lasting 12 to 15 years, the hardware procured at the start of a program was often far behind the state of the art by the time the system was fielded. For example, just after the aircraft carrier *George Washington* was commissioned in 1992, its communications processor was removed because it was obsolete. By 2000, the Air Force's F–22 fighter had been in development for almost 20 years and required up to $50 million per year just to replace its avionics and software—and the aircraft was still five years away from being deployed. Since a military service took two to three years to award a hardware contract of $25 million or more, the specifications might be obsolete before work had begun.[21]

Adding to the problem was the Defense Department's increasing dependence on the private sector for new integrated circuit designs. Semiconductor manufacturers made their profits by selling large numbers of microchips. Designing and fabricating a small number of special-purpose chips, such as "application-specific integrated circuits," was becoming prohibitively expensive. Therefore, the government had to buy from civilian firms. Access to the most advanced integrated circuits was a major motivation behind the quest to broaden the traditional defense industrial base (see chapters VI and XIV). In particular, the reformers of the 1990s pressed hard for off-the-shelf microelectronics procurement, a policy for which there was broad agreement among service and other acquisition officials. By the end of the century the services were purchasing commercial off-the-shelf products for many of their requirements, although custom-manufactured electronic components were still considered essential for critical applications where only military-unique items would do.[22]

Yet, however necessary, the turn to off-the-shelf items brought its own set of problems. For one thing, the government could no longer be certain the computer hardware products it needed for military applications would remain available. In the early years of computer development, the Defense Department had driven the innovation of critical components and other elements of computers, from transistors to data networks, by funding their development and providing a guaranteed market for them until they took hold in the civilian market. The end products, whether components or complete subsystems, were designed for military purposes; the computer industry and the public at large benefited from spin-off technologies.[23]

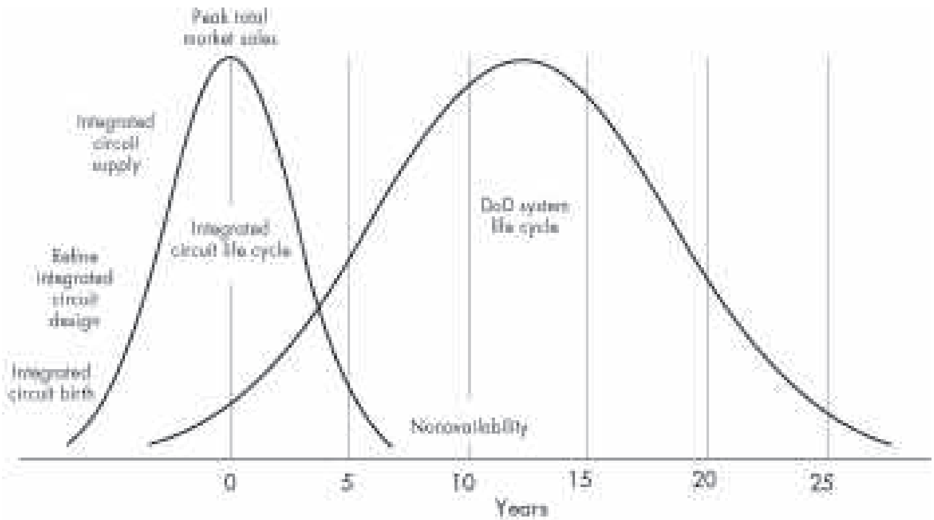
By the 1990s the situation had changed greatly. The military no longer drove computer development because its share of the electronics market dropped rapidly. For example, microchip purchases for defense applications fell from a 16 percent market share in 1975 to less than 1 percent in 1995. The department continued to fund computer research and development, but its support focused on certain targeted areas such as advanced microprocessor design and manufacturing, high-definition displays, artificial intelligence, supercomputing, and data networks. The commercial sector drove the design and large-scale manufacture of critical components such as microprocessors and memory chips. These products often sufficed for military needs but were designed for the commercial market and did not meet some military requirements. For instance, they were not normally hardened against radiation or made sufficiently rugged to withstand extreme temperature variation or the shock of high-G force maneuvers by fighter aircraft. Concerned about this problem, during the 1980s the Defense Department had invested more than $900 million on a 10-year program to develop leading-edge chips known as Very High Speed Integrated Circuits for various military applications that would address the need for integrated circuits with higher speed and greater functionality. The chips found military application and the program did produce some important microelectronics design tools. However, it failed to stimulate industry to manufacture the chips en masse or to advance the state of the art in microchip technology, which were key goals of the program.[24]

Dependence on commercially designed chips created another difficulty—managing the significant differences in life span between military programs and civilian hardware. The life cycle of electronic components was only three to five years by the end of the 1990s, while the service life of military platforms was considerably longer—sometimes measured in decades (figure 9-3). Commercial firms did not continue to manufacture old components when new ones became available, so spare parts were no longer available. By the late 1990s the problem had become serious enough for the Defense Department to initiate new programs to deal with it. OSD launched the Defense Microelectronics Activity, overseen by the deputy under secretary for logistics; the Diminishing Manufacturing Sources and Material Shortages Teaming Group, supervised by the acquisition under secretary; and a "generalized emulation of microcircuits" program to research ways to replace integrated circuits, run by the Defense Logistics Agency. The services established their own offices and programs as well. However, DoD lacked a single institutional focal point for life-cycle management of electronic components.[25]

Computer software presented its own set of development difficulties. As the Defense Systems Management College's guide to mission-critical computer acquisition noted, "Software is not something you can touch or feel. It is intangible: it has no mass, no volume, no color, no odor, no physical properties." Although it can be expensive to produce, it cost almost nothing to reproduce. But the expense of modifying the software to correct a problem, improve its performance, or adapt it to new hardware was twice its development cost.[26]

Defense systems had a large and growing appetite for sophisticated software. By 1989 the demand was increasing by 25 percent each year. The F–4 Phantom II fighter relied on software for 8 percent of its functions in the 1960s; the F–16 fighter of the early 1980s, 45 percent; and the F–22 fighter, 80 percent at the turn of the century (see tables 9-1 and 9-2). By the end of the 1980s the relative cost of a weapon system's software far outstripped that for its hardware. In 1990 the Defense Department estimated it spent $30 billion on software that year. Estimates for 1992 ranged from $24 billion to $32 billion, amounting to between 8 percent and 11 percent of the Defense budget.[27]

Figure 9-3: Life-Cycle Mismatch: Integrated Circuits vs. Weapon Systems



Note: This chart shows how the short life cycle of integrated circuits (i.e., microchips) meant state-of-the-art commercial chips acquired during the development of a weapon system were superseded by newer products and taken off the market relatively early in the system's service life, leading to problems in acquiring spare parts.

Source: Committee on Aging Avionics in Military Aircraft, Air Force Science and Technology Board, Division on Engineering and Physical Sciences, National Research Council, *Aging Avionics in Military Aircraft* (Washington, DC: National Academy Press, 2001), 27.

Software development also accounted for the bulk of the cost growth and schedule delays of a computer system. Many military systems—indeed, by the 1990s most major programs—struggled with software development. An Air Force analysis of 82 programs discovered that those heavily dependent on software ran about 20 months behind schedule, three times longer than those relying less on software. Another study of 35 Air Force projects showed similar results. By the 1990s there was talk of a "military software crisis." The commander of Air Force Systems Command, General Bernard P. Randolph, described software as the "Achilles' heel" of weapons development and added: "On software schedules, we've got a perfect record: We haven't met one yet."[28]

Software developers faced numerous challenges. Requirements, for example, could be poorly defined, incorrect, fail to meet user needs, or undergo significant uncontrolled changes. One study found that during requirements definition communication between software developers and users was poor, and more than half of all software errors originated as errors in the stated requirements. Other potential problems in software development included overly optimistic cost and schedule estimates, improperly trained programmers and managers, shortages of qualified personnel, the use of outdated development processes, and inadequate or omitted testing of the finished program. Such problems could occur in any acquisition program, not just in software development. But software's technical complexity and interconnectedness meant problems were hard

Table 9-1: Weapon System Software Size, as of 1999

WEAPON SYSTEM	SOURCE LINES OF CODE
M1 Abrams tank	600,000
M3 Cavalry Fighting Vehicle	1,000,000
M2 Infantry Fighting Vehicle	1,560,000
Crusader howitzer	1,800,000
F–22 fighter	1,960,000
Aegis naval air defense system	2,840,000

Source: Mike Nelson, James Clark, and Martha Ann Spurlock, "Curing the Software Requirements and Cost Estimating Blues," *Program Manager* 28, no. 6 (Nov-Dec 1999): 54.

Table 9-2: Dependence of U.S. Combat Aircraft on Software

WEAPON SYSTEM	YEAR DEPLOYED	% OF FUNCTIONS PERFORMED BY SOFTWARE
F–4 fighter	1960	8
A–7 attack	1964	10
F–111 fighter	1970	20
F–15 fighter	1975	35
F–16 fighter	1982	45
F–22 fighter	2000	80

Source: Nelson, Clark, and Spurlock, "Curing the Software Requirements and Cost Estimating Blues," 55.

to isolate and correct, and faults could cascade through the program, causing serious delays and cost overruns. In the worst case, a defective program would have to be discarded and rewritten from scratch.[29]

Lack of understanding of software development by the system program office, the contractor, or both resulted in mismanaged programs. Managers who knew little about computers placed exceedingly high expectations on the software, which they believed could make up for shortcomings in the hardware for meeting a system's requirements. Often they would hold off on beginning the software effort to see how the hardware turned out, which led to schedule delays. And government managers who did not understand software development prepared faulty contracts and provided weak oversight, often assuming—or hoping—the contractors knew what they were doing.[30]

The early years of the Air Force C–17 program demonstrate the problems that could arise from poorly managed software development. In 1992 the General Accounting Office declared the program "a good example of how not to approach software development when procuring a major weapons system." Failing to conduct the proper analyses, the Air Force expected little new software would be needed and completely underestimated the size and complexity of the software effort. The service did not pay much attention to the software part of the development contract and provided poor oversight when the program got underway. Furthermore, McDonnell Douglas, the contractor, had too few trained software managers and little institutional experience with developing and integrating complex software subsystems. Despite several tries, the company failed to produce a coherent Computer Program Development Plan, the fundamental basis for the software development effort and a key requirement of the contract. The Air Force eventually dropped the plan as a contractual requirement because the software development was so far along as to make the plan irrelevant.[31]

Defense software developers had little margin for error. A mistake in one line—even one character—in a program with hundreds of thousands of lines could cause a system to fail. For example, during the Persian Gulf War, the software of the Patriot missile batteries contained a tiny flaw that caused the system's timing to accumulate an error of one microsecond (i.e., one millionth of a second) per second unless it was rebooted every few hours. One battery at Dhahran Air Base in Saudi Arabia stayed in continuous operation for days and the errors accumulated to the point it misread the track of an incoming Iraqi Scud missile and failed to fire. The missile killed 28 U.S. reservists. The software upgrade package with the patch included arrived 12 hours too late.[32]

Because of the potential consequences of failure, the Defense Department applied a rigorous development and testing process that rooted out the great majority of errors in software dependent systems. And, in fact, military software tended to be quite reliable, far more so than commercial software, as demonstrated by the number and frequency of "patches" for commercial products. However, with a large program it was not possible to catch every mistake or test exhaustively for every conceivable combination of inputs. The chief of the Air Force's Special Operations Test & Evaluation Division noted in 1999 that software "affects so many systems and is so intrusive [that] it has become impossible to fully test even the safety-related effects of the software." Bugs remained in a system even after a full suite of tests and could lie dormant until well after the system was fielded. He cited the example of the MC–130 special operations aircraft in which a flight crew discovered a potentially catastrophic software error by chance when the aircraft had already been approved for deployment.[33]

Experts in software development emphasized the complexity of the effort. According to a 1990 report by the federally funded Software Engineering Institute at Carnegie Mellon University, the growth in size and complexity of software projects exacerbated the problem. The report maintained that as a software program grew in size, the number of people who could comprehend it declined, and the project became more difficult to manage. It further speculated that Defense Department demand for large, complex software projects appeared to have reached a level where the problem became inherently impossible to solve within the specified constraints (cost, time, and technical) imposed on the contractors. In short, "given the state of technology, projects as currently defined may be impossible to do." The solution to the problem, software development specialists believed, was strengthening management to improve how a project was planned, organized, and run. The key to accelerating development times and reducing errors lay in changing the methodology of software engineering.[34]

One of the first, and most common structured approaches to software design, was known as the "waterfall model." It was the practical application of the "grand design" approach to software development, in which the entire software program was planned and designed in one jump before any actual code was written. This methodology called for a project to follow a series of steps, roughly analogous to the stages in the development of a weapon system, consisting of requirements analysis, design, implementation, testing, integration, and maintenance. The original concept allowed for the possibility of developers revisiting the previous step to correct problems, but the waterfall model was generally applied in a sequential manner that went only one way. (The model is always depicted graphically as flowing downhill, as in figure 9-4, hence the waterfall image.)[35]

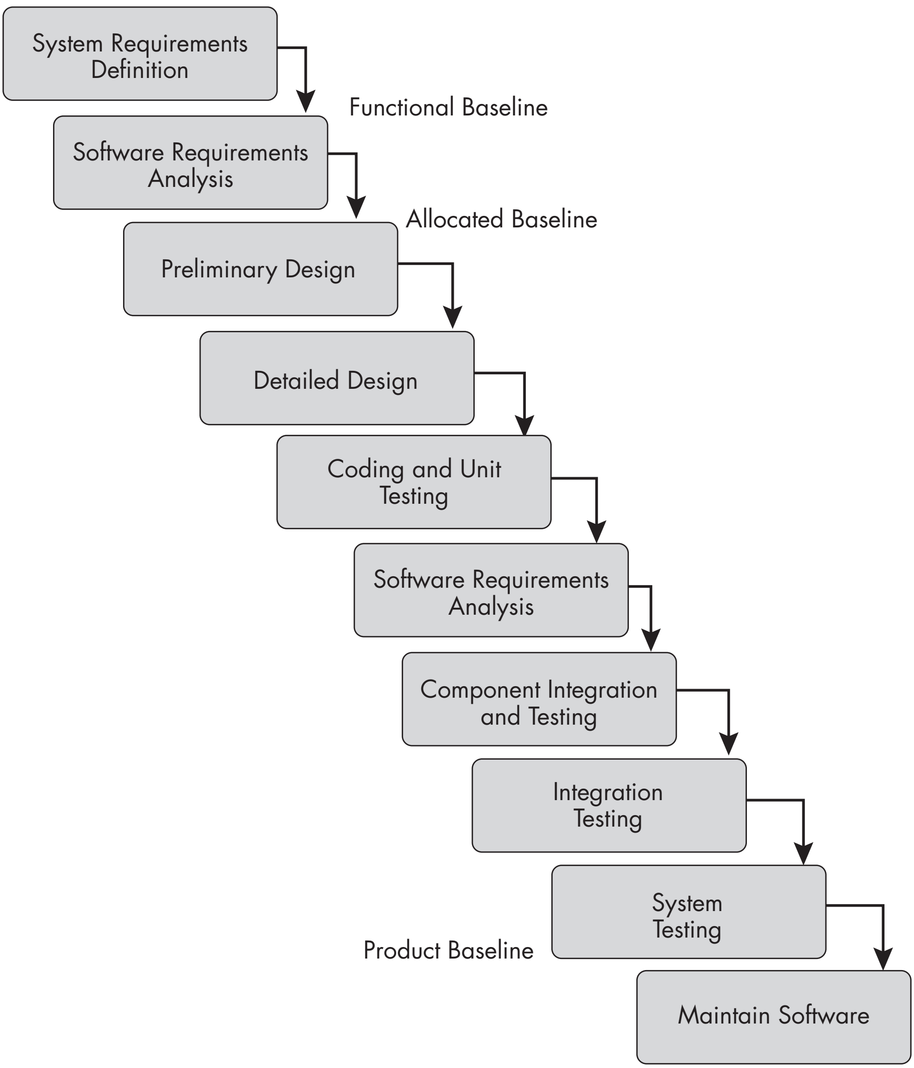
The waterfall model, first described in 1970, was a big step forward for its time. It worked well for small projects or those where user performance requirements were well understood but not for large, leading-edge efforts. The model's sequential process meant the requirements had to be spelled out at the beginning, which was much more difficult in a complex system. Furthermore, mistakes made early in the process, for example during the design stage, might not be caught until later, when changes were much more difficult and costly to effect.[36]

Therefore, many software engineers turned to other approaches, including what were collectively known as "iterative and incremental development." Incremental design involved producing the software in small packages that were each developed and tested before going on to the next. Iterative design meant repeating the various steps of the process, especially requirements analysis, to allow the developers to make revisions and correct errors relatively early. These approaches were sometimes described as "evolutionary" because the product evolved during the development process from an initial version to a final product. (This is not to be confused with "evolutionary acquisition," discussed in the chapter's next section.) Some weapons acquisition programs made use of such strategies as early as the 1970s, starting with the *Ohio*-class Trident missile submarine's command and control system. The Navy's Light Airborne Multipurpose System (LAMPS), a program to develop antisubmarine helicopters, produced 45 software iterations in one-month cycles and came in on time and under budget.[37]

The best-known iterative strategy—and one that would later become particularly significant for defense acquisition (see chapter X)—was the "spiral process model" devised by TRW software engineer Barry W. Boehm in the mid-1980s (see figure 9-5). This approach followed the waterfall model's stages but reduced the risks of that methodology by repeatedly and systematically revisiting the requirements and their implementation, and by reanalyzing the technical and programmatic risks. In this way, the project would start with a simple system and spiral outward toward the final product. Unlike later interpretations of spiral development, Boehm's model did not provide for fielding the early increments. Later, in an important revision of his model, Boehm called for all stakeholders to be actively involved in the spiral process, negotiating the goals and reviewing the results of each iteration.[38]

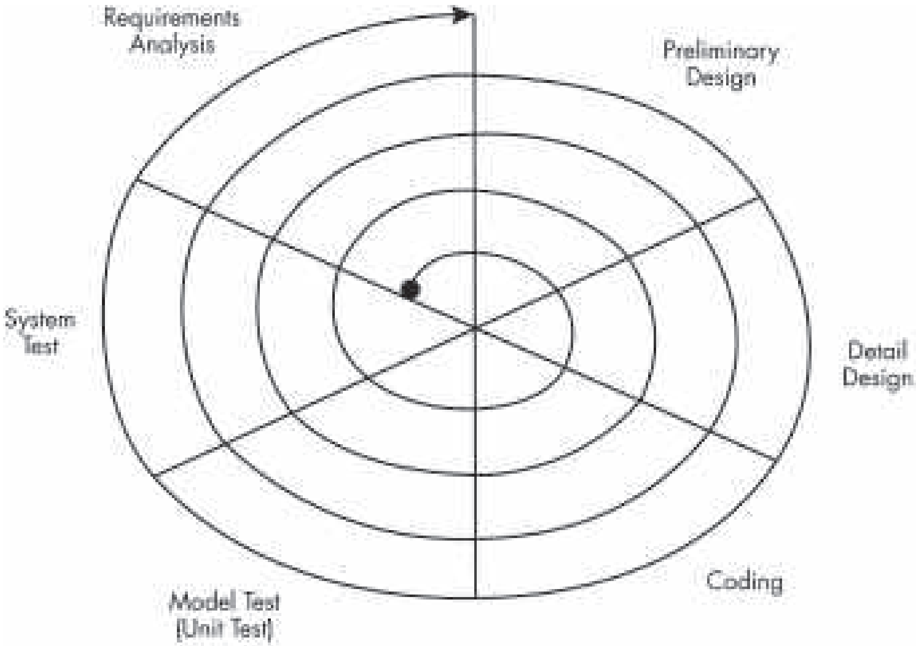
By the early 1990s most software developers considered iterative and incremental development approaches to be superior to the sequential waterfall model. However, to a large degree, the prevailing military standards dictated the development of Defense Department software. Prepared by committees of experts, these standards guided program managers in drawing up software contracts and were usually binding. It was

Figure 9-4: The Waterfall Software Development Model



Source: Reed Sorensen, "A Comparison of Software Development Methodologies," *CrossTalk* 8, no. 1 (Jan 1995), https://web.archive.org/web/19991010020706/http://www.stsc.hill.af.mil/CrossTalk/1995/jan/Comparis.asp.

Figure 9-5: The Basic Spiral Development Model



Source: Sorensen, "Comparison of Software Development Methodologies," n.p.

widely believed, somewhat incorrectly, that the primary software standard for embedded military systems mandated a rigid adherence to a sequential waterfall methodology. In fact, DoD-STD-2167A, issued in 1988, permitted an iterative approach and allowed considerable flexibility in methodologies that could be tailored to a specific project. However, the standards gave this flexibility limited emphasis while describing the basic sequential process in detail. Many acquisition professionals, especially program managers and contracting officials, overlooked the provisions regarding tailoring because they thought in terms of the sequential acquisition process defined in the 5000 series documents, and because it was easier to copy the clauses of previous software contracts. DoD-STD-2167A was also unpopular with programmers because it was "document-driven," meaning the contractor was required to prepare numerous plans, reports, and other documentation. It mandated frequent reviews and audits, the preparations for which could disrupt work for many weeks.[39]

In 1991 the under secretary for acquisition, the director of defense research and engineering, and the Joint Logistics Commanders (senior logistics officers of the military services) established a working group that three years later produced a new standard, MIL-STD-498. This document answered most of the critics' objections to its predecessor. It did not mandate any particular process model but instead described and accommodated several, including the grand design model and evolutionary strategies.

It also relieved contractors of the most burdensome paperwork, including the need to prepare special reporting documents, and it replaced formal reviews and audits with relatively informal meetings. Although highly praised, this standard remained in force for only four years. Just before its release at the end of 1994, Secretary Perry announced a new policy (described in chapter VII) of favoring commercial over military standards. In the software community, however, there was no commercial standard at that time. Indeed, DoD-STD-2167A had been the de facto commercial standard as well. Therefore, MIL-STD-498 was released as an interim standard to be in effect for only two years (later extended to four) while a committee set to work on a commercial version based on MIL-STD-498. The result, International Standards Organization (ISO) 12207, was formally adopted by the Defense Department in 1998.[40]

There were of course other essential requirements for a software project besides using the appropriate development methodology. Like other successful defense acquisition programs, software development required a planning process that accurately estimated the required resources and directed the expenditure of those resources; a clear understanding of the goals of the project and expected capabilities of the final product; a system of metrics to gauge progress; strict control of changes during the course of the project; and careful documentation of all activities. That such practices could lead to successful outcomes was demonstrated by the software component of Boeing's AGM–86 Air-Launched Cruise Missile and the avionics software for the F–16 fighter, developed by General Dynamics. In an example of a well-managed software development program, by the end of the 1980s, General Dynamics was producing a million lines of code per year for the F–16, with a defect rate of only 0.4 percent.[41]

The department made concerted efforts to improve its software development practices in the 1990s. OSD issued a draft Software Master Plan in 1990, a draft Software Technology Strategy in 1991, and, in 1992, a broad Software Action Plan, which established 17 initiatives concerning software development and management. In 1994 the department began another initiative to promote the adoption of commercial best practices and, in response to the recommendations of a Defense Science Board task force that year, a software management initiative in 1995. Both won guarded praise from Congress.[42]

The Defense Department also pushed the adoption of new analytical tools. In 1991 the Software Engineering Institute at Carnegie Mellon University released the first version of the Software Capability Maturity Model, the first effective means for evaluating the maturity of an organization's software development processes. The Software Capability Maturity Model would continue to be applied until replaced by the Capability Maturity Model Integration in 2000, and it would be credited with having a tremendous impact on the software community. In 1992 the department launched another initiative to promote software reuse—the application of existing code to new projects instead of starting over from the beginning. Many considered this to be the most promising single technique for improving the productivity of software developers.[43]

Despite flexibility with respect to development methodologies and other measures, the department's software problems persisted. In the mid-1990s defense projects still took between 50 percent and 100 percent longer to complete than similar commercial projects and cost considerably more, about the same as five years before. Much of the extra cost and time required was due to the unavoidable emphasis on quality, but that emphasis also reduced the chances for a timely and under-budget outcome. A decade later, a Defense Department observer stated bluntly, "The odds are overwhelmingly against a software-intensive program achieving [its] goals and objectives. . . . By any objective measure of success, almost every software-intensive program is probably going to deviate substantially from its initial cost, schedule, and performance baselines." The 2000 edition of a comprehensive guide to defense software development, published by the Air Force's Software Technology Support Center, illustrated the declining chances for success with the increasing size of software development teams (see table 9-3).[44]

Table 9-3: Odds of Successful Program Completion by Software Team Size

PROGRAM SIZE	NO. OF PEOPLE	LENGTH OF PROGRAM	ODDS OF SUCCESS
Small	<10	3–6 mos.	High
Medium	20–30	1–2 years	Slight
Large	100–300	3–5 years	Bleak
Mind boggling	1,000–2,000	7–10 years	Doomed

Source: Software Technology Support Center, Department of the Air Force, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems, Command and Control Systems, Management Information Systems,* ver. 3.0 (Hill AFB, UT: Department of the Air Force, May 2000), chap. 2:22.

By the end of the 1990s, the growing complexity of software continued to be a significant factor in the struggle to develop it, but a number of studies by the Defense Department, civilian agencies, and industry pointed to the causes of development failures previously cited: outdated and ineffective strategies and procedures, the lack of qualified personnel, and poor management. The problems and their causes were well understood, but the department had failed to address them effectively. In 2000 a Defense Science Board task force surveyed six major Defense Department reports on software development issued since 1987. The task force found that of the 134 recommendations they had offered, only 18 had become policy and just 3 were in practice. Despite the department's emphasis on adopting the best commercial practices, such as a variety of incremental and iterative models, most development projects still used the waterfall approach and 90 percent of those projects produced "a late, over-budget, fragile, and expensive-to-maintain software system." Throughout the decade, the accelerating spread of personal computing, the proliferation of embedded computers in commercial products, and the high-technology boom late in the decade fueled a demand for software professionals. Many flocked to jobs outside of government and the defense industry in pursuit of higher pay and stock options. In this environment, the department had trouble attracting and retaining qualified people. It also failed to provide adequate training for acquisition personnel in software development issues. The Defense Systems Management College, which provided the most important training in program management, offered only a two-week course in software—and most program managers opted out of it.[45]

The software development situation was particularly serious because the dependence of weapon systems on software continued to grow. By the end of the century the emphasis was on the development of software-intensive systems of systems as part of the transformation of the United States military into a lean, high-tech force. The difficulty of creating reliable and economical software was a serious threat to these plans.

COMMAND AND CONTROL SYSTEMS: REQUIREMENTS

The 1980s and 1990s saw rapid growth in the number of information systems used for command and control. Advances in computers, electronic components, and networking technology led to a tremendous expansion of communications systems and tools to help commanders gather intelligence, plan operations, and execute those plans. In 1993 the Defense Information Systems Agency estimated there were over 10,000 systems for command and control. This number probably included multiple units of the same system, but the number of separate systems was still high—almost 500 according to one report.[46]

The vision of the revolution in military affairs was predicated to a significant degree on the potential of these systems to perform a variety of tasks, including assisting in the management of joint operations by combining data from a variety of sources, providing targeting information, and enabling commanders to keep track of their units (and vice versa). JSTARS's ability to track ground vehicles is an excellent example of these capabilities (see chapters V and XII). Its performance explains much of the surge in interest in command and control systems. But these systems also presented new and complex challenges to defense acquisition and to American military organization. Some of the challenges, such as software development discussed in the preceding section, were common to all systems employing information technology, but some were peculiar to command and control systems. Two problems stand out: defining requirements for command and control systems, and enabling those systems to communicate with each other. By the year 2000 these problems had by no means been solved, although the department had made a significant start in effecting the changes they demanded.

The standard pipeline approach to acquisition enshrined in the 5000 series documents was largely sequential and did not begin until a system's requirements were established. The users had little involvement with the program until the developers handed them the finished product. Establishing workable requirements was difficult;

they often represented guesses about future threats and state-of-the-art technology. Throughout the Cold War and after, systems designers and acquisition managers wrestled with formal requirements that were complex, conflicting, and often changed during the course of a program.

Determining the requirements for command and control systems was especially difficult. This was partly due to the technical complexity of information systems. Given the uncountable and often unpredictable number of combinations of inputs and the wide range of potential responses, a software-based system could exist in a vast number of "states" (its stored information at any given time). For an embedded computer, such as a missile's guidance system, defining what the software should do was less difficult than for a multipurpose information system. Much more was demanded of a command and control system that combined and presented information and relayed orders. The system had to be customized to fit the needs of the commander and headquarters operations. The value of a command and control system could not easily be reduced to quantitative terms. Developers without extensive experience in the functions of the headquarters in question would be challenged to create a complete and accurate set of requirements for that system. Even users might struggle to express their requirements because they might not know enough about a future system's potential capabilities.[47]

Evolutionary acquisition offered a solution to the challenges faced by designers of complex systems, such as those providing command and control for military forces. Evolutionary acquisition drew on the development of quality assurance cycles by Walter Shewart at Bell Labs in the 1930s and further developed by Deming and others. Engineers working on NASA's Project Mercury in the late 1950s applied it to software development. Later, firms such as IBM Federal Systems Division and TRW Inc. used the methodology on major defense programs such as the software for the LAMPS helicopter program. In an evolutionary acquisition approach, a program began with a basic statement of the system's purpose and the minimum performance required by the system's users. After providing users with an initial core capability, the developer would then design improvements based on their feedback. As the system evolved, it could incorporate new technology in increments and add additional features. Serving a range of users with different demands, incorporating diverse capabilities, and depending heavily on computer software, command and control systems were a logical place to apply this methodology. At the request of then-Under Secretary of Defense for Research and Engineering Perry, a Defense Science Board task force looked into the management of command and control systems; its 1978 report argued strongly in favor of evolutionary acquisition. In 1980 Perry's revision of DoD Instruction 5000.2 (Major System Acquisition Procedures) stated, "[T]he design and testing of [command and control] systems should, in most cases, be accomplished in an evolutionary manner."[48]

Support for evolutionary acquisition grew during the 1980s. The Reagan administration endorsed the approach almost immediately. Industry favored it as well. Indeed, the Armed Forces Communications and Electronics Association in its

1982 report provided a lengthy rationale for the concept, a detailed explanation of how it might work, and suggestions for policy changes. In 1987 the Joint Logistics Commanders and acquisition experts at the Defense Systems Management College endorsed evolutionary acquisition, and the Defense Science Board reaffirmed its support. Two years later the Office of the Under Secretary of Defense for Acquisition adopted an evolutionary approach for developing its own information systems architecture.[49]

By the 1990s support for evolutionary acquisition had solidified among senior leaders. In its revision of the 5000 series documents in 1991, OSD included evolutionary acquisition as an "alternative strategy" for the development of command and control systems at the urging of the Defense Systems Management College, the assistant secretary of defense for command, control, communications, and intelligence, the Joint Staff, and others. Three years later Senator Cohen's report condemning wasteful government procurement of information technology called for the adoption of evolutionary acquisition, as did the National Performance Review's information technology working group in a report to the vice president in spring 1995. In 1996 the revised 5000 series documents once again described evolutionary acquisition as an alternative approach.[50]

Despite high-level support for the concept, evolutionary acquisition was little used by wary program managers who would have to figure out how to make it work under existing regulations and procedures. Some initial attempts to implement the approach ended badly. In the early 1980s the Air Force adopted evolutionary acquisition for several projects designed to upgrade the command and control system for the North American Aerospace Defense Command Center at Cheyenne Mountain Air Force Station in Colorado. These projects were to be conducted in overlapping blocks or phases that would deliver increasing levels of capability. They were chosen for evolutionary acquisition because of their complexity and, in at least one case, the impossibility of defining all of the requirements at the start. The upgrades were to be completed by 1987 at a cost of $968 million. By 1989 the General Accounting Office reported that the program was seven years behind schedule and $342 million over budget—and none of the upgrades had been completed. The GAO blamed poor management and a faulty assessment of the technical and financial risks.[51]

Typical of the experience was Granite Sentry, a project to improve the U.S. Space Command's ability to warn of and assess impending aircraft, missile, or space attacks. The evolutionary acquisition strategy called for the program to proceed in five two-year phases, each overlapping the previous phase by a year. The core capability would be delivered in two years, with the rest of the increments delivered yearly. The developers worked in Colorado Springs in close contact with the users. The program made heavy use of commercial off-the-shelf technology.[52]

Phase I delivered the first increment in March 1989, three months late, but the users were delighted with it and called the effort a success. Phase II had an entirely different outcome. The equipment produced in Phase I required much extra work—especially tracking down and correcting the bugs in the commercial software—and used resources required for the next phase. Having begun late because of the delay in delivering the first increment, Phase II fell further and further behind. In order to keep to the schedule, the program began to cut corners, for example, tossing out the controls intended to maintain discipline in the software development, which caused more software problems. "Major program reviews came and went without regard for the real maturity of the system design and development products," observed the authors of a review of Granite Sentry, and "the system entered formal testing even though the software was not ready." The Air Force soon canceled the tests and postponed initial operational capability indefinitely. It then restructured and restarted the program.[53]

Reviews of the program identified many faults. Some were typical of problems found in other major acquisition programs. For example, the program office underestimated the cost and work required to develop the software. Developers skimped on quality control in an effort to make up for time lost in earlier delays. But the evolutionary strategy, advantageous in a number of ways, became problematic as well. The increments were undertaken as separate efforts, with little connection to each other, so not much thought was given to future requirements. Problems with one phase cascaded into the next. The developers focused so much on the current increment they lost sight of the program as a whole. Although user participation was beneficial, it caused some problems, as the users required the developers to tweak and upgrade the first increment when they were supposed to be working on the second.[54]

The Air Force restructured all of the Cheyenne Mountain projects, including Granite Sentry, into a single program in 1989, the Cheyenne Mountain Upgrade, which was to be completed in 1995 at a total development cost of $1.58 billion (later increased to $1.76 billion). The program was again restructured in 1994. It still followed an evolutionary strategy, with an initial core program to deliver basic capabilities in 1995, followed by an annual delivery of hardware and software. Despite some mixed test results at first, the program achieved initial operational capability in October 1998.[55]

Some evolutionary acquisition programs clearly succeeded. The Navy applied the concept to the Operation Support System, a key part of the Navy Command and Control System. The program's three-increment evolutionary acquisition strategy was approved in 1988. Just over a year later operational hardware was being installed. In another case, the Joint Logistics Advanced Concept Technology Demonstration employed an evolutionary strategy in a program that was developing a decision support system for logisticians during joint operations. It, too, was considered to be a success.[56]

Evolutionary acquisition's most notable achievement was the Global Command and Control System (GCCS). It was not a single system but a complex system of systems consisting of standards, infrastructure components, user tools, and a diverse array of computing elements to connect tactical and strategic command and control systems in a worldwide network. GCCS was an ideal candidate for the evolutionary approach because it was to be a growing, evolving system without a single end-goal; it would depend on commercial computer, telecommunications, and software products; and it would take advantage of unforeseen opportunities expected to emerge, given the rapid appearance of new technologies. Furthermore, the program was to be highly responsive to the needs of the user. The evolutionary approach would allow developers to meet new requirements and add new capabilities with each new acquisition cycle. According to one description, the program was "essentially a continuous, slow upgrade of [the Global Command and Control System] designed not to overwhelm the user." The approach deviated so far from the norm that those involved with the system preferred to call it an "acquisition activity," not a program.[57]

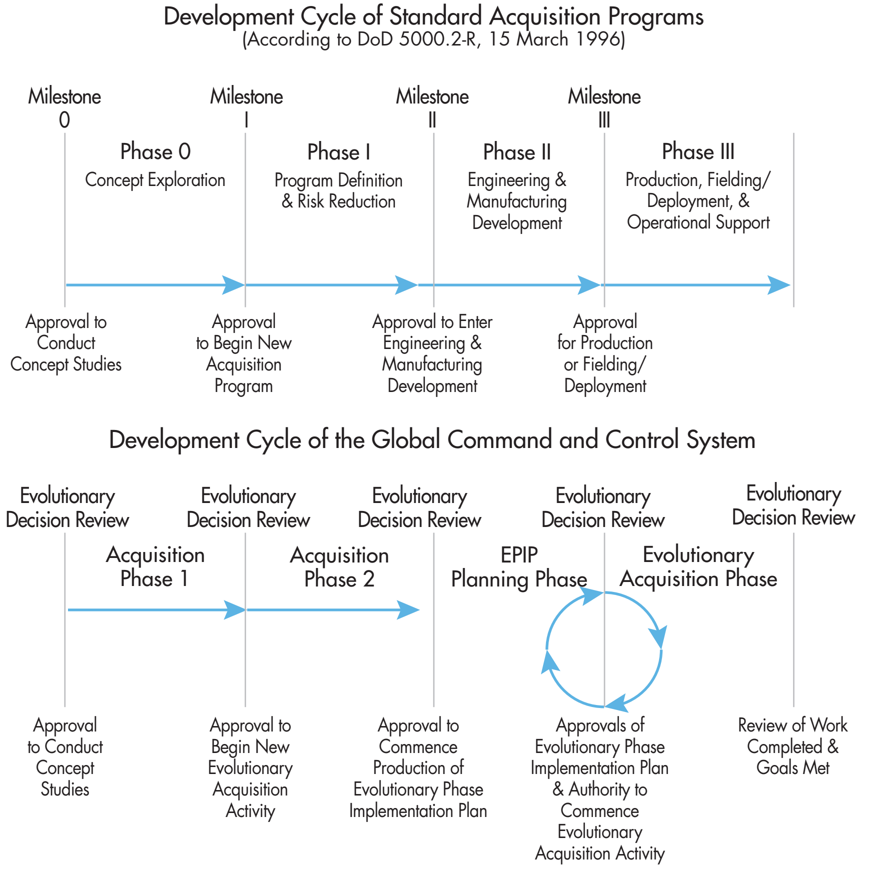
Planning for the Global Command and Control System began in 1992 and the program was formally initiated two years later. Expected costs for FY 1995 through FY 2001 were $119 million for procurement and $1.2 billion for operations and maintenance. No program of that size had ever been conducted as a full evolutionary acquisition. Program execution was poor at first and the program had trouble adapting to unexpected conditions. Following a critical DoD inspector general report, a working group devised a more formal approach, which satisfied the spirit and most of the letter of the 5000 series documents.[58]

The critical element—in fact, the basis—of the program was the integration of the requirements and acquisition processes. Under Joint Staff leadership and with the entire Global Command and Control System community involved, the program used a flexible six-step procedure for identifying, assessing, and prioritizing the requirements. Stakeholders (users, developers, testers, and overseers) next hashed out details for meeting those requirements, which they set down in a document called the Evolutionary Phase Implementation Plan covering performance goals, budgets, schedule, and test parameters. The plan was then turned over to the services for development.[59]

The acquisition part of the Global Command and Control System program followed the mandates of the 1996 revision of the 5000 series documents, which specified a standard development cycle of milestones and phases but also provided the flexibility necessary to design a unique program. The program initially followed the standard path laid out in DoD Regulation 5000.2-R, from concept studies to approval for full-scale development, but then entered cyclical evolutionary acquisition phases (see figure 9-6). Each cycle involved preparing an Evolutionary Phase Implementation Plan and executing it. Each evolutionary acquisition phase involved a number of efforts known as segments, which were performed independently. A segment need not be completed during the phase in which it began, but could continue into the next if approved to do so (see figure 9-7).[60]

The Defense Information Systems Agency managed the program with the help of working-level integrated product teams that carried out administrative and functional activities. In accordance with DoD policy and guidance, a hierarchy of integrated product teams under the authority of the assistant secretary of defense for command, control, communications, and intelligence performed oversight. Evolutionary decision reviews replaced milestone reviews. Because the Global Command and Control System had been designated a major automated information system with OSD as the milestone decision authority, it was subject to review by the Major Automated Information System Review Council, but the assistant secretary of

Figure 9-6: Evolutionary Acquisition of the Global Command and Control System



Source: Adapted from Figure 2-1 (Overlay of GCCS Evolutionary Acquisition Strategy on DoD 5000.2-R Regulation), in Richard H. White, David R. Graham, and Johnathan A. Wallis, *An Evolutionary Acquisition Strategy for the Global Command and Control System (GCCS)*, IDA Paper P-3315 (Alexandria, VA: Institute for Defense Analyses, Sep 1997), chap. 2:3.

defense for C3I rarely convened the council for a formal meeting, preferring to review program documentation instead.[61]

Deployment of the system initially encountered difficulties. In 1996 the department shut down the Worldwide Military Command and Control System and declared Global Command and Control System 2.1 to be the "system of record," the equivalent of achieving initial operational capability. In spite of the carefully designed development process, the first deployed version suffered from inadequate testing, poor documentation, and lack of training. The next version experienced fewer difficulties and its deployment went more smoothly. A 1998 Institute for Defense Analyses review of the program identified a number of problems with the acquisition process. Many of these were not unique to evolutionary acquisition.

Figure 9-7: Global Command and Control System Development Process

EPIP – Evolutionary Phase Implementation Plan
EDR – Evolutionary Decision Review

Source: Adapted from White, Graham, and Wallis, *An Evolutionary Acquisition Strategy for the Global Command and Control System*, chap. 2:7.

For example, resistance by the developers and a rush to deploy early versions led to inadequate testing and a "disastrous" fielding experience, which, the report noted, "created hard feelings that still persist today in various segments of the community." Other problems stemmed from the nature of evolutionary acquisition. Budgeters were caught between the rigid schedule of DoD's budgeting system and the program's need for more flexible funding. Identifying expected costs proved to be difficult, in part because GCCS, exempted from many of the 5000 series documentation requirements for acquisition programs, did not prepare a baseline for the system as a whole. In later years the program was accused of faulty management controls, which, for example, were blamed for a nearly four-year delay in fielding an upgrade of the Joint Operation Planning and Execution System, a GCCS component. Nonetheless, the Global Command and Control System program developed and deployed a major capability, at least in basic form, quite quickly.[62]

COMMAND AND CONTROL SYSTEMS: INTEROPERABILITY

In addition to the difficulty of defining requirements, the second major problem with command and control systems was more often than not they could not talk to each other. They had separate interface and communications protocols and could not interact or even read each other's data. In other words, they lacked interoperability. They were stovepipe systems designed and custom-built as independently functioning units without reference to others. Some were compatible with equipment within the same organization or military service but rarely could they interoperate with the systems of other services. Joint operations were expected to be the norm, so a lack of interoperability could cause serious problems. The potential for difficulties caused by incompatible networks became especially apparent in the Persian Gulf War. In the conflict, the impressive array of information technologies like personal workstations, data networks, and airborne targeting systems gave the allied coalition a decisive advantage over the Iraqi army. Yet Persian Gulf command and control was still a collection of stovepipe systems jury-rigged by the users over a number of months rather than a seamless battle network. Most notoriously, the air tasking order that directed air operations had to be printed in hard copy and flown to each aircraft carrier every day because the ships could not receive or read the Air Force-produced document in digital form. As one Navy officer recalled, the 6-pound, 300-page document had to be picked up at Central Command headquarters in Riyadh, Saudi Arabia, at 0200, delivered to the carrier, and then transferred to other ships. It often took until midday for the air tasking order to be distributed to the fleet. Many officers returned from the Gulf War with fresh memories of what the new information technologies could do—and what they could not do, at least not yet.[63]

Soon after the conflict, in October 1991, JCS Chairman General Powell released a study arguing future command and control requirements would be driven by small, mobile, and rapidly deployable joint expeditionary forces. These joint forces would need the same access to information that larger headquarters then enjoyed. The local commanders had to be able to access a wide array of data presented on the same display screen. The following June, the Joint Staff expanded this report into its overarching vision for command and control, which it called "C4I for the Warrior." (C4I was the initialism for command, control, communications, computers, and intelligence.) C4I for the Warrior was intended to enable every warfighter, whether in a command center or a fighting hole on the front line, to have access to necessary information at any time. Every operation would be supported by the "infosphere," a transparent global infrastructure that was "the total combination of information sources, [data] fusion centers, and distribution systems that represent the [C4I] resources a warfighter needs to pursue his operational objectives." Warfighters could simply plug into this infrastructure with equipment using standard interfaces and access information tailored to their specific needs. The equipment not only had to be interoperable, it had to be seamless: The data had to flow smoothly across organizational boundaries, without the need to translate it into other forms or formats. It was an ambitious vision.[64]

The Joint Staff's vision, however, could not be realized without cooperation from the services, which funded and ran acquisition programs. Service command and control programs were primarily concerned with functionality and meeting their own requirements. Interoperability with same-service equipment was the second priority, and inter-service interoperability was third. Interoperability could hinder functionality and could be expensive. Using another service's standards and interfaces could cost more, could force the vendors to stock different parts, and would likely prevent the new system from working with the service's legacy equipment. And there were significant technical issues that would make achieving interoperability difficult, even if there were no institutional obstacles. The 1990s therefore saw a long, drawn-out struggle between OSD, the Joint Staff, and the unified combatant commands on the one hand, and the services, on the other, to accept the importance of interoperability and to build it into their systems.[65]

The services would never agree on common interoperability standards and protocols on their own. What was required was an official or organization with the power and authority to impose common standards on all Defense Department components. At the time of Desert Storm, neither existed. As a Joint Requirements Oversight Council study argued, "The absence of a unified set of interoperability standards is caused largely by the fragmentation of responsibility for standards at the OSD level."[66]

The Bush administration launched a sustained effort to impose interoperability on the services in September 1992 with Defense Management Review Directive 918. Inspired by the two-year-old Corporate Information Management program and the C4I for the Warrior concept, the directive established its own version of the infosphere, the Defense Information Infrastructure, which was to represent the total of information resources, both classified and unclassified, used by the Defense Department. The Defense Information Infrastructure would not be responsible for the procurement of most computer equipment or software but would provide the infrastructure to tie in existing and future computer resources. It would include a communications backbone, gateways from the primary infrastructure to local networks, automated processing systems remotely accessible through the network, and facilities to support headquarters above the tactical level. It would also provide support for command, control, communications, computers, and intelligence systems and some standard functions and processing capabilities accessible to warfighters anywhere they might be needed.[67]

Secretary Cheney assigned responsibility for the Defense Information Infrastructure to the Defense Information Systems Agency, which would manage networks, provide switches and routers, acquire information technology components and services to be integrated into the networks, and develop and enforce information technology standards. Embedded computers and command and control systems were excluded from the agency's authority—the services would still acquire and control that equipment—but they were subject to the information technology standards the agency created. To reinforce this point, Deputy Secretary Atwood in November 1992 revised and reissued the DoD directive governing interoperability. The old directive demanded little more than common interfaces, and no one was given authority to enforce even that limited requirement. Atwood's directive declared that "for purposes of compatibility, interoperability, and integration, all [command, control, communications, and intelligence] systems developed for use by U.S. forces are considered to be for joint use." The assistant secretary of defense for C3I was charged with enforcing the requirement that new systems be interoperable; the JCS chairman was to establish the integration requirements and methods of certification.[68]

The Defense Information Systems Agency responded by creating the Joint Interoperability Test Command at Fort Huachuca, Arizona, to test for interoperability. The Joint Chiefs of Staff issued instructions for conducting the tests and certified the results. Every new system was required to be tested and certified before it received approval to move into production.[69]

Another DoD approach to promote interoperability was to create architectures that would provide a framework of standards and common approaches—enterprise architectures to govern the development of new systems. By the early 1990s each service was creating its own framework. By 1999 the Defense Department was relying on a triad of architectures: the Joint Operational Architecture, the Joint Systems Architecture, and the Joint Technical Architecture. These were all components of the overarching C4I Architectural Framework, which was expanded beyond command, control, communications, computers, and intelligence to all Defense Department systems and later renamed the DoD Architectural Framework. Of these, only the Joint Technical Architecture was considered mature.[70]

Despite the new architectures, by the end of the decade the Defense Department struggled to achieve interoperable C4I systems. The inspector general found that DoD components flaunted or ignored the mandatory policies related to interoperability. In 1996 they were directed to submit plans to the assistant secretary for C3I regarding their implementation of the Joint Technical Architecture. Only 8 of the 17 components submitted plans, and only three of these were complete. Only the Army made compliance with the Joint Technical Architecture a high priority. The inspector general was inclined to blame OSD for its failure to enforce the policy. In 1998 the General Accounting Office noted that regional commanders in chief, the services, and defense agencies were not complying with the requirement to obtain interoperability certifications for each C4I program. Often they ignored it. That may have been just as well, as the Joint Interoperability Test Command usually tested only about 100 systems per year, whereas, according to the GAO, the Defense Integration Support Tool Database listed at least 1,000 command, control, communications, and computer systems and another 1,176 unclassified intelligence systems that were potential candidates for testing. The communications problems that had plagued U.S. forces in Grenada and the Persian Gulf appeared again in Somalia, Bosnia, and Kosovo. As joint forces deployed abroad during the 1990s, they found themselves rigging ad hoc command and control systems, as they had in Kuwait during Operations Desert Shield and Desert Storm.[71]

SIMULATION-BASED ACQUISITION

Information technology could be applied to almost every aspect of the acquisition process, from planning and budgeting to design and engineering, to test and evaluation, to production and logistics, to training, and to accounting and oversight. These digital tools simplified or enhanced practices and procedures, allowed users to adopt new methods, and ultimately suggested new approaches to acquisition.

Some of the most important of these applications were in the realm of modeling and simulation (M&S). As the quality of microprocessors and graphics technology improved, and the cost of memory and storage plummeted, computers became better suited to performing these roles in real time. Among the first such applications were the computer-aided design and computer-aided manufacturing systems, commonly known as CAD/CAM systems when integrated. These tools created databases of design specifications and parameters that allowed engineers to prepare digital blueprints, visualize the end product, and create virtual three-dimensional prototypes that could be manipulated and examined from any angle. Engineers could study potential changes to the design of any component or part cheaply and easily prepare the specifications for their manufacture—the digital systems could even program the machine tools automatically.[72]

Computer-aided design and manufacturing systems had been around for decades. The Navy had been using them to design weapon systems since the 1960s; the Army and Air Force, since the 1970s. By the late 1980s the services, especially the Navy, were spending hundreds of millions of dollars on CAD/CAM systems. In the early 1990s these tools, such as IBM's Computer-Aided Three Dimensional Interactive Applications and Parametric's Pro/Engineer, were coming on the market. Sales of these commercial packages grew from $3 billion in 1985 to $12 billion in 1992. By 1996 there was significant evidence that improved CAD/CAM tools were boosting productivity and reducing expenses. For example, the Army's Tank Automotive Research, Development and Engineering Center in Warren, Michigan, designed a low-silhouette tank prototype in 16 months with 14 engineers, a task that earlier would have taken 55 engineers three years to complete. TRW redesigned a radar warning system using two approaches. The traditional approach required 96 "man months"; a concurrent-design approach with integrated design automation needed only 46.[73]

Modeling and simulation was useful for more than just product design. Mechanical—and then digital—simulators had long been viewed as valuable training devices, but it became apparent they could also be used to experiment with new military concepts, tactics, and technology. For example, a user could operate a simulated weapon system in conjunction with existing equipment under simulated battlefield conditions to allow designers to explore the best set of features. This information would help acquisition officials decide which system or system configuration would best fulfill a mission requirement. More importantly, the ultimate users of a system—the warfighters—could also try out a model of a potential system before and during development. This valuable experience would assist in setting the requirements

Modeling and Simulation Terms

Model: A representation of an actual or conceptual system that involves mathematics, logical expressions, or computer simulations that can be used to predict how the system might perform or survive under various conditions or in a range of hostile environments.

Modeling: Application of a standard, rigorous, structured methodology to create and validate a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Simulation: A method for implementing a model. It is the process of conducting experiments with a model for the purpose of understanding the behavior of the system modeled under selected conditions or of evaluating various strategies for the operation of the system within the limits imposed by developmental or operational criteria. Simulation may include the use of analog or digital devices, laboratory models, or test bed sites. Simulations are usually programmed for solution on a computer; however, in the broadest sense, military exercises and wargames are also simulations.

Modeling and Simulation: The use of models, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions. The terms "modeling" and "simulation" are often used interchangeably.[IV]

and determining the various performance trade-offs that inevitably arose during engineering and manufacturing development. Finally, although simulation was not intended to completely replace operational testing with actual systems, it allowed for virtual developmental and operational testing of system designs, saving time and expense by reducing the number of prototypes required.[74]

Industry led the way in adopting computer modeling and simulation, especially computer-aided design and manufacturing systems. Boeing's use of IBM's CAD/CAM software to design the 777 airliner without building a full-scale mock-up was widely publicized. Defense acquisition programs also began to adopt these tools, often led by their contractors. Boeing developed subsystems and components for the Air Force F–22 fighter using virtual prototypes similar to those used for the 777. Sikorsky, which had teamed with Boeing to win the contract to develop the Army RAH–66 Comanche helicopter, also used CAD/CAM and virtual environments. Like Boeing, the Electric Boat Division of General Dynamics, which designed and built submarines for the Navy, also abandoned the construction of full-scale mock-ups in favor of virtual prototypes engineered using a database of standardized, reusable parts.[75]

The Bush administration did not initially accord a high priority to modeling and simulation, but with some prodding, and $75 million in fiscal year 1991 funding from

Congress, Deputy Secretary Atwood issued a Modeling and Simulation Management Plan in June 1991. It established an advisory board, the Executive Council for Models and Simulations, comprising OSD, Joint Staff, and service officials and chaired by the director of defense research and engineering. The management plan also created the Defense Modeling and Simulation Office, a small, seven-person organization within the Office of the Director of Defense Research and Engineering that focused on improving the department's M&S capabilities. This organization was to issue policies and a master plan, coordinate activities within the services, encourage cooperation and information sharing among them, and promote the adoption of standards to improve interoperability. The office did not have any direct authority over service programs but issued a paper encouraging the application of modeling and simulation throughout the Defense Department, including the support of operations through training, development of doctrine and tactics, formulation of plans, and warfighting situational assessment. For acquisition, specifically, it suggested modeling and simulation could be used for technology assessments, system upgrades, prototyping and full-scale development, and structuring the force. To promote these applications, the M&S initiative would focus on developing common architectures.[76]

The Clinton administration valued M&S technology, especially its potential for reducing costs, and expanded the organizational structure for managing and promoting it. In January 1994 Deputy Defense Secretary Perry issued a directive that retained the established management structure. But the new directive also created the DoD Modeling and Simulation Executive Agent to provide these digital aids to other components or supervise their development and set up the DoD M&S Information Analysis Center. In 1996 OSD announced a new High Level Architecture that was mandatory for all modeling and simulation systems under development. It was intended to bring about interoperability among a range of these systems and promote their reuse.[77]

By 1996 Defense Department leadership had come to believe modeling and simulation offered more than incremental improvements to the acquisition process. In August 1995 Patricia Sanders, the deputy director in OSD's Office of the Director of Test, Systems Engineering and Evaluation, commissioned a one-year study to assess the extent of its impact on that process. The study concluded that modeling and simulation was already having a profound effect on acquisition, sometimes in ways so subtle its users did not realize they were doing things differently. The services were using it to increase effectiveness and to reduce or avoid costs. However, modeling and simulation's most significant impact was in altering the business practices used by acquisition organizations. Modeling and simulation, especially when connected through networks to form geographically distributed simulations, encouraged cooperative and collaborative activities among participants in the acquisition process. In this respect, it was ideal for DoD's concept of integrated product and process development, in which multidisciplinary teams provided oversight and participated in other decisions affecting a system throughout its development. Modeling and simulation allowed end users to work with developers, industry to work with government, and other stakeholders to work with each other. "Although it is not clear where this will lead the acquisition community in the next decade," the study's authors wrote, "it is clear that a revolution is underway and that the end result will be a new way of doing business." They called this marriage of modeling and simulation with integrated product and process development "simulation-based acquisition."[78]

Simulation-based acquisition became the new goal. Defense Department leaders, who had always believed modeling and simulation was essential for acquisition reform, embraced the concept. So did industry. Sanders and other officials promoted the concept to the acquisition community through journal articles, presentations, and conferences. As with so many other Clinton-era acquisition initiatives, however, simulation-based acquisition had not fully taken hold when the administration left office. A survey released in January 2001 noted that the use of modeling and simulation varied from program to program. About half of the 22 programs surveyed performed activities considered to be simulation-based acquisition. Respondents indicated the reasons for not performing these activities included lack of knowledge about them, not enough money in the budget, and schedule pressure.[79]

* * * * *

The benefits of acquiring and using computers and other information technologies in the period covered by this study were readily apparent in Kuwait and Iraq during Desert Storm and in Afghanistan and Iraq a dozen years later. In the latter wars, the basic platforms (ground vehicles, aircraft, ships) may have mostly been the same, but an array of new command, control, communications, and intelligence systems, especially the Global Command and Control System, offered unprecedented levels of intelligence dissemination, communications, and coordination of military operations.[80]

The impressive demonstrations of applying information technologies to military systems, however, masked the struggle that had taken place during the period between the wars to develop those applications. In addition to increasing system performance, computers promised to cut acquisition costs and cycle times. In pursuit of those objectives, the Defense Department reorganized its information systems management structure, but by the end of the decade had not achieved the savings and efficiencies it had expected from those changes. Developing computerized systems brought increased capabilities but also introduced problems that could increase costs and delay programs. Advances in digital capability were so rapid that computer hardware purchased for a system might be well behind the state of the art by the time it was fielded. Software development programs struggled with a range of difficulties, such as poorly defined and constantly changing system requirements, insufficiently skilled software developers, government and industry program managers unfamiliar with software development, inadequate testing regimens, and the inherent complexity in designing software programs for systems that could not tolerate even the smallest error.

Software development experts believed the solution to some of these problems lay in improving software engineering, particularly in "iterative and incremental" approaches such as the spiral process model, in which software was produced in small increments that were each developed and tested before "spiraling" outward to the next increment and so on to the final product. Another iterative approach, called evolutionary acquisition, saw its first application in DoD in command and control systems and included users in system development. Like spiral development, evolutionary acquisition involved successive increments, but in this case increments representing increases in the system's capability. The next chapter describes the Defense Department's application of spiral development and evolutionary acquisition to the entire range of defense systems, with evolutionary acquisition becoming department policy by the turn of the century.

Endnotes

1. Michael Kanellos, "PCs: More than 1 Billion Served," *CNET News*, 30 Jun 2002, http://news.cnet.com/2100-1040-940713.html, accessed 9 Jan 2014; Thom File, *Computer and Internet Use in the United States* (United States Census Bureau, May 2013), 2.

2. Defense Systems Management College, *Mission Critical Computer Resources Management Guide: Technical Management* (Fort Belvoir, VA: DSMC, Sep 1988), chap. 2:9–10.

3. Watts, *Six Decades of Guided Munitions*, 19–21, 192–202.

4. DSMC, *Mission Critical Computer Resources Management Guide*, chap. 3:1–2; *An Act to Provide for the Economic and Efficient Purchase, Lease, Maintenance, Operation, and Utilization of Automatic Data Processing Equipment by Federal Departments and Agencies*, P.L. 89-306 (30 Oct 1965), 79 Stat. 1127–1129; *Department of Defense Authorization Act, 1982*, P.L. 97-86 (1 Dec 1981), sec. 908 (95 Stat. 1117–1118) (quote, 1117).

5. DSMC, *Mission Critical Computer Resources Management Guide*, chap. 2:1, chap. 4:5; Panel on Technology, Committee on Technology for Future Naval Forces, Naval Studies Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, *Technology for the United States Navy and Marine Corps, 2000–2035: Becoming a 21st-Century Force*, vol. 2: *Technology* (Washington, DC: National Academy Press, 1997), 105–111; William A. Whitaker, "Ada—the Project: The DoD High Order Language Working Group," *ACM SIGPLAN Notices* 28, no. 3 (Mar 1993), n.p., http://archive.adaic.com/pol-hist/history/holwg-93/holwg-93.htm, accessed 9 Feb 2016.

6. Daniel V. Ferens, *Defense System Software Project Management* (Wright-Patterson AFB, OH: Air Force Institute of Technology, 1990), chap. 2:1–2; GAO, *ADP Procurement: Warner Amendment Has Not Reduced Defense's Acquisition Time*, GAO/IMTEC-86-29 (Jul 1986), 15–16 ("critical"), 21 ("integral parts"); DSMC, *Mission Critical Computer Resources Management Guide*, chap. 3:5; subpart 270.4 (*Acquisitions Under 10 USC 2315 Authority*), pt. 270 (*Acquisition of Computer Resources*), Chap. 2 (*Department of Defense*), Title 48 (*Federal Acquisition Regulations System*), *Code of Federal Regulations*, 691, 31 Dec 1986; DoD Directive 5000.29 (Management of Computer Resources in Major Defense Systems), 26 Apr 1976, encl. 1 ("embedded"). By the end of the 1980s there was great confusion within the Defense Department over the meaning of the various terms. During an audit in 1990 the General Accounting Office received a half-dozen different definitions of "embedded" from program managers and senior OSD officials. An Air Force software expert later recalled, "These distinctions may seem esoteric to an outsider, but within the [Department of Defense] the great religious conflicts of history pale to insignificance by comparison." See GAO, *DoD Embedded Computers: Better Focus on This Technology Could Benefit Billion Dollar Weapons Programs*, GAO/IMTEC-90-34 (19 Apr 1990), 3, 13–14; Whitaker, "Ada," 8 (quote).

7. DoD Directive 7920.1, 20 Jun 1988; DoD Instruction 7920.2, 20 Oct 1978 (revised and reissued as Automated Information System [AIS] Life-Cycle Management Review and Milestone Approval Procedures, 7 Mar 1990); Office of the Secretary of Defense, *Major Automated Information System Review Council (MAISRC): Guidelines for Program Managers* (Washington, DC: DoD, Jun 1987), chap. 2:1–10.

8. House Committee on Government Operations [HCGO], *DoD Automated Information Systems Experience Runaway Costs and Years of Schedule Delays While Providing Little Capability: Sixth Report*, 101st Cong., 1st sess., 1989, H. Rep. 101-382, 2–18; GAO, *Automated Information Systems: Schedule Delays and Cost Overruns Plague DoD Systems*, GAO/IMTEC-89-36 (May 1989), 1–3, 7, 10; GAO, *Automated Information Systems: Defense's Oversight Process Should Be Improved*, GAO/IMTEC-90-36 (Apr 1990), 3–4, 9–10, 14–22; memo, ASD (Comptroller) Vincent Puritano for Secretaries of Military Departments, Directors of Defense Agencies, 23 Jun 1983, subj: Revisions to Major Automated Information Systems (MAIS) Approval Process, report in Office of the Secretary of Defense, *MAISRC,* app. A; HCAS, *National Defense Authorization Act for Fiscal Years 1990–1991*, 101st Cong., 2d sess., 1 Jul 1989, H. Rep. 101-121,182; HCGO, Legislation and National Security Subcommittee, *Management of the Department of Defense Automated Information Systems: Hearing*, 101st Cong., 1st sess., 18 May 1989, 132–133, 135, 137, 139.

9. GAO, *DoD Embedded Computers*, 21.

10. Ibid., 20–23 (quote, 22).

11. DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 6, sec. D.

12. Memo, DepSecDef Donald Atwood for Secretaries of Military Departments et al., 4 Oct 1989, subj: DoD Corporate Information Management (CIM); memo, Duane Andrews, Chairman MAISRC, for Secretaries of Military Departments et al., 1 Mar 1991, subj: Implementation of the MAISRC: copies of both in author files, OSD/HO; Robert Green, "Cheney Adopts Secret Plan, Overhauls CIM Management," *Government Computer News*, 10 Dec 1990, 1, copy in author files; David O. "Doc" Cooke, "Organizational/Management Issues for Transition," Nov 1992, 1–3, Subject Files, IV, OSD/HO; Organization, E. OSD, Transition Studies/Issues, 1975–1997, Defense Reform Initiatives Issues (Cooke Blue Book), ca. 1997. In 1989 Congress authorized the secretary of defense to divide the functions of the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence between two assistant secretaries. In the 1990s Secretaries Cheney, Aspin, and Cohen each considered but ultimately rejected the option. For issues concerning efforts to divide the position, see tab B, Defense Reform Initiatives Issues (Cooke Blue Book); Michael B. Donley et al., *The Office of the Secretary of Defense: Creating a New Organization for a New Era* (McLean, VA: Hicks & Associates, May 1997), 62–71; William S. Cohen, *Defense Reform Initiative Report* (Washington, DC: DoD, Nov 1997), 23, 58–60; DoD News Release 239-98, "DoD Announces Reorganization of C3I Office," 13 May 1998.

13. DoD Directive 5137.1 (Assistant Secretary of Defense for Command, Control, Communications, and Intelligence [ASD(C3I)]), 27 Mar 1990; DoD Directive 5137.1 (Assistant Secretary of Defense for Command, Control, Communications, and Intelligence [ASD(C3I)]), 12 Feb 1992; memo, SecDef Dick Cheney for Secretaries of Military Departments et al., 16 Nov 1990, subj: Implementation of CIM Principles; memo, Atwood for Secretaries of Military Departments et al., 27 Nov 1990, subj: Assistant Secretary of Defense for Command, Control, Communications, and Intelligence: copies of both in author files.

14. Memo, Andrews for Secretaries of Military Departments et al., 22 May 1991, subj: CIM in DoD, copy in author files; DoD Directive 8000.1 (Defense Information Management [IM] Program), 27 Oct 1992; Office of the Director of Defense Information, *Status of the Department of Defense Corporate Information Management (CIM) Initiative* (Washington, DC: DoD, Oct 1992), 42–43; Strassmann, "The Policies and the Realities of CIM – Lessons Learned" (address to the 4th AFCEA Computing Conference, 3 Feb 1993), 5–6, 14, 16–19, copy in author files; Strassmann, "The Road to CIM," n.p., ibid.

15. Emmett Paige Jr., interview by Alfred Goldberg and Richard Hunt, 4 Oct 2000, 7–10, 12–14, 16–22, 25–26, 28–32, 37; John J. Hamre, interview by Alfred Goldberg and Richard Hunt, Washington, DC, 18 May 2001, 4–6; Hamre, interview by Alfred Goldberg and Rebecca Cameron, Washington, DC, 29 Jun 2001, 15–16: all in OSD/HO.

16. Memo, USD(A&T) Kaminski, Philip Coyle, Director, Operational Test and Evaluation, and ASD(C3I) Paige for the Defense Acquisition Community, 15 Mar 1996, subj: Update of the DoD 5000 Documents, in DoD, *Executive Summary: DoDD 5000.1, DoD 5000.2-R*, 15 Mar 1996; DoD Directive 5000.1 (Defense Acquisition), 15 Mar 1996, ref. b and para. 1.2. MAIS acquisition was still overseen by the MAISRC, but that body met so rarely—a result of reforms calling for more informal reviews by integrated product teams—that it was finally eliminated in 1998; its oversight functions were taken up by the newly designated Information Technology Overarching Integrated Product Team. See DepSecDef John Hamre, memo for distribution, 28 Jul 1998, subj: Elimination of the MAISRC; Arthur L. Money, Senior Civilian Official, OASD(C3I), memo for distribution, 28 Jul 1998, subj: Elimination of the MAISRC: copies of both in author files; Gregory Slabodkin, "DoD Revamps Process for Overseeing IT Buys," *Government Computer News* 17, no. 25 (10 Aug 1998): 3; Cohen, *Computer Chaos: Billions Wasted Buying Federal Systems*, Investigative Report of Senator William S. Cohen (n.p., 12 Oct 1994), 9; DoD IG, *Information Resources Management at the Defense Information Systems Agency*, Audit Report 94-080 (Washington, DC: DoD, 11 Apr 1994), 8–11, 15–16, 24; *Information Technology Management Reform Act*, P.L. 104-106 (10 Feb 1996), Div. E of *National Defense Authorization Act for Fiscal Year 1996*, U.S. Code, Title 40, sec. 1401 et seq.

17. Memo, Alice Rivlin, Director, Office of Management and Budget, for Heads of Executive Departments and Establishments, M-96-20, 4 Apr 1996, subj: Implementation of the Information Technology Management Reform Act of 1996; memo, DepSecDef John P. White for Secretaries of Military Departments et al., 14 Mar 1996, subj: Designation of the Chief Information Officer of the Department of Defense, copies of both in author files; GAO, *Chief Information Officers: Ensuring Strong Leadership and an Effective Council*, GAO/T-AIMD-98-22 (27 Oct 1997), 1–7. In OSD, the extra burden on the assistant secretary, already overseeing the imposition of standards and an architecture for the department's information infrastructure, was minimal. Clinger-Cohen codified the assistant secretary's authority. *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999*, P.L. 105-261 (17 Oct 1998), Div. A, Title III, sec. 331.

18. Memo, SecDef William Cohen for Secretaries of Military Departments et al., 2 Jun 1997, subj: Implementation of Subdivision E of the Clinger-Cohen Act of 1996 (P.L. 104-106); memo, DepSecDef White for Secretaries of Military Departments et al., 14 Mar 1996, subj: Designation of the Chief Information Officer of the Department of Defense: copies of both in author files.

19. U.S. Code, Title 40, sec. 11103; USD(A&T) Kaminski, USD (Comptroller) Hamre, and ASD(C3I) Paige, memo for distribution, 1 May 1997, subj: Requirements for Compliance with Reform Legislation for Information Technology (IT) Acquisitions (Including National Security Systems); memo, Acting ASD(C3I) Anthony M. Valetta for Secretaries of Military Departments et al., 25 Jul 1997, subj: Information Technology (IT) Investment Management Insight Policy for Acquisition: copies of both in author files.

20. Robert R. Schaller, "Moore's Law: Past, Present and Future," *IEEE Spectrum* 34, no. 6 (Jun 1997): 52–59. Gordon Moore, the electrical engineer and future cofounder of the semiconductor manufacturer Intel, originally presented the idea in 1965 in an article claiming the number of components would double every year. In 1975 he revised that estimate. Years later he would adamantly insist he said two years, not 18 months, but the latter figure is almost universally associated with his law. See Moore, "Cramming More Components onto Integrated Circuits," *Electronics* 38, no. 8 (19 Apr 1965), report in *Proceedings of the IEEE* 86, no. 1 (Jan 1988): 82–85; "Excerpts from *A Conversation with Gordon Moore: Moore's Law*," video transcript (Intel, 2005), n.p., https://web.archive.org/web/20121029060050/http://download.intel.com/museum/Moores_Law/Video-Transcripts/Excepts_A_Conversation_with_Gordon_Moore.pdf, accessed 1 Oct 2020; Denos C. Gazis, "Brief Time, Long March: The Forward Drive of Computer Technology," in Derek Leebaert, ed., *Technology 2001: The Future of Computing and Communications* (Cambridge,

MA: MIT Press, 1991), 42–52; Intel Corporation, timeline, "The Evolution of a Revolution," http:download.intel.com/pressroom/kits/IntelProcessorHistory.pdf, accessed 13 Aug 2016.

21. Peter Grier, "DoD's Computer Hardware Paradox," *Military Forum* (Jul 1989): 36; Kenneth Allard, *Command, Control, and the Common Defense*, rev. ed. (Washington, DC: NDU, Institute for National Strategic Studies 1996), 296; Committee on Aging Avionics in Military Aircraft, Air Force Science and Technology Board, Division on Engineering and Physical Sciences, National Research Council, *Aging Avionics in Military Aircraft*, 8; GAO, *Information Technology: A Statistical Study of Acquisition Time*, GAO-AIMD-95-65 (Mar 1995), 29; DoD, *Overcoming Barriers to the Use of Commercial Integrated Circuit Technology in Defense Systems* (Washington, DC: DoD, Oct 1996), app. A, 2–3.

22. DoD, *Overcoming Barriers*, app. A, 3-6.

23. Kenneth Flamm, *Creating the Computer: Government, Industry, and High Technology* (Washington, DC: The Brookings Institution, 1988), 16–19, 29–79. See also Arthur L. Norberg and Judy E. O'Neill, *Transforming Computer Technology: Information Processing for the Pentagon, 1962–1986* (Baltimore, MD: Johns Hopkins University Press, 1996); Alex Roland, with Philip Shiman, *Strategic Computing: DARPA and the Quest for Machine Intelligence, 1983–1993* (Cambridge, MA: MIT Press, 2002); Katie Hafner and Matthew Lyon, *Where Wizards Stay Up Late: The Origins of the Internet* (New York: Simon & Schuster, 1996).

24. Committee on Aging Avionics in Military Aircraft, *Aging Avionics*, 7, 9; DoD, *Overcoming Barriers*, chap. 1:1–4; Department of Defense Advisory Group on Electron Devices, *Special Technology Area Review on Commercial Off-the-Shelf Electronic Components* (Washington, DC: OUSD[A&T], Jun 1999), 27–29; VHSIC Program Office, Deputy Director, Defense Research and Engineering for Research and Advanced Technology, Office of the Under Secretary of Defense for Acquisition, *Very High Speed Integrated Circuits – VHSIC – Final Program Report* (Washington, DC: DoD, 30 Sep 1990), iii–iv, 2–48, 149–182. See also Glenn R. Fong, "The Potential for Industrial Policy: Lessons from the Very High Speed Integrated Circuit Program," *Journal of Policy Analysis and Management* 5, no. 2 (1986): 264–291.

25. Walter Tomczykowski et al., *Program Manager's Handbook: Common Practices to Mitigate the Risk of Obsolescence* (draft revision D, May 2000), 1–2; Committee on Aging Avionics in Military Aircraft, *Aging Avionics*, 15, 25–27, 47–54.

26. DSMC, *Mission Critical Computer Resources Management Guide*, chap. 3:5 (quote); chap. 7:1, 5–7; Office of Technology Assessment, *SDI: Technology, Survivability, and Software*, OTA-ISC-353 (Washington, DC: GPO, May 1988), 263.

27. Fain quote in Carl G. O'Berry, "An Air Force Perspective on Software Development," *CrossTalk* 8, no. 7 (Jul 1995), n.p., copy in author files; James Kitfield, "Is Software DoD's Achilles' Heel?" *Military Forum* (Jul 1989): 28; "Software Acquisition Management Issues," paper attached to memo, Gene Porter, Principal Deputy Director (Acquisition Policy and Program Integration), for Charles Herzfeld, Director Defense Research and Engineering, 30 Oct 1990, subj: Software Acquisition Management, box 3, Acc 330-96-0008, OSD Records, WNRC; Kathy A. Bannick, "Breakdown of Software Expenditures in the Department of Defense, United States and in the World" (master's thesis, Naval Postgraduate School, Sep 1991), 34–50; GAO, *Embedded Computer Systems: Defense Does Not Know How Much It Spends on Software*, GAO/IMTEC-92-62BR (Jul 1992), 2–3.

28. Kitfield, "Is Software DoD's Achilles' Heel?" 28 (Randolph quote); Jane A. L. Siegel et al., *National Software Capacity: Near-Term Study*, Technical Report CMU/SEI-90-TR-12 (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, 1 May 1990), 7; Evelyn Richards, "Pentagon Finds High-Tech Projects Hard to Manage," *Washington Post*, 11 Dec 1990, 1; GAO, *Mission-Critical Systems: Defense Attempting to Address Major Software Challenges*, GAO/IMTEC-93-13 (Dec 1992), 1–5, 8, 14–26.

29. Software Working Group, Science and Technology Committee, Defense Acquisition Board, *Department of Defense Software Master Plan* (Washington, DC: DoD, 9 Feb 1990), vol. 2: *Background*, annex E, 1–6; Software Technology Support Center, Department of the Air Force, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems*, ver. 2.0 (Hill AFB, UT: Department of the Air Force, Jun 1996), 1, chap. 1:2–22; James A. Hess et al., *Report of the*

AMC Software Task Force (n.p., 28 Feb 1989), 7–22 and app. A; GAO, *Mission-Critical Systems*, 2; Jay R. Hopkins and Curtis R. De Keyrel, "An Analysis of the Root Causes of Delays and Deficiencies in the Development of Embedded Software for Air Force Weapons Systems" (master's thesis, Air Force Institute of Technology, 1994), 86–87; Defense Science Board, *Report of the Defense Science Board Task Force on Acquiring Defense Software Commercially* (Washington, DC: OUSD[A&T], Jun 1994), 17. For an older statement of many of the same problems, see GAO, *Contracting for Computer Software Development—Serious Problems Require Management Attention to Avoid Wasting Additional Millions*, FGMSD-80-4 (Washington, DC: Comptroller General, 9 Nov 1979), 5–31. For the shortage of competent programmers in the 1980s and 1990s, see Defense Science Board, *Report of the Defense Science Board Task Force on Military Software* (Washington, DC: OUSD[A], Sep 1987), 38–41; Siegel et al., *National Software Capacity*, 14, 16–17, 24–25, 27–29.

30. Kitfield, "Is Software DoD's Achilles' Heel?" 28.

31. GAO, *Embedded Computer Systems: Significant Software Problems on the C–17 Must Be Addressed*, GAO/IMTEC-92-48 (May 1992), 17–20 (quote, 17); Hopkins and De Keyrel, "Analysis," 40–51. For a case study of the C–17 program, see chap. XI.

32. Rick Atkinson, *Crusade: The Untold Story of the Persian Gulf War* (Boston: Houghton Mifflin, 1993), 416–420; GAO, *Patriot Missile Defense: Software Problem Led to System Failure at Dhahran, Saudi Arabia*, GAO/IMTEC-92-26 (Feb 1992), 1–10, 15.

33. Nancy G. Leveson, "The Role of Software in Spacecraft Accidents," *AIAA Journal of Spacecraft and Rockets* 41, no. 4 (Jul 2004): 4–22; Robert N. Charette, "Why Software Fails," *IEEE Spectrum* 42, no. 9 (Sep 2005): 47; David L. Parnas, "Software Aspects of Strategic Defense Systems," *Communications of the ACM* 28, no. 12 (Dec 1985): 1327–1328, 1330; OTA, *SDI Technology, Survivability, and Software*, 262–263; L. D. Alford, "Software Surprise: Three Invisible Problems of Weapon System Software Development," *Program Manager* 28, no. 2 (Mar-Apr 1999): 65 (quote). See also Bernard D. Knox, "Ten Years' Worth of Procurement Reforms with Specific Attention to Selected DON Programs" (thesis, Naval Postgraduate School, Dec 2002), 50.

34. Parnas, "Software Aspects," 1328, 1330–1334; Parnas and Paul C. Clements, "A Rational Design Process: How and Why to Fake It," *IEEE Transactions on Software Engineering*, SE-12, no. 2 (Feb 1986): 251–257; Siegel et al., *National Software Capacity*, 41–42 (quote); DSB, *Military Software*, 7. See also Charette, "Why Software Fails," 47.

35. Barry Boehm, "A View of 20th and 21st Century Software Engineering," *Proceedings of the 28th International Conference on Software Engineering, Shanghai, China, 20–28 May 2006* (New York: Association for Computing Machinery, 2006), 14–15; Winston W. Royce, "Managing the Development of Large Software Systems," *Proceedings of the IEEE Western Electronic Show and Convention (WESCON)*, 26 (Aug 1970), report in *Proceedings of the 9th International Conference on Software Engineering* (Washington, DC: IEEE Computer Society Press, 1987), 328–330; Craig Larman and Victor R. Basili, "Iterative and Incremental Development: A Brief History," *IEEE Computer* 36, no. 6 (Jun 2003): 48–49.

36. Royce, "Managing the Development," 329–330, 335.

37. Larman and Basili, "Iterative and Incremental Development," 47, 49.

38. Reed Sorensen, "A Comparison of Software Development Methodologies," *CrossTalk* 8, no. 1 (Jan 1995): n.p., https://web.archive.org/web/19991010020706/http://www.stsc.hill.af.mil/CrossTalk/1995/jan/Comparis.asp, copy in author files; Larman and Basili, "Iterative and Incremental Development," 51; Barry Boehm, "A Spiral Model of Software Development and Enhancement," *IEEE Computer* 21, no. 5 (May 1988): 61–72; Boehm and Prasanta Bose, "A Collaborative Spiral Software Process Model Based on Theory W," in *Proceedings of the Third International Conference on the Software Process: Applying the Software Process,* Reston, VA, 10–11 Oct 1994 (Washington, DC: IEEE Computer Society Press, 1994), 59–68, http://csse.usc.edu/csse/TECHRPTS/1994/usccse94-501/usccse94-501.pdf, accessed 2 Jan 2014, 1–4; Boehm, "Anchoring the Software Process, "*IEEE Software* 13, no. 4 (Jul 1996): 73–82.

39. Larman and Basili, "Iterative and Incremental Development," 52–53; DoD-STD-2167A (Defense System Software Development), 29 Feb 1988, secs. 4.1.1 and 4.1.2; OTA, *Holding the Edge: Maintaining the Defense Technology Base*, OTA-ISC-432 (Washington, DC: GPO, Jan 1990), vol.

2:107–109; House Committee on Science, Space, and Technology, Subcommittee on Investigations and Oversight, *Bugs in the Program: Problems in Federal Government Computer Software Development and Regulation*, Staff Study, 101st Cong., 1st sess., Sep 1989, 9; Paul V. Shebalin, "Software Development Standards and the DoD Program Manager," *Acquisition Review Quarterly* 1, no. 3 (Summer 1994): 208, 210; George A. Newberry, "Changes from DoD-STD-2167A to MIL-STD-498," *CrossTalk* 8, no. 4 (Apr 1995): n.p., copy in author files; Jane Radatz, Myrna Olson, and Stuart Campbell, "MIL-STD-498," *CrossTalk* 8, no. 2 (Feb 1995): 4–7; *Military Handbook: A Tailoring Guide for DoD-STD-2167A Defense System Software Development*, MIL-HDBK-287, 11 Aug 1989, 6–29; DSB, *Military Software*, 11, 33–34. The predecessor to 2167A professed to permit an iterative approach (DoD-STD-2167, Defense System Software Development, 4 Jun 1985, sec. 4.1.2) but gave it so little emphasis as to be generally considered to require a rigid waterfall approach. A separate standard, DoD-STD-7935A, applied to automated information systems.

40. DoD, MIL-STD-498 (Military Standard: Software Development and Documentation), 5 Dec 1994; Newberry, "Changes," n.p.; Radatz, Olson, and Campbell, "MIL-STD-498," 4–7; Reed Sorensen, "Software Standards: Their Evolution and Current State," *CrossTalk* 12, no. 12 (Dec 1999): 23; *DoD-STD-498 vs. DoD-STD-2167A Issue Paper* (Sep 1996), copy in author files; Jim Moore, "ISO 12207 and Related Software Life-Cycle Standards," http://www.acm.org/tsc/lifecycle3.html, accessed 6 Feb 2007; Shebalin, "Software Development Standards," 215.

41. Dennis D. Doe, "Current Practice," in *Aerospace Software Engineering*, eds. Christine Anderson and Merlin Dorfman (Washington, DC: American Institute of Aeronautics and Astronautics, 1991), 17–29.

42. Software Working Group, Science and Technology Committee, Defense Acquisition Board, *Software Master Plan*, vol. 1: *Plan of Action*; GAO, *Mission-Critical Systems*, 6; Anita D. Carleton et al., *Software Measurement for DoD Systems: Recommendations for Initial Core Measures*, Technical Report CMU/SEI-92-TR-019 and ESC-TR-92-019 (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, 1996 [*sic* 1992]), Introduction; memo, Acting USD(A&T) Noel Longuemare and ASD(C3I) Paige, 8 Jul 1994, subj: Software Acquisition Best Practices Initiative, copy in author files; SCAS, *National Defense Authorization Act for Fiscal Year 1997: Report . . . S. 1745*, 104th Cong., 2d sess., 13 May 1996, S. Rep. 104-267, 312.

43. Boehm, "A View," 18; Mark C. Paulk, "A History of the Capability Maturity Model for Software," *ASQ Software Quality Professional* 12, no. 1 (Dec 2009): 5–19; Software Engineering Institute, "Brief History of CMMI," n.p., copy in author files; Watts S. Humphrey, *Characterizing the Software Process: A Maturity Framework*, Technical Report CMU/SEI-87-TR-11 and ESD-TR-87-112 (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, Jun 1987), 1–10; Linda Brown, *DoD Software Reuse Initiative: Vision and Strategy* (Arlington, VA: OASD[C3I], Director of Defense Information, 15 Jul 1992), iv–v, 1–13; Robert J. Bowes and Theresa R. Huber, "A New Beginning: Acquisition Planning with Software Reuse," *Acquisition for the Future: Imagination, Innovation, and Implementation: Research and Reality: Closing the Gap: Proceedings of the 1993 Acquisition Research Symposium* (Fort Belvoir, VA: DSMC, 1993), 79–90; Director of Defense Information, *Status of the Department of Defense Corporate Information Management (CIM) Initiative*, app. O, 1–4.

44. Donald J. Reifer, "Quantifying the Debate: Ada vs. C++," *CrossTalk* 9, no. 7 (Jul 1996), n.p., copy in author files; David Cottengim, "Irreducible Truths of Software-Intensive Program Management," *Defense Acquisition Review Journal* 12, no. 3 (Dec 2005-Mar 2006): 393–394 (quotes); Software Technology Support Center, Department of the Air Force, *Guidelines for Successful Acquisition and Management of Software-Intensive Systems: Weapon Systems, Command and Control Systems, Management Information Systems*, ver. 3.0 (Hill AFB, UT: Department of the Air Force, May 2000), chap. 2:22 (hereafter *GSAM 3.0*), copy in author files. See also DSB, *Acquiring Defense Software Commercially*, 19.

45. Defense Science Board, *Report of the Defense Science Board Task Force on Defense Software* (Washington, DC: OUSD[AT&L], Nov 2000), 3–4, 8–10, 15–17 (quote, 15), 24; Jack R. Ferguson and Michael E. DeRiso, "Software Acquisition: A Comparison of DoD and Commercial Practices," Special Report CMU/SEI-94-SR-9 (Pittsburgh, PA: Carnegie Mellon University, Software

Engineering Institute, Oct 1994), 2–10; DSB, *Acquiring Defense Software Commercially*, 17; John A. Tirpak, "The F–22 on the Line," *Air Force Magazine* (Sep 2002): 43, http://www.airforcemag.com/MagazineArchive/Documents/2002/September%202002/0902raptor.pdf, accessed 19 Feb 2020; *GSAM 3.0*, chap. 2:28–31. For the effectiveness of the incremental and iterative strategies, see Alan MacCormack, "Product Development Practices That Work: How Internet Companies Build Software," *MIT Sloan Management Review* 42, no. 2 (Winter 2001): 7–84.

46. Paige, "Re-Engineering DoD's C3I Operations," *Defense 93*, no. 6 (1993): 18; L. Sheehan and M. Wilson, *Joint Command, Control, Communications, and Computers Systems Descriptions* (McLean, VA: Science Applications International Corporation, 1995), vol. 2, sec. 2, 2–92.

47. Defense Science Board, *Report of the Defense Science Board Task Force on Command and Control Systems Management* (Washington, DC: OUSD [Research & Engineering], Jul 1978), 8–9, 11–12; Armed Forces Communications and Electronics Association, *Command & Control (C2) Systems Acquisition Study Final Report* (n.p.: Armed Forces Communications and Electronics Association, 1 Sep 1982), chap. 1:11–12; chap. 3:19–21.

48. Larman and Basili, "Iterative and Incremental Development," 47–50; Armed Forces Communications and Electronics Association, *Command & Control (C2) Systems Acquisition Study Final Report*, chap. 3:3–4, 57–58; DSB, *Command and Control Systems Management,* 8–13, 17–18, 37–44; David E. Pearson*, The World Wide Military Command and Control System: Evolution and Effectiveness* (Maxwell AFB, AL: Air University Press, Jun 2000), 204–212; DoD Instruction 5000.2 (Major System Acquisition Procedures), 19 Mar 1980, 18 ("design and testing").

49. Memo, DepSecDef Frank C. Carlucci for Secretaries of Military Departments et al., 30 Apr 1981, subj: Improving the Acquisition Process, copy in author files; DoD Instruction 5000.2 (Major System Acquisition Procedures), 8 Mar 1983, encl. 2; Armed Forces Communications and Electronics Association, *Command & Control (C2) Systems Acquisition Study: Final Briefing* (n.p.: Armed Forces Communications and Electronics Association, 16 Jul 1982), iii–vii, 2–54; Armed Forces Communications and Electronics Association, *Command & Control (C2) Systems Acquisition Study: Final Report*, iii–ix, chaps. 1–5, 388, plus appendices; *Joint Logistics Commanders Guidance for the Use of an Evolutionary Acquisition (EA) Strategy in Acquiring Command and Control (C2) Systems* (Fort Belvoir, VA: DSMC, Mar 1987), v, 1–10, 17–23; DSB, *Command and Control Systems Management*, 6–10, 12, 24–25, 27; Carl H. Groth Jr. and Sharon M. Murry, *Information Resource Management Planning in the Office of the Under Secretary of Defense (Acquisition)*, Rep. AQ801R1 (Bethesda, MD: Logistics Management Institute, Aug 1989), chap. 4:20. See also Edward Hirsch, "Evolutionary Acquisition of Command and Control Systems," *Program Manager* 14, no. 6 (Nov-Dec 1985): 18–22.

50. DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 5, sec. A, 2(e); memo, Maj. Gen. Lynn H. Stevens, USA, Commandant, Defense Systems Management College, for Deputy Director (Acquisition Policy and Program Integration), Office of the Under Secretary of Defense (Acquisition), 25 Jan 1990, subj: DSMC Comments on DoDD 5000.1 and DoD 5000.1M, Defense Systems Management College file; memo, Gregory T. Wierzbicki, Provost and Deputy Commandant, DSMC, for Director (Acquisition Policy and Program Integration), 2 Jul 1990, subj: DSMC Comments on DoDD 5000.1 and DoDI 5000.2, with attachment; memo, ASD(C3I) Andrews for Director, Acquisition Policy and Program Integration, 1 Feb 1990, subj: DoD Directive 5000.1 and DoD 5000.1M, ASD (Command, Control, Communications, and Intelligence) (C3I) file; memo, Andrews for Director, Acquisition Policy and Program Integration, 2 Jul 1990, subj: Comments on Draft Series 5000 Acquisition Documents; memo, Robert T. Herres, Vice Chairman JCS, for USD(A), 5 Feb 1990, subj: DoD Directive 5000.1 and DoD 5000.1-M, with attachment, Chairman of the Joint Chiefs of Staff file: all in 5000 Series 1991 Revision Files, OSD/HO; Cohen, *Computer Chaos*, 14–16; memo, Roger Johnson, Administrator, General Services Administration, and John A. Koskinen, Deputy Director for Management of the Office of Management and Budget, for the Vice President, 17 May 1995, subj: Report of Information Technology Working Group, *Improving the Performance of Federal Information Technology Investments*, n.p., 16 May 1995, 1, both attached to memo, Koskinen for President's Management Council, 19 May 1995, subj: Report of Information Technology Working Group,

copy in author files; DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs [MDAPs] and Major Automated Information System [MAIS] Acquisition Programs), sec. 1.4.3 and app. V, sec. C.

51. GAO, *Attack Warning: Status of the Cheyenne Mountain Upgrade Program*, GAO/AIMD-94-175 (Sep 1994), 3; GAO, *Attack Warning: Better Management Required to Resolve NORAD Integration Deficiencies*, GAO/IMTEC-89-26 (Jul 1989), 10–12, 22–24, 29–35. For a description of the projects, see GAO, *Attack Warning: Better Management Required*, 45–46.

52. Russell N. Peter, Christos Scondras, and Randy Srba, "Granite Sentry: A Command and Control Application of Evolutionary Acquisition," *Proceedings of the 1991 Acquisition Research Symposium* (n.p., 1991), vol. 1:1–4.

53. Ibid., 5–6 (quote, 6).

54. Ibid., 6–11.

55. "Cheyenne Mountain Upgrade," in Director, Operational Test and Evaluation, *Report FY97*, n.p., n.d.; Director, Operational Test and Evaluation, *Report FY98* (Washington, DC: DoD, Feb 1999), n.p.: copies of both in author files.

56. F. A. Holk Jr., et al., "Evolutionary Acquisition of Command and Control Systems in Practice: The Operations Support System," in *Acquisition for the Future*, 311–323; Barrick and Alberts, "Acquisition of State-of-the-Art Logistics Combat Support Systems: The Joint Logistics Advanced Concept Technology Demonstration Program," 349–359.

57. *C4I for the Warrior—Global Command and Control System: From Concept to Reality* (Falls Church, VA: Information Assurance Technology Analysis Center, 1996), n.p.; Richard H. White, David R. Graham, and Johnathan A. Wallis, *An Evolutionary Acquisition Strategy for the Global Command and Control System* (GCCS), IDA Paper P-3315 (Alexandria, VA: IDA, Sep 1997), chap. 1:3; chap. 2:1 ("acquisition activity"); Johnathan A. Wallis, David R. Graham, and Richard H. White, *Field Action Officer Roles in GCCS Development*, IDA Document D-2023 (Alexandria, VA: IDA, Oct 1997), 1 ("continuous, slow upgrade").

58. Johnathan A. Wallis, David R. Graham, and Richard H. White, *Evolutionary Acquisition of the Global Command and Control System: Lessons Learned*, IDA Paper P-3397 (Alexandria, VA: IDA, 1998), 8–9; DoD, *Management of the Global Command and Control System*, Audit Report 95-201 (Washington, DC: DoD, 24 May 1995), 8–18.

59. White, Graham, and Wallis, *Evolutionary Acquisition Strategy*, chap. 2:4, 7–12; chap. 3:7; chap. 4:1–12.

60. Ibid., chap. 2:2–7.

61. Ibid., chap. 2:4–6; chap. 3:6–15.

62. Wallis, Graham, and White, *Evolutionary Acquisition*, 4–6, 8, 10–13 (quote, 10); White, Graham, and Wallis, *Evolutionary Acquisition Strategy*, chap. 3:15; DoD IG, *Information Technology Management: Global Command and Control System Joint Operation Planning and Execution System*, Report D-2003-078 (Washington, DC: DoD, 15 Apr 2003), 3–12.

63. Anthony W. Faughn, *Interoperability: Is It Achievable?* (Cambridge, MA: Harvard Center for Information Policy Research, Program on Information Resources Policy, Oct 2002), 9–12; Sterling D. Sessions and Carl R. Jones, *Interoperability: A Desert Storm Case Study*, McNair Paper 18 (Washington, DC: Institute for National Strategic Studies, National Defense University, Jul 1993), 2–4 (quote, 3).

64. Paul Strassmann, "CIM: Consider it Mañana?" *Defense Issues* 7, no. 55 (22 Sep 1992): 2; C4 Architecture & Integration Division, J-6, Joint Staff, *C4I for the Warrior*, 12 Jun 1992; Edward H. Eidson, "Introduction to Command, Control, and Communications: A Primer" (thesis, Naval Postgraduate School, Jun 1995), 175–183. For more information on the technical elements composing C4I for the Warrior, see Sheehan and Wilson, *Joint Command, Control, Communications, and Computers Systems Descriptions*, vol. 2, sec. I, chap. 2:1–7; J-6, Joint Staff, *C4I for the Warrior: A 1995 Progress Report* (n.p., nd), 1–28, copy in author files.

65. For good discussions of the technical and institutional obstacles to interoperability, see Faughn, *Interoperability*, 21–32; Stuart Starr and Stuart Johnson, "The Challenge of Achieving Interoperability of Information Technology Systems," in Joseph N. Mait, ed., *Making IT Happen:*

Transforming Military Information Technology (Washington, DC: National Defense University Center for Technology and National Security Policy, Sep 2005), 44–48; and Committee to Review DoD C4I Plans and Programs, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, *Realizing the Potential of C4I: Fundamental Challenges* (Washington, DC: National Academy Press, 1999), 64–84.

66. As quoted in Mark K. Hayden, "The Basis for Interoperability," Individual Research Project (Carlisle Barracks, PA: U.S. Army War College, 1991), 5, https://apps.dtic.mil/dtic/tr/fulltext/u2/a233608.pdf, accessed 19 Feb 2020.

67. *Defense Information Infrastructure: Rationale for Defense Management Report Decision 918* (DoD, Sep 1992), attached to memo, Cynthia Kendall, Deputy Assistant Secretary of Defense (Information Systems), for Director, Defense Research and Engineering et al., 26 May 1993, subj: Defense Management Report Decision (DMRD) 918 Reference Document, 1–5.

68. Ibid., 6; Hayden, *Basis for Interoperability*, 12; DoD Directive 4630.5 (Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence [C3I] Systems), 12 Nov 1992.

69. Chairman of the Joint Chiefs of Staff Instruction 6212.01A (Compatibility, Interoperability, and Integration of Command, Control, Communications, and Computer Systems), 30 Jun 1995.

70. Committee to Review DoD C4I Plans and Programs, *Realizing the Potential of C4I*, 100–103, 109–111. For more information on architectures and architecture frameworks, see ibid., 85; P. Kathie Sowell, "The C4ISR Architecture Framework: History, Status, and Plans for Evolution" (MITRE Corp., Aug 2000), n.p., copy in author files.

71. DoD IG, *Implementation of the DoD Joint Technical Architecture*, Audit Report 98-023 (Washington, DC: DoD, 18 Nov 1997), 10, 17–18; Committee to Review DoD C4I Plans and Programs, *Realizing the Potential of C4I*, 111–113; GAO, *Joint Military Operations: Weaknesses in DoD's Process for Certifying C4I Systems' Interoperability*, GAO-NSIAD-98-73 (Mar 1998), 1–10; Faughn, *Interoperability*, 13–15.

72. For a description of computer-aided design/computer-aided manufacturing systems, see Albert B. Garcia, Robert P. Gocke Jr., and Nelson P. Johnson Jr., *Virtual Prototyping: Concept to Production,* Report of the DSMC 1992–93 Military Research Fellows (Fort Belvoir, VA: DSMC Press, Mar 1994), 17–24.

73. GAO, *Computer Procurement: Information on Defense Department CAD/CAM Acquisitions*, GAO/IMTEC-89-3FS (Jan 1989), 2–3, 10, 13; GAO, *Computer Procurement: Navy CAD/CAM Acquisition Has Merit But Management Improvements Needed*, GAO-IMTEC-88-22 (May 1988), 8; Garcia, Gocke, and Johnson, *Virtual Prototyping*, 17–20; Annie Patenaude, *Study on the Effectiveness of Modeling and Simulation in the Weapon System Acquisition Process: Final Report* (Washington, DC: OSD, Oct 1996), chap. 3, sec. C3, n.p.

74. For general discussions of modeling and simulation, see David A. Cook, "Computers and M&S—Modeling and Simulation 101," *CrossTalk* 14, no. 1 (Jan 2001): 8–10; Garcia, Gocke, and Johnson, *Virtual Prototyping*, 5–122; and Lalit K. Piplani, Joseph G. Mercer, and Richard O. Roop, *Systems Acquisition Manager's Guide for the Use of Models and Simulations,* Report of the 1993–1994 DSMC Military Research Fellows (Fort Belvoir, VA: DSMC Press, Sep 1994), chap. 1:1 to chap. 8:17.

75. Garcia, Gocke, and Johnson, *Virtual Prototyping*, 89–101.

76. Robert Holzer, "DoD to Create New Simulation Office," *Defense News*, 8 Jul 1991, 10; Garcia, Gocke, and Johnson, *Virtual Prototyping*, 12–13; *Charter for the DoD Executive Council for Modeling and Simulation* (EXCIMS), n.d., copy in author files; [DoD], *Defense Modeling and Simulation Initiative*, AD-A252 712 (n.p., 1 May 1992), iii, 1–2, 11–24.

77. DoD Directive 5000.59 (DoD Modeling and Simulation [M&S] Management), 4 Jan 1994; DoD 5000.59-P (Modeling and Simulation [M&S] Master Plan), Oct 1995; memo, Kaminski for Secretaries of Military Departments et al., 10 Sep 1996, subj: DoD High Level Architecture (HLA) for Simulations, copy in author files; Judith S. Dahmann, Richard M. Fujimoto, and Richard M. Weatherly, "The Department of Defense High Level Architecture," in *Proceedings of the 1997 Winter Simulation Conference*, 142–143, www.informs-sim.org/wsc97papers/0142.PDF.

78. Patenaude, *Study on the Effectiveness of Modeling and Simulation*, chap. I, sec. B (quote from executive summary, n.p.). For additional information on simulation-based acquisition, see Michael V. R. Johnson, Mark F. McKeon, and Terence R. Szanto, *Simulation Based Acquisition: A New Approach,* Report of the 1997–1998 DSMC Military Research Fellows (Fort Belvoir, VA: DSMC Press, 1998), chaps. 4 and 5. For a brief overview, see Kenneth "Crash" Konwin and Dave Thomen, "Simulation Based Acquisition: An Overarching View," in *Proceedings of the Fall 2000 Simulation Interoperability Workshop* (Orlando, FL: Simulation Interoperability Standards Organization, 2000), 00F-SIW-082.

79. Command, Control, Communications and Combat Systems Steering Committee of the Undersea Warfare Division, American Defense Preparedness Association, "Study on the Application of Modeling and Simulation to the Acquisition of Major Weapons Systems" (briefing, American Defense Preparedness Association, 27 Sep 1996), 5:13–15; Anne Hillegas et al., *The Use of Modeling & Simulation (M&S) Tools in Acquisition Program Offices: Results of a Survey* (McLean, VA: Hicks & Associates, 31 Jan 2001), 11–13, 17 (quote, 11).

80. Joshua Davis, "If We Run Out of Batteries, This War Is Screwed," *Wired News* 11, no. 6 (Jan 2003), http://www.wired.com/wired/archive/11.06/battlefield_pr.html, accessed 19 Feb 2020; Gregory Fontenot, E. J. Degen, and David Tohn, *On Point: The United States Army in Operation Iraqi Freedom* (Washington, DC: Office of the Chief of Staff, United States Army, 2004), 11, 59–63, 206; Tony Perry, "Technology Cuts 'Friendly Fire,'" *Los Angeles Times*, 18 Jan 2005, http://articles.latimes.com/2005/jan/18/world/fg-friendly18, accessed 19 Feb 2020.

I. Subpart 270.4, pt. 270, chap. 2, Title 48, *Code of Federal Regulations*, 31 Dec 1986, 691.

II. Duane P. Andrews website, http://andrews-web.com, accessed 10 Dec 2015; attachment A (Resumes of Commission Members), *Report of the Commission to Assess United States National Security Space Management and Organization Pursuant to Public Law 106-85* (Washington, DC, 11 Jan 2001), A-1; Armed Forces Communications and Electronics Association website, biography of Duane P. Andrews, http://www.afcea.org/about/andrews.asp, accessed 23 Feb 2016.

III. Craig B. Hanford, *Executive Summary: Senior Officer Oral History Program Interview of Lieutenant General (Retired) Emmett Paige Jr.* (Carlisle Barracks, PA: U.S. Army War College, 25 Apr 1997), 1–30; President's Office, University of Maryland, University College, biography of Lt. Gen. Emmett Paige Jr., Retired, member Board of Visitors, http://www.umuc.edu/visitors/president/paige.cfm, accessed 22 Feb 2016; Rebecca Robbins Raines, *Getting the Message Through: A Branch History of the U.S. Army Signal Corps* (Washington, DC: CMH, 1996), 391–392, 398–499.

IV. Acquisition Policy Department, Defense Systems Management College, *Glossary: Defense Acquisition Acronyms and Terms*, 10th ed. (Fort Belvoir, VA: DAU Press, Jan 2001); DoD 5000.59-M (DoD Modeling and Simulation [M&S] Glossary) (Washington, DC: OUSD[A&T], Jan 1998).

CHAPTER X

Acquisition Reform, 1997–2001

A new set of reformers came to the Defense Department during the Clinton administration's second term. They were no strangers to acquisition or to acquisition reform, having been involved with both for years and having played a role in establishing the reforms of the first administration. Under Secretary of Defense for Acquisition and Technology Jacques Gansler took the lead in pursuing an aggressive reform agenda that built on work begun during Clinton's first term. He was determined to broaden the defense industrial base by attracting companies producing needed technologies that had not previously competed in military markets; to streamline acquisition processes further and to make them more flexible and responsive; to pare costs whenever possible; and to integrate the acquisition and logistics communities. To achieve these objectives, Gansler reorganized the oversight of acquisition reform and launched a series of studies to promote a comprehensive, integrated reform program. During his term, Gansler and other Defense Department officials also explored new approaches to developing defense systems. One of these—evolutionary acquisition—would become policy by the end of the century.

THE FISCAL CONTEXT OF REFORM

Reducing acquisition costs was a high priority for the new group of reformers who took over the Defense Department. The Defense budget had begun falling sharply in FY 1990 from almost $293 billion (current or then-year dollars) to $251.3 billion in FY 1994, with relatively little increase through FY 1997's budget of just over $258 billion. An agreement between the White House and Congress, made soon after Clinton's second term began, reduced the prospect that defense spending would increase much for the next several years.[1]

In spring 1997 the president and Congress negotiated an extension of the Budget Enforcement Act of 1990 (see chapter IV), which placed new caps on discretionary spending. The 1990 caps had been extended in 1993 and were due to expire in 1998.

The new agreement extended them another five years, with the goal of balancing the budget in 2002. Like the agreement of 1990, it also mandated separate defense and nondefense caps for two years and then a single cap on total discretionary spending for the next three years. Furthermore, the agreement continued the "pay-as-you-go" rules, which required that the source of funding for an increase in any part of the budget from either spending cuts or new taxes had to be explicitly identified. These restrictions meant, once again, the Department of Defense would have to compete with every other agency within a fixed level of funding. Appropriations remained a zero-sum game: In the first two years, money added to any defense program had to be paid for out of another program's budget; afterwards, with the single cap, money could be added to defense but only by cutting domestic programs (and vice versa). Congress codified the agreement in a budget resolution and then in a new Budget Enforcement Act, passed as part of the Balanced Budget Act of 1997. The Defense Department's FY 1998 budget of slightly over $258.5 billion, only two tenths of 1 percent increase over the FY 1997 budget, reflected the tight fiscal environment.[2]

By fall 1997, however, a consensus was growing within the defense establishment that the procurement budget was inadequate for the modernization program outlined in the Bottom-Up Review of 1993. Since 1995, General John Shalikashvili, chairman of the Joint Chiefs of Staff, had been arguing that procurement spending had to rise to $60 billion by 1998 to fulfill the military's modernization requirements, a figure endorsed by the Quadrennial Defense Review, or QDR, in 1997. The administration expressed support for that objective, but gave greater priority to readiness and quality of life issues. With every new budget plan, the $60 billion mark was pushed back another year. The procurement budget for FY 1998 remained below $45 billion—only three-quarters of the JCS chairman's target (see table 10-1 and figure 10-1).[3]

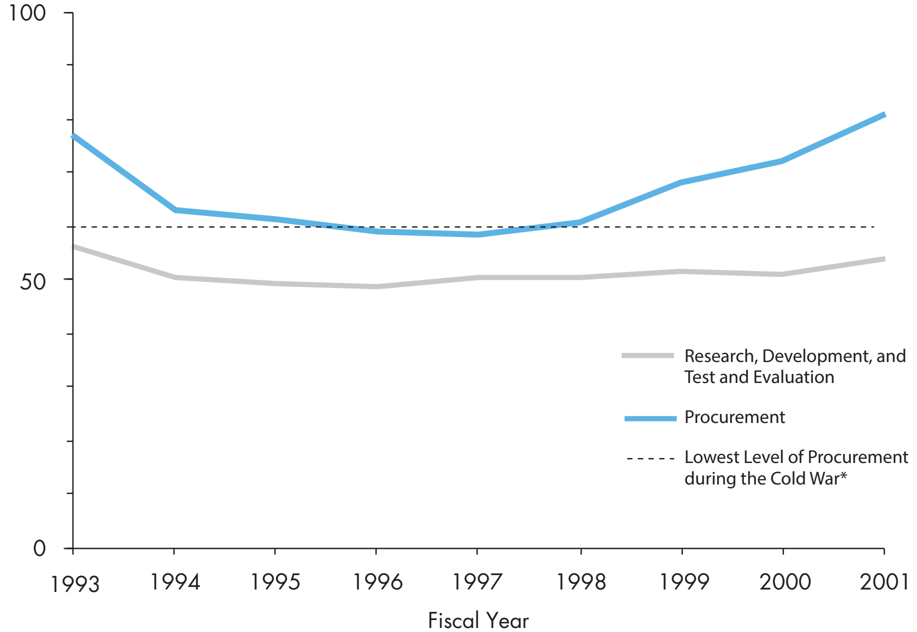
In 1998 General Henry H. Shelton, Shalikashvili's successor, set out to persuade Secretary Cohen and others in the Pentagon of the critical need to increase defense spending. He had little difficulty convincing Cohen. For a year the secretary of defense had taken the position that the administration's proposed budgets, combined with planned savings through managerial reforms and cuts in infrastructure, would be enough to fund the strategy and force structure outlined in the QDR report. By 1998 he had begun to question that conclusion. He was particularly concerned by evidence of a steady decline in readiness and morale due to funding shortfalls for training and spare parts. After receiving a briefing from Shelton, he met with the Joint Chiefs and OSD officials on 2 July and launched a campaign with Shelton and allies in Congress to increase defense spending above the levels specified in the balanced budget agreement.[4]

The advocates of more spending followed a multipronged approach to achieve their objective. First, Shelton and the service chiefs applied their prestige to push public opinion in the direction of a spending increase, thereby strengthening their hand against both budget cutters and domestic spending advocates in Congress—as well as in the Office of the Secretary of Defense and the White House. In a hearing on 29 September 1998, the chiefs testified that readiness was declining at an alarming

Table 10-1: Acquisition Budgets, FY 1993–FY 2001
(Budget authority in then-year billions of dollars)

	1993	1994	1995	1996	1997	1998	1999	2000	2001
RDT&E	38.0	34.6	34.5	35.0	36.4	37.1	38.3	38.4	41.6
Procurement	52.8	44.1	43.6	42.6	43.0	44.8	51.1	55.0	62.6

Figure 10-1: Acquisition Budget Trends, FY 1993–FY 2001
(Budget authority in constant 2014 billions of dollars)



*In 1955 procurement funding dropped to $6.8 billion, or $59.3 billion in constant 2014 dollars. In 1975 it went almost as low, to $16.7 billion ($60 billion in constant 2014 dollars). RDT&E funding, even at its post–Cold War low in 1996 ($48.9 billion in constant 2014 dollars), was still higher than at any time before 1984.

Source: DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8.

rate, an issue of considerable political potency. They required an additional $17 billion per year to fix those problems and to raise retirement benefits to stem the flow of highly trained personnel from the services to the private sector.[5]

Second, with the help of Representative Jack Murtha, the ranking Democrat on the House Appropriations Committee, Cohen and his OSD staff went to work on the White House. Again, they focused on funding for readiness and increases in retirement benefits. Clinton, too, was easily persuaded. Cohen and the chiefs laid out their case in a meeting in September, after which Clinton gave them permission to ask Congress publicly for more money. Later, he promised to add funding in the FY 2000 budget, overruling deficit cutters in the Office of Management and Budget.[6]

Third, Under Secretary for Acquisition and Technology Gansler began to call for an increase in procurement funding. He emphasized the aging of weapon systems then in service, most having been manufactured in the 1970s and 1980s. Rising costs, lengthening development cycles, and the sharp decline in procurement budgets had combined to ensure that few new systems had entered service or transitioned from development into production during the 1990s. Thus the average age of the inventory was starting to increase. Aircraft were Gansler's main concern. Ships and ground systems were aging, too, but major construction programs during the 1980s, and the retirement of older and less capable systems due to the drawdown, helped alleviate the problem.[7]

During summer 1998, in keeping with Cohen's campaign to increase the Defense budget, Gansler highlighted the issue of aging weapon systems, pointing out the older the system the higher its operations and maintenance costs. To maintain readiness and conduct current operations, the services had to divert money from procurement. Reductions in that funding forced program stretchouts and cuts in planned procurement, further deferring modernization and leaving the services to make do with aging equipment. Gansler blamed this predicament on the "procurement pause" instituted by the George H. W. Bush administration, which, he maintained, had not moved replacement systems into the acquisition pipeline soon enough. He considered the situation to be urgent and prescribed a number of measures to free up money for procurement, including a renewed emphasis on acquisition reform, the overhaul of the logistics system, base closures, and the termination of (unspecified) "traditional weapon systems," in Gansler's phrasing, in favor of transformational systems more suited to the revolution in military affairs.[8]

By this time a growing bipartisan consensus had emerged in favor of increased defense spending, but neither party wanted to take responsibility for breaking the caps they had established just the previous year. Although the Clinton administration was privately signaling it supported increased defense spending, the Republican leadership was unable to persuade it to recommend breaking the caps either. The solution congressional proponents of increased defense spending offered was to declare the additional money as "emergency" funding, which according to the law was not subject to the caps. Their colleagues, facing an election in a few weeks and buoyed by the announcement of the first surplus in almost 30 years, four years earlier than expected, embraced the plan. The resulting emergency supplemental was tacked on to a $520 billion omnibus appropriations bill funding eight federal agencies in FY 1999. The supplemental cost $20.8 billion, of which $7.8 billion went to the Pentagon. Congress directed $4 billion of the $7.8 billion to the account that funded readiness—the stated reason for the supplemental. The increase in retirement benefits was left out of the bill altogether, though Congress approved it a few months later. The supplemental also included $1 billion for missile defense, the top priority of congressional Republicans. The White House, which obtained money for domestic programs, certified the funds were indeed for emergencies. The cap was broken.[9]

Using the emergency supplemental as a politically safe tool to increase defense spending worked so well in October 1998 that Congress did it again the following

May. For FY 1999, the Defense Department had asked for more, a $5.4 billion supplemental to pay for the Kosovo campaign, the largest combat operation of Clinton's presidency. Congress doubled the request, with the extra money applied to spare parts, maintenance, and other operating costs unrelated to Kosovo. Indeed, Congress had deliberately left those expenses out of the regular FY 1999 appropriations act in anticipation of funding them in the supplemental. Together, the regular appropriations act and the two supplementals raised the department's budget authority for 1999 above that of the previous year by nearly 5 percent. Procurement increased even more substantially, by 12.5 percent in real terms, to $51 billion.[10]

With a presidential election looming, Clinton and the Republicans competed with each other to prove who was more "pro-defense." In 1999 Clinton proposed adding $112 billion to the FY 2000–2004 program. The increase did not satisfy the service chiefs, who maintained much more was needed, but it was a significant start. For FY 2000 the administration requested $268.7 billion for the Defense Department, $13 billion above the previous year's request. Congressional Republicans, concerned Clinton would take political credit for the increase, added $7.4 billion. Congress exempted $21 billion from the caps, including the bill's $7 billion in emergency funding. Two supplemental appropriations in 2000 brought the total appropriation for the fiscal year to $290.5 billion. The procurement slice rose to $55 billion. For the first time since the Republicans took over Congress in 1995, legislators who worried about budget deficits did not insist on offsetting cuts to pay for a supplemental appropriation passed in summer 2000.[11]

The budget increase continued in FY 2001. Clinton asked for $292.5 billion for the Defense Department, almost $24 billion more than the previous year, to which Congress added another $7.5 billion. The appropriations bill passed quickly with significant bipartisan support. The service chiefs and some in Congress wanted more—Clinton's budget proposal was still $16 billion short, the chiefs said—but the size of the request and the resistance of fiscal conservatives restrained them. However, under the George W. Bush administration in 2001, Congress passed two large supplementals totaling $20 billion, of which almost three-fourths were appropriated in response to the terrorist attacks on 11 September, less than two weeks before the end of the fiscal year. All told, the department received $319.4 billion for FY 2001. Procurement passed the $60 billion mark, reaching $62.6 billion.[12]

THE NEW TEAM: ORGANIZATION AND PRIORITIES

As he had planned, Defense Secretary William Perry left office in January 1997, three days after Clinton's second inauguration. His successor, William Cohen, was a moderate Republican senator from Maine who had long been associated with defense reform. For his deputy, Cohen chose DoD Comptroller John Hamre who was widely experienced in defense matters, including familiarity with acquisition. Before becoming the department's comptroller in 1993, Hamre had served for 10 years on the staff of the Senate Armed Services Committee where his responsibilities included R&D and procurement. From 1978 to 1984 he had been deputy assistant director for national security and international affairs in the Congressional Budget Office.[13]

Cohen did not immediately fill the under secretary for acquisition and technology position. Although Under Secretary Paul Kaminski had announced his intention to leave office at about the same time as Perry, he was in no hurry to go. He was staying on a few months, the Defense Department announced, "to provide continuity in the Quadrennial Defense Review and maintain momentum in acquisition reform and international armaments cooperation." He also wanted to see through reforms intended to stabilize acquisition program budgets before his departure. Kaminski stepped down on 16 May 1997, three days before release of the QDR report. After a delay of almost six months, Jacques Gansler, the new under secretary for acquisition and technology, was sworn in on 10 November. Like his predecessor, Gansler understood defense acquisition, having 40 years of experience in the field. He was a forceful advocate of acquisition reform, having participated in the major reform studies and reviews of the 1980s and 1990s, including the Packard Commission. He was also a strong proponent of opening the defense market to businesses outside the traditional defense industrial sector.[14]

Gansler selected retired naval officer David R. Oliver Jr. as his deputy. A graduate of the Naval Academy, Oliver was a submariner before ending his military service as principal deputy to the Navy's civilian acquisition chief. After retiring in 1995, he joined Westinghouse's Electronic Systems Group, and when Northrop Grumman acquired that group, he became director of business development and technology for naval systems at its Electronic Sensors and Systems Division.[15]

Stan Z. Soloway became the new deputy under secretary for acquisition reform in March 1998. His predecessor, Colleen Preston, had vacated the position suddenly and unexpectedly in January 1997, causing considerable concern in the acquisition community about the future of the reform program with which she had long been identified. The cause for her departure was said to be a conflict with the DoD director of defense procurement, Eleanor Spector, who resisted Preston's more aggressive approach to acquisition reform. Soloway had spent most of his career as an industry public affairs consultant. During the 1990s he represented the Contract Services Association of America on a wide range of acquisition reform and general procurement issues. An advocate of privatization and outsourcing, he was a founder of the industry-sponsored Acquisition Reform Working Group and the Government Competition Coalition, and was chairman of the Industry Depot Coalition.[16]

The budget agreement of May 1997, which seemed to eliminate the possibility for any significant short-term boost in funding for defense programs, defined the operating parameters for the new defense acquisition team. If the Defense Department wanted to increase the funding available for acquisition, it had to cut costs elsewhere, which would allow Congress to boost R&D and procurement funding while remaining within the overall defense spending caps. To do this, the department, imitating the revolution in military affairs, developed a five-part approach

Jacques Gansler, under secretary of defense for acquisition and technology, 1997–1999; under secretary of defense for acquisition, technology, and logistics, 1999–2001. *(NARA)*

Jacques S. Gansler (1934–2018)

With four decades of acquisition-related experience in government, industry, and academia, Jacques Gansler was exceptionally well prepared to become the under secretary of defense for acquisition and technology (acquisition, technology, and logistics after October 1999). (In one of his last official actions as under secretary, Gansler secured funding for the Defense Acquisition History Project; this volume on the 1990s is one of its products.)

Born on 21 November 1934 in Newark, New Jersey, Gansler initially studied electrical engineering. Later he would earn a doctorate in economics. From 1956 to 1972 he held engineering and management positions successively with the Raytheon, Singer, and ITT Corporations, the last as vice president for business development. In the 1970s Gansler entered government service, first as deputy assistant secretary of defense for materiel acquisition with responsibility for procurement and the defense industry, and then as assistant director of defense research and engineering for electronics. After leaving the Defense Department in 1977, he spent the next 20 years as executive vice president and a director of TASC Inc., an applied information technology company.

While at TASC, Gansler published three major books on acquisition, all by MIT Press: *The Defense Industry* (1980), *Affording Defense* (1989), and *Defense Conversion* (1995). He was also a visiting scholar at Harvard's John F. Kennedy School of Government and an honorary professor at the Industrial College of the Armed Forces. During this period, he headed two industry associations, the Procurement Roundtable and the Professional Services Council. In the years just before becoming under secretary, Gansler was vice chairman of the Defense Science Board and chairman of the Board of Visitors of the Defense Acquisition University.

After leaving the under secretary's post in January 2001, Gansler held the Roger C. Lipitz Chair in Public Policy and Private Enterprise and was director of the Center for Public Policy and Private Enterprise at the University of Maryland School of Public Policy. He died on 4 December 2018.[1]

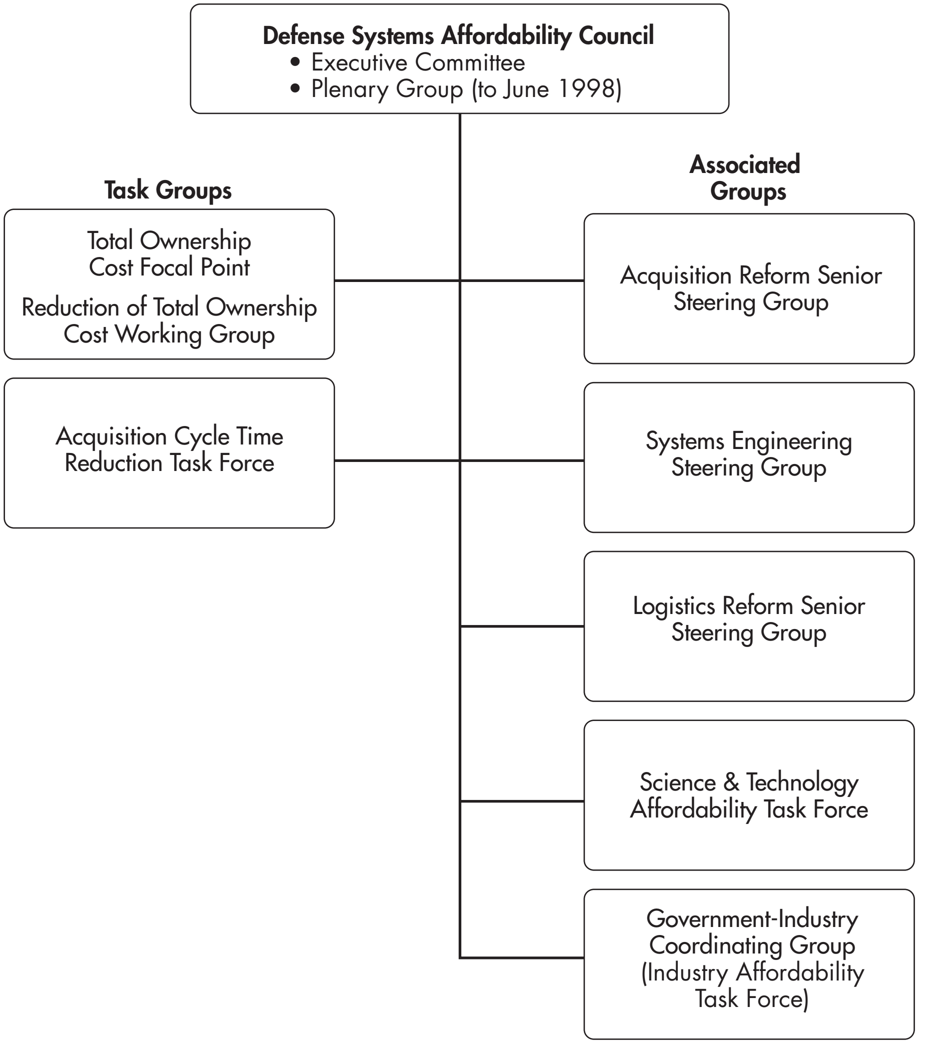
it called the "revolution in business affairs." First, it would continue and expand the acquisition reform effort begun during Perry's term and take steps to institutionalize the various initiatives and ensure their longevity. Second, it would broaden the defense industrial base to "take advantage of high-quality commercial suppliers" that were often leaders in developing defense technologies, particularly information technology. Third, it would eliminate surplus Cold War–era infrastructure and overhaul the department's business practices to reduce the support costs for personnel and existing weapon systems, which consumed a growing portion of the Defense budget. Fourth, it would revamp logistics organizations and processes, applying the latest technologies and business methods to reduce costs and improve performance. Finally, the Defense Department would train the acquisition workforce in the ideas and practices coming out of the acquisition and logistics reforms. The pressure Gansler and other Pentagon officials faced over the next four years to reduce costs through military and civilian personnel cuts made improving the quality and productivity of the workforce particularly critical.[17]

Secretary Cohen's signature reform program, the Defense Reform Initiative, focused on the third goal. It aimed at eliminating unneeded infrastructure, consolidating redundant activities, cutting excess personnel, and reengineering business practices to increase efficiency and reduce costs. The initiative's report, issued in November 1997, did not have much to do with acquisition per se, except for the reorganization of acquisition offices as part of the general reorganization of OSD. For example, the Office of the Under Secretary of Defense for Acquisition and Technology lost the position of deputy under secretary for space, whose acquisition functions transferred to the Office of the Assistant Secretary for Command, Control, Communications, and Intelligence. These measures stemmed as much from the pressure to eliminate staff positions as from the desire to improve organizational effectiveness.[18]

Acquisition reform represented another potential source of savings. Early efforts had focused on establishing a process and metrics for reform, launching major initiatives, winning support and assistance both inside and outside of DoD, and achieving early and well-publicized successes to gain momentum. Cohen would focus on reform implementation and enforcement. With some exceptions, the bold pronouncements and broad-brush policy statements of OSD's early reform issuances gave way to workmanlike implementation guidelines and explanatory memoranda. The new leadership also faced the task of institutionalizing the reforms so they would continue after the administration left office. This required gaining support both within the defense bureaucracy and in industry, tasks the Perry team had tackled with energy but had only just begun.

During Cohen's tenure, the Acquisition Reform Senior Steering Group continued to meet, with Soloway as chair, but in 1997 OSD revamped and strengthened the Defense Manufacturing Council as another avenue for acquisition reform. Although the council had always looked at acquisition broadly, the name confused some, who assumed that it dealt with issues relating to the factory floor.

Figure 10-2: Defense Systems Affordability Council
(as of 21 September 1998)



Source: Derived from Charter, Defense Systems Affordability Council, http://web.archive.org/web/20001214073100/http://www.acq.osd.mil/dsac/charter.htm.

OSD therefore changed the name to the Defense Systems Affordability Council (DSAC) and gave it a broad mandate to develop and implement a department-wide strategy for achieving "affordable defense systems that meet all essential performance requirements." The DSAC's purview included all Defense Department processes required to develop, produce, support, and dispose of those systems.[19]

The under secretary of defense for acquisition and technology chaired the Defense Systems Affordability Council. Its executive committee comprised up to 20 (later 15) key acquisition officials in OSD, the services, and the Joint Staff. During its first year the DSAC executive committee received advice from a plenary group made up of a broad group of officials working in acquisition or related areas chaired by the principal deputy under secretary of defense for acquisition and technology. The council also enjoyed the input of the conferences of program executive officers and commanders of the systems commands (PEO/SYSCOMs), which Kaminski had started and which continued to meet twice a year with Gansler and the service acquisition executives. As before, they formulated plans to tackle problems identified by DSAC and the conferees, and spread information about the latest ideas and policies throughout the acquisition community. After spring 1999, the Defense Department allowed industry representatives to participate.[20]

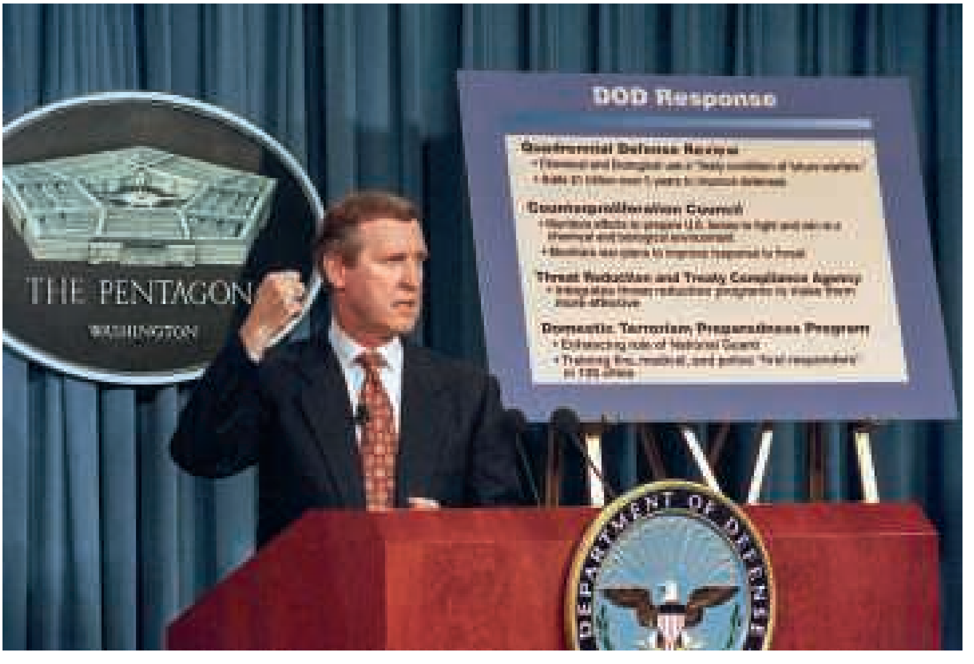
Gansler considered the Defense Systems Affordability Council to be a valuable forum for bringing together the various acquisition stakeholders to discuss reform issues. He convened the council at regular two-to-four-month intervals, viewing those meetings as a useful way to organize and manage the sprawling reform effort and the numerous executive committees, working groups, and senior steering groups directing it. The high-level groups now worked under the DSAC's oversight, guidance, and coordination. The initial four, called associated groups, were the Acquisition Reform Senior Steering Group, the Systems Engineering Steering Group, the Science and Technology Affordability Task Force, and the Government-Industry Coordinating Group. When the under secretary for acquisition and technology assumed responsibility for the entire life cycle of defense systems, including their logistics, in 1999, the council organized a Logistics Reform Senior Steering Group. Together, the five associated groups covered all aspects of weapon system development. They kept the DSAC informed of their activities but referred to the council only those issues they could not resolve by themselves. Each group had specific priorities. For example, the Acquisition Reform Senior Steering Group focused on program stability, civil-military integration, the requirements process, and workforce education and training. The DSAC expected the groups to align their activities with the top-level policies and goals set by the council, the Defense Reform Initiative, and the National Performance Review. It also expected them to relay information about their activities to their respective communities and to provide assistance to the council.[21]

The Defense Systems Affordability Council focused most of its efforts on two fundamental issues, reducing total ownership costs and shortening cycle times. It assigned supervision of the first task to an integrated product team, called the Reduction of Total Ownership Cost Working Group, under Spiros Pallas of the Office of the Under Secretary for Acquisition and Technology. The council's second major goal was to reduce the time required to develop and produce weapon systems. The Acquisition Cycle Time Reduction Task Force supervised this undertaking. The council played a hands-on role in these two areas, selecting goals and approaches and monitoring their implementation through regular briefings and quarterly reports. It hoped to integrate all of the reform efforts and initiatives into a coherent, overarching vision, with a strategy and goals, by the year 2000.[22]

In January 1999 the Defense Systems Affordability Council published its overall plan, *Into the 21st Century: A Strategy for Affordability.* It laid out three major goals that became the Defense Department's top priorities in acquisition management:

- To field high-quality defense products quickly and support them responsively
- To lower the total ownership cost of defense products
- To reduce the overhead cost of the acquisition and logistics infrastructure

The document set ambitious targets. For example, it called for all programs begun in 1999 to reduce their average cycle time—measured from the program's start to its achievement of initial operational capability—by 50 percent compared with the existing average. Another objective was a 20 percent to 50 percent reduction in average unit costs and total ownership costs below historical levels among half of the programs then developing systems, while systems that had been fielded already were to cut their logistics support costs 7 percent by fiscal 2000, 10 percent by FY 2001, and 20 percent by FY 2005. Gansler recognized that the programs would have difficulty achieving these "stretch goals," but he believed even if a program fell short, its attempts to meet the targets would result in saving money and time.[23]

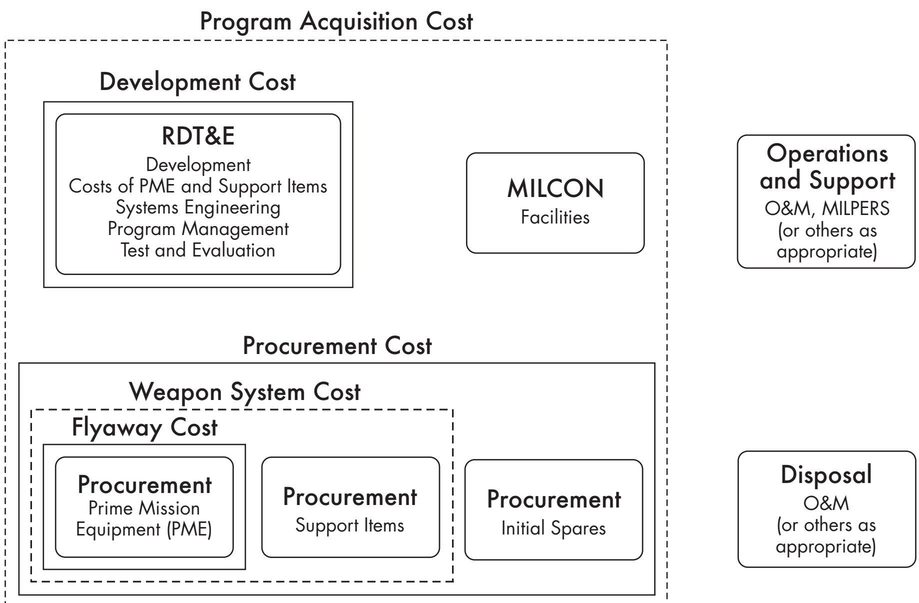


Secretary of Defense William S. Cohen addresses the Defense Department response to the worldwide threat of nuclear, chemical, and biological weapons during a Pentagon press briefing on 25 November 1997. *(NARA)*

REDUCTION OF TOTAL OWNERSHIP COSTS

Of the two top council goals—reducing total ownership costs and cycle times—the former received the most attention initially. The scope of the Reduction of Total Ownership Cost (R-TOC) initiative was ambitious: Determine the cost drivers in a given program—the factors that added expense throughout its life cycle, from program initiation through system disposal—and reduce their impact on cost as much as possible. Gansler defined total ownership cost as the "sum of all financial resources necessary to organize, equip, train, sustain, and operate military forces to meet national goals." In greater detail, Gansler equated total ownership cost with life-cycle cost as defined in Defense Department acquisition guidance: "the TOTAL cost to the Government for a program over its full life, [including] the cost of research and development, investment in mission and support equipment (hardware and software), initial inventories, training, data, facilities, etc., and the operating, support, and, where applicable, demilitarization, detoxification, or long term waste storage [costs]" (see figure 10-3). In addition to developing a better understanding of these life-cycle costs, reformers planned to improve the acquisition system to reduce these costs over a program's lifetime.[24]

Figure 10-3: Life-Cycle Cost Composition for Aircraft



Source: DAU's Program Manager's e-Tool Kit, www.acqnotes.com/Attachments/DAU%20 Program%20Managers%20Toolkit.pdf (Jan 2011), 28.

The effort to control total ownership cost consisted of two parts: cost as an independent variable, or CAIV, and reduction of total ownership cost, or R-TOC. CAIV addressed the issues relating to total ownership cost during the development phase of a program's life cycle. With CAIV, a program office set cost targets and then managed the program to meet those targets, making cost and performance trade-offs that, when conducted during the design process, ideally allowed the program to create an optimal configuration balancing those factors. R-TOC focused on the phases after development, that is, production, deployment, logistics support, modification, and disposal. It sought to reduce in particular the average unit procurement cost and operations and support costs. Of these, the largest costs by far were the costs to operate and support a system. According to one estimate, a system incurred 81 percent of its total ownership cost after it was delivered to the user. Making substantive changes presented the greatest difficulty during this time, compared with the period before the system was delivered to the user, because reengineering and modifying the system cost more once it was built and the budget provided less money for such purposes.[25]

Identifying the sources of ownership costs was a daunting task. Many factors contributed to the expense of operating and maintaining a complex military system, and because the Defense Department expected weapon systems to stay in service for decades, it found many of these "cost drivers" difficult to predict. Moreover, the department had no effective way to determine the drivers of *current* expenses. In April 1997 a PEO/SYSCOM Commanders' Conference concluded that accounting deficiencies represented the main obstacle to driving down operations and support costs: The services did not have any clear notion of how much it cost to operate, maintain, and dispose of a given system, and they had no way to track these expenses with their accounting systems. As but one example of the difficulty involved, the database systems used by the services since the 1980s to track and record historical cost data could say *what* equipment was repaired and *where* but not *why*. Were these repairs routine, or were they unusual? Did recurring repairs represent the same or different problems? How many problems did a given repair deal with? The services had trouble answering such questions systematically. The opacity of operations and support costs may not have been accidental. As the DoD comptroller later noted, in the early 1990s the department did not *want* to know the real costs, and for that matter did not want anyone else to know either. Lacking visibility into the expenditures, DoD could not identify with any certainty what the major cost drivers were, a necessary prerequisite to controlling them. Therefore reduction of total ownership cost focused heavily on overhauling and upgrading existing accounting systems and exploring alternatives.[26]

The division of responsibility among several organizations for the various activities comprising a system's life cycle also caused problems that matched the severity of the accounting challenges. The system's program manager and program executive officer had little responsibility, and no money, for sustaining the system once it was fielded. They therefore had limited incentives to reduce operations and support costs, where achieving savings often required an up-front investment in time and money that would come out of the program's schedule and budget. On the other hand, the logisticians charged with the system's transportation, maintenance, supply of spare parts, and disposal did not generally work with the acquisition community and had little input during the acquisition process.[27]

The Defense Department could address this organizational problem in two ways. The first was to give the program manager increased responsibility for the support of the weapon system beyond its production and deployment, indeed for its entire life cycle, in what was called life-cycle management, or total life-cycle management. By the early 1990s the services had already begun to move in this direction. For example, as early as 1991 the Air Force implemented its integrated weapon system management philosophy, which made the program manager the "single manager" for the life of the system (see chapter XI).

More closely integrating the acquisition and logistics communities was the second potential solution. By 1997 the Defense Department had already begun what it called logistics reinvention, which involved a variety of efforts to reduce costs and bring defense logistics up to commercial standards. The department also initiated efforts to integrate the acquisition and logistics reform programs and communities. The PEO/SYSCOM Commanders' Conference in April 1997 brought together leaders of both communities. Under Secretary Kaminski noted that it "represented a major step towards better cohesion between the acquisition, logistics, and user communities." In pursuit of what it called the "revolution in logistics affairs," the new administration accelerated these efforts to align acquisition and logistics reform. It considered such an alignment especially important for reducing weapon system ownership costs; consequently, DoD decided early to "join R-TOC and logistics reinvention at the hip," according to OSD officials.[28]

OSD worked to promote the integration of acquisition and logistics functions throughout the late 1990s. It included logistics reform activities in the annual Acquisition Reform Week, which in 1999 was renamed Acquisition and Logistics Reform Week. That same year Congress also supported the move to integrate acquisition and logistics by redesignating the under secretary's position as the under secretary of defense for acquisition, technology, and logistics. It also created a new position, the deputy under secretary of defense for logistics and materiel readiness, to give those functions greater organizational stature and visibility. This official took charge of all Defense Department logistics activities and became the principal advisor to the secretary and under secretary in that area. The new deputy under secretary of defense required Senate confirmation, a measure intended to enhance the quality of the nominees for the position and to increase congressional oversight of logistics. Gansler further strengthened the new deputy's office in 2000 by giving it responsibility for all logistics policy and career development in logistics.[29]

The Defense Department began its campaign to reduce total ownership costs with the April 1997 PEO/SYSCOM Commanders' Conference, followed by a life-cycle cost management/reduction off-site meeting in May and the Defense Systems Affordability Council's subsequent formation of task forces to address the issue. The department attacked the problem with enthusiasm, but by the time Gansler arrived at the Pentagon, in November 1997, its efforts had become a chaotic set of parallel and often overlapping service, OSD, and DoD-wide initiatives. The under secretary attempted to bring order to them by appointing Pallas, chairman of the R-TOC Working Group, the focal point for the issue.[30]

Gansler presented two approaches to reducing total ownership costs at the December 1997 meeting of the Defense Systems Affordability Council's executive committee. First, he proposed to establish ambitious goals for reduction of total ownership cost and to assign clear lines of responsibility and accountability. The 1999 *Strategy for Affordability* realized these objectives. Second, Gansler decided to experiment with R-TOC using pilot programs similar to those exploring other aspects of acquisition reform. In January 1998, the DSAC directed each of the military departments to designate 10 programs, for a total of 30 pilots (see table 10-2). The council directed that the pilots include systems in development, production, and operation. Each service was to present the programs selected and their target goals to the DSAC. The pilots would constitute test beds for two aspects of R-TOC, reducing costs for the weapon, platform, and support systems and accelerating the logistics cycle. Gansler insisted that the services not focus their R-TOC efforts exclusively on the pilots but apply them to all acquisition programs. Indeed, he considered the broader efforts more important and applauded the Navy when it announced all of its programs would formulate and implement R-TOC plans.[31]

Gansler, however, found that the other services required prodding. For example, the Air Force R-TOC plans for the first six pilots, presented to the Defense Systems Affordability Council in July 1998, were disappointing. The service projected savings for each program of 1.1 percent to 15 percent—an average of only 8.8 percent—spread over periods ranging from 5 to 22 years. Gansler's deputy, David Oliver, who chaired the meeting, complained that the target reductions and the timelines for achieving them were not aggressive enough and that "greater innovation and guidance were needed from senior Air Force leadership" to make the process improvements necessary to generate the level of savings seen in industry. The Air Force objected to the DSAC's targets—cost reductions for fielded systems of 6 percent by 2000, 10 percent by 2001, and 25 percent by 2005, far greater than the yearly 1 percent reductions called for by the service's most recent annual program guidance. The protest must have had some effect because the DSAC adjusted the targets to increase from 7 percent in 2000 to 20 percent by 2005. These goals were still ambitious, but Gansler insisted that the pilots—and in fact all major acquisition programs—meet or exceed them.[32]

In fall 1998 Congress made Gansler's approach a legislative mandate. Section 816 of the National Defense Authorization Act for FY 1999 required the Defense Department to designate 10 pilots, instead of the 30 requested by the Defense Systems Affordability Council, and to indicate for each the steps that would be taken to ensure the program managers had responsibility for product support of their systems. Gansler accordingly designated 10 of the 30 R-TOC pilot programs as Section 816 pilots that would report to Congress, although all of them would continue to report to the DSAC (see table 10-2).[33]

By this time Gansler was impatient with the slow-moving efforts. He had originally hoped to have the Reduction of Total Ownership Cost initiative fully

Table 10-2: Reduction of Total Ownership Cost Pilot Programs

ARMY	NAVY	AIR FORCE
M1 Abrams Tank System	Aviation Support Equipment	F–16 fighter
AH–64 Apache helicopter	H–60 helicopter	B–1B bomber
Advanced Field Artillery Tactical Data System	Standoff Land Attack Missile–Expanded Response (SLAM–ER)	C–5 airlifter
RAH–66 Comanche helicopter	Common Ship	C/KC–135 tanker
CH–47 helicopter	*Nimitz* (CVN 68)-class aircraft carrier	C–17 airlifter
Guardrail/ Common Sensor	EA–6B Prowler electronic warfare aircraft	F–117 stealth fighter
Heavy Expanded Mobility Tactical Truck	*Ticonderoga* (CG 47)-class Aegis cruiser	Airborne Warning and Control System
M142 High Mobility Artillery Rocket System	*San Antonio* (LPD 17)-class amphibious transport dock	Space-Based Infrared System
Tube-launched, Optically tracked, Wire-guided Missile System–Improved Target Acquisition System	Medium Tactical Vehicle Replacement	E–8 Joint Surveillance and Target Attack Radar System
XM2001 Crusader self-propelled howitzer	Advanced Amphibious Assault Vehicle	Cheyenne Mountain Complex

Note: Shaded area indicates Sec. 816 pilots.

Source: Spiros Pallas and Mike Novak, "Reduction of Total Ownership Cost (R-TOC): Recent History and Future Prospects," *Program Manager* 29, no. 6 (Nov-Dec 2000): 65.

underway by July 1998, but by the beginning of December, the services had not yet named all of the pilot programs. Furthermore, they were still projecting only single-digit reductions over periods of from 7 to 10 years, and few of the savings came from the revamping of logistics support processes. The services were also reluctant to make the up-front investment necessary for R-TOC. Gansler therefore increased the pressure on the services; by the time he delivered his Section 816 report to Congress in February 1999 he had a full slate of pilot programs. He also insisted that each program prepare a Modernization/TOC Reduction Plan that would demonstrate the operations and support savings it would achieve by improving the weapon system's reliability and maintainability, streamlining the logistics to reduce the need for spare parts, and sourcing product support competitively.[34]

Pallas's Total Ownership Cost Working Group took charge of the R-TOC pilots and collected their reduction plans. Starting in August 1999, the program managers met at quarterly gatherings called the R-TOC Pilot Program Forum, where they compared cost-saving ideas and shared problems and concerns. Gansler, Oliver, and the service acquisition executives attended to demonstrate the importance of the effort. Each program manager reported in writing four times a year and presented an oral briefing annually. The briefings and discussions at the forum remained confidential to promote candor, and the gatherings proved to be both popular and useful. Meanwhile, the working group assisted the pilot programs in other ways, by compiling and disseminating the lessons learned, helping to identify barriers to success, organizing panels and discussion groups at conferences, and coordinating the various service and non-DoD activities.[35]

The Defense Systems Affordability Council's actions received strong support from Deputy Defense Secretary John Hamre. In addition to accepting the council's top-level goal of reducing operations and support costs by 20 percent by 2005, the 2001–2005 Defense Planning Guidance directed each service to set aside $200 million per year for up-front R-TOC costs, and the working group monitored the service budgets for compliance. However, OSD also provided money of its own. With the working group's help, the pilot programs identified R-TOC-related costs for which they had no funding, and in December 1999, OSD identified $13 million for FY 2001 and $56.3 million over the course of the Future Years Defense Program. The funding boost was relatively modest, but it demonstrated OSD's commitment to reduction of total ownership cost.[36]

THE SECTION 912 STUDIES

To help bring about the overhaul and restructuring of the acquisition reform program, Gansler took advantage of Section 912 of the National Defense Authorization Act for FY 1998, which directed DoD to make "an examination of the missions, functions, and responsibilities of the various acquisition organizations of the Department of Defense, including the acquisition workforce of the Department." In response to the congressional mandate, Gansler chartered a Defense Science Board task force that would focus particularly on developing reform metrics and reviewing the organization and functions of the department's acquisition system.[37]

In March 1998 the Acquisition Workforce Sub-panel of the Defense Science Board's task force issued a report boldly asserting the need for radical changes in defense acquisition. The sub-panel's recommendations included calls to restructure the department's research, development, and test and evaluation organizations, eliminating any in-house research capability already available in the private sector; outsourcing support activities; adopting price-based, as opposed to cost-based, acquisition; and assigning program managers and program executive officers responsibility for the entire life cycle of weapon systems. The report also recommended redesigning the nature of acquisition work to rely on a smaller, better-trained workforce whose members are "more skilled as managers than as doers, more focused on systems engineering and less on component development, and more capable of making business judgments rather than being guided by rule-based thinking." If implemented, the recommendations would reduce the acquisition workforce and rely much more heavily on industry for a variety of acquisition-related capabilities.[38]

The Defense Science Board's study became the basis of the report that Secretary Cohen submitted to Congress in April 1998 in response to the Section 912 requirement. Entitled *Actions to Accelerate the Movement to the New Workforce Vision*, the Defense Department's report was less far-reaching than the Defense Science Board's study, but nonetheless followed the latter's proposed approach. The DoD report recommended 14 actions in four areas directed toward restructuring RDT&E, restructuring sustainment, increasing acquisition workforce education and training, and adopting integrated paperless acquisition. It also proposed studies in two areas: a price-based approach to acquisition and better integration of test and evaluation with the acquisition process.[39]

The Defense Department's Section 912 report, combined with the activities of the Defense Systems Affordability Council, formed the foundation for Gansler's reform program for the rest of his tenure. Some provisions simply ordered the implementation of measures called for by the Defense Reform Initiative and OSD memoranda, such as completing the transition to paperless business operations. However, most required study, and in the months following the report's submission the under secretary chartered a number of groups—much like the earlier process action teams—to prepare implementation plans. One group focused on streamlining science and technology, engineering, and test and evaluation infrastructure, while another looked at the integration and interoperability of command and control. Three groups addressed workforce issues, including training for service contracting, training for the commercial business environment, and hiring and retaining technically skilled workers and managers. Gansler later chartered a fourth workforce group to lay out a vision for the future, projecting how acquisition organizations would function, what knowledge and skills the workers would require, and the personnel and information management policies that would be affected.[40]

A particularly significant study by one of Gansler's groups presented an alternative to the traditional cost-based approach—requiring potential contractors to reveal their cost data to the government—which had long dissuaded commercial firms from bidding on government contracts. The preferred alternative, price-based acquisition, would allow acquisition managers and contracting officers to procure products and services based on the prevailing price in the commercial marketplace (or a close approximation, if no commercial market for the product existed).

Recommendations in DoD's Section 912 Report to Congress

1. **Restructure Research, Development, and Test**
   - 1.1 Streamline the Science and Technology, Engineering, and Test and Evaluation Infrastructure
   - 1.2 Establish a Joint Command, Control, and Communications (C3) Integrated System Development Process

2. **Restructure Sustainment**
   - 2.1 Reengineer the Product Support Process to Use Best Commercial Practices
   - 2.2 Competitively Source Product Support
   - 2.3 Modernize Through Spares
   - 2.4 Establish Program Manager Oversight of Life-Cycle Support
   - 2.5 Greatly Expand Prime Vendor and Virtual Prime Vendor

3. **Increase Acquisition Workforce Education and Training**
   - 3.1 Establish Training in Contracting for Services
   - 3.2 Institutionalize Continuous Learning for Acquisition Professionals
   - 3.3 Enhance "Commercial Business Environment" Education and Training
   - 3.4 Recruit, Develop, and Retain Technology Leaders
   - 3.5 Identify the Future Acquisition Workforce

4. **Move to Integrated, Paperless Acquisition**
   - 4.1 Achieve Paperless Contracting
   - 4.2 Create a Paperless Integrated Data Environment

5. **Future Focus Areas**
   - 5.1 Price-Based Approach to Acquisition
   - 5.2 Integrated Test and Evaluation[II]

The Defense Department had already taken important steps toward eliminating the requirement for contractors to reveal their costs. Contracting agencies were increasingly using the authority they had been granted to issue waivers for that purpose. Yet implementing priced-based acquisition presented challenges. Limited competition in the defense marketplace made it difficult for government purchasers and source-selection boards to determine a fair price for goods and services. Even when contracting officers had the authority to accept bids based solely on price, they lacked training in accepting bids of that kind. The Defense Department's Section 912 report to Congress had called price-based acquisition a "future focus area," because no previous study had been able to make any specific recommendation on the subject. Nonetheless, the concept was considered to be one of the most important for integrating defense-oriented with commercially oriented industry, and the department made attempts to deal with it, most notably the Price-Based Acquisition Study Group in 1999, which, however, failed to reach agreement on the concept and could not find a path to implementation.[41]

One of the Section 912 reports, a study of ways to train workers how to operate in a more commercial environment, led to an experiment in "change management." The study group examined some new ideas emanating from the business world regarding the process of change, all based on the concept of teaming and on the communications and knowledge management capabilities of computer networks and databases. The basic idea was to accelerate change through an "enterprise change model." This model included rapid improvement teams (RITs) as the agents for planning reforms. An RIT was an ad hoc organization, similar to a process action team or a tiger team, but with a much shorter life span, usually under 90 days. William Mounts of OSD's acquisition reform office likened the RIT process "to 'rapid group mediation,' whereby you lock people in a room for 3 days and they come out with a solution." Trained facilitators would assist the group's discussions. Such teams would conduct a Rapid Improvement Process Campaign, in which they would follow a standard process to deal with any problem or assigned task. By the time the Commercial Business Environment study group reported in October 1999, the concept was already sweeping through the Defense Department. By one count, 100 such campaigns were conducted during 11 months in 2000 alone. For example, the Performance-Based Services Acquisition RIT was given 90 days to prepare a strategic plan outlining goals, training strategy, and reporting requirements for that approach. The model also included a "change management center," an in-house organization to plan, implement, and oversee a continuous process of change. In industry, the change management center was a repository for knowledge relating to the business as well as to the process of reengineering it. Deputy Under Secretary for Acquisition Reform Soloway established a DoD change management center at the Defense Acquisition University under Mounts's leadership in December 1999.[42]

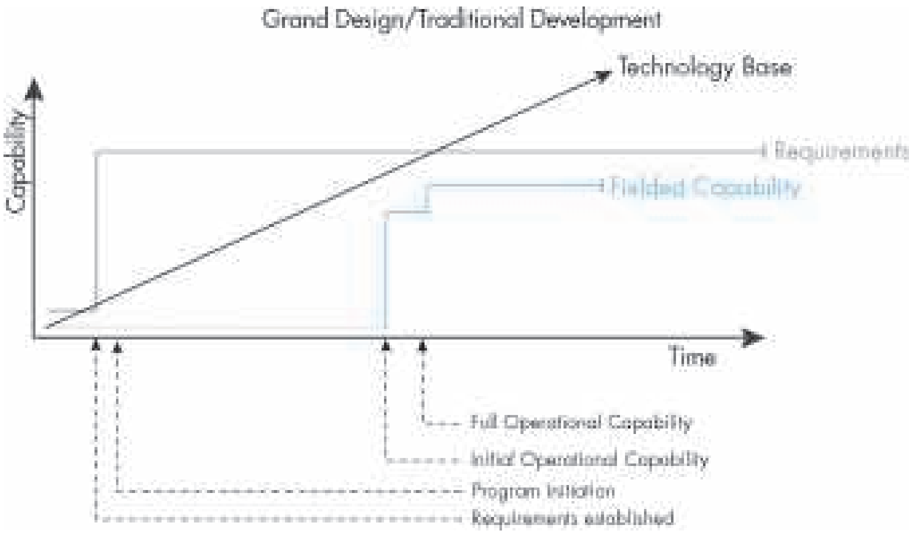
THE RISE OF ALTERNATIVE ACQUISITION APPROACHES

Of all the Section 912 studies, the most significant was an examination of whether the requirements generation system was adequate to fulfill the Defense Department's current and future acquisition needs. Issued in November 1998, the charter for the study acknowledged that the requirements and acquisition processes were closely linked, and improving both required the active cooperation of their respective communities. Gansler and General Joseph W. Ralston, the JCS vice chairman, cosigned the charter and chaired its oversight group, a sign of the importance they placed on the effort. The Requirements and Acquisition Study focused on three main issues: reducing the length of system development cycles, promoting interoperability among the systems acquired by the services, and ensuring that requirements writers considered cost when preparing requirements documents. The group also studied ways for the services to coordinate their requirements generation efforts and to provide common training in the requirements and acquisition processes for the personnel of both communities in all of the services.[43]

For Gansler, the most important issue covered in the study was the reduction of acquisition cycle times. There was increasing evidence that long development times led to increased costs, greater programmatic risk, and a growing likelihood a system would be obsolescent by the time it was fielded. In 1994 Secretary Perry had challenged the services to reduce cycle times 50 percent by 2000, but did not follow up. His acquisition reform program emphasized cutting costs, not development cycles. Long familiar with the cycle time problem, Gansler tackled it with a more sustained effort. He made it the second priority for the DSAC, just behind the reduction of total ownership costs, and appointed an OSD-led Acquisition Cycle Time Reduction Task Force to address it.[44]

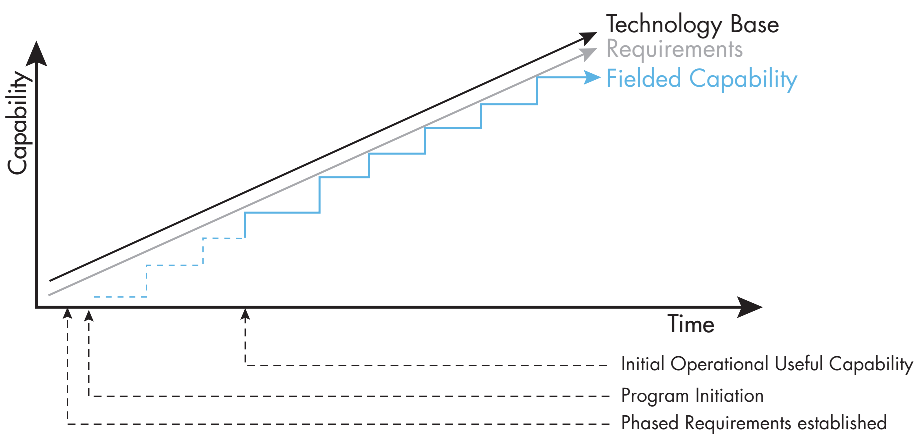
When he came to office in 1997, Gansler already had a solution for the cycle time problem: evolutionary acquisition. As related in chapter IX, evolutionary acquisition had emerged during the 1970s and early 1980s as a means of developing information systems with uncertain or fluctuating requirements, especially command and control systems. Following this approach, a system would be developed in a series of increments starting with a "core" that had a reduced capability, compared to the potential of the completed system, but also carried a much lower development risk. Through each increment—which would be programmed and budgeted as if a separate program—the developers, testers, and users would work closely together to refine the requirements and decide on the direction of future increments. The incremental approach addressed not only the problem of technological risk but also that of long cycle times by enabling new capabilities to be fielded in shorter development cycles. Command and control systems developers and users, as represented by the Joint Staff, the Joint Logistics Commanders, and the assistant secretary of defense for C3I, backed the approach enthusiastically, as did the Defense Systems Management College, which had earlier helped refine and publicize the concept. OSD was persuaded to include evolutionary acquisition in the 1991 revision of the 5000 series documents as an "alternative strategy" that was "well suited to high technology and software intensive programs."[45]

Figure 10-4: Evolutionary Acquisition vs. Grand Design



In the traditional grand design (or "single-step-to-full-capability") approach, the final requirements for a new capability were established at the outset, often well beyond the technological state of the art. The high technological risk often led to long delays in completing the development and capabilities that did not fully meet the requirements. No interim capability was fielded until the system was finished.

Evolutionary Acquisition ⟶ Incremental Deliveries



Evolutionary acquisition was intended to address technological risk by defining time-phased increments and developing new capability in smaller increments, allowing shorter development cycles and more frequent fielding of usable capability.

Source: Illustrations adapted from Denis Catalano, "DoD 5000 Rewrite," briefing, 4 Apr 2000, copy in author files, OSD/HO.

Until the mid-1990s interest in evolutionary acquisition was still largely confined to the information technology community. As late as 1996, the newly revised 5000 series documents made only a brief mention of it. However, by that time some evolutionary acquisition advocates were considering how it might be applied to the development of all major systems, not just command and control or other information technology systems. The traditional grand design approach to acquisition—choose a complete design at or beyond the technological state of the art and then seek to achieve that design in one jump—seemed to be less effective for developing increasingly complex systems, and it provided no escape route from technological dead ends short of abandoning the system. Furthermore, given the dependence of weapons on computers, software, and other information technologies, the distinction between an information system and any other was shrinking, and the processes for developing each were converging. The Joint Logistics Commanders—who had played an important role in refining and promoting evolutionary acquisition during the previous decade—took the lead in encouraging its use in major weapon system programs.

In 1995 the Joint Logistics Commanders again commissioned the Defense Systems Management College to publish a new guide to evolutionary acquisition. Like the original 1987 version, the document did not include new policies but explained how the evolutionary acquisition process would work, should a program manager want to try it. The Joint Logistics Commanders argued that changes in the post–Cold War strategic and economic environment called for the use of an evolutionary methodology because of uncertainties in requirements and the great expense of the traditional approach. The guide defined evolutionary acquisition as a "strategy for use when it is anticipated that achieving the desired overall capability will require the system to evolve during development, manufacture or deployment." The program would first field a well-defined core capability and then incorporate upgrades in increments. Close interaction among the developers and users would provide the feedback necessary to refine the requirements and reduce the risk. Thus the Joint Logistics Commanders and the Defense Systems Management College envisioned applying the evolutionary methodology used in developing command and control systems to other systems.[46]

The guide, published by the Joint Logistics Commanders and the Defense Systems Management College in 1995, still treated evolutionary acquisition as an alternative acquisition approach to be used under certain conditions. The National Center for Advanced Technologies (NCAT) did not. A nonprofit research and development center formed in 1989 by the Aerospace Industries Association to guide the development of key technologies, NCAT helped the Defense Department refine reform concepts such as cost as an independent variable and integrated product and process development. Under Secretary Kaminski asked the center to comment on the existing 5000 series documents prior to their revision. In April 1996 the National Center for Advanced Technologies issued a white paper setting out what it called Evolutionary Defense Acquisition, under which defense systems would be developed with an initial set of "threshold" requirements and then upgraded incrementally with five-year development cycles. The paper recommended the application of evolutionary acquisition to weapons development generally, not just to information systems. The NCAT concept would replace the existing acquisition milestones and phases with "an affordable, incremental approach." Although issued too late to influence the new 5000 series documents, published the previous month, the white paper was incorporated into an official digital reference source, the Defense Acquisition Deskbook (see chapters VII and XV). In 1997 Kaminski endorsed evolutionary acquisition and encouraged program managers to apply it.[47]

A year later, in June 1998, the Defense Systems Management College reissued the Joint Logistics Commanders guide, with a new preface urging that evolutionary acquisition become the preferred alternative approach: "The EA [evolutionary acquisition] concept is no longer simply a viable optional methodology for acquiring new weapon systems. . . . As current events clearly demonstrate, it is perhaps the *only mechanism available* to achieve and maintain weapon superiority given the rapid pace of technology change and changes in U.S. and world economic and political conditions." The preface concluded, "We again strongly recommend the use of the EA methodology, as the *primary alternative* rather than as one of a number of secondary acquisition alternatives."[48]

A second alternative approach to systems acquisition was preplanned product improvement (P3I), also called incremental development during and after the 1990s. It appeared at about the same time as evolutionary acquisition but had developed independently and in a different context. Under pressure from tight Defense budgets and Soviet technological competition in the late 1970s, the aerospace community tried to make upgrading a more cost-effective alternative to developing a new system from scratch. The basic idea was to incorporate the capacity for upgrade into the aircraft's design from the start. Contemporary practice had usually shoehorned custom-made subsystems into the airframe to create a tight, efficient, but almost unalterable design. In contrast, P3I first established an architecture for the aircraft, allowing engineers to swap modular subsystems with standardized interfaces. Thus the program used existing or low-risk subsystems so that system development could proceed independently of the development of high-risk, leading-edge subsystems, the failure of which could delay or kill the whole program.[49]

Because it held out the promise of reducing system development costs and cycle times, preplanned product improvement found ready acceptance among DoD leaders and outside observers. The methodology held a prominent place in the Carlucci Initiatives, the Acquisition Improvement Program of 1981. As then required by OSD, the services designated a few programs to adopt it. One successful early use of P3I was the Air Force's F–16 fighter program, which retrofitted the aircraft with modular spaces and standard interfaces that greatly reduced the time and expense required for subsequent upgrades.[50]

But by and large, preplanned product improvement, like evolutionary acquisition, was slow to gain acceptance among program managers. Some were confused by the similarity between preplanned product improvement and evolutionary acquisition. In 1991 OSD presented a workable distinction between the two approaches in its revision of DoD Instruction 5000.2, which recommended the use of evolutionary acquisition when the final requirements were unknown or could not be defined in advance. P3I would be used when the final requirements were known but the service wished to field a less capable system quickly while it deferred incorporating high-risk technologies to a parallel or subsequent development effort.[51]

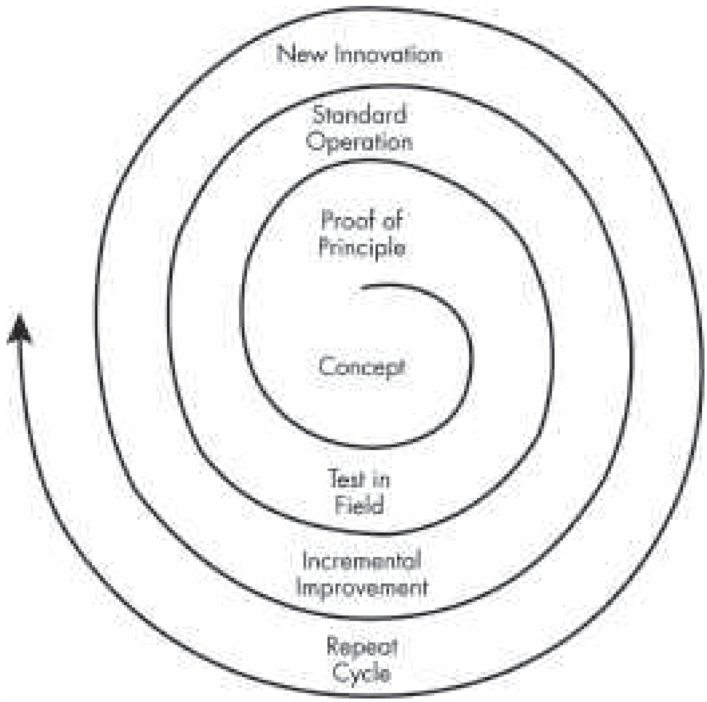
A more significant obstacle to the use of preplanned product improvement existed—program managers who balked at investing the additional time and expense needed to design and build a system for upgrades that might never occur. For this reason, the concept changed, with future upgrades being planned at the time the program was drawn up, with funding identified and included. This somewhat defeated one of P3I's main advantages—to permit the program to take advantage of unexpected opportunities. Yet even this concession did not allay the fears of program managers who reasoned that the funding anticipated for the upgrades might be delayed or never come through. Therefore, when caught in a budget pinch, program managers often deleted the provisions for future growth. Finally, preplanned product improvement required a significant cultural change in the approach to system design. Requirements writers had to develop a vision of future requirements and accept a more limited initial capability in the core system; contracting officers had to incorporate the requirements for future upgrades in solicitations and contracts; and program managers and industry engineers had to follow through on those requirements.[53]

There was a third alternative approach for acquisition, albeit one not officially recognized in the 5000 series documents until 2003: spiral development. As described in chapter IX, the history of spiral development paralleled that of evolutionary acquisition. Both began as models for computer development that moved into the mainstream of acquisition. Devised in the mid-1980s as a software life-cycle process model to reduce the risk in developing complex software programs, the spiral development model involved iterated steps allowing for regular reviews by all of the program's stakeholders—overseers, developers, testers, buyers, users—so that at every step they could study results, formulate plans for the next cycle, and evaluate the risks before agreeing to proceed. Stakeholder involvement was intended to help ensure that the program was proceeding satisfactorily, without any hidden surprises, and that the users knew exactly what they were getting. During the 1990s spiral development became more popular as the need for an iterative life-cycle model for software became widely recognized.

By the middle of the decade the concept of the spiral began to spill over from the realm of software to other arenas. The spiral provided a compelling visual image. It suggested an iterative, feedback-driven approach to change that was particularly appealing to an organization contemplating an evolution toward a desired goal, whether acquisition of a weapon system or transition to new processes. Not surprisingly, one of the first appearances of the spiral as a model for change in the Defense Department came in a white paper issued in 1994 by the assistant secretary of defense for command, control, communications, and intelligence, who oversaw acquisition of systems especially dependent on information technology.[53] (Figure 10-5 illustrates the first of what would be a series of spiral cycles in the development of a system.)

The idea of the spiral spread quickly in the services. In 1995 the Navy used it to describe some of its acquisition reform processes. The Army later adapted the spiral

Figure 10-5: Spiral Model for Development in the Department of Defense, 1994

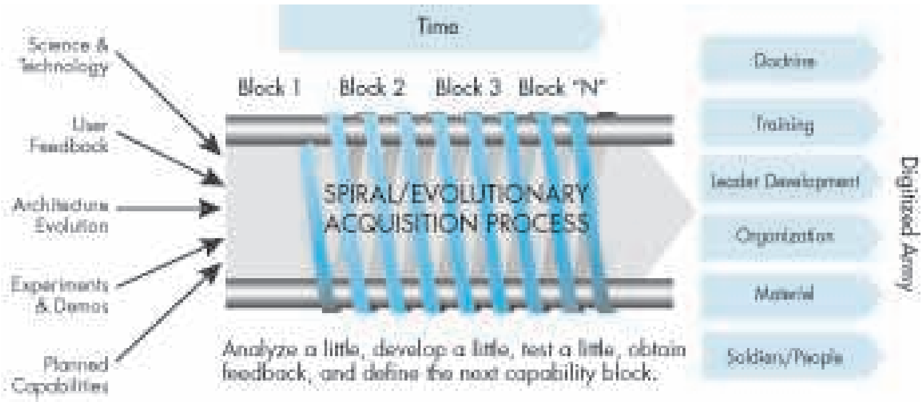


Source: Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), *The DoD Enterprise Model*, vol. 2: *Using the DoD Enterprise Model—A Strategic View of Change in DoD* (Washington, DC: DoD, Jan 1994), 62.

concept to its Force XXI experiments (see figure 10-6 and chapter XII). Force XXI's materiel development efforts involved creating equipment prototypes that users tested and that were then quickly modified according to the results, a process sometimes referred to as "build a little, test a little." The Army initially referred to a "rolling baseline concept," in which successful technology experiments were a starting point for further development. In 1996 Lt. Gen. Otto J. Guenther, the Army's director of information systems for command, control, communications, and computers, was introduced to the "iterative, recursive, spiral development process" during a visit to the U.S. Military Academy at West Point. Within a year the rolling baseline nomenclature had evolved into the term "spiral development process." By 1998 the Army liked the name so much it broadened the term's meaning to describe its approach to developing technology, doctrine, and training simultaneously.[54]

Of the services, the Air Force pursued the idea of spiral development the most seriously. The first organization to adopt the approach was the Electronic Systems Center (ESC) at Hanscom Air Force Base, Massachusetts, which developed hardware and software for aircraft avionics, command and control systems, and other information technologies. During a major reorganization in 1997, ESC commander Lt. Gen.

Figure 10-6: Spiral Development in the Army, ca. 2000



Source: Adapted from Stan Levine, "Implementing System of Systems in a Spiral Development/ Evolutionary Acquisition Environment" (briefing, CMU/SEI Spiral Development Workshop, Washington, DC, 13 Sep 2000), https://web.archive.org/web/20060907120415/http://www.sei.cmu.edu/cbs/spiral2000/september/Levine/index.htm.

Ronald T. Kadish announced that spiral development could deliver the initial system in 18 months, matching the shorter development cycles of commercial technology, by using off-the-shelf products and by incorporating feedback throughout the design process from users who would also develop operating concepts. Subsequent spirals, also lasting 18 months or less, would add functionality and upgraded components, until the user was satisfied with the system. During this process, the system was not expected to be fielded until development was complete. The Electronic Systems Center had used this approach on specific projects, but for the first time it became standard procedure and the center helped to popularize the concept.[55]

The Air Force applied the spiral concept to its annual expeditionary force experiment (EFX), an exercise designed to measure the impact of information technology on the service's tactics and capabilities. The Electronic Systems Center used a variation of its spiral process in a series of initiatives to prepare for the first, EFX '98, to be held at Eglin Air Force Base, Florida, in September that year. Beginning in April, the command conducted four "spirals" that tested its Theater Battle Management Core System and software modules that were developed and integrated during the course of the year. The final version was tested successfully during EFX '98.[56]

An Air Force officer summarized spiral development as practiced by ESC:

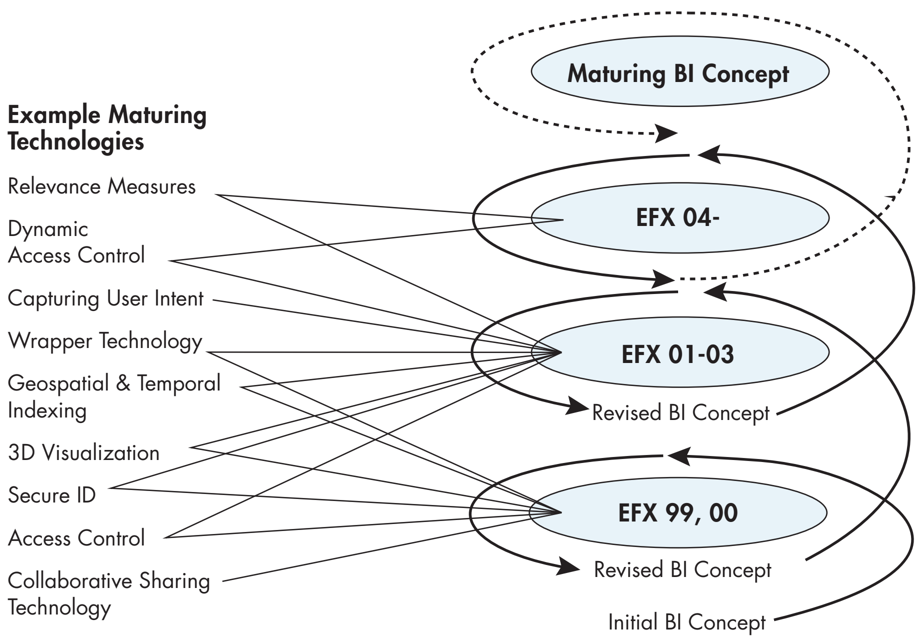
> The process begins with an idea, from [technology demonstrations] . . . or within the formal acquisition process. From here, the developer, tester and end user begin a process of assessments, both technical and operational. A series of test [*sic*] validate the concept's technical ability and operational capability. Once an idea is ready for application, it is integrated into an experiment that links it with other systems and stress tests it in an operational environment. After a period of maturing, hardening, integration, and training, the developed concept is implemented into warfighting exercises and fielded to the warfighters.

The Air Force Scientific Advisory Board liked the center's spiral development methodology so much that in December it recommended that future experiments use it to develop concepts and doctrine as well as technology (see figure 10-7).[57]

Despite its appeal, there was considerable confusion about the meaning of spiral development. The 1991 revision of the 5000 series documents had made a sensible distinction between evolutionary acquisition and preplanned product improvement, but until the end of the decade OSD did not give serious thought to defining spiral development. The Army, Air Force, and other organizations both inside and outside the Defense Department developed their own spiral development concepts and applied them in their own way. Even information technologists were uncertain what constituted spiral development or how it should be practiced. They did agree, however, that spiral development was primarily intended to reduce risk, not to field products quickly. Others in the acquisition community saw spirals as a means to rapid acquisition through incremental fielding.[58]

Furthermore, the similarities between evolutionary acquisition and spiral development likely increased the confusion. Kadish and others referred to the approach as "evolutionary spiral development," and the Air Force's Scientific Advisory

Figure 10-7: Spiral Development as Applied to the Air Force Expeditionary Force Experiments



BI – Battlespace InfoSphere

Source: U.S. Air Force Scientific Advisory Board, *Report on Information Management to Support the Warrior*, SAB-TR-98-02 (n.p., Dec 1998), 68.

Board called it "spiral technology evolution." The Air Force distinguished the two by describing evolutionary acquisition as an overall strategy that incrementally improved a core capability and spiral development as an engineering process to be used within each increment. This distinction, which OSD would codify in 2003, was lost on some practitioners. To eliminate confusion, in 2008 OSD banned the use of the term spiral development in any but the narrowest technical context.[59]

The real problem, however, was not the terminology but the difficulty in putting alternative acquisition methodologies into practice, particularly evolutionary acquisition and spiral development. The concepts had originally been devised by particular communities to develop particular technologies. Only preplanned product improvement had been intended for major systems such as aircraft. Evolutionary acquisition had been devised specifically to develop command and control systems, while spiral development was for software. During the 1990s these approaches had been lifted out of their native environments and applied to acquisition more broadly, increasing the probability that using them would encounter significant additional obstacles.

The structure and workings of the entire acquisition system—the laws, regulations, organizations, and practices—were geared toward the traditional grand design strategy that had been followed for almost half a century. Evolutionary approaches required changes not only in the procedures for technical development but also in requirements formulation, programming and budgeting, contracting, testing, and oversight. At root, the traditional system was based on certainty:

Figure 10-8: DoD Instruction 5000.02

"Spirals" are out. "Spiral Development" is an engineering term that will continue to be used for software development. However, using it as a "strategy" term caused problems.

—Defense Acquisition University briefing

Source: Illustration and quote from Salvatore "Sam" Fazio, "DoD Instruction 5000.02, 8 Dec 2008," briefing, 20–21 Apr 2009, slide 9 with notes, www.mvac-ohio.org/docs/DoD_5000_update.ppt.

Costs, schedules, and system performance could be stated definitively and precisely. Evolutionary approaches were by definition based on uncertainty. They assumed the requirements were unknown or would change over time, the pace and direction of technological development were not entirely predictable, and no one could determine exactly how long a development effort would last. The uncertainty created challenges for the participants in the acquisition process. Testers, for example, worried that test criteria were moving targets; end users feared that future increments would never be funded, leaving them with a reduced capability; and legislators suspected that the Pentagon would use evolutionary approaches to understate long-term costs, hide performance shortfalls, and bypass congressional authority over funding decisions. Evolutionary methodologies could struggle in such an environment. They required effective teamwork, open communication, active stakeholder involvement, and trust—all of which tended to be in short supply. And if the decades spent trying to reform the acquisition system had revealed anything, it was the tremendous difficulty in changing the culture of defense acquisition to foster the characteristics essential for evolutionary approaches to work.

EVOLUTIONARY ACQUISITION BECOMES POLICY

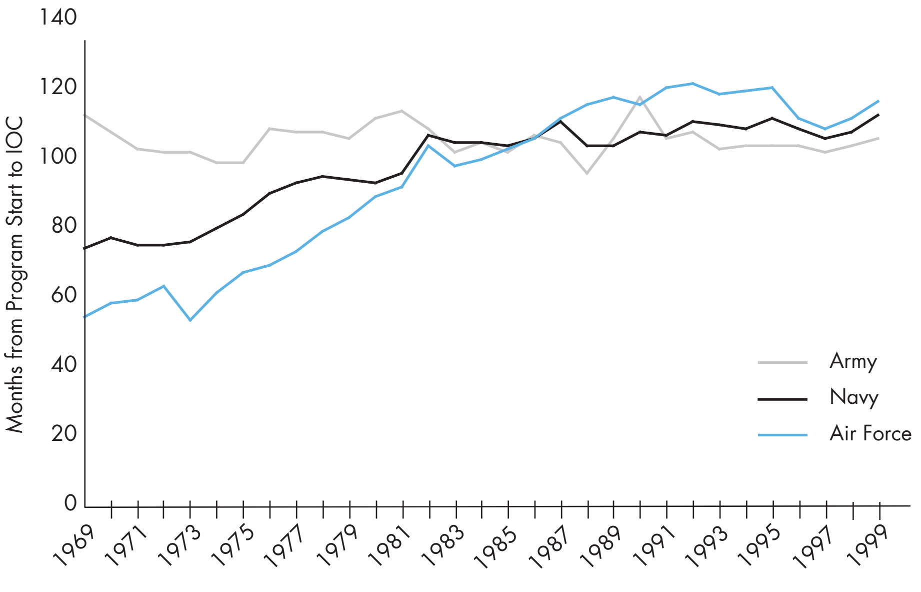
Gansler had been exposed to evolutionary acquisition early and supported the idea for major systems when he became under secretary in 1997. At his confirmation hearing, he said he intended to use the lessons learned from the advanced concept technology demonstrations "to establish an evolutionary acquisition process, using demonstrated technology, as the normal way of acquiring systems in order to significantly reduce cycle time." He made the consideration of evolutionary acquisition an explicit goal of two Section 912 studies, most importantly the one on requirements generation, because the success of an evolutionary approach depended heavily on having "time-phased" requirements that evolved with the projected threat.[60]

By 1999 the results of those studies began coming in. The DSAC's Acquisition Cycle Time Reduction Task Force and the Section 912 Requirements and Acquisition study group both recommended adopting evolutionary acquisition as the "preferred" (as opposed to just an alternative) acquisition strategy. They also advocated greater use of advanced concept technology demonstration-like prototypes, with special funding allocated to help the most promising make the difficult transition from development to production. The DSAC agreed "in principle" that Defense Department policy should treat evolutionary acquisition as the normal approach to systems acquisition. On 9 July Gansler ordered the implementation of the Requirements and Acquisition study group's recommendations, including the adoption of evolutionary acquisition, "within four months." He also directed several actions to reduce cycle time and noted that the JCS vice chairman would require each service to express future military requirements in a "time-phased manner." Formulating requirements in this way was essential to adopting an incremental approach to system development.[61]

In fact, the Air Force was ahead of OSD in thinking seriously about cycle time reduction. Service leaders were becoming alarmed about the lengthening development cycles of their programs, of which the F–22 fighter (in development since the mid-1980s, based on a requirement formulated in 1981) was but one example. The Air Force had special cause to worry, as its cycle times had grown much faster than those of the other services. By one estimate, since the 1970s the average development cycle for a major Air Force system had doubled, to more than 11 years by 2001.[62]

In March 1996 Art Money, who became the assistant secretary of the Air Force for acquisition at the beginning of the year, established a new reform initiative charging the service's acquisition community with finding ways to reduce cycle times by 50 percent. However, the scope of the effort was soon limited to reducing the time required to award contracts. This eliminated the need to consider factors such as requirements that lay beyond the control of acquisition personnel, but it also prevented them from examining some of the main sources of the problem. In September 1997 officials of the key Air Force acquisition organizations agreed to deal directly with the cycle time issue. The high-level Cycle Time Reduction Tiger Team presented a plan the following May advocating evolutionary acquisition as part of the solution. Soon after, several "reinvention teams" set about putting the plan into action: one to help create a practicable process for evolutionary acquisition, another to study the requirements process, a third to develop incentives for contractors and program offices to reduce cycle times, and a fourth to find tools to help government and industry program managers plan shorter schedules. In September 1999 the Evolutionary Acquisition Reinvention Team produced the first draft of the *Air Force*

Figure 10-9: Average Acquisition Cycle Times for Major Programs
(from Program Start to Initial Operational Capability)



Source: Adapted from Ross McNutt, "The Air Force Cycle Time Reduction Program: Creating a Fast and Responsive Acquisition System," briefing, 1 Sep 2000, http://web.archive.org/web/20010506010831/http://www.safaq.hq.af.mil/acq_ref/cycletime/briefings/ReducingAFProdDevTime40901.ppt. Data is from OSD database.

Evolutionary Acquisition Guide, a significant attempt to work out the practical details for adapting the concept to the development of major systems and to teach them to program personnel.[63]

Both the Air Force and the DSAC cycle time reduction teams benefited from research by an energetic Air Force officer, Ross T. McNutt, who had become the service's expert on the subject. As a doctoral candidate at MIT from 1994 to 1998, the young captain performed groundbreaking research for the Lean Aircraft Initiative, a government-industry-academia consortium that worked toward improving productivity and affordability in the defense aircraft industry. Previously there had been little substantive data to indicate why schedules were so long and getting longer. There was little information on how a program schedule was put together in the first place—few programs documented the process. With the help of the MIT faculty, McNutt surveyed program offices, contractors, and the Pentagon to understand the scheduling process. He discovered that schedules were developed largely according to financial, not technical, considerations—primarily the projected size of the budget; that there were no incentives to create shorter schedules, nor were there any to shorten a project's schedule once it had begun; and that three-quarters of schedule slips were caused by funding instability and requirements changes, while only one quarter were due to technical problems. Furthermore, program managers gave schedule a much lower priority than cost and performance. Therefore, if a program ran into trouble in any of those areas, the schedule was the first to be abandoned.[64]

In early 1998 McNutt presented this information and recommendations from the Lean Aircraft Initiative team to OSD's Acquisition Cycle Time Reduction Task Force, the Air Force's Cycle Time Reduction Tiger Team, and the DSAC. By this time McNutt was coleader of the Air Force team and the Air Force representative on the Defense Department task force. Awarded his doctorate at the end of the year, McNutt, now a major, took charge of the tiger team and then the new Air Force Cycle Time Reduction Program at Air Force headquarters. He worked to raise awareness of the issue—not everyone in the Air Force or elsewhere in the Defense Department believed that the increasing length of cycle times was a real problem—and he gave many presentations on the subject at workshops and conferences.[65]

The Cycle Time Reduction Program did not focus solely on increasing the use of evolutionary acquisition and spiral development. It also performed other activities to identify, analyze, and remove obstacles to reducing cycle times. As an example, after a couple of rounds of expeditionary force experiments, Air Force leaders realized they struggled to procure the technologies that the Electronic Systems Center's spiral development was able to create in short order. A proposed acquisition program had to pass through at least 24 separate reviews within the Pentagon before it could start, a process requiring a minimum of two to five years. In November 1999, at one of their thrice-yearly meetings, called Corona Conferences, senior Air Force leaders established a task force to "develop a method to quickly initiate and fund projects that result from spiral development, warfighter experiments, and other sources to improve AF systems and programs." Corona approved three ideas proposed by the task force: a modification of the Rapid Response Process the service had developed in Operations

Air Force Major Ross T. McNutt. *(Courtesy of Ross McNutt)*

Desert Shield and Desert Storm, for urgent needs; a flexible preplanned product improvement program that would use an evolutionary approach to allow existing programs to apply new technologies quickly in block upgrades; and a Warfighter Rapid Acquisition Program, modeled on an Army program with a similar name (see chapter XII), to streamline the development of new systems and apply the new lessons learned to them.[66]

McNutt and his staff worked closely with the DSAC team. They agreed evolutionary acquisition should be adopted. Air Force leaders, although convinced of evolutionary acquisition's importance, were aware of the difficulties in implementing such a radical concept and thought it a mistake to jump into it too quickly. In his late August response to Gansler's early July 1999 memorandum mandating the application of evolutionary acquisition, General Lester L. Lyles, the Air Force vice chief of staff, reiterated the Air Force position that while, in principle, evolutionary acquisition should become the primary acquisition approach, "we strongly recommend focusing first on the development of EA doctrine and methodologies prior to adoption of policy advocating its preferred use." Despite his go-slower admonition, Lyles had already initiated action to incorporate the new policy into DoD's guidance.[67]

Gansler wanted to press forward rapidly. He was also ready to issue a new set of 5000 series documents encapsulating the reforms and other changes he had made in the acquisition system since taking office. The current policy seemed too limiting. It treated advanced concept technology demonstrations and evolutionary approaches as nontraditional excursions. Although the policy approved adapting evolutionary acquisition to programs, it did not explain how that should occur. Nor did it specify how to accelerate entry of demonstration programs into the acquisition system.[68]

In August 1999 Gansler directed the Defense Acquisition Policy Steering Group, a senior-level committee created by his predecessor, to review and execute proposed revisions to the 5000 series documents and to organize a working group to begin a review of DoD Directive 5000.1, DoD Regulation 5000.2-R, and other relevant policy documents. Gansler set an ambitious schedule, calling for the revisions to be ready for his signature by February 2000, in time for the budget hearings on Capitol Hill.[69]

The goals of the new acquisition policy were to field systems faster, reduce total ownership costs, and provide a more flexible process that focused on greater interoperability, supportability, and affordability. The reduction of development cycle times was accorded top priority. The acquisition system was to adopt a more commercial style and use flexible, streamlined procedures, as recommended in the Section 912 studies, the simulation-based acquisition initiatives, and reports by other organizations, including the Defense Science Board and the General Accounting Office. As Gansler had directed, the policy guidance emphasized the following:

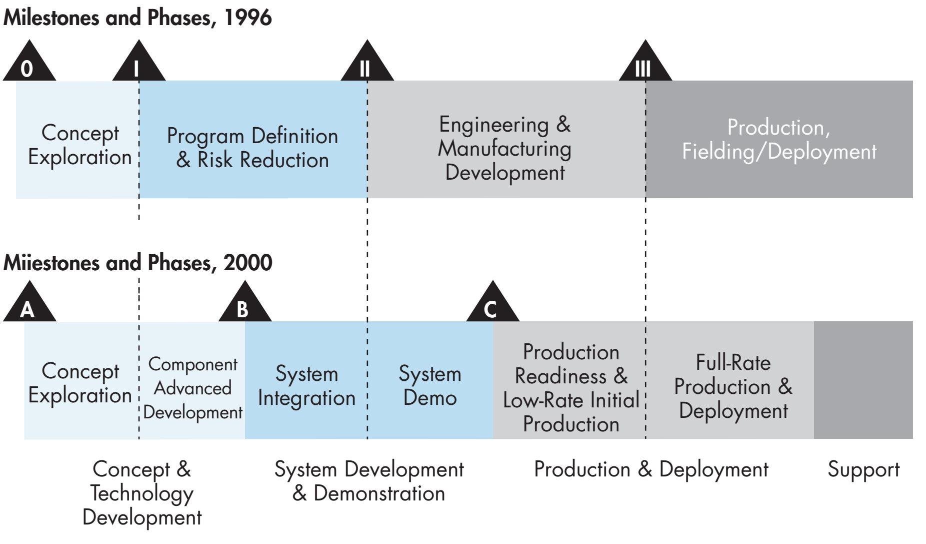
- Rapid acquisition with demonstrated technology
- Time-phased requirements and evolutionary development
- The integration of acquisition and logistics
- Integrated test and evaluation
- Interoperability
- Cost as a requirement that drives design, procurement, and support
- Increased competition[70]

The review looked closely at the milestones and phases of the acquisition model. The old model appeared too rigid. Programs had essentially one way to enter the process and then moved along a standard route, unless they followed a nontraditional path, which was discouraged. The working group completely overhauled the process, as Gansler wished. It revamped the milestone structure (see figure 10-10), reducing the number of milestones from four (0, I, II, and III) to three. The under secretary himself scrapped the traditional Roman numerals and redesignated them A, B, and C. Milestone A (Analysis) was the gateway for the Concept and Technology Development Phase, Milestone B (Begin) for the System Development and Demonstration Phase, and C (Commitment) for low-rate production. Each phase was divided into two (e.g., Milestone B included System Integration and System Demonstration). The program passed from one phase to the next after undergoing an interim progress review by the milestone decision authority, the DoD official with the authority to approve a program's entry into the next phase. Programs could enter the system at any point, depending on the maturity of the technology, in an attempt to get promising new technologies, especially commercial products, into the field quickly. The new documents made few changes to organization, documentation, reporting, and the integrated product team oversight structure. The major changes were the reorganized milestones and phases, the emphasis on cycle time reduction, the use of technology readiness levels (a scale developed by NASA for describing a technology's maturity), and the implementation of evolutionary acquisition.[71]

Evolutionary acquisition was a critical part of the new policy, but, as the Air Force, the Defense Systems Affordability Council, and others pointed out, the details had not been fully worked out. Gansler sought help in doing this. Both the spring and fall meetings of the PEO/SYSCOM Commanders' Conference in 2000 considered and commented on the issues (see figure 10-11). Also that fall, the Software Engineering Institute hosted a conference that focused on evolutionary acquisition and its relationship to the spiral process. The conference highlighted the obstacles the Defense Department faced in attempting to implement the concept. However, by that point the new policy documents were only weeks away from being released. Evolutionary acquisition was about to become policy.[72]

The process of obtaining agreement in the Department of Defense delayed the release of the new documents well past Gansler's ambitious February 2000 deadline into the fall. The old Directive 5000.1 and Regulation 5000.2-R were canceled to make way for a new Directive 5000.1 and revived Instruction 5000.2. The Defense Acquisition Policy Steering Group planned to issue three documents: Directive 5000.1, a statement of basic principles, based on the results of the 912 studies; Instruction 5000.2, a detailed explanation of the new milestone process; and Regulation 5000.2-R, which would include forms and procedures. After going through several

Figure 10-10: Comparison of 1996 and 2000 Milestones and Phases



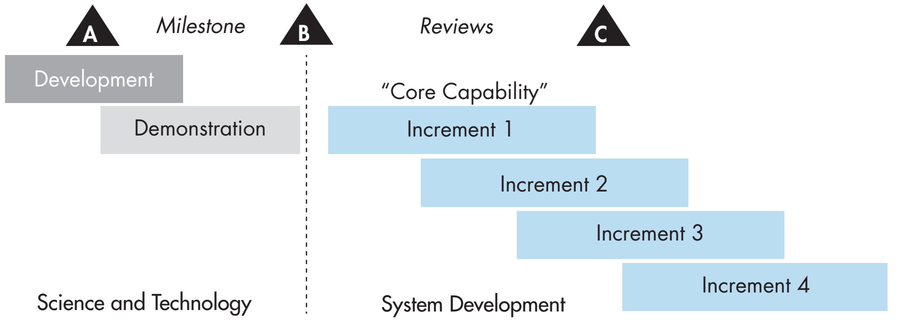
Sources: Adapted from Breakout Group 2, "The Evolutionary Development Process" (briefing, PEO/SYSCOM Commanders' Conference, 4 Apr 2000), http://web.archive.org/web/20011127094123/http://www.acq.osd.mil/dsac/peosyscpresents/bog2/5000briefing.ppt, and Richard Sylvester, "The New DoD Systems Acquisition Process," briefing, 26 Oct 2000, https://web.archive.org/web/20001109160000/http://www.acq.osd.mil/ar/doc/5000rewritebrief.pdf.

drafts, Directive 5000.1 and Instruction 5000.2 were signed on 23 October 2000. Regulation 5000.2-R was not ready, so the old version was hastily edited and released as interim guidance. On 4 January 2001 Gansler reissued Directive 5000.1 and Instruction 5000.2 with additional changes. The new 5000.2-R was still not ready, so he substituted a new interim regulation for the interim guidance that had replaced the old 5000.2-R. He left office the next day. Some issues remained unresolved, but the new policy documents were in effect, and their authors were holding town hall meetings and preparing satellite broadcasts to explain the new procedures to the acquisition community. Three months later, the chairman of the Joint Chiefs of Staff

Figure 10-11: Acquisition in the New 5000 Series, 2000–2001

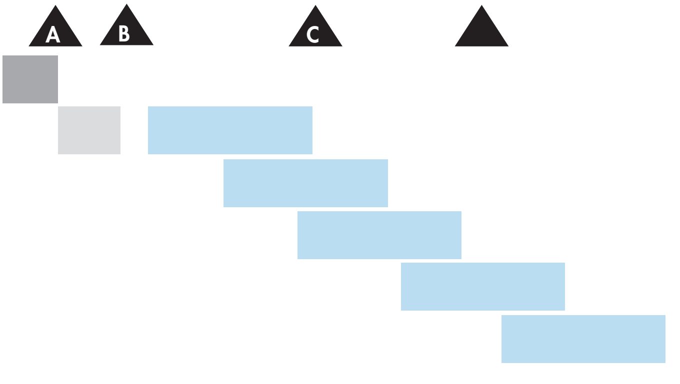
In May 2000 attendees at the PEO/SYSCOM Commanders' Conference examined evolutionary acquisition and suggested how it might work:

Evolutionary Acquisition (Basic Approach)



The new policy would make evolutionary acquisition the "preferred" approach. The core technology had to be fully developed and demonstrated before being approved for system development at Milestone B. Development would occur in a series of separate (and separately funded) increments, with the product of each, if successful, then produced and deployed.

Commercial Off-the-Shelf Products



However, one size would not fit all, and the approach would have to be tailored to the nature and circumstances of the program. For example, commercial off-the-shelf products would have shorter technology development and demonstration phases and also shorter increments, which would involve adapting and "militarizing" the technology.

released his own instruction, calling on the requirements writers to produce time-phased requirements to support evolutionary acquisition.[73]

The new 5000 series documents did not remain in effect for long. Gansler's successor, Edward C. "Pete" Aldridge Jr.—who supported the reforms—issued a final 5000.2-R in June 2001 and then a new 5000.2 the next spring. But in fall 2002 Deputy Secretary of Defense Paul Wolfowitz canceled all three documents because he considered them "overly prescriptive" and believed they hindered "efficiency, flexibility, creativity, and innovation." He replaced them with more interim guidance until new policy documents could be put into place. The new Republican administration, however, did embrace evolutionary acquisition and spiral development and strongly promoted both. By the middle of the decade a number of high-profile programs followed an evolutionary strategy in some form, including the antimissile Airborne Laser, the DD(X) destroyer program that became the *Zumwalt*-class, the Littoral Combat Ship (LCS), the Joint Direct Attack Munition, an F–16 upgrade, and the National Missile Defense program.[74]

* * * * *

When the Clinton administration left office, it had initiated the most dramatic changes in the acquisition process in decades. Building on the initiatives taken by the Defense Department during Clinton's first term, Under Secretary of Defense Jacques Gansler reorganized acquisition reform oversight and made reducing weapon system total ownership cost and development cycle time the major objectives of the department's reform program. He and others in the acquisition community believed that achieving those goals meant abandoning the traditional grand design approach and adopting a new method for developing, producing, and fielding major systems. Called evolutionary acquisition, it was characterized by time-phased, development increments that began with a core capability and incorporated upgrades in subsequent increments. Through aggressive leadership Gansler made the new approach Defense Department policy before the end of his term in January 2001.

Endnotes

1. DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8. The Defense budget (in current or then-year dollars) for FY 1995 was $255.7 billion and $254.6 billion for FY 1996.

2. *CQ Almanac 1997*, chap. 2:3, 18–27, 48–49, 52–53; chap. 8:9; Eric Pianin and John F. Harris, "President, GOP Agree on Balanced Budget Plan," *Washington Post*, 3 May 1997, 1, http://www.washingtonpost.com/wp-srv/politics/special/budget/stories/050397.htm, accessed 20 Feb 2020; *Bipartisan Budget Agreement*, 15 May 1997, 7, https://web.archive.org/web/20121120011831/http://keithhennessey.com/wp-content/uploads/2011/07/AGREEMNT.pdf, accessed 20 Feb 2020; U.S. Congress, *Concurrent Resolution on the Budget for Fiscal Year 1998*, H. Con. Res. 84, 105th Cong., 2d sess., 5 Jun 1997, Title I, sec. 103; *Balanced Budget Act of 1997*, P.L. 105-33 (5 Aug 1997), Title X, Subtitle B, sec. 10203; Robert Keith, *Budget Enforcement Act of 1997: Summary and Legislative History*, CRS Report 97-931 GOV (Washington, DC: CRS, 8 Oct 1997), 1–8; George C. Wilson, *This War Really Matters: Inside the Fight for*

Defense Dollars (Washington, DC: CQ Press, 2000), 75–83; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8.

3. *CQ Almanac 1996*, chap. 8:3–4; Cohen, *Report of the Quadrennial Defense Review*, 60–61; William Perry, testimony before the HCAS on the FY 1995 defense authorization request, 22 Feb 1994, *Perry Public Statements 1994*, 1:375; Wilson, *This War*, 19–20; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8; *CQ Almanac 1997*, chap. 2:8; GAO, *DoD Budget: Substantial Risks in Weapons Modernization Plans*, GAO/T-NSIAD-99-20 (8 Oct 1998), 4.

4. Wilson, *This War*, 84–85, 97, 129–133.

5. Ibid., 89–97; *CQ Almanac 1998*, chap. 8:14–15.

6. Wilson, *This War*, 133–138.

7. Committee on Aging of U. S. Air Force Aircraft, National Materials Advisory Board, Commission on Engineering and Technical Systems, National Research Council, *Aging of U.S. Air Force Aircraft: Final Report* (Washington, DC: National Academy Press, 1997), 11, 22–26, 99; Congressional Budget Office, *A Look at Tomorrow's Tactical Air Forces* (Washington, DC: CBO, 1997), 25–30; HCAS, Military Procurement Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 2000—H.R. 1401 . . . Title I—Procurement*, 106th Cong., 1st sess., 24 Feb and 9 Mar 1999, HASC No. 106-3, 74–81, 84–103, 120, 141–142; GAO, *Tactical Aircraft: Modernization Plans Will Not Reduce Average Age of Aircraft*, GAO-01-163 (Feb 2001), 16–21, 26–45.

8. Daniel Gouré and Jeffrey M. Ranney, *Averting the Defense Train Wreck in the New Millennium*, Significant Issues Series (Washington, DC: Center for Strategic and International Studies Press, 1999), 5; Jacques Gansler, "The Revolution in Business Affairs: The Need to Act Now," *Program Manager* 27, no. 5 (Sep-Oct 1998): 32; House Committee on National Security, Military Procurement and Research and Development Subcommittees, *Department of Defense Modernization Plans: Joint Hearing*, 105th Cong., 2d sess., 8 Oct 1998, HNSC No. 105-48, 21–22.

9. Wilson, *This War*, 83, 87–108, 111–112, 114–115, 131; *CQ Almanac 1998*, chap. 2:112–117, chap. 6:16.

10. *CQ Almanac 1998*, chap. 2:28, 122; *CQ Almanac 1999*, chap. 2:147–165; *CQ Almanac 2000*, chap. 2:41; Linwood B. Carter and Thomas Coipuram Jr., *Defense Authorization and Appropriations Bills: A Chronology, FY 1970–FY 2006*, CRS Report 98-756C (Washington, DC: CRS, 23 May 2005), 22–23; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8.

11. DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8; *CQ Almanac 2000*, chap. 2:176.

12. DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-8; Carter and Coipuram, *Defense Authorization*, 24; *CQ Almanac 1999*, chap. 2:29, 30, 41–42, 45; chap. 9:5; *CQ Almanac 2000*, chap. 2:42, 44, 175–176; chap. 8:3–4, 6, 8–10.

13. See "John Julian Hamre," in Shannon E. Mohan and Erin R. Mahan, *Deputy Secretaries of Defense, 1949–2015* (pamphlet produced by OSD/HO [2015]), 7; "John J. Hamre, CSIS President and CEO," https://www.csis.org/people/john-j-hamre, accessed 4 Nov 2019.

14. Paul G. Kaminski, "Departure Announcement, 1-7-97," draft memo for correspondents, 7 Jan 1997, copy in author files, OSD/HO; "Nomination of Dr. Jacques S. Gansler To Be Under Secretary of Defense for Acquisition and Technology," *Nominations Before the Senate Armed Services Committee, First Session, 105th Congress*, 1 Oct 1997, S. Hrg. 105-371, 568, 598–599.

15. Office of the Press Secretary, The White House, "President Clinton Names David R. Oliver Jr. as Principal Deputy Under Secretary of Defense for Acquisition and Technology," http:www.dau.mil/pubscats/PubsCats/PM/articles98/oliverma.pdf, accessed 14 Mar 2016.

16. "Preston to Leave DoD," *Federal Computer Week* 3, no. 3 (19 Jan 1997), http://fcw.com/Articles/1997/01/19/FEDWIRE.aspx, accessed 20 Feb 2020; "Amid Controversy, Pentagon Acquisition Reform Chief Leaves Post," *Inside the Pentagon*, 13 Feb 1997, 1; Tony Capaccio, "Acquisition Reform Chief Preston Resigns," *Defense Week*, 21 Jan 1997, 2; "Response to Query on Resignation of Colleen A. Preston," 17 Jan 1997; memo, Kaminski for Elaine Kamarck, 18 Jan 1997; Kaminski, response to query from *Inside the Air Force*, 6 May 1997: copies of all in author files; "Stan Z. Soloway," *Program Manager* 27, no. 3 (May-Jun 1998): 128.

17. "Nomination of Dr. Jacques S. Gansler To Be Under Secretary of Defense for Acquisition and Technology," 1 Oct 1997, 555; Gansler, "Defense Modernization" (keynote address, fall meeting of the Aerospace Industries Association, n.p., 21 Nov 1997), http://web.archive.org/web/19980425083800/www.acq.osd.mil/ousda/speech/modernization.html, accessed 3 Oct 2020.

18. Cohen, *Defense Reform Initiative Report*, 55, 58–64; "Defense Reform Initiatives Issues," Cooke Blue Book, ca. 1997, box 604, Transition Studies/Issues, 1975–1997, Subject Files, OSD/HO; memo, DepSecDef Hamre for Secretaries of Military Departments et al., 20 May 1998, subj: Department of Defense Reform Initiative Directive #42 – Transfer of the Space Policy Function from the Under Secretary of Defense for Acquisition and Technology to the Office of the Assistant Secretary for Command, Control, Communications, and Intelligence; DoD Directive 3100.10 (Space Policy), 9 Jul 1999, attached to memo, Cohen for Secretaries of Military Departments et al., 9 Jul 1999, subj: Department of Defense Space Policy, copy in author files. The original Defense Reform Initiative plan called for the under secretary of defense for acquisition and technology to lose the space acquisition functions to the under secretary of defense for policy and to receive the C3 functions from the assistant secretary of defense for command, control, communications, and intelligence, who would focus solely on intelligence; but in the event, rather than be eliminated, the Office of the Assistant Secretary of Defense for C3I was strengthened (see chap. IX).

19. Acquisition Reform Senior Steering Group [ARSSG], meeting minutes, 1997–2001, http://web.archive.org/web/20020615101246/http://www.acq.osd.mil/ar/arssg.htm, accessed 20 Feb 2020; "What is the DSAC?" page from the DSAC website, http://web.archive.org/web/20011127093533/www.acq.osd.mil/dsac/dsac.htm, accessed 20 Feb 2020; "The 'M' Word Makes a Quiet Exit at Pentagon," *Manufacturing and Technology News* 5, no. 1 (5 Jan 1998): 5; DSAC charter as of 21 Sep 1998 (quote), http://web.archive.org/web/20001214073100/http://www.acq.osd.mil/dsac/charter.htm, accessed 20 Feb 2020; DSAC Executive Committee Offsite, 5–6 Dec 1997, summary, http://web.archive.org/web/20001214203200/http://www.acq.osd.mil/dsac/offsite.htm, accessed 20 Feb 2020; DSAC Exec. Comm. meeting minutes, 2 Dec 1998 (DSAC minutes can be found at http://web.archive.org/web/20011130112235/http://www.acq.osd.mil/dsac/minutes.htm), accessed 20 Feb 2020.

20. DSAC charter; DSAC Exec. Comm. meeting minutes, 12 Jan 1998; Collie J. Johnson and Diane M. Wright, "Defense Manufacturing Council (DMC) Chairman Sponsors 2-Day PEO/SYSCOM/PM Conference at DSMC," *Program Manager* 25, no. 1 (Jan-Feb 1996): 26–27; ARSSG meeting minutes, 28 Apr 1998, 4 May 1999. See also the archived web pages for the PEO/SYSCOM Commanders' Conferences at http://web.archive.org/web/20001214082800/http://www.acq.osd.mil/dsac/confern.htm, accessed 20 Feb 2020.

21. DSAC Plenary Group meeting minutes, 2 Jun 1997; DSAC Exec. Comm. meeting minutes, 18 Jul 1997, 8 Sep 1997, 12 Jan 1998; ARSSG meeting minutes, 9 Sep 1997. The Government-Industry Coordinating Group was sometimes referred to as the Industry Affordability Task Force.

22. DSAC Exec. Comm. meeting minutes, 18 Jul 1997, 8 Sep 1997, 12 Jan 1998, 1 Apr 1999; DSAC Plenary Group meeting minutes, 7 Aug 1997; Michael F. McGrath, "Overview of the Defense Systems Affordability Council (DSAC)" (briefing, Defense Manufacturing Conference, Palm Springs, CA, 3 Dec 1997), copy in author files.

23. Jacques S. Gansler, *Into the 21st Century: A Strategy for Affordability* (n.p., 20 Jan 1999), 1–5.

24. Memo, USD(A&T) Gansler for Secretaries of Military Departments et al., 13 Nov 1998, subj: Definition of Total Ownership Cost (TOC), Life Cycle Cost (LCC), and the Responsibilities of Program Managers, copy in author files; DoD 5000.4-M (Department of Defense Cost Analysis Guidance and Procedures) (Washington, DC: ASD[PA&E], Dec 1992), 49 (quote).

25. Randy T. Mathews, "Total Ownership Cost Reduction—A Secretary of Defense Imperative," *Army Logistician* 31, no. 1 (Jan-Feb 1999): 138. Good sources of information on R-TOC can be found in Michael W. Boudreau and Brad R. Naegle, *Reduction of Total Ownership Cost*, Acquisition Research Sponsored Report Series (Monterey, CA: Naval Postgraduate School, 30 Sep 2003); and Danny L. Reed and Leon S. Reed, *Reduction of Total Ownership Costs* (R-TOC) *Best Practices Guide*, IDA Document D-2843 (Alexandria, VA: IDA, Jul 2003).

26. Bob O'Donohue and Dayton Silver, "DSMC Hosts Fifth Semiannual PEO/SysCom Commanders/PM Conference," *Program Manager* 27, no. 4 (Jul-Aug 1997): 88–89; *Acquisition and Technology Weekly Report*, 9 May 1997, copy in author files; DoD IG, *Implementation of a Cost-Accounting System for Visibility of Weapon Systems Life-Cycle Costs*, Audit Report D-2001-164 (Washington, DC: DoD, 1 Aug 2001), 3–7; ARSSG meeting minutes, 4 Nov 1997; see also Boudreau and Naegle, *Reduction of Total Ownership Cost*.

27. William Cohen, *Actions to Accelerate the Movement to the New Workforce Vision: Report to Congress* (Washington, DC: DoD, [1 Apr 1998]), sec. 2.4, http://web.archive.org/web/20030219174332/http://www.acq.osd.mil/ar/912crpt.htm, accessed 27 Jun 2016.

28. "Draft – Fall PEO/SysCom Conference 1996 Action Items," n.d., copy in author files; *Acquisition and Technology Weekly Report*, 9 May 1997 (Kaminski quote); Jay Mandelbaum and Spiros Pallas, "Reducing Total Ownership Cost in DoD: Increasing Affordability of DoD Systems," *Program Manager* 30, no. 4 (Jul-Aug 2001): 78 ("at the hip").

29. HCAS, *National Defense Authorization Act for Fiscal Year 2000: Report*, 106th Cong., 1st sess., 24 May 1999, H. Rep. 106–162, 381–382; *National Defense Authorization Act for Fiscal Year 2000: Conference Report to Accompany S. 1059,* 106th Cong., 1st sess., 6 Aug 1999, H. Rep. 106-301, 782–783; *National Defense Authorization Act for Fiscal Year 2000*, P.L. 106-65 (5 Oct 1999), sec. 911; memo, Gansler for distribution, 14 Jul 2000, subj: Acquisition Logistics Functional Transfer, copy in author files.

30. ARSSG meeting minutes, 9 Sep 1997, 4 Nov 1997, 30 Jun 1998; Spiros Pallas and Mike Novak, "Reduction of Total Ownership Cost (R-TOC): Recent History and Future Prospects," *Program Manager* 29, no. 6 (Nov-Dec 2000): 62–63; "Defense Systems Affordability Council: TOC is Major Issue," *AR Today* 3, no. 5 (Sep-Oct 1998): 8; DSAC Exec. Comm. meeting minutes, 13 Jul 1998. Pallas and his working group replaced an ad hoc TOC Executive Group that had been working for DSAC under the leadership of Lucien "Lou" Chaker, the assistant deputy under secretary of defense for corporate logistics integration, who had led the May 1997 off-site meeting.

31. DSAC Exec. Comm. meeting minutes, 12 Jan, 13 Jul, 2 Dec 1998; memo, Gansler for SAEs et al., 13 Apr 1998, subj: Total Ownership Cost (TOC) Pilot Programs, copy in author files; Mandelbaum and Pallas, "Reducing Total Ownership Cost in DoD," 77–78; ARSSG meeting minutes, 17 Nov 1998; memo, ASN(RDA) John W. Douglass for distribution, 5 May 1998, subj: Implementation of Total Ownership Cost (TOC) Baselines in the Department of the Navy, copy in author files.

32. DSAC Exec. Comm. meeting minutes,13 Jul 1998 (Oliver quote), 1 Apr 1999; Col. Larry "Scoop" Cooper, "R-TOC Offsite Summary," briefing, 27 Oct 1998, copy in author files; Gansler, *Strategy for Affordability*, 1.

33. SCAS, *Department of Defense Authorization Act for Fiscal Year 1999: Report to Accompany S. 2060*, 105th Cong., 2d sess., 11 May 1998, S. Rep. 105-189, 320; U.S. House of Representatives, *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999: Conference Report to Accompany H.R. 3616*, H. Rep. 105-736, 105th Cong., 2d sess., 22 Sep 1998, 693; U.S. Congress, *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999*, P.L. 105-261 (17 Oct 1998), sec. 816; DSAC Exec. Comm. meeting minutes, 2 Dec 1998; ltr, Gansler to Al Gore Jr., 5 Feb 1999, with attached *Report in Response to Section 816 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999* (n.p., n.d.), copy in author files.

34. DSAC Exec. Comm. meeting minutes, 2 Dec 1998; Stan Soloway, briefing, DSAC Exec. Comm., 2 Dec 1998, attached to the meeting minutes; memo, Gansler for Under Secretaries of Military Departments et al., 10 May 1999, subj: Future Readiness, copy in author files.

35. Pallas and Novak, "Reduction of Total Ownership Cost," 65–66; ARSSG meeting minutes, 14 Sep 1999.

36. Mandelbaum and Pallas, "Reducing Total Ownership Cost in DoD," 78; "Budgeting for R-TOC," http://web.archive.org/web/20040319214020/http://ve.ida.org/rtoc/open/budget.html, accessed 27 Jun 2016.

37. *National Defense Authorization Act for Fiscal Year 1998,* P.L. 105-85 (18 Nov 1997), sec. 912(e)1.

38. Defense Science Board, *Report of the Defense Science Board Acquisition Workforce Sub-Panel of the Defense Acquisition Reform Task Force on Defense Reform* (Washington, DC: OUSD[A&T], Mar 1998), ES-1–ES-11; the quote is from ltr, William G. T. Tuttle Jr. et al. to Craig I. Fields, chairman, Defense Science Board, 16 Mar 1998, included in ibid.

39. Cohen, *Actions to Accelerate*, n.p.

40. Memo, Hamre for Under Secretaries of Defense et al., 21 May 1997, subj: Management Reform Memorandum #2 – Moving to a Paper-free Contracting Process by January 1, 2000; memo, Hamre for Under Secretaries of Defense et al., 29 Jul 1997, subj: Addendum to Management Reform Memorandum #2 – Moving to a Paper-free Contracting Process by January 1, 2000; Cohen, *Actions to Accelerate*, secs. 4.1, 4.2; memo, Hamre for Secretaries of Military Departments et al., 2 Jul 1997, subj: Policy for the Transition to a Digital Environment for Acquisition Programs; memo, Acting USD(A&T) Noel Longuemare for Secretaries of Military Departments et al., 15 Jul 1997; memo, Lance A. Davis and Patricia Sanders for Service Vice Chiefs et al., 20 Aug 1998, subj: Development of an Implementation Plan to Streamline the Science and Technology, Engineering, and Test and Evaluation Infrastructure – Section 912(c), with memo, Gansler for Secretaries of Military Departments et al., 17 Aug 1998, subj: Development of an Implementation Plan to Streamline the Science and Technology, Engineering, and Test and Evaluation Infrastructure; memo, Arthur Money, Senior Civilian Official, OASD(C3I), for Gansler, 24 Nov 1998, subj: Section 912(c) Memorandum of Agreement (MOA) for the Establishment of the Joint Command and Control Integration/Interoperability Group, with attached MOA between US Army Communications-Electronics Command et al., 23 Oct 1998; memo, Gansler for Secretaries of Military Departments et al., 19 Oct 1998, subj: Review of Acquisition Workforce Training, Processes and Tools for Services Contracts, with attached charter; memo, Dave Oliver for Secretaries of Military Departments et al., 12 Nov 1998, subj: Commercial Business Environment Training Team, with attached charter; memo, Gansler and Rudy deLeon, Under Secretary of Defense (Personnel and Readiness), for Secretaries of Military Departments et al., 22 Sep 1998, subj: Development of an Implementation Plan to Recruit, Develop, Reward and Retain Technology Leaders, with attached charter; memo, Gansler for Secretaries of Military Departments et al., 25 Aug 1999, subj: The Future Acquisition and Technology Workforce, with attached charter: copies of all in author files; ARSSG meeting minutes, 8 Feb 2000.

41. Mark A. Lorell, John C. Graser, and Cynthia R. Cook, *Priced-Based Acquisition: Issues and Challenges for Defense Department Procurement of Weapon Systems* (Santa Monica, CA: RAND, 2005), 1–17, 29–54; Edward L. Will, "Paving the Way for Price-Based Acquisition," *Acquisition Review Quarterly* 6, no. 4 (Fall 1999): 369–381; Cohen, *Actions to Accelerate*, sec. 5.1; memo, Gansler for Secretaries of Military Departments et al., 15 Oct 1998, subj: Establishment of a Study Group to Analyze Implementation of Price-Based Acquisition within the Department of Defense, with attached charter, copy in author files; Price-Based Acquisition Study Group, *Report* (Washington, DC: OUSD[AT&L], 15 Nov 1999), ES-3–ES-11, 159, https://web.archive.org/web/20011129212531/http://www.acq.osd.mil/ar/doc/pbarpt.pdf, accessed 14 Jul 2017; memo, Gansler for Secretaries of Military Departments and the Ballistic Missile Defense Organization, 29 Nov 2000, subj: Price-Based Acquisition, copy in author files.

42. Department of Defense Section 912(c) Commercial Business Environment Study Group, *The Commercial Business Environment: Accelerating Change Through Enterprise Teaming: Report* (Washington, DC: DoD, Oct 1999), chap. 1:1–4; chap. 3:1–5; chap. 4:1–6, 13–17, http://web.archive.org/web/20000829074127/http://alpha.lmi.org/cbe/reports/pdfindex.htm, accessed 20 Feb 2020; ARSSG meeting minutes, 14 Sep 1999 (Mounts quote), 16 Nov 1999; Stan Soloway, special briefing, 15 Dec 2000, DefenseLink transcript, http://www.defense.gov/transcripts/transcript.aspx?transcriptid=1879, accessed 20 Feb 2020; "Soloway Directs Establishment of New Change Management Center," *Program Manager* 29, no. 1 (Jan-Feb 2000): 78; William E. Mounts (briefing, DoD Change Management Center Business Managers' Conference, 14 Jun 2000), 2–4, 6–13; Mike Dowe (briefing, Change Agent Summit and Training Session, n.d., n.p.): copies of both in author files; *Better Business Practices for the Business of Defense: DRI Transition Report, 2001* ([Washington, DC: DoD], 2001), 66–70.

43. Memo, General Joseph W. Ralston, Vice Chairman JCS, and Gansler for Secretaries of Military Departments et al., ca. 17 Nov 1998, subj: Establishment of an Oversight and Steering Group to Review the Adequacy of the Requirements Generation System to Fulfill Current and Future Acquisition Needs of the Department, with charter for the Requirements and Acquisition Steering Group, copy in author files.

44. Ross T. McNutt, "Reducing Acquisition Cycle Time: Creating a Fast and Responsive Acquisition System," in *Providing the Means of War*, 319–321; memo, Perry for Secretaries of Military Departments et al., 14 Sep 1994, subj: Reducing Cycle Time, copy in author files; Walter B. LaBerge, "'Cycle Time' – A Military Imperative as Well," *Acquisition Review Quarterly* 3, no. 2 (Fall 1996): 79–82.

45. See chap. IX and DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 5, sec. A, 2(e).

46. Defense Systems Management College, *Joint Logistics Commanders Guidance for Use of Evolutionary Acquisition Strategy to Acquire Weapon Systems* (Fort Belvoir, VA: DSMC Press, May 1995), chap. 1:1; chap 2:2 (quote); chap. 3:4.

47. National Center for Advanced Technologies, *Proposed Acquisition Teamwork and Cycle Time Improvements: Evolutionary Defense Acquisition* (Washington, DC: NCAT, 19 Apr 1996); Mike Robinson, "The Development of Evolutionary Defense Acquisition: An Industry Perspective" (briefing, PEO/SYSCOM Commanders' Conference, 4 Apr 2000), slide 2, copy in author files. Robinson, a team leader on NCAT's Affordability Task Force, credits the NCAT white paper for the adoption of evolutionary acquisition as the "preferred approach" in the 2000 revision of the 5000 series documents.

48. DSMC, *Joint Logistics Commanders Guidance for Use of Evolutionary Acquisition Strategy to Acquire Weapon Systems*, rev. ed. (Fort Belvoir, VA: DSMC Press, Jun 1998), ix, xi (emphasis added).

49. For the origin and early definition of the P3I concept, see "Modular Evolutionary Development Proposed," *National Defense* 64, no. 358 (Feb 1980): 52; American Defense Preparedness Association, *Pre-Planned Product Improvement: Summary Briefing*, n.d. (ca. 1980); Hylan B. Lyon, "Pre-Planned Product Improvement," *National Defense* 65, no. 364 (Jan 1981): 20–25; Norman R. Augustine, "P3I: An Idea Whose Time Has Come . . . Again," *National Defense* 65, no. 364 (Jan 1981): 27–31, 62; Frederick Biery and Mark Lorell, "Preplanned Product Improvement and Other Modification Strategies: Lessons from Past Aircraft Modification Programs," RAND Note N-1794-AF (Santa Monica, CA: RAND, Dec 1981); Stephen W. Sickels, "Pre-Planned Product Improvement (P3I)" (master's thesis, Air Force Institute of Technology, Sep 1981).

50. Memo, DepSecDef Frank C. Carlucci for distribution, 6 Jul 1981, subj: Improving the Acquisition Process Through Pre-Planned Product Improvement, unlabeled folder, box 1, series 84-0005, OSD Records, WNRC; Carlucci, "Making the Acquisition Product Efficient," *Program Manager* 10, no. 5 (Sep-Oct 1981): 4; Senate Committee on Governmental Affairs, *Management of the Department of Defense*, 98th Cong., 1st sess., 23 Mar 1983, S. Hrg. 98-150, 69; ltr, W. H. Sheley Jr., Director, General Accounting Office, to Secretary of Defense Caspar W. Weinberger, 13 Aug 1981, subj: National Defense: Adoption of Preplanned Product Improvement Techniques Can Reduce Cost of Improving Effectiveness of Systems during Their Lifetime (MASAD-81-39).

51. Defense Acquisition Circular 76-43 (Acquisition Management and System Design Principles), 28 Feb 1983, as quoted in Hirsch, "Evolutionary Acquisition of Command and Control Systems," 21; Senate Committee on Governmental Affairs, *Management of the Department of Defense*, 69; DoD Instruction 5000.2 (Defense Acquisition Management Policies and Procedures), 23 Feb 1991, pt. 5, sec. A, 5.

52. Frederick P. Biery, "Are Other Acquisition Strategies Superior to the P3I Approach?" *Defense Management Journal* 19, no. 1 (First Quarter, 1983): 13–14 (quote, 14); Garcia E. Morrow and Jules J. Bellaschi, "A Cultural Change: Pre-Planned Product Improvement," *Concepts* 5, no. 3 (Summer 1982): 20–21; Marlene M. Elkins, "P3I—Help in Reducing Weapon Systems Costs," *Concepts* 5, no. 2 (Spring 1982): 108–109; Biery and Lorell, *Pre-Planned Product Improvement*, 22–23, 31–33, 47–50.

53. Advocates of spiral development at the Software Engineering Institute went so far as to post a webpage celebrating the spiral form in nature, art, product design, and even primitive cave

paintings. See "Some Links to Spiral Images," versions of 27 Sep 2000, http://web.archive.org/web/20010820214846/http://www.sei.cmu.edu/cbs/spiral2000/spiralimagelinks/, and 28 May 2002, http://web.archive.org/web/20021018111921/http://www.sei.cmu.edu/cbs/spiral2000/spiralimagelinks/index.html, both accessed 20 Feb 2020; Office of the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence), *The DoD Enterprise Model*, vol. 2: *Using the DoD Enterprise Model—A Strategic View of Change in DoD* (Washington, DC: DoD, Jan 1994), 62.

54. For the Navy, see "Charting the Course to Acquisition Excellence: Department of the Navy's Management Action Plan," undated briefing (ca. 1995), slide 4, copy in author files. For the Army, see *Army Digitization Master Plan* (n.p., 1995), sec. 4.4, http://web.archive.org/web/19980426104234/http://www.ado.army.mil/ADMP/1995/adotoc.htm, accessed 20 Feb 2020; *Experimentation Master Plan For Force XXI Battle Command—Brigade and Below (FBCB2)*, Rev. A (n.p., 19 Oct 1995), 65–70, http://web.archive.org/web/19980426112557/http://www.ado.army.mil/exmp/exmpcovr.htm, accessed 20 Feb 2020; U.S. Army Digitization Office, *U.S. Army Digitization Master Plan*, 1 Mar 1996, chap. 8:1–3, available on the Defense Technical Information Center website at https://apps.dtic.mil/dtic/tr/fulltext/u2/a308047.pdf, accessed 20 Feb 2020; Otto J. Guenther, "Department of the Army Joint Service Software Perspective," *CrossTalk* 9, no. 7 (Jul 1996), n.p., https://web.archive.org/web/19991010020706/http://www.stsc.hill.af.mil/CrossTalk/1996/jul/departme.asp, accessed 20 Feb 2020; Carl W. Lickteig, *Research Methods for Advanced Warfighting Experiments*, Technical Report 1047 (n.p.: US Army Research Institute for the Behavioral and Social Sciences, Aug 1996), 10; Steven Boutelle and Alfred Grasso, "A Case Study: The Central Technical Support Facility," *Army RD&A* 39, no. 2 (Mar-Apr 1998): 30–32; Marc W. Gutleber, "Spiral Development: New Opportunities and Challenges," *Army RD&A* 40, no. 4 (Jul-Aug 1999): 44–45; Paul J. Kern, "Modernizing the Army: Spiral Development Process" (presentation, MANPRINT Symposium, Arlington, VA, 16 Sep 1998), slides Spiral 16:1, 16:7–9, 16:11–12, copy in author files.

55. "Message from the ESC Commander," 24 Jan 1997, http://web.archive.org/web/19971007092137/www.hanscom.af.mil/Orgs/O_Orgs/PA/reorg/reorg2.htm, accessed 20 Feb 2020; ESC Public Affairs Office (Kevin Gilmartin) press release, "Spiral Development: ESC's New Way of Business," 14 Feb 1997, http://web.archive.org/web/19971007092112/www.hanscom.af.mil/Orgs/O_Orgs/PA/reorg/reorg5.htm, accessed 20 Feb 2020; *The New ESC Command and Control Acquisition Handbook Concept of Operations* (draft, 15 Feb 1997), sec. 2.1, http://web.archive.org/web/19970227182032/http://afmc.wpafb.af.mil/MSG/SX/escah/conops.htm; "Spiral Development, the Next Logical Step in Evolutionary Acquisition," *Angle on Reform* (USAF Acquisition Support Team newsletter), 15 (Mar 1998): 1–2; Leslie F. Kenne, "Inside the Spiral," *Aerospace Acquisition 2000* 2, no. 3 (Nov-Dec 1999): 7.

56. ESC Public Affairs Office (Kevin Gilmartin) press release, "Spiral Development Key to EFX 98," 14 Jul 1998, http://web.archive.org/web/20011103123947/http://www.hanscom.af.mil/Esc-PA/news/1998/jul98/efx98.htm, accessed 20 Feb 2020; Committee on Network-Centric Naval Forces, Naval Studies Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, *Network-Centric Naval Forces: A Transition Strategy for Enhancing Operational Capabilities* (Washington, DC: National Academy Press, 2000), 80–81.

57. James Bryan Bearden, "Command and Control Enabling the Expeditionary Aerospace Force," Research Report AU/ACSC/023/2000-04, Air Command and Staff College, Air University, Maxwell AFB, AL, Apr 2000, 26 (quote); U.S. Air Force Scientific Advisory Board, *Report on Information Management to Support the Warrior*, SAB-TR-98-02 (USAFSAB, Dec 1998), 67–74.

58. Thomas F. Saunders, "Spiral Acquisition and the Integrated Command and Control System" (presentation, Spiral Development Workshop, Feb 2000), slides 2–5, copies in author files; Barry Boehm, *Spiral Development: Experience, Principles, and Refinements*, Special Report CMU/SEI-2000-SR-008, Spiral Development Workshop, 9 Feb 2000 (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, Jul 2000), 3–5; Wilfred J. Hansen et al., *Spiral Development–Building the Culture: A Report on the CSE-SEI Workshop, February 2000* (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, Jul 2000), 7–10, 40–42.

59. Ronald T. Kadish, "The New ESC Acquisition Framework" (remarks to the Armed Forces Communications and Electronics Association, Lexington-Concord Chapter Luncheon, 28 Jan 1997), http://web.archive.org/web/19971007075718/www.hanscom.af.mil/Orgs/O_Orgs/PA/state.htm, accessed 20 Feb 2020; Software Productivity Consortium, *Process Engineering with the Evolutionary Spiral Process Model*, SPC-93098-CMC, ver. 01.00.06 (Herndon, VA: Software Production Consortium Services Corporation, Jan 1994), chap. 3:1–7; Software Productivity Consortium, "Lessons Learned from Applying the Evolutionary Spiral Process" (briefing, USC-SEI Spiral Workshop, 9 Feb 2000), copy in author files; AF Instruction 63–123 (Evolutionary Acquisition for C2 Systems), 1 Apr 2000, 1–3, 7; Ross McNutt, "Reducing Air Force Acquisition Response Times and Spiral Development" (briefing, USC-SEI Spiral Workshop, Feb 2000), slides 23–25; SAF/AQ Evolutionary Acquisition Reinvention Team, "Air Force Evolutionary Acquisition Guide" (draft), Mar 2000: all in author files. A 2001 OSD information paper noted that evolutionary acquisition and spiral development were often used interchangeably, and then proceeded to use them interchangeably. See Mona Lush, "Spiral Development," 22 May 2001, copy in author files. Even Lieutenant General Kadish, who institutionalized the spiral development process at ESC, stated "spiral development [is] also called evolutionary development." See Kadish, "Achieving Information Superiority" (address, SSG, Montgomery, AL, 8 Sep 1997). See also McNutt, "Reducing Air Force Acquisition Response Times," slide 23 (notes); Committee on Network-Centric Naval Forces, *Network-Centric Naval Forces*, 77; Sam Fazio, "DoD Instruction 5000.02, 8 December 2008," briefing, 20–21 Apr 2009, slide 9 with notes, https://slideplayer.com/slide/722056/, accessed 20 Oct 2020.

60. "Nomination of Dr. Jacques S. Gansler To Be Under Secretary of Defense for Acquisition and Technology," *Nominations Before the Senate Armed Services Committee, First Session, 105th Congress*, 1 Oct 1997, 570 (quote); Charter for the Requirements and Acquisition Steering Group, attached to memo, Ralston and Gansler for Secretaries of Military Departments et al., 18 Nov 1998; Charter for the Price-Based Approach to Acquisition Study Group, attached to memo, Gansler for Secretaries of Military Departments et al., 15 Oct 1998.

61. John C. Wilson Jr., "Acquisition Cycle Time Reduction" (briefing, DSAC, 1 Apr 1999), slides 8–12; Kelly Cormican, "Requirements and Acquisition Section 912c Briefing to NARSOC [Navy Acquisition Reform Senior Oversight Council]," 15 Mar 1999, slides 5–7; Section 912c Requirements and Acquisition Study Working Group, *Sect. 912c Report: Requirements and Acquisition*, Jun 1999, ES: 2–3; chap. 3:3–6; app. B: 2–3; DSAC meeting minutes, 1 Apr 1999; memo, Gansler for distribution, 9 Jul 1999, subj: Implementing Cycle Time Reduction Recommendations; memo, Gansler and Ralston for distribution, 14 Jul 1999, subj: Implementing Requirements Generation and Acquisition Policy: copies of all in author files.

62. Memo, Gen. Lester L. Lyles, USAF VCS, for Gansler, 30 Aug 1999, subj: Implementing Cycle Time Reduction Recommendations, http://web.archive.org/web/20010506013413/http://www.safaq.hq.af.mil/acq_ref/cycletime/leadership/lylesresponse.pdf, accessed 20 Feb 2020; McNutt, "Reducing Air Force Acquisition Cycle Time," 319.

63. "Lightning Bolt #10: Reduce Cycle Time," Air Force briefing, 21 May 1996, copy in author files; "Two New Lightning Bolts!!" *News from AFAR* [*Air Force Acquisition Reform*] 3, no. 1 (Mar/Apr 1996): 2; "Lightning Bolt #10 Strikes Fast!!!" archived web page, copy in author files; McNutt, "Reducing Acquisition Cycle Time," 322–323; McNutt, "The Air Force Cycle Time Reduction Program: Creating a Fast and Responsive Acquisition System" (briefing, 1 Sep 2000), slides 123–125, copy in author files; *Aerospace Acquisition 2000* 2 (Nov-Dec 1999): 5; SAF/AQ Evolutionary Acquisition Reinvention Team, "Air Force Evolutionary Acquisition Guide" (draft), Nov 2000, http://web.archive.org/web/20010508213411/http://www.safaq.hq.af.mil/acq_ref/cycletime/action/acquisition/AFEAGuideDraftNov2000.doc, accessed 20 Feb 2020. This version is based on the new 5000 series documents of Oct 2000; an older version dated Mar 2000 can be found in author files.

64. McNutt, "Reducing DoD Product Development Time: The Role of the Schedule Development Process" (PhD diss., MIT, Dec 1998), 136–140, 229–315; MIT, Lean Aircraft Initiative, *Annual Report*, 1996–1997, 20–29, copy in author files; McNutt, "Reducing Acquisition Cycle Time," 323–324.

65. MIT, Lean Aircraft Initiative, *Annual Report*, 1997–1998, 35, 39–41, 55, 60; DSAC Plenary Group meeting minutes, 9 Feb 1998; McNutt, "Reducing DoD Product Development Time," 15, 57n.

66. McNutt, "Reducing Acquisition Cycle Time," 330–331; G. S. Martin, "Strategies for Rapid Development and Fielding of Operational Initiatives (CORONA Tasker CS99T-18)" (briefing, 2 Nov1999), slides 2–3 (quote, slide 3), 7–20, http://web.archive.org/web/20010506010940/http://www.safaq.hq.af.mil/acq_ref/cycletime/wrap/CoronaRapidDevelopment2Nov99.ppt, accessed 20 Feb 2020; McNutt, "Strategies for Rapid Development and Fielding of Operational Initiatives, Corona Task CS99T-18 (Approved)," information paper, 22 Nov 1999, http://web.archive.org/web/20010506010940/http://www.safaq.hq.af.mil/acq_ref/cycletime/wrap/StrategiesforRapidDevelopment22Nov001pg.doc, accessed 20 Feb 2020.

67. Memo, Lyles for Gansler, 30 Aug 1999; Staff Summary Sheet, 26 Jul 1999, http://web.archive.org/web/20010506013413/http://www.safaq.hq.af.mil/acq_ref/cycletime/leadership/cycletimeresponsesss.pdf, accessed 20 Feb 2020.

68. Joseph Ferrara, "DoD 5000 Rewrite: Update for the NARSOC," briefing, 2 Dec 1999, http://web.archive.org/web/20000611161007/http://www.acq-ref.navy.mil/narsoc/1245000b/index.htm, 11 Jun 2020.

69. Kaminski, *Acquisition and Technology Weekly Report*, 13 Sep 1996; memo, Gansler; Philip Coyle, Director, Operational Test and Evaluation; and Senior Civilian Official, Office of the Assistant Secretary of Defense (C3I), for Members and Advisors of the Defense Acquisition Policy Steering Group, 5 Aug 1999, subj: Policy Changes to Improve the Acquisition Process; Denis Catalano, "DoD 5000 Rewrite," briefing [with notes], 4 Apr 2000, slide 4: copies of all in author files.

70. Ferrara, "DoD 5000 Rewrite."

71. Chris Fry, "Defense Acquisition Process: Milestones and Phases: A Summary of the Revised 5000 Series," Teaching Note, DSMC Acquisition Policy Department, 2 Jul 2001, 1–9, copy in author files; Richard K. Sylvester, "The New DoD Systems Acquisition Process," briefing, 26 Oct 2000, https://web.archive.org/web/20001109160000/http://www.acq.osd.mil/ar/doc/5000rewritebrief.pdf, accessed 20 Feb 2020; Catalano, "DoD 5000 Rewrite," slides 14, 29–30.

72. Breakout Group 2, "The Evolutionary Development Process" (briefing, PEO/SYSCOM Commanders' Conference, 4 Apr 2000), http://web.archive.org/web/20011127094123/http://www.acq.osd.mil/dsac/peosyscpresents/bog2/5000briefing.ppt, accessed 20 Feb 2020; PEO/SYSCOM Conference, 11–13 Oct 2000, agenda and session summaries, http://web.archive.org/web/20001009191606/http://129.246.225.152/, accessed 20 Feb 2020; W. J. Hansen et al., *Spiral Development and Evolutionary Acquisition: The SEI-CSE Workshop, September 2000*, Special Report CMU/SEI-2001-SR-005 (Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, May 2001), ftp://ftp.sei.cmu.edu/pub/documents/00.reports/pdf/00sr006.pdf, accessed 20 Feb 2020.

73. Catalano, "DoD 5000 Rewrite"; ARSSG meeting minutes, 12 Apr 2000, 12 Sep 2000, 9 January 2001; DoD Directive 5000.1 (The Defense Acquisition System), 23 Oct 2000; DoD Instruction 5000.2 (Operation of the Defense Acquisition System), 23 Oct 2000; memo, Gansler, ASD(C3I) Art Money, and Philip Coyle, Director, Operational Test and Evaluation, for Secretaries of Military Departments et al., 23 Oct 2000, subj: Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs, with interim guidance attached; DoD Directive 5000.1 (The Defense Acquisition System), change 1, 4 Jan 2001; DoD Instruction 5000.2 (Operation of the Defense Acquisition System), change 1, 4 Jan 2001; memo, Gansler, Money, and Coyle for Secretaries of Military Departments et al., 4 Jan 2001, subj: Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs; Chairman of the Joint Chiefs of Staff Instruction 3170.01B (Requirements Generation System), 15 Apr 2001, encl. A, 2–3; encl. E, 2.

74. Memo, USD(AT&L) Aldridge for Secretaries of Military Departments et al., 10 Jun 2001, subj: The New DoD Regulation 5000.2-R, copy in author files; DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs [MDAPS] and Major Automated Information System [MAIS] Acquisition Programs), Jun 2001; DoD Instruction 5000.2 (Operation of the Defense Acquisition System), 5 Apr 2002; memo, DepSecDef Paul Wolfowitz for Director,

Washington Headquarters Services, 30 Oct 2002, subj: Cancellation of DoD 5000 Defense Acquisition Policy Documents, copy in author files; "Interview with Marvin Sambur, Assistant Secretary of the Air Force (Acquisition): Pathfinder Program Testing the Potential of Spiral Arms Development," *Program Manager* 32, no. 4 (Jul-Aug 2003): 2–9.

I. "Nomination of Dr. Jacques S. Gansler To Be Under Secretary of Defense for Acquisition and Technology," *Nominations Before the Senate Armed Services Committee, First Session, 105th Congress*, 1 Oct 1997, 568, 598–599; biography of Jacques S. Gansler, University of Maryland School of Public Policy website, http://faculty.publicpolicy.umd.edu/jgansler/biocv, accessed 21 Mar 2016.

II. William Cohen, *Actions to Accelerate the Movement to the New Workforce Vision: Report to Congress*, 1 Apr 1998, n.p.

CHAPTER XI

The Air Force and Acquisition, 1989–2001

In June 1990 the Air Force issued a white paper, *Global Reach–Global Power*, articulating the service's vision for airpower in the post–Cold War era. Fulfilling that vision would depend, in part, on the Air Force continuing to develop the advanced weapon systems that would give it a competitive advantage over opponents, even as its forces declined in numbers during this period (see appendix I). Just a few months before releasing *Global Reach–Global Power*, the Air Force had announced a restructuring of its organization for acquisition. The impetus for reorganization came not from within the Air Force but from the outside—from a presidential commission, Congress, and the Office of the Secretary of Defense, all specifying changes that the service would implement over a five-year period. In the 1990s, with their control over acquisition increased by the new organizational arrangements, civilian Air Force officials, particularly Darleen Druyun in the Office of the Assistant Secretary of the Air Force for Acquisition, aggressively applied reform measures to ongoing and new weapon system programs. This chapter's case study of the C–17, the aircraft intended to modernize the Air Force's airlift fleet, shows how acquisition reform helped turn around a program that was far behind schedule and billions of dollars over budget.[1]

ACQUISITION ORGANIZATION AND MANAGEMENT

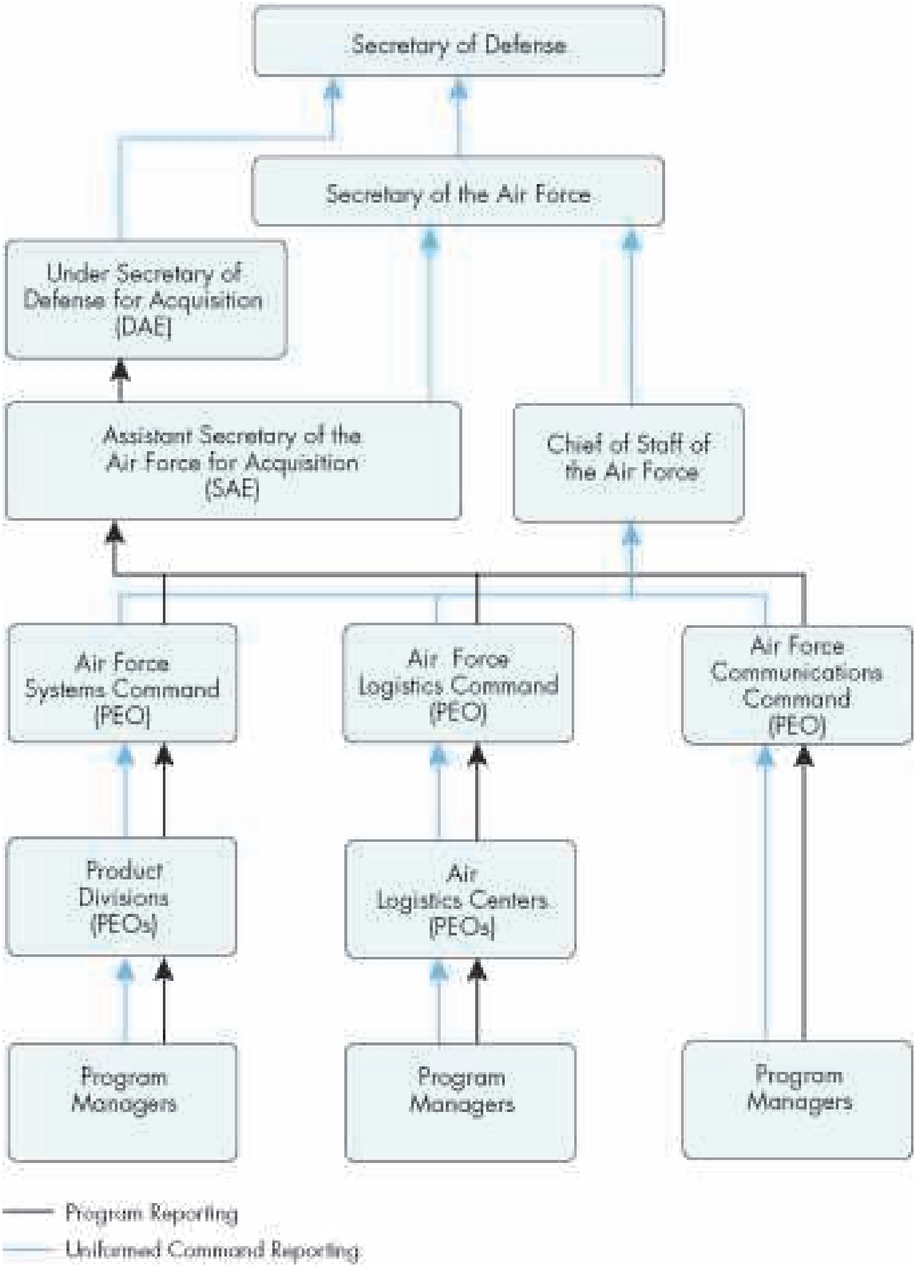
In the late 1980s and early 1990s, the Air Force reorganized both its headquarters and field acquisition organizations. The changes stemmed from reforms recommended in 1986 by the Packard Commission and mandated by the Goldwater-Nichols Act the same year. Major reform objectives were to strengthen civilian control of acquisition and to streamline program management (see chapter II). The Air Force, however, moved slowly in implementing the reforms.

Before 1987, at Air Force headquarters, responsibility for acquisition was divided between the civilian secretariat, headed by the secretary of the Air Force, and the uniformed Air Staff. The latter, which reported to the Air Force chief of staff, dominated acquisition. The assistant secretary of the Air Force for research, development, and logistics had a staff of 38 who primarily performed oversight, reviewing policy and positions formulated by the Air Staff. In contrast, the Air Staff's deputy chief of staff for research, development, and acquisition employed more than 400 military and civilian personnel to establish policy and procedures, define system operational capabilities, provide programs with guidance, and prepare and coordinate planning, programming, and budgeting. In the field, the commander of Air Force Systems Command (AFSC), headquartered at Andrews Air Force Base, Maryland, reported to the chief of staff through the Air Staff. The command's "product" divisions (e.g., Aeronautical Systems Division, Electronic Systems Division) managed nearly every Air Force weapon system program from R&D through production. Four large laboratories that were part of Systems Command supported the service's science and technology work. Three organizations performed testing: AFSC Air Force Flight Test Center in California carried out developmental test and evaluation; Air Force Operational Test and Evaluation Center in New Mexico, which reported directly to the chief of staff, conducted independent operational test and evaluation; and AFSC Arnold Engineering and Development Center in Tennessee provided simulation flight testing and evaluation. Air Force Communications Command at Scott Air Force Base, Illinois, also managed some acquisition programs. Life-cycle logistics support for each system came from Air Force Logistics Command (AFLC), headquartered at Wright-Patterson Air Force Base, Ohio, and its five air logistics centers.[2]

In response to Packard and Goldwater-Nichols, in 1987 the Air Force reorganized the service headquarters and field acquisition structure. It merged the deputy chief of staff's office with that of the assistant secretary, creating a new acquisition organization, the Office of the Assistant Secretary for Acquisition (SAF/AQ), headed by the assistant secretary. That official, now with a staff of 320, would be the Air Force acquisition executive as well as the senior procurement executive and would be responsible for developing acquisition policy and for overseeing the execution of the 433 programs the former deputy chief of staff for research, development, and acquisition previously managed. For 43 of its major systems, the Air Force also instituted a simplified three-tiered management chain of command that ran from the program manager to the program executive officer to the assistant secretary, the service's acquisition executive (see figure 11-1). However, the field commands continued to manage hundreds of programs.[3]

Although the General Accounting Office concluded that the changes gave the assistant secretary more control of acquisition and increased the secretariat's participation in the system, its analysts nevertheless argued that the reorganization fell short of the Packard Commission recommendations and the requirements of the Goldwater-Nichols legislation. The 1986 law mandated that a single office within the secretariat have responsibility for acquisition. Yet, after reorganization, the new position of assistant secretary for readiness support performed acquisition-related functions, including logistics oversight. The assistant secretary for acquisition also shared acquisition responsibilities at Air Force headquarters with Air Staff officials:

Figure 11-1: Air Force Acquisition Organization after 1987



DAE – Defense Acquisition Executive
PEO – Program Executive Officer
SAE – Service Acquisition Executive

Source: Adapted from Figure 2-12 (Evolution of Top-Level Air Force Acquisition Organizations), in Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review: Report*, Jun 2007, 2-26, https://apps.dtic.mil/dtic/tr/fulltext/u2/a470388.pdf, accessed 3 Dec 2020.

the deputy chief of staff for plans and operations (for system requirements); the deputy chief of staff for logistics and engineering; and the assistant chief of staff for command, control, communications, and computer systems. Together, the three Air Staff officers oversaw the execution of more than 350 programs. Although not precluded by the law, the division of responsibility between uniformed officers on the Air Staff and the assistant secretary for acquisition weakened the latter's authority.[4]

While the assistant secretary's enhanced authority increased civilian control of acquisition, as the General Accounting Office noted, the uniformed military still dominated the function. In SAF/AQ, the assistant secretary's principal deputy was a lieutenant general; general officers headed the office's six functional directorates and two of the other three organizational elements. Within the directorates, uniformed "program element monitors" maintained close contact with the program offices of their assigned systems and served as the headquarters focal point for those systems. Most civilians were in nonsupervisory positions, including the four officials who in the prior organization had served as deputies to the assistant secretary but who lost influence in the reorganized structure. They continued to perform oversight in their assigned functional areas, but they lacked the necessary professional staff to assist in carrying out that responsibility. Also, their signatures were no longer required on key acquisition documents before the assistant secretary reviewed them; nor did the assistant secretary meet with them very often.[5]

According to the GAO, the uniformed military also maintained its preeminence in acquisition at headquarters because the Air Staff retained effective control of program and budget development. A "board structure" comprising a series of councils, boards, committees, and panels managed this process. Fifteen working-level panels, all composed of uniformed officers, reviewed program and budget issues and submitted recommendations to the Air Force hierarchy. After 1987, officials from SAF/AQ participated, but they too were uniformed military. This setup gave the Air Staff tremendous power over acquisition. The board process distributed both research and development and procurement funds, thus limiting the assistant secretary's ability to control program execution. Additionally, decisions to terminate a program were almost always made by the Air Staff during the board process and not by the formal acquisition management structure—the Air Force Systems Acquisition Review Council, chaired by the assistant secretary—during program milestone reviews.[6]

In reorganizing its acquisition management, the Air Force also instituted the three-tiered structure recommended by the Packard Commission to decentralize program decision-making; create short, unambiguous chains of command; and reduce program briefings, oversight, and personnel. The service designated 43 of its most visible, high-dollar programs as "executive programs" and assigned them to 11 program executive officers, who would supervise the program managers and report directly to the assistant secretary. But the program executive officers were not separate from the existing uniformed military command chain. They were dual-hatted and included the commanders of Air Force Systems Command, Air Force Logistics Command, and Air Force Communications Command (see figure 11-1). Most of the rest commanded

Air Force Program Executive Officer Structure in 1987

- Commander, Air Force Systems Command
- Commander, Air Force Logistics Command
- Commander, Air Force Communications Command
- Commander, Aeronautical Systems Division, AFSC
- Commander, Electronic Systems Division, AFSC
- Commander, Armaments Division, AFSC
- Commander, Space Division, AFSC
- Commander, Air Logistics Center Sacramento
- Commander, Air Logistics Center Ogden
- Commander, Air Logistics Center Oklahoma City
- Commander, Air Logistics Center Warner Robins
- Commander, Air Logistics Center San Antonio
- Deputy Chief of Staff for Science and Technology (S&T), AFSC

(All were PEOs for "designated executive programs" except the Deputy Chief of Staff for S&T, who was PEO for Science & Technology.)

Air Force Program Executive Officer Structure in 1991

- PEO Strategic Systems
- PEO Information Systems
- PEO Tactical/Airlift Systems
- PEO Space Systems
- PEO Command, Control, and Communications Systems
- PEO Tactical Strike Systems
- PM B–2 Bomber

Air Force Program Executive Officer Structure in 1993

- PEO Tactical/Airlift
- PEO Bombers/Missiles/Trainers
- PEO Conventional Strike
- PEO Space
- PEO Command, Control, and Communications Systems
- PEO Combat Support

Air Force Program Executive Officer Structure in 2000

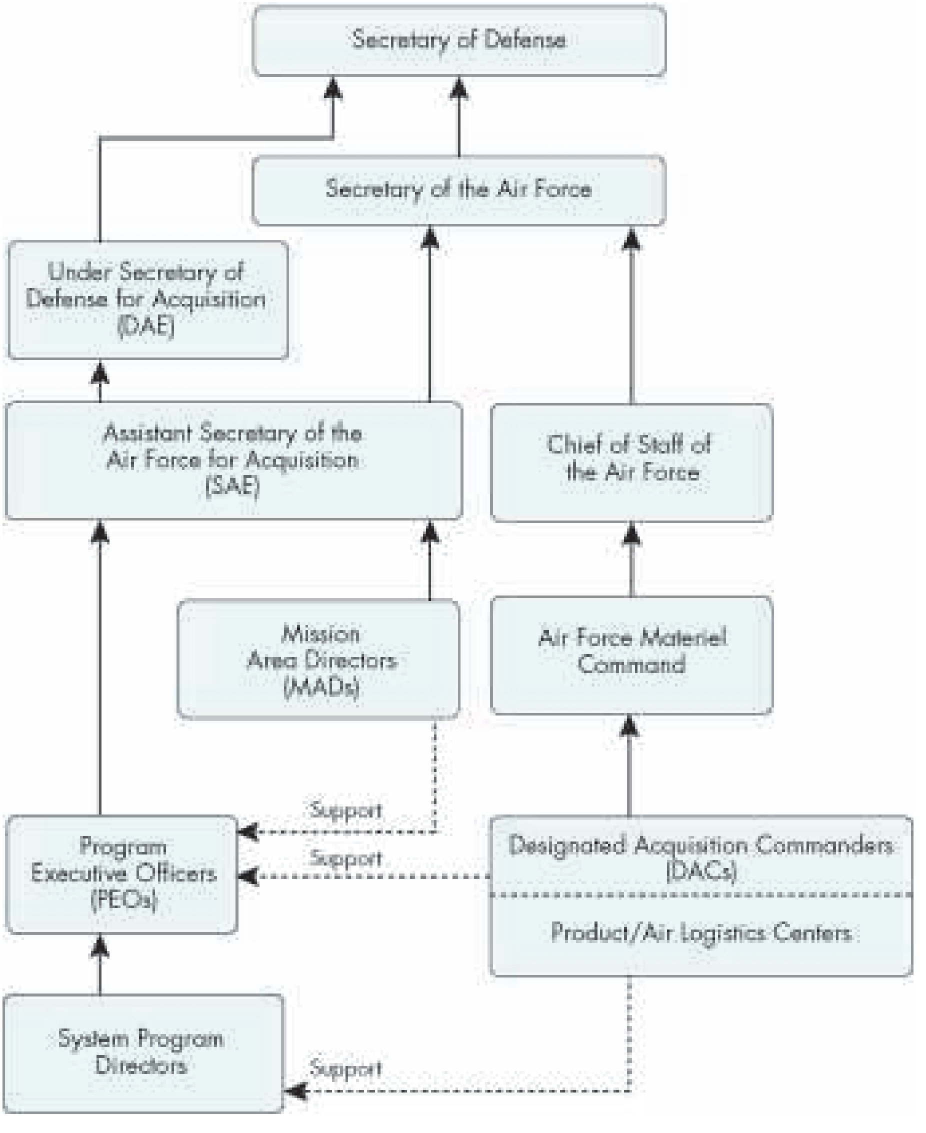
- PEO Airlift and Trainers
- PEO Fighters and Bombers
- PEO Logistics Information Systems
- PEO Space
- PEO Weapons
- PEO Command and Control[1]

AFSC product divisions or AFLC air logistics centers. All remained physically with their commands. The new reporting structure did not develop and process such key documents as acquisition strategies, sole-source justifications, or budgets. Instead, these activities remained the province of the field commands, primarily Air Force Systems Command. The General Accounting Office argued that the Air Force had created an organizational arrangement that provided the assistant secretary with more information about programs, but in which "the existing command chain retained much of the authority and control over acquisition matters."[7]

The findings of Defense Secretary Dick Cheney's Defense Management Review in 1989 were in sync with the GAO analyses. Its report forced the Air Force to reorganize further to strengthen civilian control of acquisition. In February 1990 the Air Force established a program director/program executive officer structure separate from the military command chain, with six full-time program executive officers overseeing 37 major programs. (The numbers of program executive officers would vary from six to eight over the decade.) The program executive officers were to have no other responsibilities, have a staff of their own, report only to the assistant secretary for acquisition, and relocate from the field organizations to the Washington, D.C. area to be closer to SAF/AQ and Congress. The reorganization removed from the acquisition reporting loop the chief of staff/Air Staff and the commanders of AFSC and AFLC (the two commands combined into Air Force Materiel Command in 1992) as well as the commanders of the product divisions and the air logistics centers (see figure 11-2).[8]

Although the 1990 reorganization was supposed to make the three-tiered system a direct and unambiguous reporting channel, the restructuring created two other sets of officials that diluted the chain's authority. The first were the designated acquisition commanders (DACs) who commanded Systems Command's product divisions and Logistics Command's air logistics centers. These officers, normally two- or three-star generals, were, in effect, the program executive officers for non-major programs classified as ACATs II through IV. But, significantly, they also provided support for the major programs. The second were the mission area directors (MADs), one-star generals who served on the assistant secretary's staff and were assigned one of four mission areas—Global Reach, Global Power, Information Dominance, and Space and Nuclear Deterrence. The mission area directors were responsible for the secretariat's input into acquisition planning and budgeting; helped integrate the Air Force's acquisition program; and prepared the Program Management Directive, a document that authorized every program, outlined its goals and parameters, and assigned responsibilities to key officials. They also coordinated on acquisition matters with the Air Staff, the board structure, and Congress, and assisted the program executive officers more with advice and help with external relationships than with material support (see figure 11-2).[9]

Figure 11-2: Air Force Acquisition Organization after 1992



DAE – Defense Acquisition Executive
SAE – Service Acquisition Executive

Source: Charles W. Pinney, "The USAF PEO/DAC/MAD Structure: Successful Pattern for Future Weapon System Acquisition?" *Acquisition Review Quarterly* 6, no.1 (Winter 1999): 25–29.

Neither the designated acquisition commanders nor the mission area directors were included in the three-tiered chain of command, yet they enjoyed substantial influence in the acquisition process. The designated acquisition commanders controlled the resources they provided to the system program directors and the program executive officers. They selected, assigned, reassigned, and—crucially—evaluated support personnel, and they decided the level of financial support for the program in such areas as salaries, equipment, and training. No doubt the system program director was always mindful of the DAC's power and worked hard to maintain good relations with that officer. In this way the designated acquisition commanders—and through them the Air Staff—could have a critical impact on programs. The mission area directors also provided support to the program executive officers. Although often less direct than that provided by the designated acquisition commanders—smoothing the way with the Air Staff or Congress, for example—the support was nonetheless important to the program. The MADs' involvement, however, could be a two-edged sword. In one instance, a program executive officer protested a proposed 50 percent staff cut and prepared a rebuttal for Congress, but the mission area director did not consider the reclama worth forwarding to the congressional staff. (Most of the cut was eventually recovered.) The mission area directors also had considerable authority over program budgets. Although the program executive officers controlled the current year's budget, with advice from the mission area directors, they were dependent on the latter and the board process for future funding.[10]

The officials involved in acquisition programs could usually avoid major problems by maintaining active and cordial relations with their counterparts; even so, overlapping responsibilities added to the confusion and difficulties that normally attended the transition to new organizational arrangements. Uncertainty regarding the nature of the PEO's relationship with the assistant secretary actually increased over time. This, in spite of the fact that Assistant Secretary for Acquisition John J. Welch Jr., in the 1990 memorandum chartering the program executive officers, had defined that relationship: "PEO organization is a field agency reporting to the AFAE [Air Force Acquisition Executive] and not part of the Assistant Secretary's acquisition staff." Initially, program executive officers did not perform staff work, coordinate on staff actions, or attend the assistant secretary's staff meetings; they were left free to focus on program responsibilities as the Packard Commission had intended. As the Air Force acquisition leadership changed, however, the new appointees did not seem to understand the role contemplated for program executive officers who found themselves performing staff duties.[11]

The post-Packard organizational changes had deprived Air Force Systems Command of much of its core mission of managing major weapon system programs. The 1990 reorganization restricted the command to managing relatively small programs as well as carrying out RDT&E in its laboratories and test centers. Although it still supported the system program offices, or SPOs, for major systems, it no longer controlled those organizations. Nevertheless, some program managers were uncertain whether SAF/AQ or AFSC was their real boss.[12]

Even before 1990, defense reformers had begun to call into question AFSC's viability as a separate major command, especially since the Air Force, like the rest of the Defense Department, was under pressure to reduce the size of its organizations and streamline its operations. In May 1989 Donald Atwood, the new deputy secretary of defense, was reported to be considering abolishing both Air Force Systems Command and Army Materiel Command. Anticipating action in that direction, the Air Force deputy chief of staff for logistics and engineering, Lt. Gen. Charles C. McDonald, and the commander of AFSC's Aeronautical Systems Division, Lt. Gen. John M. Loh, led a panel in summer 1989 to study the feasibility of merging Systems Command and Logistics Command. The panel recommended a merger, albeit with the warning that such a reorganization could cause major disruptions in the existing acquisition and logistics systems.[13]

Although some within the Air Force may have quietly supported a merger, AFSC and AFLC commanders opposed the change. General Alfred G. Hansen of Logistics Command expressed concern "that we will take an efficient logistics structure and destroy it to fix an acquisition function that really only needs fine tuning." General Bernard Randolph defended Systems Command with particular vigor—after all, the reorganization would amount to eliminating his organization and transferring its functions from Andrews Air Force Base to Wright-Patterson Air Force Base. He argued that Systems Command was needed to manage the huge acquisition support infrastructure and that its uniformed officers had operational experience civilians could not match: "If you begin to separate those people from that background, then . . . you do have to ask yourself why bother having any uniformed people at all." With reforms already in place and working, he maintained, new changes were unnecessary: "Anyone who says nothing is being done to reform the system already is either uninformed or has some other motive."[14]

The protests by the AFSC and AFLC commanders and actions they took to downsize and streamline their respective organizations were to no avail. The November 1990 draft of Defense Management Report Decision 943 proposed disestablishing Systems Command and moving its staff to Logistics Command. Deputy Secretary Atwood chose not to release the document, but Secretary of the Air Force Donald B. Rice agreed that the time was right for a merger. He permitted the organizations themselves and their new leaders, General McDonald of Logistics Command, recently promoted and reassigned from the Air Staff, and General Ronald W. Yates of Systems Command, to determine how to implement the complex undertaking.[15]

On 10 January 1991 Secretary Rice announced the decision to disestablish both commands and integrate their functions and personnel into a new organization, Air Force Materiel Command (AFMC). With respect to the change, Rice stated: "I want to emphasize . . . this will not be an absorption of either command into the other. In private business terms, this will be a double liquidation with a new company formed from the assets of the current commands." A few months later the acquisition functions of Air Force Communications Command were added as well. The combined organization would be located at Wright-Patterson but would include as many personnel as possible from Andrews. The merger began with the establishment of a provisional AFMC headquarters at Wright-Patterson in April 1991 and was largely completed by 1 July 1992, when Systems Command and Logistics Command were officially disestablished. General Yates became Materiel Command's first commander.[16]

The new organization was huge. Air Force Materiel Command controlled more than 50 percent of the service's budget, as well as over 100 programs, 10,000 aircraft, 32,000 engines, and 128,000 people. At the command's activation ceremony, General Merrill A. McPeak, the Air Force chief of staff, noted the obstacles that had been overcome in creating Materiel Command from Systems Command and Logistics Command: "Frankly, when we began the process of combining the commands, we were not sure we could do it. There were a lot of pitfalls, even some potential showstoppers. We decided to go ahead because we knew there would never be a better time."[17]

For the first time since early 1950, when Air Materiel Command lost its R&D functions to the newly established Air Research and Development Command, responsibility for the life cycle of Air Force systems was under one organizational roof. In the new Air Force Materiel Command, the in-house laboratories were responsible for technology exploration and application. The product centers were the home for system development for as long as "significant development or integration risks are involved." When such risks had subsided, the air logistics centers—charged with ensuring the "operational ability" of the fielded system—would take over control of system sustainment, maintenance, modification, and ultimately disposal.[18]

The handoff of a system from the product centers to the air logistics centers had occurred when the commands were separate. What was new was that the same program director's office would manage the system throughout its life cycle. This "single manager" concept was the critical element of the new management philosophy underpinning what Air Force Materiel Command called integrated weapon system management, or IWSM. The single manager—system program directors and "product group" and "materiel group" managers—was responsible for the life cycle of a weapon system, not later than Milestone I (concept demonstration approval) through its disposal. This cradle-to-grave management was intended to ensure that the system program office properly considered sustainment issues from the very beginning. When making critical trade-offs during the design phase that determined sustainment costs and effort, the single manager knew these early decisions would have consequences throughout the life of the system. As noted in *Integrated Weapon System Management*, an AFMC pamphlet, "It is no longer beneficial for developers to delay actions and decisions on sustainment and supportability issues." Cradle-to-grave management was also supposed to be seamless. Under the old arrangement, a fielded system was transferred from the system program office in Systems Command to a new office in Logistics Command, an often disruptive process known as Program

Management Responsibility Transfer. With Materiel Command there would be no such transfer, although the program office might move from the product center to a logistics center.[19]

The single manager was also known as the "single face to the user." The "customer," the product's end user, no longer had to work with a variety of offices for different problems. More importantly, the user did not have to deal with two organizations—often at the same time—in order to address acquisition and logistics issues. The same was true for industry. Now its representatives could work with a single office headed by a single individual who had the authority and the responsibility to address problems and make changes. This was especially important given that Materiel Command had adopted total quality management, with its emphasis on satisfying the customer.[20]

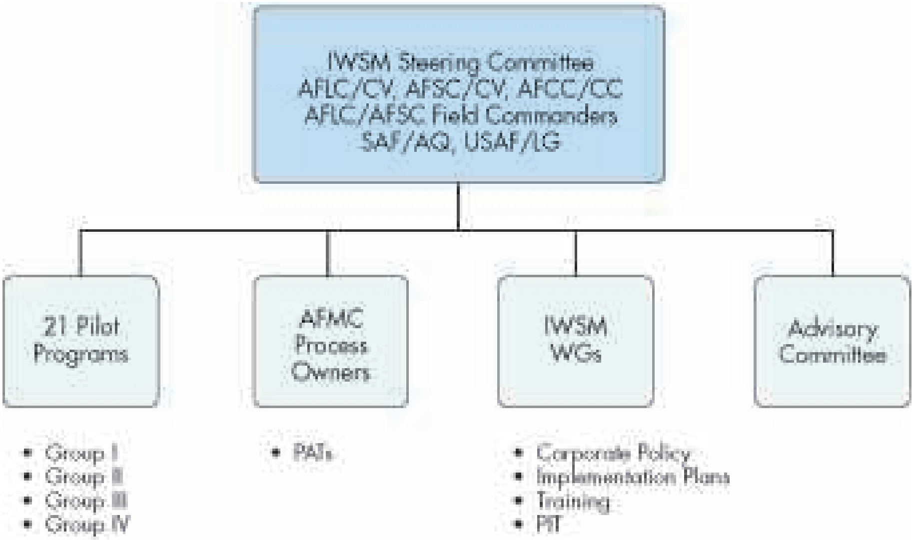
Integrated weapon system management grew out of the merger of Systems Command and Logistics Command and rolled out in two phases. The concept development phase, from January to March 1991, defined the management philosophy's basic precepts and established its integration objectives. In March the two organizations set up a joint executive committee, called the Integration Planning Team, to prepare for implementing IWSM. At this time, the Air Force selected 16 programs as pilots to experiment with the approach. The programs were divided into three groups depending on how quickly they could adopt the new philosophy. Later, a fourth group with five additional programs was added as Communications Command merged into Materiel Command. The programs spanned the spectrum of Air Force major systems—aircraft, communications, electronics, missiles, and space. They were at all levels of maturity, from the F–111, a program established in the early 1960s, to the Advanced Tactical Fighter program (the F–22) that began in the 1980s. Every product and logistics center was involved.[21]

During the second phase—process development—from April 1991 to July 1992, the pilot programs applied IWSM principles. The programs received general objectives but were not told specifically how to achieve them. Each program could decide for itself what approaches to take and which new procedures to adopt, thus providing the Air Force with a range of experiences to study. The programs reported on these experiences and the lessons learned.[22]

To monitor and oversee the experimentation with integrated weapon system management, the Air Force organized a team headed by a steering committee consisting of senior service acquisition officials (see figure 11-3). The pilot programs, AFMC "process owners," several IWSM working groups, and an advisory committee reported to the steering committee. Each process owner headed a process action team covering one of the following: program management, financial management, contracting, test and evaluation, technology insertion, logistics, system engineering, and requirements.[23]

Process action teams evaluated the approaches taken by the pilot programs in their respective functional areas and recommended new business methods to incorporate into the *Integrated Weapon System Management Implementation Guide*, first published in March 1993. Among the working groups was the Process Integration

Figure 11-3: IWSM Implementation Structure



AFCC/CC – Air Force Communications Command/Commander
AFLC/CV – Air Force Logistics Command/Vice Commander
AFMC – Air Force Materiel Command
AFSC/CV – Air Force Systems Command/Vice Commander
IWSM – Integrated Weapon System Management
IWSM WGs – IWSM Working Groups
PATs – Process Action Teams
PIT – Process Integration Team
SAF/AQ – Assistant Secretary of the Air Force for Acquisition
USAF/LG – Deputy Chief of Staff, Logistics, Air Staff

Source: Scott A. Dalrymple and Lester F. Pietraszuk, "An Investigation of Integrated Weapon System Management Implementation Issues" (master's thesis, Air University, Sep 1992), 18.

Team (PIT), chartered as a "clearinghouse" to coordinate new policies and findings produced by the process action teams and to integrate their recommendations in specifically assigned cross-process areas. Ultimately, the recommendations produced by the PIT, PATs, and pilot programs were compiled into the guide.[24]

Just as the combined acquisition and logistics organization depended on integrated weapon system management, so did IWSM depend on integrated product development, or IPD. In this new approach to acquisition, every aspect of a system's life cycle, including the processes used to acquire it, were considered during the design phase. However, IPD was also a philosophy for design of both products and processes by multidisciplinary teams, known as integrated product teams, or IPTs. The integrated product teams would take into account all phases of the product's life cycle, including development, manufacturing, and logistics support.

Integrated product development grew out of concurrent engineering, which itself was an element of total quality management. In contrast to concurrency, an acquisition approach, which overlapped development with production activities, concurrent engineering was "the integrated, concurrent [simultaneous] design of products and their related processes, including manufacture and support." In 1988 Under Secretary of Defense for Acquisition Robert Costello, responding in part to the release of the Packard Commission report, commissioned two studies of the concept. The Institute for Defense Analyses held a workshop to help define and explain it. The IDA report noted that concurrent engineering, with its use of interdisciplinary teams, "is intended to cause the developers, from the outset, to consider all elements of the product's life cycle from conception through disposal, including quality, cost, schedule, and user requirements." Meanwhile, a DoD/industry task force said that many of the department's acquisition practices would inhibit applying concurrent engineering. Based on these studies, Costello, who had ordered the department to adopt total quality management in its acquisition system (see chapter III), issued instructions in 1989 for implementing concurrent engineering. Over the next two years, additional studies by the Institute for Defense Analyses, the Defense Science Board, and others continued to flesh out the idea.[25]

Air Force Systems Command took an early interest in concurrent engineering, and a number of its programs experimented with and refined the concept. For example, the Advanced Tactical Fighter program employed an innovative management structure known as the Integrated Management System. Logistics Command also adopted elements of concurrent engineering when it reorganized its air logistics centers using the "product directorate" concept, a teaming approach. Air Force Materiel Command's implementation of integrated weapon system management called for the widespread adoption of concurrent engineering, now referred to as integrated product development. In a white paper in January 1992, General Yates stated that teams built on the IPD philosophy would be a guiding principle for Materiel Command. In November a command regulation introduced integrated product teams as a key element of integrated weapon system management. In January 1993 the command organized a steering committee and a working group to plan its IPD implementation. In March, the Space and Missile Systems Center at Los Angeles Air Force Base issued the *Integrated Product Development Implementation Guide* that sketched out how the concept could work. The next month Yates ordered AFMC to adopt IPD by 1 October. Soon after, the command published its own, expanded guide on the subject. This occurred well before 1995 when OSD directed the Defense Department to adopt the concept under the name integrated product and process development.[26]

Integrated product development was to apply to all elements of Air Force Materiel Command, to all of its products, and to all aspects of each product's life cycle. Integrated product teams dominated every aspect of acquisition and sustainment processes; an IPT could itself consist of several smaller teams working on a piece of the whole. The teams would include members of the functional elements representing the life cycle: managers, engineers, accountants, contracting officers, logisticians and maintenance experts, and so on. Any organization that had a stake in a program was represented. The extensive use of integrated product teams was expected to play a critical role in implementing the cradle-to-grave approach that could help integrate acquisition and logistics, the two communities then struggling to put integrated weapon system management into practice.[27] (For the application of IPD and IPTs to the floundering C–17 program, see page 378.)

DARLEEN DRUYUN AND ACQUISITION REFORM

The Air Force leadership gave strong and even enthusiastic support to the Clinton administration's acquisition reform program. The service had begun working to change its acquisition system even earlier, with initiatives such as integrated weapon system management and integrated product development. The service organized its first integrated product team in 1984. By 1995, when IPT use was mandated for all of DoD, the Air Force had already set up 21 teams, almost half of them working on the F–22.[28]

During the 1990s the Air Force's acquisition reform program would go well beyond what OSD called for, or other services attempted, largely because of Darleen Druyun, the principal deputy assistant secretary of the Air Force for acquisition and management. Her achievements in acquisition reform, however, would be overshadowed by the revelation soon after she left office in November 2002 that she had betrayed the public trust.

Druyun's nearly 10-year tenure as deputy assistant secretary began on shaky ground. Soon after taking up the post in February 1993, she was caught up in the C–17 contracting scandal. In January 1993 the DoD inspector general cited five Air Force uniformed and civilian officials, including Druyun, for improperly speeding up progress payments in 1990 to McDonnell Douglas in the C–17 program (see next section). At the time of the alleged wrongdoing, Druyun was the principal assistant to the deputy chief of staff for contracting at Air Force Systems Command headquarters and directly involved in the program. Although the Air Force's own investigation found no criminal violations by any of the five, at the end of April 1993 Secretary of Defense Les Aspin disciplined four of them, effectively ending their careers. Druyun alone survived. One likely reason is that she received support from General McPeak, the chief of staff, who personally appealed on her behalf to John Deutch, under secretary of defense for acquisition, attesting to her character and value to the service. McPeak also reminded Aspin of the Clinton administration's desire to have more women in leadership positions.[29]

Having escaped adverse consequences from the alleged C–17 contracting improprieties, Druyun went on to establish herself in the mid-1990s as the Air Force civilian official with the most influence on the service's acquisition program, particularly with respect to reform. Several factors accounted for her influence. She was a proven performer who had demonstrated exceptional administrative ability

Darleen A. Druyun, principal deputy assistant secretary of the Air Force for acquisition and management, 1993–2002. *(DIMOC)*

Darleen A. Druyun

From February 1993 through November 2002, Darleen Druyun was the principal deputy assistant secretary of the Air Force for acquisition and management. A hallmark of that near-decade of service was her effective leadership of the Air Force's acquisition reform program. After leaving the Air Force, however, she admitted to illegally favoring Boeing in contract awards for personal gain.

Born in November 1947 in Vallejo, California, Druyun grew up in central Georgia where her father was a civilian employee at Robins Air Force Base. In 1968 she earned a bachelor's degree in political science from Chaminade College in Honolulu, Hawaii. In June 1970 she began her Air Force career with a position as a contracts negotiator at Warner Robins Air Logistics Center.

For the next 30 years, Druyun ascended the professional career ladder. After two years at Warner Robins, she became chief of the Construction Purchasing Branch at Lackland AFB in Texas. Her next two assignments were as a procurement analyst at Air Force headquarters from 1973 to 1979 and as a contract clearance procurement analyst at Air Force Systems Command headquarters from 1979 to 1980. She then left the Defense Department for the position of deputy associate administrator for major systems and policy at the Office of Management and Budget. In 1982 she returned to Air Force Systems Command. At AFSC during the next nine years, she rose to become principal assistant, deputy chief of staff for contracting, and was the senior contracting civilian in the command. From 1991 to 1993, before becoming principal deputy assistant secretary of the Air Force for acquisition and management, she was associate administrator for procurement at NASA, and then the space agency's chief of staff.

In January 2003, two months after retiring from government service, Druyun went to work for Boeing. Following an investigation by the DoD inspector general, in 2004 she acknowledged using her position while in office to influence government contracts and was sentenced to nine months in prison.[II] in several executive branch departments and agencies. The NASA administrator thought so highly of Druyun he named her his chief of staff. But prior to taking up that position in 1992, she had been in procurement and contracting during her more than 20 years of civil service, including her first position at NASA, six years at Air Force headquarters in the 1970s, and more than a decade at Systems Command headquarters. When she returned to the Pentagon in early 1993, her considerable knowledge and experience in these fields earned her the respect of superiors and peers. She was also a team player, dedicated to Air Force institutions and priorities and a vigorous advocate of its major aircraft acquisition programs in the 1990s—the B–2 bomber, the C–17 transport, and especially the F–22 fighter. These systems together received nearly half of the service's RDT&E and procurement funding in FY 1996. Additionally, Druyun maintained a reputation for high integrity until after her departure from government service.[30]

For much of her tenure as deputy assistant secretary for acquisition and management, the position of assistant secretary—her immediate supervisor—was vacant, leaving her in charge of acquisition. In fact, when she returned to the Air Force secretariat in early 1993, the top posts for civilian officials in acquisition were still vacant. Sheila Widnall, the new secretary of the Air Force, would not begin serving until August 1993. She then had to wait for the better part of a year to obtain the other senior executives she needed in the secretariat. Only in May 1994—more than a third of the way through President Clinton's first term—did Rudy deLeon, most recently the staff director for the House Armed Services Committee, become Air Force under secretary and Clark G. Fiester become the service's acquisition chief.[31]

Assistant Secretary for Acquisition Fiester had been associated for 35 years with GTE Government Systems Corporation, eventually becoming a group vice president and general manager in its Electronic Defense Sector. He was a longtime friend of Secretary of Defense William Perry, who personally asked him to lead the

Clark G. Fiester, assistant secretary of the Air Force for acquisition, 1994–1995. *(NARA)*

Air Force acquisition reform program—the two had been undergraduates together at Penn State. Tragically, Fiester's tenure was cut short. On 17 April 1995 his Air Force C–21 Learjet crashed near Alexander City, Alabama, killing him and seven others. It would be nine months until Art Money, who had been vice president and deputy general manager for the TRW Avionics and Surveillance Group, was confirmed as his successor in January 1996. During the intervening period, Druyun was again in charge of Air Force acquisition, this time formally designated by Widnall as interim assistant secretary.[32]

After two years, in February 1998 Money accepted an appointment in OSD, and again the Air Force was without an assistant secretary for acquisition. In the meantime, Under Secretary F. Whitten Peters became acting secretary and took on the roles of Air Force acquisition executive and senior procurement executive. But, since Peters also continued to perform the duties of under secretary, he was stretched too thin. He delegated acquisition responsibilities to two officials in the Office of the Assistant Secretary for Acquisition, Druyun and Lt. Gen. George K. Muellner, and divided the duties of that office between them. They co-ran the office until Lawrence J. Delaney, an executive with more than three decades of experience in the private sector in high-technology program acquisition, management, and engineering, became assistant secretary in April 1999. While serving as the Air Force's acquisition chief, Delaney was simultaneously the service's chief information officer.[33]

Druyun stepped in to fill the void during each vacancy in the assistant secretary's post. When Widnall first arrived, she authorized Druyun to exercise the functions of the Air Force acquisition executive and the senior procurement executive. After Fiester's death, as mentioned previously, Widnall named her the acting assistant secretary for acquisition. Shortly afterward, she received a promotion, becoming the principal deputy assistant secretary for acquisition and management.[34]

At the end of May 1995, Druyun launched a series of bold acquisition reform measures called "Lightning Bolts." With Widnall's blessing, she also planned the reorganization of the secretariat's acquisition structure. In changes intended to increase the "synergy" between the program executive officers and their associated mission area directors, she modified the directorates to match the recently reorganized Air Force board structure and realigned the PEO setup so that each program executive officer correlated with a mission area director. She also created a new mission area directorate for Information Dominance and a new program executive office for Joint Logistics Systems. The reorganization was announced in fall 1995, just ahead of Art Money's arrival in January.[35]

When Acting Secretary Peters delegated his acquisition authority to his principal deputies at the start of the third vacancy in the assistant secretary position, following Money's departure in early 1998, Druyun was assigned by far her most important responsibilities: overseeing the PEO programs and contracting, acting as the source selection authority for all procurement actions requiring one at the secretariat level, and running all depot maintenance contracting. As the Defense Science Board task force noted in its report on Air Force acquisition management prepared after her downfall, Peters had "consolidated essentially all acquisition authorities, oversight, and management with Mrs. Druyun."[36]

Druyun's acquisition reform measures continued and expanded on initiatives set in motion by Assistant Secretary Fiester. Under his leadership, the Air Force planned roadshows to spread the word about reform (Fiester's fatal aircraft crash occurred while he was traveling to a roadshow event) and began publishing a newsletter, *News from AFAR* [*Air Force Acquisition Reform*]. More significantly for the future of acquisition reform, Fiester had selected four of the five pilot programs that the Federal Acquisition Streamlining Act authorized in October 1994: the Joint Direct Attack Munition, the Joint Primary Aircraft Training System, the Non-Developmental Airlift Aircraft (NDAA), and the Commercial Derivative Engine. (For the NDAA program, see the C–17 section below and chapter VII.) In keeping with the legislation, these programs did not have to comply with a number of laws and regulations. SAF/AQ then expanded the experiment by designating four Air Force Lead Programs: the Space Based Infrared System, Evolved Expendable Launch Vehicle, Wind Corrected Munitions Dispenser, and the Ground Theater Air Control System. For these programs, the Air Force could waive or modify any service rule, policy, or regulation, as long as the waiver did not violate any federal statute or affect operational test and evaluation. The lead programs were to use "experimental" management processes and document the results for future acquisitions.[37]

The Space Based Infrared System, designated an Air Force lead program in November 1994, reflected the new approach. It was given an accelerated timetable that forced managers to improvise and innovate. One way the system program office met the schedule was to combine all of the information required to win approval by the Defense Acquisition Board into one 39-page document known as the Single Acquisition Management Plan (SAMP). This information, which covered technical, budget, contracting, programmatic, and other issues, was normally contained in 17 different documents that could total as many as 1,000 pages, many of them redundant. Because Air Force and OSD staffs were heavily involved in preparing the SAMP, the system program office was able to reduce the number of program briefings it was required to give. Milestone I approval, allowing the program to enter the demonstration and validation phase, came from the board in only three months, a quarter of the normal time.[38]

After Fiester's death, Acting Assistant Secretary Druyun stepped in and drove the acquisition reform effort forward, or, as she sometimes called it, the "Acquisition Renaissance." In her view, acquisition reform was not a fad: "[T]here is the mindset that 'this too shall pass,'" she told the readers of *News from AFAR* in September 1995. "Let me assure you that 'this' will not pass!" She made the same point in a speech to the Air Force Association in October. "We are engaged in a significant culture change with respect to how we do acquisition," she noted. "We have to get rid of the old school of thought, which requires all of us to engage in what I would term guerrilla warfare battles, to fight those individuals within the system who refuse to change." She concluded her remarks with what would be her reform mantra (in use at NASA while she was at the agency): "It is time for each of us to join hands with the warfighter and become a warrior in the acquisition community with the battle cry, *better, faster, cheaper* [emphasis added]."[39]

Figure 11-4: Air Force Acquisition Reform Logo, 1996

Source: Druyun (presentation, American Institute of Aeronautics and Astronautics, Reston, VA, Oct 1996).

Druyun made it clear she fully supported OSD acquisition reforms and worked to see them implemented properly. On 22 June 1995 she reissued Secretary Perry's memorandum banning, with some exceptions, the use of military specifications and standards. "The Secretary of Defense, Secretary of the Air Force, and I are totally committed to military specifications and standards reform," she wrote in the covering memo. Because reducing the use of MILSPECs was as much a requirements problem as it was an acquisition problem, she worked with the Air Staff to form a common front on the issue. In September the Air Force assistant secretary for acquisition and the deputy chief of staff for plans and operations issued a joint message to the requirements community calling for streamlining and improving the focus of the Operational Requirements Document—the document that specified what the warfighters wanted—and reducing the use of MILSPECs. Druyun followed up with a memorandum to the acquisition community pointing out that "streamlining the ORDs attacks only one part of the problem." Users, she said, often put unnecessary detail into their requirements documents, fearing they would miss the only opportunity to have input into the acquisition process. For their part, acquirers have stoked this fear "by a 'just-tell-us-the-requirement-and-we'll-give-you-the-system' attitude"; they have also "encouraged users to add detail to their ORDs under the guise of 'firming up the requirements.' These cultural behaviors must change," Druyun warned. She directed the system program offices to ensure a "full participatory role" for the user on integrated product teams and to stop insisting on having complete, detailed specifications laid out in the Operational Requirements Document.[40]

In spring 1995 OSD directed the use of integrated product teams to streamline and accelerate program oversight and review. These multidisciplinary teams would work to resolve problems quickly and perform the oversight previously provided in time-consuming program reviews by stovepipe hierarchies of offices, committees, and boards. The Air Force made implementing the mandate a top priority. In support of the IPT initiative, Air Force Chief of Staff General Ronald R. Fogleman directed a reorganization—the Enhanced Air Force Corporate Structure—to take place by 1 November. The new organizational structure would rely heavily on integrated product teams, not just for acquisition but for all the functional elements at Air Force headquarters. Indeed, the service would essentially be run by such teams—71 in all.[41]

The acquisition community struggled to adapt the IPT concept to its programs. The Air Force had previously used teams selectively on a few programs such as the F–22. The model proposed by OSD—with each program having multiple teams—contrasted with the Air Force practice of using one working-level team for each program. It also ran counter to the intention of the Enhanced Air Force Corporate Structure to have a single integrated product team act as a focal point for any activity.[42]

To promote acquisition reform, Druyun continued the educational program begun by Fiester through the roadshows. They came in two rounds. Roadshow I was originally planned as 29 SAF/AQ briefings in spring 1995, one at each Air Force Materiel Command and user location, but was curtailed after Fiester's death and became instead a series of conferences with the senior staff, including program executive officers, designated acquisition commanders, and single managers. Roadshow II, which focused on training the frontline workers, began in summer 1995. At the same time, Druyun conducted Acquisition Renaissance workshops and conferences for the senior Air Force leadership. When it was pointed out to her that defense contractor employees needed information about acquisition reforms, she initiated joint Air Force-industry roundtables and workshops to help educate that community.[43]

Meanwhile, Druyun planned an even more ambitious program to advance acquisition reform. This program centered on her Lightning Bolts initiatives that would collectively overhaul much of the Air Force's acquisition process. "Each Lightning Bolt is a focused opportunity to harness the energy and talent of a dedicated group of individuals to meet a specific need for reform," she explained. "In the language of the warfighter, a Lightning Bolt is a combat operation with a set objective that rolls up to support the Acquisition Reform Campaign."[44]

Druyun announced the Lightning Bolts in her first policy statement as acting assistant secretary at a conference of Air Force program managers on 31 May 1995. There were initially eight Lightning Bolts; three more would be added by March of the following year. Some were activities that had begun earlier and were folded into this new initiative; others reflected the results of experiments conducted by the lead programs that were then to be applied to other programs. Druyun followed the announcement with a series of Acquisition Renaissance workshops for senior leaders, in which program managers, program executive officers, and secretariat staff worked out the goals and alternatives for each Lightning Bolt. Each bolt was then assigned to a team consisting of personnel from various organizations. The 11 Lightning Bolts covered much of the acquisition process and, taken together, represented a sweeping change. They included creating panels to review requests for proposal and acquisition strategies; preparing a plan for the overhaul of the Air Force Systems Acquisition Review Council and its replacement with the mandated integrated product team structure; and reviewing and canceling policies issued by Air Force Materiel Command product centers.[45]

Several Lightning Bolts merit more detailed discussion. Lightning Bolt No. 3 called for a 50 percent reduction in the personnel of system program offices—ideally no more than 140 for a major system in development and 50 for one in production. The team was to find a way to make the reductions by studying highly classified Special Access Programs, such as the F–117 stealth fighter, which often had streamlined management, and construct a model that could be applied to all major systems. The report, issued in November 1995, provided a set of guiding principles for system program directors, such as managing risk more aggressively, reducing oversight in favor of "insight" (i.e., using process metrics in decision-making), flattening the SPO's organizational structure, borrowing expertise instead of maintaining it in-house, and relying more on contractors. Of course, the prospect of making such reductions was upsetting to those involved, but *News from AFAR* noted that the plan would simply implement the cuts ordered by Congress.[46]

Lightning Bolt No. 7 aimed at taking the concept of the Single Acquisition Management Plan devised in the Space Based Infrared System program and adapting it for widespread application. In April 1996 the study team issued as its report a guide for preparing SAMPs, which were immediately made mandatory for all ACAT I and II programs. According to the guide, an integrated product team drawn from the Air Staff and OSD would prepare the SAMP, write the document at the "strategic" level, and provide guidance on how to carry out the acquisition. The SAMP was supposed to look forward to the entire acquisition cycle and not limit itself to the SPO's plan to reach contract award, as the existing documents tended to do. The switch to a SAMP was difficult because it was a new concept of program documentation that required new procedures. Many simply replaced the title "Acquisition Plan" with SAMP, without changing anything between the covers. When prepared properly, however, the SAMP worked well—so well, in fact, OSD also adopted the idea. Druyun reaffirmed the policy in 1997, and a new, more polished SAMP guide was published in 2001.[47]

By August 1996 all but the last three Lightning Bolts—the late additions—were marked *"Implemented!!"* in the periodic updates published by the secretariat. At this time Druyun was claiming a savings (more accurately, a cost avoidance) of $17 billion from four programs applying acquisition reform principles and techniques: the C–17, the Global Positioning System, JDAM, and the MILSTAR communications satellite program.[48]

In spring 1998 Druyun, again in charge of Air Force acquisition, began another imaginative reform program, the Air Force Acquisition and Sustainment Reinvention Process, which covered both acquisition and logistics. For maximum effect, she announced it at the opening of Acquisition Reform Week Three during a panel discussion with senior OSD and Air Force acquisition officials that was broadcast live by satellite to acquisition and logistics workers in government and industry. The idea was to create a disciplined process that would take acquisition reform ideas from the workforce and industry and develop them into workable, high-impact initiatives. The four-step process involved identifying new ideas, studying and developing those ideas to see how they might be made workable, testing the proposed sets of solutions (Innovation Packages), and deploying the Innovation Packages across the workforce, with heavy reliance on education and training.[49]

"Reinvention teams," similar to those working on the Lightning Bolts, but with a broader mandate, would perform the studies. Each team was located at a separate AFMC facility. The first four teams would study contract award cycle times, evolutionary acquisition, the consolidation of program elements, and cost as an independent variable in the requirements process with an emphasis on sustainment. Four more soon followed, covering commercial services, source selection, centralized sustainment contracts, and acquisition reform training. The teams were to focus on processes, people, and change management techniques, and were to provide a reform package that could be implemented directly.[50]

Governing this process was a more elaborate structure than had existed with the Lightning Bolts. An Acquisition Reform Core Team comprising representatives of headquarters, field activities, and industry would supervise the reinvention teams. The core team would review the reform ideas that had been submitted, integrate the various proposals as well as existing practices and reform initiatives, guide the reinvention teams, and recommend recognition and awards. Another group, whose members operated individually, was the Acquisition Reform Champions. They were mid-ranking officials—lieutenant colonels, colonels, and their civilian equivalents—from AFMC's product, air logistics, and test centers; from the other major commands; and from industry. These individuals would promote acquisition reform at their facilities, such as providing support to the reinvention teams.[51]

Finally, organizing and overseeing the work at the top level was the Acquisition Reform Leadership Council. This group was first chaired by Druyun, and then by Lawrence Delaney when he became assistant secretary for acquisition in late 1999. It consisted of other senior military and civilian officials in the Air Force as well as representatives of several industry associations. The council met for the first time in October 1998 and at least three more times the following year. By its first meeting, nine reinvention teams were already functioning and one, for total ownership cost, had been added. The council reviewed the status of the existing teams and studied ideas for others, depending on "which initiatives have the greatest payoff to industry, government, or both."[52]

By January 1999, when several teams were showing results, Druyun added to the mix by announcing a new round of lightning bolts called "Lightning Bolts '99." These were intended to complement reinvention team efforts by focusing on specific aspects of the broader subjects the teams were investigating. "After 3½ years," Druyun stated, "we've resolved many of the easier issues, and now this next round of Bolts takes on the tough areas of acquisition reform we've all talked about." There were seven new Lightning Bolts on topics such as alternative dispute resolution, improved payment procedures, and superior source selections.[53]

Appearing before a subcommittee of the Senate Armed Services Committee in March 1999, Druyun reported on the Air Force acquisition reform effort. Her long statement was full of specific achievements, including a 50 percent reduction in the average length of requests for proposal, elimination of more than 6,000 pages of acquisition policy, replacement of the Air Force Systems Acquisition Review Council with a review structure based on integrated product teams, adoption of the Single Acquisition Management Plan, and major personnel reductions in program offices. Druyun claimed that every Air Force program had successfully implemented the Lightning Bolts and other aspects of acquisition reform that had yielded cost and manpower savings and cost avoidance. She illustrated how several major programs, including the Advanced Medium Range Air-to-Air Missile, the C–17, the Evolved Expendable Launch Vehicle, GPS, the Joint Air-to-Surface Standoff Missile, and JDAM, had implemented the reforms and achieved those results. With the reinvention teams going strong and new Lightning Bolts on the way, acquisition reform was moving ahead in the Air Force.[54]

With the departure of the Clinton administration and the arrival of leaders who were not impressed with her, Druyun's influence diminished. Marvin R. Sambur, the new assistant secretary for acquisition and former president and CEO of ITT Corporation's defense sector, accused her of hoarding information, keeping her decision-making a secret, and awarding no-bid contracts without telling him. In March 2002, with the full support of Secretary of the Air Force James G. Roche, Sambur cut down her contracting authority and her ability to make decisions autonomously, prompting her decision to retire in November.[55]

By the late 1990s a general sense emerged, as one SAF/AQ staff briefing put it, that there was no more "low hanging fruit" in acquisition reform. The easier tasks had given way to problems that were far more complex. Other vital reforms, such as the application of market analysis and price comparison on complex or unfamiliar commercial technologies, would require greater efforts.[56]

THE C–17 GLOBEMASTER III: A TROUBLED PROGRAM REVERSES COURSE

Few programs in the 1990s so strained the existing acquisition system, and so highlighted the need for reform, as the Air Force's C–17 four-engine jet transport. Following the cancellation of the Navy's A–12 Avenger II attack aircraft, the C–17 Globemaster III attracted scrutiny as one of the most expensive military acquisition programs then experiencing a combination of delays and cost overruns. Between 1990 and 1994 the program, which began in 1979, was nearly terminated, destroyed the careers of several uniformed officers and civilian acquisition professionals, and triggered billions of dollars in losses for the contractor, McDonnell Douglas. At the end of 1993, OSD, the Air Force, and the contractor focused on turning the program around in an intense effort that included the application of acquisition reforms. Within two years, the C–17 was operational and the Defense Department had decided on full production.[57]

The high-wing, high-tailed C–17 originated in a series of plans for greater airlift capacity. In the early 1970s the Air Force solicited proposals for an improved theater-level cargo aircraft, the AMST, or Advanced Medium STOL Transport, to replace the aging, propeller-driven C–130 Hercules. From among the designs submitted, the Air Force awarded contracts to Boeing and to McDonnell Douglas to build two prototypes each, but the program was later canceled with no selection made. By the late 1970s the Air Force, at the prodding of Secretary of Defense Harold Brown, began exploring ways to increase its strategic airlift capability as part of the broader U.S. commitment to defend Western Europe. These studies, also influenced by Army requirements, eventually concluded that the United States needed approximately 66 million ton-miles of airlift capacity per day in the event of a general war in Europe. With some of its transports beginning to show their age, the Air Force raised concerns about an approaching "airlift shortfall." In December 1979 the service began developing a new transport, known as the C–X (the C–17), to address the problem.[58]

When work began on the C–X, two aircraft, the C–141A Starlifter and the C–5A Galaxy, made up the U.S. strategic airlift fleet. Entering service in 1965, the C–141 had been used extensively in the Vietnam War. In the late 1970s, the Air Force began to modify the aircraft by adding aerial refueling capability and increasing its payload to almost 66,500 pounds (transported 3,000 nautical miles unrefueled) by "stretching" (extending) its fuselage. Even so, the modified aircraft, the C–141B, could not operate from unpaved airfields as could the C–130 or, like the C–5, carry

Lockheed C–141B Starlifter (foreground) and Lockheed C–5A Galaxy. *(U.S. Air Force)* "outsize" cargo such as tanks, other armored vehicles, and large helicopters. The C–5 became operational in 1970 in time for Vietnam service after a near disastrous development period that began in 1964 and resulted in the government's absorbing huge cost overruns incurred by the aircraft's manufacturer, Lockheed. The giant Galaxy was almost 250 feet long with a wingspan of nearly 225 feet; it could transport as much as 261,000 pounds, including outsize cargo. But the C–5's size and weight (more than 750,000 pounds maximum gross takeoff weight) limited its airfield access: it required long, wide, reinforced concrete runways that could accommodate the almost one-half length of a football field it needed to turn around. Airfields capable of accommodating the C–5 were generally farther away from the likely front lines, necessitating a secondary, in-theater transport capacity over land or in the air to bring supplies to forces in the field.[59]

The need for greater airlift capacity and the limitations of the C–141 and the C–5 influenced the performance requirements of the C–X. Through 1979, Air Force Logistics Command and Military Airlift Command developed the underpinnings for the program in a Preliminary System Operational Concept (PSOC). The concept envisioned an airlifter capable of accepting outsize cargo up to 130,000 pounds, the equivalent of three infantry fighting vehicles or one M1 Abrams tank (then entering production). The aircraft would also straddle the intertheater and intratheater roles—it would be able to fly 2,800 nautical miles carrying a 100,000-pound payload without refueling, and land and take off from austere, even unpaved, airfields of 3,000 feet or less, unlike the C–5, which required 5,000 feet of runway. Secretary Brown's review of the PSOC in 1980 prompted a number of adjustments to extend the range requirement under various conditions and advance initial operational capability, or IOC, to 1985 from 1987. Though the C–X program claimed to seek low-risk technology solutions to speed development and quickly address the airlift shortfall, the earlier IOC date would force more concurrency into the program.[60]

Designing a new aircraft from scratch, even if proven technologies were used and all went well, was still an expensive proposition. The airlift shortfall might also arrive sooner than anticipated due to accelerated retirements of C–141s or program delays. Thus, for the next decade and a half, officials at almost every level of government and numerous studies would question the need for the C–X/C–17 and examine potentially cheaper alternatives that could be delivered faster. In response, program managers, Air Force Logistics Command, and Military Airlift Command would argue that no alternative could meet the combined requirements for outsize cargo capacity, austere airfield operation, and intratheater delivery capability. As each alternative, regardless of its comparative cost, came up short on one or more of these counts, Air Force officials would have the justification necessary to inch the C–X/C–17 program further along.[61]

In 1980 the Defense Department struggled to establish funding to initiate the program. Estimating a $12 billion acquisition, the Air Force requested $80 million for fiscal year 1981. Despite several efforts by the House Armed Services Committee to eliminate the funds, Congress eventually provided $35 million, with assurance from DoD that legislators had not signed on to a multiyear program likely to cost tens of billions of dollars, and that congressionally mandated studies would consider all possible options for meeting airlift requirements. This early position established a pattern that would repeat over the next decade when it came to congressional funding—provision of only limited funds and a refusal to sign off on a full-fledged program, but without ever coalescing around an alternative.[62]

Meanwhile, C–X selection continued, with competitors making their final sales pitches in January 1981 and the Air Force announcing its choice in August. Boeing and Lockheed both promoted derivatives of existing designs, Boeing of its commercial B–727, and Lockheed an upgraded version of its C–141. Air Force reviewers found Lockheed's offering to be lackluster. Also, the company's simultaneous advertising and lobbying campaign promoting acquisition of additional C–5s seemed to indicate that Lockheed did not fully embrace Air Force plans for a new aircraft. McDonnell Douglas, however, proposed a substantially upgraded design of its YC–15, the prototype it built for the canceled AMST program in the early 1970s. Douglas Aircraft Company, the corporation's commercial aviation division, would develop the proposed plane. Traditional Air Force resistance to using derivative commercial designs and Lockheed's apparent indifference to the contest left McDonnell Douglas as the most credible remaining competitor and the eventual victor. Formally designating it the C–17, the Air Force expected the aircraft to make its first flight in 1985 and achieve initial operational capability in 1987.[63]

This schedule would not be realized. After the Air Force announced its selection of McDonnell Douglas, Lockheed submitted an unsolicited proposal for an upgraded C–5, the C–5B, to supplant the C–17 program and lobbied directly with Richard DeLauer, the under secretary of defense for research and engineering, for his support. The company contended its proposal would satisfy airlift requirements more quickly, at lower cost, and with reduced developmental risk. These arguments eventually persuaded the DoD leadership. In January 1982 Deputy Secretary of Defense Frank Carlucci, supported by Secretary of Defense Caspar Weinberger, chose to purchase 50 Lockheed C–5Bs. For the next four years, the C–17 continued as an R&D program. During this time the program, both on the Air Force side and the company side, lost personnel with crucial knowledge and skills.[64]

In 1983 the Air Force completed a series of studies and plans that identified the optimum mix of airlift aircraft for the next 15 years. Their conclusions revalidated the requirement for the C–17: Only the combination of outsize cargo capacity, austere airfield capability, and intratheater transport could adequately meet the military's requirements. According to these plans, as the Air Force retired or transferred C–130s and C–141s to the Reserve, it would procure up to 210 C–17s by 2000, at a life-cycle cost of over $33 billion. Program delays had nullified the original pricing of the C–X contract, which, consequently, would require renegotiation.[65]

During the period of low-level R&D, C–17 advocates marshaled support for the program inside the Air Force and with the other services, OSD, and Congress. In February 1985, based on the recommendation of the Defense Systems Acquisition Review Council, Secretary Weinberger approved the program for Milestone II, unlocking funding for full-scale engineering development. Then, on 31 December, the Air Force awarded McDonnell Douglas a $3.4 billion fixed-price-incentive contract for the C–17, officially beginning full-scale engineering development. This contract, and others associated with numerous subsystems, envisioned a Milestone IIIA decision on low-rate initial production in October 1986 and IOC in January 1992.[66]

In the next several years the C–17 program achieved important objectives—approval in 1987 to fund the first two aircraft, completion in 1988 of critical design reviews, and approval for low-rate initial production in January 1989, just before the George H. W. Bush administration took office. Still the C–17 continued to face funding uncertainty, especially with opponents in OSD, like Robert Costello, the under secretary of defense for acquisition, criticizing the aircraft. Additionally, problems with the system itself emerged during full-scale engineering development. Two of these—software development and weight control—were responsible for cost growth and schedule delays that threatened the program.[67]

The C–17 program depended on successful computer software development. The aircraft's subsystems contained 19 embedded computers incorporating 80 microprocessors and 1.3 million lines of code "in almost every computer language known at that time." McDonnell Douglas, the prime contractor and subsystems integrator, however, lacked experience in managing large-scale software development and integration. These deficiencies became apparent in development and integration of the aircraft's complex avionics suite, especially its flight control system and its mission computer. The company's decision to change from a combination of hydro-mechanical and electronic flight controls to a primarily "fly-by-wire" system exacerbated the software development problems. Bush administration officials in 1989 discovered a software backlog of hundreds of thousands of lines of code, and the company admitted it might not have a fully functioning flight computer ready for use until the 20th aircraft came off the line.[68]

In addition to software development problems, the C–17 program encountered difficulties managing the aircraft's increasing weight. In the original contract signed in 1982, McDonnell Douglas projected the C–17's empty operating weight to be 236,000 pounds; five years later, after new requirements necessitated changes to the aircraft's design, that estimate had increased by 17 percent to 276,000 pounds. An engineering team comprising representatives from the C–17 program office, Military Airlift Command, and McDonnell Douglas eventually identified over 16,000 pounds of possible weight savings. The weight reduction campaign strained the relationship between the Air Force and the contractor. At one point, the Air Force suspected the company of saving weight by using cheaper, less-effective components in the aircraft's cargo rail system. In other cases, the company refused to implement certain changes without a contract modification or a reduction in performance requirements. The fixed-price contract, which did not provide compensation for unanticipated development difficulties or design changes, exacerbated these pressures and heightened suspicions on both sides. The sheer scope of the modifications and the high visibility of the program also may have contributed to the antagonistic relationship. As a result mainly of changes necessary to bring the aircraft's weight under control, by August 1988 the estimated life-cycle cost of the program had risen by $747 million over the 1980 baseline.[69]

The problems besetting the C–17 made it an attractive program to cut as Secretary Cheney considered how the Cold War's end would alter defense requirements. In April 1990 he announced that changes in military requirements as a result of the collapse of the Warsaw Pact permitted the military to reduce its strategic airlift capacity from the previous 66 million ton-miles per day to 48 million ton-miles. Accordingly, Cheney reduced the C–17's total procurement from 210 to 120 aircraft. The practical effect of this decision was to increase the aircraft's unit price, but reduce the program's life-cycle cost.[70]

The secretary's action was the first among decisions and revelations spanning several years that reflected dissatisfaction with McDonnell Douglas's performance. His cancellation of the A–12 Avenger in January 1991 left a gaping hole in McDonnell Douglas's balance sheet. In civilian markets, Douglas Aircraft increasingly lost ground to Boeing, leaving few possibilities for the company's return to profitability.[71]

The C–17 might have been a path to recovery for McDonnell Douglas, but, like the A–12, the airlifter was in trouble. The C–17 program's most persistent difficulties involved management and organization. Plant visits and interviews with managers at Douglas Aircraft revealed a program in a state of neglect, with management incapable of performing as required but seemingly unable or unwilling to recognize this and right itself. Senior managers showed little interest in the program. The company's inefficient and outdated manufacturing processes also contributed to the problems. With corporate balance sheets stretched to the limit, officials found the program understaffed to meet its schedule. Integration and coordination, both within the company and with subcontractors, were also inadequate. For example, hundreds of hours were routinely wasted as workers waited for specific items, and with little effort to limit redundancies. Attempts to remedy these problems by reorganizing or using new quality standards held out some hope for success, but implementing the measures threatened serious delays as employees and managers had to re-learn their jobs under the new systems. Air Force managers opened a satellite program office near McDonnell Douglas headquarters to provide better oversight, but improving government-contractor coordination could only go so far when intra-company coordination was so poor. Under pressure, McDonnell Douglas optimistically set a first-flight date throughout 1990 and 1991, but the flight did not take place until 15 September 1991. For the Air Force, the repeated schedule slips reflected a lack of realism by company management.[72]

As the problems snowballed, they attracted congressional scrutiny, and the C–17 became a target for House and Senate dissatisfaction with the acquisition system. In October 1992, a C–17 wing snapped, well shy of its load-bearing requirement, providing a high-profile issue on which congressional committees could focus. The wing failure was the capstone to a stream of program difficulties from the previous months, including significant shortfalls in range and payload capabilities. McDonnell Douglas's preferred approach to fixing these deficiencies was to reduce

A C–17 Globemaster III, the T–1 flight test aircraft, takes off from Douglas Aircraft facilities at Long Beach, California, on its first flight, 15 September 1991. *(National Museum of the U.S. Air Force)*

the stated requirements, much to the chagrin of Air Force officials. Two Democratic representatives, John Conyers of New York, chairman of the House Government Operations Committee's Subcommittee on Legislation and National Security, and John Dingell of Michigan, chairman of the House Energy and Commerce Committee, both began investigations into the company's conduct. In part, as a result of these hearings, Congress again limited the first several production years to only a few aircraft each, embargoing a portion of the funds until the Defense Department submitted reports on alternatives, contractor performance, and plans for addressing the program's deficiencies.[73]

In January 1993 the C–17's problems culminated with a DoD inspector general report that put the program, and the nascent Clinton administration, to the test. At the request of Conyers, the inspector general had conducted an investigation into certain payment irregularities that occurred during the final months of 1990, at a time when McDonnell Douglas, as it was later discovered, was near bankruptcy. The report claimed that from August to December 1990, senior Air Force uniformed and civilian officials conspired to accelerate contract payments to Douglas Aircraft in order to avert bankruptcy, conceal the true state of the company's finances, and prevent a total work stoppage on the C–17 program. The officials supposedly had advanced more than $400 million in inappropriate payments, and then concealed the irregularity of those payments from oversight agencies and investigators. The report also indicated that McDonnell Douglas issued debt and securities based on assumptions and assurances that the C–17 program and Douglas Aircraft in general were healthy. These irregularities prompted the Securities and Exchange Commission to launch an investigation of McDonnell Douglas executives, in addition to the one the Air Force was conducting of its own personnel.[74]

The scandal was the nadir for the C–17 program. Congressional hearings followed release of the DoD inspector general's report, but the Air Force resisted the scrutiny. Because its own investigation was ongoing, the Air Force refused to make the accused officials available for testimony. McDonnell Douglas CEO John F. McDonnell likewise initially declined to testify. Subsequent Air Force and OSD investigations exposed problems in the IG report's interpretation of the regulations. Also, the report was not a full-fledged investigation, but only an "administrative inquiry," as a result of a congressional request, a classification that substantially lowered its standard of evidence. The Air Force investigation concluded that the conduct of the officials, while atypical, accorded with acceptable management practices and the law, a position which found favor in much of the acquisition community and OSD. As the public debate and dueling investigations delved into disputes over the interpretation of acquisition regulations, Clinton administration leaders, especially incoming Defense Secretary Aspin, realized that an inspector general's allegation of illegal activity did not necessarily mean subsequent litigation would breeze through the courts.[75]

Recognizing the scandal's potential to derail his agenda only weeks after he took office, Aspin acted quickly to discipline the Air Force officials. The inspector general's report had cited the conduct of five government officials as improper, but not criminal. All of these officials had since been promoted or moved on to other projects: Maj. Gen. Michael J. Butchko Jr., the C–17 program director in 1990; Lt. Gen. Edward P. Barry, the program executive officer; Brig. Gen. John M. Nauseef, the deputy chief of staff for financial management at Air Force Systems Command; A. Allen Hixenbaugh, the C–17 program's civilian deputy director for contracting; and Darleen Druyun, then Air Force System Command's senior civilian contracting official. Aspin ordered that Butchko be relieved of his current duties and prohibited the others involved, save Druyun, from working in acquisition-related fields in the future. Justifying his actions, Aspin held the officials responsible for management failures in the C–17 program and for their attempts to cover them up: "I must insist that program leaders understand their responsibilities to identify, early and forthrightly, significant program difficulties. Clearly, this was not done in the case of the C–17."[76]

While these disciplinary actions gave the Defense Department and the Air Force time and political space to determine a way forward, the C–17 program was still years behind schedule and billions of dollars over budget. Representative Norman Sisisky (D-VA) ably summed up the dilemma facing Congress during a House Armed Services Committee hearing in May 1993: Canceling the program would be self-defeating, as the United States needed greater airlift capacity. A new program would force the Defense Department to start from scratch, wasting money already invested and causing "a financial disaster of unparalleled proportions." Yet, if the contractor went unpunished, the message would go out that contractors would never be held accountable for poor performance. "I think we will be taken to the cleaners, because we will be asking to be taken to the cleaners," he concluded.[77]

After the low point of the payments scandal, the Defense Department and McDonnell Douglas began to turn the C–17 program around. John Deutch, who became under secretary for acquisition early in April 1993, took the lead in sorting out what to do with it. At a Defense Acquisition Board meeting at the end of the month, Air Force officials maintained that the program had improved; significant technical and schedule problems were in the past. Deutch was not convinced. In May and June, in testimony to Congress, he described the program as "very troubled." On 11 May, in a letter to John McDonnell, he wrote that if the company did not meet contract requirements, "the C–17 program could not be continued." At the same time, he established a Defense Science Board task force to carry out a comprehensive review of the program. An Institute for Defense Analyses study, requested by Congress, would also be part of the assessment.[78]

The Defense Science Board and the Institute for Defense Analyses produced reports in December 1993. Balancing cost against the ability to meet requirements, both reports concluded that while an all-C–17 force was ideal, the next best arrangement would involve a mix of several dozen C–17s and commercial wide-bodied cargo aircraft. These reports gave Deutch realistic fallback positions if the cost of a full C–17 program proved politically unsustainable.[79]

In light of the two reports, and the Defense Acquisition Board review, Aspin announced in December that the department would commit to procuring only 40 C–17s, down from 120. If, within two years, McDonnell Douglas managed to right the program, the government would consider purchasing more. If not, the Air Force would instead procure another, cheaper design as a "good enough" solution. The 40 C–17 buy would ensure some outsize cargo and austere airfield capability, which no commercial design could achieve, while meeting the remainder of the airlift requirement with a more cost-effective option.[80]

The new options strengthened Deutch's hand in negotiations with McDonnell Douglas over the future of the program. The company could continue to grind out 40 overpriced, underperforming aircraft, but these would likely be the last C–17s ever produced. Conversely, its senior management could refocus on producing C–17s on time, and without further cost overruns, in order to potentially win additional orders. In January 1994 Deutch proposed a take-it-or-leave it settlement that grew into an "omnibus agreement" codifying the steps both contractor and government would take to ensure the program's success. In this agreement, McDonnell Douglas would forsake all of its claims, approximately $1.25 billion, against the government for out-of-scope work (work not included in the original contract terms). Under the fixed-price contract, overages triggered by government-initiated changes were not McDonnell Douglas's responsibility. As cost overruns mounted, the contractor made claims for hundreds of millions of dollars that the government could only dispute through litigation. Under these conditions, relations between the company and the C–17 system program office had deteriorated to the point that each routed communications through their respective attorneys, creating a management environment described as "extremely negative" by the Defense Science Board C–17 task force. In exchange for the company's dropping its claims, the government would pay the company an additional $348 million to complete engineering development and flight testing and reduce certain performance requirements. Finally, McDonnell Douglas agreed to management changes and to investing an additional $456 million of its own money into improving its flight testing, systems engineering, transition to production, and manufacturing, including the purchase of a computer-aided design and manufacturing system.[81]

Even before the Defense Science Board published its report and the omnibus agreement was signed, changes were underway to strengthen C–17 program management. Over summer and fall 1993, the Air Force replaced both the C–17 program executive officer and program director with officers who had recently managed successful weapon system programs. Brig. Gen. James S. Childress, who spent almost two years as director of the F–15 program, became the C–17 program executive officer, and Brig. Gen. Ronald Kadish, with three years' experience as program director for both the F–15 and F–16, took over the C–17 system program office. McDonnell Douglas also infused the program with new leadership. John McDonnell announced he would move some of his best managers to the program, along with 100 new engineers and 50 more information technology workers. Early in

Lt. Gen. Ronald Kadish, Air Force C–17 program director. *(NARA)*

Lt. Gen. Ronald T. Kadish

When then-Brigadier General Kadish took over the C–17 system program office in October 1993, his experience, education, and training made him a logical choice for the job. Entering the Air Force in 1970, he became a pilot, flying primarily the C–130 transport. In addition to his operational tours, he had served in numerous acquisition posts—four years, including one as director, in the F–16 fighter SPO; a year in the B–1 bomber SPO; two years directing the F–15 fighter SPO; and four years in acquisition staff positions, including a year as the military assistant to the secretary of the Air Force for acquisition. His education and training reinforced his acquisition on-the-job experience—a master's degree in business administration, a year in the Air Force's Education with Industry program (with Vought Corp.), and degrees from the Industrial College of the Armed Forces and the Defense Systems Management College. Kadish concluded his Air Force career with assignments as commander of the Electronic Systems Center and finally as director of the Defense Missile Agency. Following his retirement in 2004, he became an executive with Booz Allen Hamilton.[III]

Donald Kozlowski, C–17 program director at McDonnell Douglas.

Donald R. Kozlowski (1937–2015)

When selected in December 1993 to direct McDonnell Douglas's C–17 program, 55-year-old Don Kozlowski had been with the company for more than 30 years. Educated in electrical engineering, with a bachelor's degree from St. Louis University (1959) and a master's degree from Washington University in St. Louis (1968), he spent his first decade with McDonnell Douglas working in avionics, then shifted in 1982 to aircraft design as the chief engineer for the F–15E Strike Eagle fighter program. In 1987 he went into program management. When named vice president and general manager for the C–17, Kozlowski had already run several programs for the company, including the YF–23, its prototype entry in the Air Force's Advanced Tactical Fighter competition; the Navy's F/A–18 C/D; and the high-speed civil transport. Kozlowski headed the C–17 program for just over three years, retiring from Boeing in September 1997 (after its merger with McDonnell Douglas in July) as senior vice president of military air transport aircraft. He then engaged in aerospace management consulting. In 2002 Kozlowski received the Alumni Achievement Award from the Washington University in St. Louis School of Engineering and Applied Science.

After Kozlowski's death in 2015, retired Lt. Gen. Ronald Kadish, Kozlowski's Air Force counterpart in the C–17 program, wrote: "I first met him when he was assigned to the C–17 program at McDonnell Douglas—a difficult time for the program and for each of us as leaders of the program. He was a great leader and technical giant in the industry. He was personally responsible for the success of that important program."[IV]

December, Donald R. Kozlowski, who had managed five major programs in 30 years with McDonnell Douglas, became the company's C–17 program director.[82]

Brigadier General Childress developed the Pentagon's plan to put the program on a course justifying full production and deployment (Milestone III) by November 1995, the deadline announced by Secretary Aspin. For high-level program oversight and issue resolution, the plan provided for the already established quarterly meetings between the secretary of the Air Force and the CEO of McDonnell Douglas to continue. A "Milestone III Steering Committee," chaired by Rudy deLeon, the under secretary of the Air Force, and including representatives from OSD, would also meet quarterly. To make credible DoD's intention to be ready with an alternative to the C–17, Childress drew up a plan integrating the schedules for the two programs.[83]

In its report, the Defense Science Board recommended that the C–17 program adopt integrated product development, integrating program activities from product concept through production and field support. At that time, as described earlier in the chapter, the Air Force was already pioneering integrated product development within the Defense Department. In fact, before the board's report was published in December 1993, McDonnell Douglas had agreed to implement IPD management. Although acknowledging the company's steps toward that end, the Defense Science Board judged them to be "immature." Given the inherent difficulty in adopting a new management approach with system development nearing production, along with the record of poor relations between McDonnell Douglas and the C–17 SPO, it is not surprising that the company had not made much progress.[84]

The Defense Science Board also called for setting up integrated product teams, the foundation of integrated product development, in the C–17 program. IPTs would comprise functional specialists from various program areas (e.g., design engineering, systems engineering, manufacturing, logistics support, finance) and from both the contractor and the government, including representatives of different organizations within the latter. The teams would address important program activities or problems, such as master planning, affordability, and manufacturing, and would shift the traditional emphasis on separate functional processes to a greater focus on the product as a whole. The IPT concept also empowered team leaders to make on-the-spot decisions on their own. This, along with the multidisciplinary nature of the teams, made it more likely that problems would come to light sooner and be resolved more quickly.[85]

Working together, Kadish, the system program office director, and Kozlowski, the company's program director, set out to implement the integrated product development approach recommended by the Defense Science Board. They formed integrated product teams organized around C–17 product-related areas and gave team leaders the authority to make decisions relative to program execution. Jay Kappmeier, a McDonnell Douglas logistician in the C–17 program, described the impact of the IPTs: "Once the teams formed, there was a feeling among all of us that we have to have a quality product before it goes to the next step. Problems were solved at a lower level instead of passing them back and forth. We started talking instead of writing memos. Not only did the organization charts change, the whole culture changed." Together, the C–17 SPO and the contractor prepared a master plan to fix the program that included milestones and schedules integrated through the working level, set up joint configuration control, established a reporting system that consolidated issues and tracked actions, and instituted quarterly executive program reviews.[86]

The close working relationship between McDonnell Douglas and the C–17 system program office was replicated between the company and the Defense Contract Management Command office at the C–17 plant in Long Beach, California. As did the contractor and the SPO, the Contract Management Command's office, headed by Air Force Col. Eugene E. Kluter, reorganized along product and process lines.

This change, in concert with the organizational realignment made by the company, promoted harmonious and effective cooperation at the working level and resulted in significant reductions in instances of contract nonconformance, product defects, mandatory government inspection hours, the number of military specifications, and the time required to manufacture each aircraft. All of these improvements translated into lower costs.[87]

In his communications with John McDonnell early in 1994, Under Secretary Deutch reinforced the government's commitment to pursuing an alternative to the C–17. In February 1994 Deutch testified to Congress that although the program was "broken," it was worth saving. He said that the end of the road would come in two years "when either [McDonnell Douglas] will have demonstrated the ability to build C–17s successfully, or we shall move to an alternative airplane."[88]

In compliance with the National Defense Authorization Act for Fiscal Year 1994, which directed the secretary of defense to come up with an alternative to the C–17, the Air Force established the Non-Developmental Airlift Aircraft system program office in February 1994. Its task was to prepare plans to acquire competitively a commercial- or military-derivative aircraft as a supplement or alternative to the C–17. The plans were to be developed rapidly and to provide for employing standard business practices as much as possible. Only Lockheed's C–5D (an upgraded C–5B) qualified as the alternative aircraft because it could carry outsize cargo. Consequently, planning for an alternative was deferred in favor of work on acquiring a supplement, with a modified Boeing 747-400F transport emerging as the choice to fill that role.[89]

By virtue of its designation in the Federal Acquisition Streamlining Act as one of five programs in the Defense Acquisition Pilot Program, the NDAA was granted relief from certain statutory and regulatory acquisition requirements. Thus empowered, it became a laboratory for the application of acquisition reforms, primarily related to the government-industry relationship. Among the many innovative and streamlined acquisition practices the program implemented were payments based on calendar dates and set percentages of contract price favored by industry in lieu of the traditional government progress payments and production milestones; mutually agreed contract changes rather than changes directed unilaterally by the government, although some could be made unilaterally by the contractor; the substitution of performance requirements for military specifications and standards; reliance upon Federal Aviation Agency quality assurance standards and certification instead of government inspection; and provision for government access to contractor engineering data in place of the administratively burdensome requirement to deliver such data to the government. When the NDAA system program office released the request for proposal on 31 March 1995, 63 clauses had been deleted from the original RFP baseline and the document numbered 175 pages instead of the usual 1,000 or more.[90]

Much like Aspin's discipline of C–17 officials in mid-1993, the omnibus agreement of early 1994 bought more time and breathing room for the main players but failed to satisfy some outside observers and oversight authorities. The General Accounting Office was especially scathing, criticizing the settlement in an April 1994 report as a de facto bailout whose combination of outlays and reduced requirements essentially paid McDonnell Douglas to produce an inferior aircraft while labeling it a success. The GAO further disputed the conclusion reached by the earlier Defense Science Board and Institute for Defense Analyses studies that an all-C–17 force was in fact both operationally preferable and more cost-effective than maintaining a mix of airlift aircraft. More ominous that month, however, was the House Armed Services Committee's recommendation to purchase only four C–17s in the sixth production lot rather than the six originally planned. The unspent funds would be used to buy commercial airlifters.[91]

The proposed legislation would derail the agreement with McDonnell Douglas, and DoD responded with an all-out effort to secure funding according to the terms of the omnibus agreement for at least the coming year. Under Secretary of the Air Force deLeon took the lead, preparing a white paper laying out the case against the cuts and mobilizing senior department leaders to lobby members of Congress. The campaign was successful; Congress approved C–17 funding and schedules according to the omnibus agreement.[92]

Strong leadership in OSD, in the Air Force, and at the program level; contractor capital investments; integrated product teams; and the threat of competition or cancellation finally began to pay off. Although the first C–17s delivered in 1993 came with shoddy interior workmanship, beginning in mid-1994 each aircraft turned over to the Air Force moved up the quality curve and the rate of improvement accelerated. On 29 June 1994 the Air Force took possession of the 13th C–17, the first to be delivered ahead of schedule. The 14th arrived on 20 August, 10 days early and with significantly fewer waivers required for the Air Force to take delivery than previously. For the next two years, McDonnell Douglas delivered each subsequent aircraft further ahead of schedule than the last. On 17 January 1995, the Air Force declared the first C–17 squadron to have achieved IOC, and in July and August the C–17 successfully completed its reliability, maintainability, and availability evaluation.[93]

Throughout 1995, as awareness of these achievements grew and McDonnell Douglas approached the 40-units-delivered mark, the Defense Acquisition Board considered the next steps. As the cost and capabilities of the C–17 became clear, the board added new requirements to the Non-Developmental Airlift Aircraft in order to keep any resulting aircraft design (the modified Boeing 747) competitive with the C–17. Improving C–17 capabilities, and its associated lower risk, made it difficult for NDAA options to wring sufficient capabilities out of commercial designs at prices that were likely to remain competitive. In November 1995, with its recommendation to complete the C–17 buy, the Defense Acquisition Board effectively ended the NDAA program.[94]

Although the program did not result in the acquisition of an airlifter either as an alternative or a supplement to the C–17, its impact on the latter program and on the acquisition process was significant. In less than two years, the NDAA system program office issued a request for proposal and negotiated a $13.9 billion contract with Boeing to acquire 75 of its modified 747-400F transports over 10 years. The

C–17 Globemaster IIIs fly in formation over South Carolina, January 2000. *(Air Mobility Command)*

Defense Department credited the competitive pressure with spurring McDonnell Douglas to find cost reductions resulting in a 25 percent decrease in projected C–17 costs and to implement improvements saving $4.4 billion, $1.7 billion of which was directly attributed to the NDAA. Beyond the C–17, the NDAA program's application of reforms demonstrated ways to streamline the acquisition process and realize savings in future programs. The NDAA program office estimated it achieved a 25–50 percent reduction in RFP costs and avoided 18–30 percent in contract administration costs by reducing the number of government unique contract clauses.[95]

With the decision made in favor of the C–17, the Defense Acquisition Board and the Air Force began drawing up plans for a multiyear buy of the remaining 80 aircraft necessary to meet strategic airlift requirements. By this time perceptions of the program had changed dramatically; it was increasingly hailed as an example of successful government/contractor collaboration and the power of new management methods to drive acquisition reform. At the end of May 1996, the Air Force agreed to purchase 80 C–17s over seven years, at a total cost of $16.2 billion. The unit cost of the airplane under this agreement, ignoring development costs, was now $173 million. The multiyear purchasing strategy likely saved the Air Force more than $1 billion.[96]

Operational experience has since confirmed the C–17's utility. The first C–17 squadrons provided support to U.S. and NATO forces in the Balkans in the 1990s, getting supplies much closer to units than would have been possible with larger aircraft. As the C–17 became the mainstay of the strategic airlift force, it saw extensive use in Iraq and Afghanistan. Particularly in the early stages of these wars, the C–17 provided essential deliveries of heavy equipment and armored vehicles to remote, austere airfields not otherwise accessible. In light of these experiences, Congress steadily expanded the total force to 223 aircraft, with the last delivered in 2013.[97]

That the C–17 performed well does not mean the program was cost-effective. Yet the alternatives for strategic airlift all involved trade-offs between cost, time-to-acquire, and capability. For example, although the C–5 was a proven system, it was also expensive, and its maintenance costs were high enough to make it possible to argue buying more of those aircraft would fail to save money in the out-years. Commercial derivatives appeared to be more affordable to purchase and operate, but they could not carry outsize cargo, arguably the most important mission requirement in the early days of a conflict. Instead of weighing options, forming consensus, and then moving forward to fill a gap in capabilities, the C–17 and its alternatives fell into a sweet spot: fulfilling a need just crucial enough to make ignoring it impossible, but not so pressing as to earn a blank check. While the C–17 could earn support from a subset of Air Force leadership, it was not compelling enough for Congress to fund completely at the outset or so expensive or technologically speculative to support the program's cancellation. Instead, from the late 1970s onward, each party in the dispute litigated and relitigated the central questions of balancing cost, performance, and risk, coming to different conclusions but never forcing a decisive outcome until the 1995 Defense Acquisition Board decision.

* * * * *

The Air Force began the last decade of the millennium with a reorganized acquisition management structure. Its major purposes were to increase civilian control of acquisition and to simplify decision-making regarding weapon system programs. Throughout the more-than five years of reorganization, the uniformed military resisted attempts to reduce its control of acquisition. In the end, however, its influence had declined substantially and that of civilian officials had grown appreciably. By the mid-1990s acquisition reform, reflecting the Clinton administration's desire to "reinvent" government, was well underway and dominated the Defense Department's agenda. The Air Force strongly supported the reform initiatives; indeed, the service had been experimenting with innovations in acquisition management, such as integrated product development and integrated product teams, as early as the 1980s. Beginning in 1994, SAF/AQ spearheaded the service's reform effort. The Air Force believed that the reform measures, when applied to many of its major weapon system programs, yielded cost and personnel savings. Certainly reforms, including integrated product development and integrated product teams, were an important factor in salvaging the C–17 program. The successful application of standard business practices and contract administration reforms in the Non-Developmental Airlift Aircraft program also showed how to streamline an acquisition program, adding credibility to DoD's threat to find a timely alternative to the C–17 at reasonable cost.

A C–17 Globemaster III off-loads equipment at Kandahar International Airport, Afghanistan, during Operation Enduring Freedom, January 2002. *(NARA)*

Endnotes

1. Department of the Air Force, *The Air Force and US National Security: Global Reach–Global Power* (Washington, DC: Jun 1990), 3.

2. GAO, *Acquisition Reform: Military Departments' Response to the Reorganization Act*, GAO/NSIAD-89-70 (Jun 1989), 30–32; Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review: Report*, Jun 2007, 2:24, https://apps.dtic.mil/dtic/tr/fulltext/u2/a470388.pdf, accessed 31 Oct 2014. The other product divisions were Human Systems, Munitions, and Space. In 1989 AFSC's Ballistic Missile Organization and Space Division were redesignated the Ballistic Systems Division and

the Space Systems Division, respectively. The five air logistics centers were Ogden, Oklahoma City, Sacramento, San Antonio, and Warner Robins (Georgia). The four laboratories were Armstrong in Texas, Phillips in New Mexico, Rome in New York, and Wright in Ohio.

3. Lawrence R. Benson, *Acquisition Management in the United States Air Force and Its Predecessors* (Washington, DC: Air Force History and Museums Program, 1997), 41–42; GAO, *Military Departments' Response to the Reorganization Act*, 30, 32, 41–42; Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review*, 2:24.

4. GAO, *Military Departments' Response to the Reorganization Act*, 3, 10, 32, 34, 35, 37–39, 41, 42, 44, 64; GAO, *DoD's Efforts to Streamline Its Acquisition System*, 27.

5. "Reorganization of the Military Departments' Acquisition Management Structures" (Statement of Bill W. Thurman, Deputy Director for Planning and Reporting, National Security and International Affairs Division [GAO], before the Subcommittee on Investigations, Committee on Armed Services, House of Representatives, 20 Apr 1988), GAO/T-NSIAD-88-28 (1988), 18–19; GAO, *Military Departments' Response to the Reorganization Act*, 3, 32, 34–35, 44, 61.

6. GAO, *Military Departments' Response to the Reorganization Act*, 40.

7. GAO, "Reorganization of the Military Departments' Acquisition Management Structures," 12–13; GAO, *Military Departments' Response to the Reorganization Act*, 41–42, 59; GAO, *DoD's Efforts to Streamline Its Acquisition System*, 24–25 (quotes, 24), 28, 30–31, 42–43.

8. GAO, *DoD's Efforts to Streamline Its Acquisition System*, 37–38; Benson, *Acquisition Management*, 43; Charles W. Pinney, "The USAF PEO/DAC/MAD Structure: Successful Pattern for Future Weapon System Acquisition?" *Acquisition Review Quarterly* 6, no. 1 (Winter 1999): 24–26; Lawrence R. Benson, "History of US Air Force Acquisition Management" (unpublished briefing with notes, 20 Mar 2000), 70. This structure was codified in Air Force Policy Directive 63-1 (Acquisition System), 31 Aug 1993, and Air Force Instruction 63-101 (Acquisition System), 11 May 1994, copies in author files, OSD/HO.

9. Benson, *Acquisition Management*, 43; Pinney, "USAF PEO/DAC/MAD Structure," 28–29; Benson, "History of US Air Force Acquisition Management," 70; SAF/AQ organization charts, copies in author files. The 1990 reorganization also reduced the number of functional directorates in SAF/AQ; subsequently, some would be headed by civilians.

10. Pinney, "USAF PEO/DAC/MAD Structure," 32–35.

11. Ibid., 30–32 (quote, 31).

12. Benson, *Acquisition Management*, 43; James Kitfield, "Randolph: Reorganization Is Working," *Military Forum* 5 (May 1989): 50.

13. Kitfield, "Reorganization Is Working," 50; Benson, *Acquisition Management*, 43.

14. Lawrence A. Skantze, "USAF Acquisition Process Headed in Wrong Direction," *National Defense* 82, no. 532 (Nov 1997): 36; Benson, *Acquisition Management*, 43–44 (Hansen quote, 44); Kitfield, "Reorganization Is Working," 51–52 (Randolph quotes).

15. Memo, DepSecDef Atwood for SecAF Donald B. Rice, 1 Nov 1990, subj: Defense Management Report Decision (DMRD) Relative to Air Force Systems Command and Air Force Logistics Command, folder 310.1, box 40, Acc 330-92-0097, OSD Records, WNRC; Benson, *Acquisition Management*, 44.

16. Scott A. Dalrymple and Lester F. Pietraszuk, "An Investigation of Integrated Weapon System Management Implementation Issues" (master's thesis, Air Force Institute of Technology, Air University, Sep 1992), 20 (quote); Benson, *Acquisition Management*, 44, 46.

17. Al Coutinho, "Integrated Weapon System Management: A New Management Philosophy for the Air Force Materiel Command," *Air Force Journal of Logistics* 17, no. 3 (Summer 1993): 15; Merrill A. McPeak, *Selected Works, 1990–1994* (Maxwell AFB, AL: Air University Press, 1995), 164 (quote).

18. Memo, General Ronald W. Yates, 1 Oct 1992, subj: Commander's Policies: Role of AFMC Product and Logistics Centers (AFMCR 500-8), (quotes), with attached memo, SecAF Rice and CSAF Merrill A. McPeak, 11 Jun 1992, subj: The New Air Force Materiel Command—Policy Memorandum: copies of both in author files. For the evolution of the Air Force's field acquisition and logistics organizational structure from the late 1940s through the 1960s, see Converse, *Rearming for the Cold War,* chaps. V and IX; and Poole*, Adapting to Flexible Response*, chap. VI.

19. J. S. Przemieniecki, ed., *Acquisition of Defense Systems*, AIAA Education Series (Washington, DC: American Institute of Aeronautics and Astronautics, 1993), 93–99; Department of the Air Force, AFMC Pamphlet 800-60, *Integrated Weapon System Management (IWSM)*, 31 Mar 1993 (rev. 20 Dec 1994), 7–17 (quote, 12), 40–46, copy in author files. "Product groups" were "several like products in all life cycle phases . . . characterized by an ongoing development requirement as well as a much larger cumulative sustainment effort, e.g., propulsion." "Materiel groups" were "several like products that normally receive[d] consolidated management for sustainment largely for reasons of economy of scale and specialization of technical/engineering expertise, e.g., landing gear." The latter did not usually have any ongoing development efforts. See AFMC Pamphlet 800-60, 10 (quotes).

20. Przemieniecki, *Acquisition of Defense Systems*, 95; AFMC Pamphlet 800-60, 12, 17.

21. Dalrymple and Pietraszuk, "Investigation," 16–17, 19. For a chronology of the development and implementation of IWSM, see John R. Ward, "Beyond 'Integrated Weapon System Management'—Acquisition in Transition," Executive Research Project RS8A (Washington, DC: Industrial College of the Armed Forces, NDU, 1993), 18–19.

22. Dalrymple and Pietraszuk, "Investigation," 17, 19–20.

23. Ibid., 17–18.

24. Ibid., 19; Betty J. Coronado and Jane M. Kwiecinski, "An Analysis of the Impact of Integrated Weapon System Management (IWSM) Upon the Support Equipment Acquisition Process (Covering the Period from Submittal of SERD Through the Preparation of the Statement of Work)" (master's thesis, Air Force Institute of Technology, 1994), 13–15; AFMC Pamphlet 800-60.

25. The definition of concurrent engineering is from Defense Systems Management College, *Glossary: Defense Acquisition Acronyms and Terms*, 5th ed. (Fort Belvoir, VA: DSMC, Sep 1991), B–17; Winner et al., *Role of Concurrent Engineering in Weapon System Acquisition*, 11 (IDA report quote). See also *Integrated Product Development Implementation Guide* (Los Angeles AFB, CA: HQ Space and Missile Systems Center, Mar 1993), 2. There was no connection between *concurrent engineering* and the concept of *concurrency*. Concurrent engineering did not involve conducting design (or other aspects of development, including testing) and production simultaneously. The IDA report noted that concurrent engineering "emphasizes completion of all design efforts prior to production initiation." See Winner et al., *Role of Concurrent Engineering*, 22; memo, USD(A) Costello for Secretaries of Military Departments (Attn: SAEs), 9 Mar 1989, subj: Concurrent Engineering—A Total Quality Management Process, folder 09 March 1989, box 3, Acc 330-92-0136, OSD Records, WNRC; David A. Dierolf and Karen J. Richter, *Concurrent Engineering Teams*, IDA Paper P-2516, 2 vols. (Alexandria, VA: IDA, Nov 1990); Raymond R. Hill Jr., *A Quality Philosophy for Integrated Product Development* (Brooks AFB, TX: AFSC, Aug 1991); DSB, *1991 Summer Study on Weapon Development and Production Technology*, 17–18, 25–26.

26. *Integrated Product Development Implementation Guide*, 2–3 (cites AFMCR 500-11, 1 Nov 1992); memo, HQ AFMC/XR for ALAFMC/CC, 13 Jan 1993, subj: Integrated Product Development, in AFMC Pamphlet 800-60, 364–366. The memorandum, known as the IPD Definition Letter, can also be found in *Air Force Materiel Command Guide on Integrated Product Development: A Guide for Understanding and Implementing IPD Throughout AFMC*, 25 May 1993, 95–97; AFMCR 500-19 (Commander's Policy: Integrated Product Development), 21 Apr 1993: copies of all in author files.

27. *Air Force Materiel Command Guide on Integrated Product Development*, 18–24.

28. Janice Klein and Gerald I. Susman, *Lean Aircraft Initiative Organization & Human Resources (O&HR) Survey Feedback—Integrated Product Teams (IPTs)*, Case Study LEAN 95-03 (Cambridge, MA: Lean Aircraft Initiative, MIT, 7 Apr 1995), 4.

29. Renae Merle, "Long Fall for Pentagon Star," *Washington Post*, 14 Nov 2004, A01; ltr, Sheila Widnall to John Dowd [Druyun's attorney], 20 Mar 2004, https://web.archive.org/web/20041022193708/http://www.taxpayer.net/nationalsecurity/learnmore/Druyuncharacterwitness/Sheilawidnall.pdf, accessed 5 Nov 2014; Peter Pae, "Defense Dealing Too Close to Comfort?" *Los Angeles Times*, 13 Jun 2004, C1; George Cahlink, "Fallen Star: The Cautionary Tale of a Celebrated Federal Executive's Corporate Flameout," *Government Executive* 36, no. 2 (Feb 2004): 21–22.

30. NASA Press Release 92-58, "Druyun Named Chief of Staff; Bush to Head Procurement Office," 6 May 1992, http://web.archive.org/web/20090903011537/http://www1.nasa.gov/home/hqnews/1992/92-058.txt, accessed 5 Nov 2014; Office of Public Affairs, Secretary of the Air Force, "Biography: Darleen A. Druyun" (Feb 1995), http://web.archive.org/web/19961129234528/http://www.safaq.hq.af.mil/biography/druyun_bio.html, accessed 5 Nov 2014; Cahlink, "Fallen Star," 21–23; James Fallows, response to letter to the editor by Brian Pangrle, *The Atlantic Monthly* 293, no. 2 (Mar 2004), www.theatlantic.com/magazine/archive/2004/03/letters-to-the-editor/302901/, accessed 5 Nov 2014; Merle, "Long Fall," A01; Andy Pasztor and Jonathan Karp, "Career Crash: How an Air Force Official's Help for a Daughter Led to Disgrace," *Wall Street Journal*, 9 Dec 2004, A1; ltrs, various individuals to John Dowd, 2004, Taxpayers for Common Sense website, https://web.archive.org/web/20041022193708/http://www.taxpayer.net/nationalsecurity/learnmore/Druyuncharacterwitness/index.htm, accessed 5 Nov 2014; House Committee on Government Reform, Subcommittee on National Security, Veterans Affairs, and International Relations, *F–22 Cost Controls: Will Product Cost Savings Materialize? Hearings*, 106th Cong., 2d sess., 15 Jun 2000, Serial No. 106-221, 55–76; Defense Science Board, *Report of the Defense Science Board Task Force on Management Oversight in Acquisition Organizations* (Washington, DC: OUSD[AT&L], Mar 2005), 6.

31. OSD/HO, *Department of Defense Key Officials, 1947–2014*, 96; "Acquisition Community Saddened," *News from AFAR* 1, no. 2 (May 1995): 1.

32. DoD News Release 207-95, "Air Force C–21 Crash," 18 Apr 1995; DoD News Release 208-95, "Secretary Perry Statement on C–21 Accident," 18 Apr 1995; Office of the Press Secretary, The White House, "Air Force Officials Named," 1 Nov 1993, https://clintonwhitehouse6.archives.gov/1993/11/1993-11-01-four-nominations.html, accessed 21 Jan 2020; "Clark George Fiester," Arlington National Cemetery website, http://www.arlingtoncemetery.net/cgfiester.htm, accessed 21 Jan 2020; Strategic Advisory Group, Paladin Capital Group, "The Honorable Arthur L. Money," http://www.paladincapgroup.com/people/the-honorable-arthur-l-money/, accessed 8 May 2016; "Acquisition Community Saddened," 8.

33. Money went to the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence as the senior civilian official until confirmed as the assistant secretary in October 1999. See Strategic Advisory Group, Paladin Capital Group, "The Honorable Arthur l. Money"; memo, Acting SecAF Whitten Peters for Muellner and Druyun, 17 Mar 1998, subj: Further Assignment of Responsibilities in the Absence of an Assistant Secretary for Acquisition, copy in author files; DSB, *Report . . . on Management Oversight*, 7; U.S. Air Force, "Biography: Dr. Lawrence J. Delaney" (Jul 1999), copy in author files.

34. DSB, *Report . . . on Management Oversight*, 7; U.S. Air Force, "Biography: Dr. Sheila E. Widnall" (Nov 1996), http://web.archive.org/web/19990421182335/http://www.af.mil/news/biographies/widnall_se.html, accessed 5 Nov 2014; ltr, Widnall to Dowd, 20 Mar 2004.

35. "SAF/AQ Undergoes Reorg—PEOs to Align with MADs," *News from AFAR* 1, no. 6 (Nov/Dec 1995): 1, 12.

36. Memos, Peters for Muellner and Druyun, 17 Mar 1998; DSB, *Report . . . on Management Oversight*," 7, 13 (quote).

37. "Who's Who In Acquisition Reform," *News from AFAR* 1, no. 1 (Mar 1995): 4; "DoD Pilot and Air Force Lead Programs," *News from AFAR* 1, no. 2 (May 1995): 7; Secretary of the Air Force, Acquisition, *Acquisition Reform: Initiatives*, "Pilot and Lead Programs," 30 Nov 1996, https://web.archive.org/web/19961130003807/http://www.safaq.hq.af.mil/acq_ref/progs/, accessed 5 Nov 2014. The Evolved Expendable Launch Vehicle program was to develop a family of more affordable space launch vehicles; the Wind Corrected Munitions Dispenser would integrate cluster bomb units with inertial guidance systems, allowing for more accurate delivery from high altitude; and the Ground Theater Air Communications System was to be an automated command, control, and communications system with transportable modular components.

38. Matt Dubois and Scott Dalrymple, "SBIRS SPO Used Innovation to Streamline DAB and RFP Cycles," *News from AFAR* 1, no. 2 (May 1995): 5.

39. Druyun, "Dare to Change: Ingenuity and Risk Taking Are a 'Must Do,'" *News from AFAR* 1, no. 5 (Sep 1995): 5; Druyun, "Acquisition Reformed" (speech, Los Angeles Air Force Association Symposium, Los Angeles, CA, 27 Oct 1995) (quotes), http://secure.afa.org/aef/pub/la2.asp, accessed 23 Apr 2016. For the origins of NASA's "Faster, Better, Cheaper" program, see Howard E. McCurdy, *Faster, Better, Cheaper: Low-Cost Innovation in the U.S. Space Program* (Baltimore: Johns Hopkins University Press, 2001), 44–78.

40. Acting SAF/AQ Darleen A. Druyun, memo for distribution, 22 Jun 1995, AQ Policy 95A-003, subj: Specifications and Standards—A New Way of Doing Business (quote); msg, Lt. Gen. R. E. Eberhart, XO, for [numerous addressees], 151700Z Sep 1995, subj: Operational Requirements Documents (ORDs) Scope and Content; Druyun, memo for distribution, 16 Nov 1995, subj: Involving the User in the Acquisition Process (quotes): copies of all in author files.

41. Maj. Gen. John Hawley, "Integrated Process Teams" (AQ/XO Offsite Presentation, Aug 1996), copy in author files.

42. "Feedback," *News from AFAR* 2, no. 2 (May/Jun 1996): 6.

43. "Acquisition Reform Message Taken On the Road," *News from AFAR* 1, no. 2 (May 1995): 1, 10; Capt. Kenneth Delano, "HSC Conducts USAF's First Acquisition Reform Roadshow," *News from AFAR* 1, no. 5 (Sep 1995): 11; Myrna-Lynne Whitney, "Propelling Acquisition into the 21st Century," *News from AFAR* 1, no. 4 (Jul 1995): 1; Kim Hurd, "Lightning Bolts Star at Acquisition Renaissance Workshop," *News from AFAR* 1, no. 4 (Jul 1995): 5, 9; "Industry Partners Speak Out on Lightning Bolts at AFA Round Table," *News from AFAR* 1, no. 5 (Sep 1995): 8–9; "Industry Round Tables Are a Resounding Success," *News from AFAR* 1, no. 6 (Nov-Dec 1995): 4.

44. Secretary of the Air Force, "Ask Mrs. Druyun," 2 (quotes), https://web.archive.org/web/19991010225905/http://www.safaq.hq.af.mil/acq_ref/questions.html, accessed 6 Nov 2014.

45. "Druyun Introduces Radical Changes at AFMC Conference," *News from AFAR* 1, no. 3 (Jun 1995, Special Edition): 1–2; Hurd, "Lightning Bolts Star," 5, 9; "Air Force Acquisition Lightning Bolt Initiatives," release 0, 31 May 1995, http://web.archive.org/web/19961114091348/http://www.safaq.hq.af.mil/acq_ref/bolts/update0.html, accessed 6 Nov 2014. Details about the individual initiatives and their implementation updates are at the archived Lightning Bolt webpage, accessed 6 Nov 2014, as well as in various issues of *News from AFAR*, http://web.archive.org/web/19991112021431/http://www.safaq.hq.af.mil/acq_ref/news/archive.html, accessed 6 Nov 2014.

46. Druyun, memo for distribution, 6 Nov 1995, subj: System Program Office Downsizing Tenets, and attached report "Lightning Bolt #3 Final Report: Tenets to Assist the System Program Director Acheive [*sic*] Efficiencies in Operations and Reductions in Manpower," http://web.archive.org/web/19961114093500/http://www.safaq.hq.af.mil/acq_ref/bolts/bolt3/dt.pdf, accessed 6 Nov 2014; "Feedback," *News from AFAR* 1, no. 4 (Jul 1995): 4.

47. SAF/AQ, memo for distribution, 29 Apr 1996, subj: Single Acquisition Management Plan (SAMP) Policy & Guide, Acquisition Policy 96A-005, and attached "Single Acquisition Management Plan Guide," 29 Apr 1996, http://web.archive.org/web/19961114093500/http://www.safaq.hq.af.mil/acq_ref/bolts/bolt3/dt.pdf, accessed 6 Nov 2014; Maj. Chris Pelc, "The SAMP Revisited," *News from AFAR* 2, no. 1 (Mar–Apr 1996): 2, 4, 7, 10; SAF/AQ, memo for distribution, 24 Apr 1997, subj: Processing Single Acquisition Management Plans (SAMPs), Policy Memo 97-02, http://web.archive.org/web/20011130145145/http://www.safaq.hq.af.mil/acq_ref/afae/pol17m.pdf, accessed 26 Nov 2014; *Air Force Single Acquisition Management Plan Guide*, rev. ed. (Washington, DC: SAF/AQ, 16 May 2001), https://web.archive.org/web/20030513180003/http://www.safaq.hq.af.mil/contracting/toolkit/part07/word/sampguide.doc, accessed 6 Nov 2014.

48. Office of the Assistant Secretary of the Air Force (Acquisition), "Air Force Acquisition Reform Lightning Bolt Initiatives, Update #11," 23 Aug 1996, http://web.archive.org/web/19961114094224/http://www.safaq.hq.af.mil/acq_ref/bolts/updat11.html, accessed 6 Nov 2014; Darleen Druyun, "Acquisition Renaissance: A Culture Change in Work" (presentation, American Institute of Aeronautics and Astronautics, 17 Oct 1996), copy in author files.

49. Bruce D. Wyman, "A New Acquisition Reform Culture for the Air Force," *Program Manager* 28, no. 1 (Jan-Feb 1999): 62–64; "Air Force Announces New Acquisitions Process," *News from AFAR* 1, no. 2 (May-Jun 1998): 1; Maj. Jim Hubert, "First Live Video Shoot A Success," ibid., 6.

50. Wyman, "New Acquisition Reform Culture," 65; "The Heart of Reinvention," *News from AFAR* 1, no. 3 (Jul-Aug 1998): 1; "Reinvention Teams: The Second Wave," ibid., 3, 10; "A Closer Look at Reinvention Teams," ibid., 4–5.

51. Wyman, "New Acquisition Reform Culture," 64–65; Col. Bill Selah, "Air Force Acquisition Reform: Acquisition & Sustainment Reinvention Process," briefing, 27 Oct 1998, copy in author files; "AR Champions," *News from AFAR* 1, no. 3 (Jul-Aug 1998): 2.

52. Selah, "Air Force Acquisition Reform"; AR Leadership Council executive summary, meeting of 13 Oct 1998 (quote), copy in author files. See also other council meeting minutes and documents in author files.

53. "Lightning Bolts '99" (undated briefing), quote, copy in author files; Col. William W. Selah, "Air Force Announces Acquisition Reform Lightning Bolts '99," *Aerospace Acquisition 2000* 2, no. 1 (Apr 1999): 1–8; "Lightning Bolt '99 Fact Sheets," https://web.archive.org/web/20010801142213/http://www.safaq.hq.af.mil/acq_ref/bolts99/, accessed 6 Nov 2014.

54. SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 2000 and the Future Years Defense Program: Hearings . . . on S. 1059*, 106th Cong., 1st sess., 17 Mar 1999, S. Hrg. 106-116, pt. 3:125–139 (quotes, 127, 129, 130). The Air Force Research Laboratory consolidated in one organization the four Air Force laboratory facilities—Armstrong, Phillips, Rome, and Wright—and the Air Force Office of Scientific Research.

55. U.S. Air Force, "Biography: Dr. Marvin R. Sambur" (Apr 2002), http://web.archive.org/web/20020605065253/www.af.mil/news/biographies/sambur_mr.html, accessed 23 May 2016; Secretary of Defense Donald Rumsfeld and General Richard Myers, transcript of Defense Department Operational Update Briefing, 23 Nov 2004, http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=2207, accessed 19 May 2016; Merle, "Long Fall,"A01; Pasztor and Karp, "Career Crash," A1; "DoD Investigating Contracts, Reviewing Procedures," *Air Force Print News*, 18 Nov 2004, www.af.mil/News/ArticleDisplay/tabid/223/Article/135572/dod-investigating-contracts-reviewing-procedures.aspx, accessed 5 Nov 2014.

56. Acquisition Management Policy Division, SAF/AQXA, "Proposed Approach and Themes for Air Force Acquisition Reform" (undated briefing [ca. 2000]), quotes, copy in author files.

57. The C–17 was also one of the most audited programs in Defense Department history. In the three years from April 1990 to July 1993 alone, the Air Force's C–17 system program office underwent 16 audits involving hundreds of separate inquiries. See Defense Science Board, *Report of the Defense Science Board Task Force on C–17 Review* (Washington, DC: OUSD[A&T], Dec 1993), 10.

58. For early plans, see Betty Raab Kennedy, *Globemaster III: Acquiring the C–17* (Scott AFB, IL: Air Mobility Command, Office of History, 2004), 3, 8–12, 17–18; DoD, *Congressionally Mandated Mobility Study*, vol. 1 (Washington, DC: OSD, 30 Apr 1981), 30, 10–29, 10–30.

59. CBO, *Improving Strategic Mobility: The C–17 Program and Alternatives*, Sep 1986, 48; U.S. Air Force Fact Sheet 88-16 (C–141B Starlifter), Aug 1988; GAO, *Performance Capabilities of the C–5 and C–17 Cargo Aircraft,* GAO/NSIAD-84-119 (Jul 1984), 6, 7, 9; Kennedy, *Acquiring the C–17*, 28–30, 142. Outsize cargo is an item having dimensions that exceed 1,090 inches in length, 117 inches in width, or 105 inches in height. See Ronald O'Rourke, *Air Force C–17 Aircraft Procurement: Background and Issues for Congress*, CRS Report RS22763 (Washington, DC: CRS, 7 Oct 2009), 2n3. For acquisition of the C–141 and C–5, see Poole, *Adapting to Flexible Response*, chap. VI.

60. Kennedy, *Acquiring the C–17*, 30–32.

61. See, for example, GAO, *Performance Capabilities of the C–5 and C–17 Cargo Aircraft*; GAO*, Military Airlift: C–17 Faces Schedule, Cost, and Performance Challenges*, GAO/NSIAD-89-195 (Aug 1989); Betty Raab Kennedy, "Historical Realities of C–17 Program Pose Challenge for Future Acquisitions," *Program Manager* 28, no. 6 (Nov-Dec 1999): 72–73.

62. Kennedy, *Acquiring the C–17*, 35, 38; *Making Appropriations for the Department of Defense for Fiscal Year 1981, and for Other Purposes: Conference Report [to accompany H.R. 8105],* 96th Cong., 2d sess., 4 Dec 1980, H. Rep. 96-1528, 34.

63. Charles Mohr, "Lockheed's Grip on Washington," *New York Times*, 17 Oct 1982, sec. 3, 1; SCA Subcommittee, *Hearings on Department of Defense Appropriations for Fiscal Year 1983*, 97th Cong., 2d sess., 6, 12, 13, 19, 20 May and 10, 24 Jun 1982, pt. 3:150; Kennedy, *Acquiring the C–17*, 54.

64. Kennedy, *Acquiring the C–17*, 57–64, 70, 84; Katherine McIntire Peters, "It Flies!" *Government Executive* 28, no. 6 (1 Jun 1996).

65. Kennedy, *Acquiring the C–17*, 72–74, 82; O'Rourke, *Air Force C–17 Aircraft Procurement: Background and Issues for Congress*, 2n5.

66. Kennedy, *Acquiring the C–17*, 79–80, 82, 86. The December 1985 contract was a restructure of the R&D contract awarded by the Air Force to McDonnell Douglas in July 1982. That contract provided for full-scale engineering development, but Congress did not appropriate the necessary funds. See GAO, *Military Airlift: Cost and Complexity of the C–17 Aircraft Research and Development Program*, GAO/NSIAD-91-5 (Mar 1991), 10.

67. Kennedy, *Acquiring the C–17*, 94, 98, 100, 103, 109.

68. A. Lee Battershell, *The DOD C–17 versus the Boeing 777: A Comparison of Acquisition and Development* (Washington, DC: NDU Press, 1999), 73–74 (quote, 74); Kennedy, *Acquiring the C–17*, 89, 92–93, 99, 101–102. Wind tunnel tests indicating that the pilot, using the C–17's combination hydro-mechanical and fly-by-wire system, could not prevent the aircraft from stalling during a slow, high-angle, short-field landing approach, prompted the change to primarily fly-by-wire flight controls. For a detailed discussion of the C–17 program's software development difficulties, see GAO, *Embedded Computer Systems: Significant Software Problems on the C–17 Must Be Addressed*, GAO/IMTEC-92-48 (May 1992).

69. Kennedy, *Acquiring the C–17*, 94–97.

70. Andy Pasztor and Rick Wartzman, "Cheney Offers Cuts in Stealth Program Under 8-Year Plan to Save $35 Billion," *Wall Street Journal*, 27 Apr 1990, A3: GAO, *Status of the Air Force's C–17 Aircraft Program*, GAO/T-NSIAD-90-48 (Jun 1990), 4.

71. "McDonnell Douglas Fires Douglas Heirs," *Los Angeles Times*, 16 Jun 1990, C7; David J. Jefferson, "McDonnell Douglas Faces More Losses Over the A–12," *Wall Street Journal*, 21 Mar 1991, 7.

72. Air Force Col. Kenneth Tollefson, the chief Department of Defense representative at the McDonnell Douglas C–17 plant, provided some of the most damning accounts of the contractor's lassitude. See Ralph Vartabedian, "He Dared Say the C–17 Had No Clothes," *Los Angeles Times*, 9 Mar 1993, D1; For Colonel Tollefson's somewhat tamer congressional testimony, see HCAS, Military Acquisition Subcommittee and the Oversight and Investigations Subcommittee, *C–17 Aircraft Program Review: Joint Hearings*, 103d Cong., 1st sess., 9, 10 Mar and 11 May 1993, 5–48. See also Kennedy, *Acquiring the C–17*, 114–115.

73. Rick Wartzman, "McDonnell Seen Exceeding Cap On C–17 Costs," *Wall Street Journal*, 26 Aug 1991, A3; "McDonnell Douglas Says Wing of C–17 Failed Test," *Wall Street Journal*, 5 Oct 1992, A9. For congressional responses, see GAO, *C–17 Aircraft: Cost and Performance Issues*, GAO/NSIAD-95-26 (Jan 1995), 2–4.

74. DoD IG, *Government Actions Concerning McDonnell Douglas Corporation Financial Condition during 1990*, Report of the Department of Defense Office of Inspector General to the Committee on Government Operations, House of Representatives, Jan 1993, i–iii (Committee Print).

75. "An Air Force Watergate?" *St. Louis Post-Dispatch*, 29 Jan 1993, C2; John T. Correll, "Blood on the Rock" (editorial), *Air Force Magazine* 76, no. 7 (Jul 1993): 2.

76. Memo, SecDef Les Aspin for SecAF, 19 Feb 1993, subj: Inspector General's 1993 Report on Government Actions Concerning McDonnell Douglas Corporation Financial Condition during 1990, folder 000.5 (Feb), box 2, 95-0037, OSD Records; memo, Aspin for Acting SecAF, 29 Apr 1993, subj: Air Force Review of the DoD Inspector General Report on the C–17 Aircraft, 14 Jan 1993 (quote); memo for correspondents no. 149-M, 30 Apr 1993: both in folder Aspin Apr 1993, box 96, Biographical Files, OSD/HO (hereafter Aspin Files).

77. Eric Schmitt, "Aspin Dismisses General as Head of Plane Project," *New York Times*, 1 May 1993, 1; Rep. Norman Sisisky, statement of 11 May 1993, in HCAS, *Hearings: C–17 Aircraft Program Review*,135.

78. Kennedy, *Acquiring the C–17*, 128–129 ("very troubled," 129; "not be continued," 128), 131.

79. HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1995—S. 2182 (H.R. 4301) . . . Military Acquisition Subcommittee Hearings on Title I—Procurement*, 103d Cong., 2d sess., 10 Feb 1994, no. 103-33, 5–8; Kennedy, *Acquiring the C–17*, 131.

80. DoD News Release 590-93, “Secretary of Defense Announces Future Airlift Plans,” 15 Dec 1993, with attached Aspin statement on C–17, 15 Dec 1993, *Aspin Public Statements 1993–1994*, 3:1850–1856; Randy Davis, Bill Phillips, and Bud Vazquez, “The Phoenix Rises,” *Acquisition Review Quarterly* 4, no. 4 (Fall 1997): 415; Kennedy, *Acquiring the C–17*, 131.

81. Kennedy, *Acquiring the C–17*, 131–133; Battershell, *DOD C–17 versus Boeing 777*, 36; Peters, “It Flies!”; DSB, *Task Force on C–17 Review*, memo for Chairman of the Defense Science Board (quote). For the full text of the agreement, see HCAS, *Hearings on National Defense Authorization Act for Fiscal Year 1995—Procurement*, 10–29.

82. Kennedy, *Acquiring the C–17*, 130, 138, 272.

83. Davis, Phillips, and Vazquez, “Phoenix Rises,” 416–417, 419–420. At the time of the events described in their article, Air Force Lt. Col. Davis led an IPT in the C–17 SPO at Wright-Patterson AFB, Army Lt. Col. Phillips headed the DCMC office at the McDonnell Douglas plant in California, and Air Force Lt. Col. Vazquez was the director of airlift programs for the Air Force’s program executive officer for tactical airlift (Brigadier General Childress, the C–17 PEO).

84. DSB, *Task Force on C–17 Review*, 9, 12, and slide, “IPT Assessments: Production Management & Transition” (“immature”), in “C–17 Senior Level Review Group Final Briefing, 28 Aug 1993,” appended to *Task Force on C–17 Review*; Kennedy, *Acquiring the C–17*, 130.

85. DSB, *Task Force on C–17 Review*, slides, “Other Settlement Issues,” in “C–17 Senior Level Review Group Final Briefing, 28 Aug 1993.” See also chap. VII in this volume.

86. Davis, Phillips, and Vazquez, “Phoenix Rises,” 422–423; Maj. Gen. Timothy Malishenko, “C–17 Program—From the Brink of Cancellation to Baldridge National Quality Award Winner,” *Program Manager* 28, no. 3 (May-Jun 1999): 35–38; Peters, “It Flies” (Kappmeier quote).

87. Davis, Phillips, and Vazquez, “Phoenix Rises,” 425–429; Malishenko, “C–17 Program,” 36–38.

88. Kennedy, *Acquiring the C–17*, 132, 139–140 (quote).

89. Dominique B. Myers and D. Colleen Griffith, “A Pilot Program’s Legacy: Lessons Learned in Applying Commercial-like Practices to a Large, Sophisticated Program,” *Program Manager* 25, no. 3 (May-Jun 1996): 19–20; Kennedy, *Acquiring the C–17*, 157.

90. Myers and Griffith, “Pilot Program’s Legacy,” 19–23.

91. GAO, *Military Airlift: C–17 Settlement Is Not a Good Deal,* GAO/NSIAD-94-141 (Apr 1994), 2–4, 6–9, 13; Kennedy, *Acquiring the C–17*, 140–142; Davis, Phillips, and Vazquez, “Phoenix Rises,” 417.

92. Davis, Phillips, and Vazquez, “Phoenix Rises,” 417–418; Kennedy, *Acquiring the C–17*, 141–143.

93. DoD News Release 022-95, “First C–17 Squadron Declared Operational,” 17 Jan 1995; Kennedy, *Acquiring the C–17*, 134–136, 144, 148, 152; Davis, Phillips, and Vazquez, “Phoenix Rises,” 423–424.

94. DoD News Release 587-95, “DOD Announces C–17/NDAA Aircraft Decision,” 3 Nov 1995, Aspin Files.

95. DoD News Release 138-96, “Defense Acquisition Pilot Programs Forecast Cost/Schedule Savings of Up to 50 Percent from Acquisition Reform,” 15 Mar 1996; Myers and Griffith, “Pilot Program’s Legacy,” 18, 32; Kennedy, *Acquiring the C–17*, 138.

96. DoD News Release 320-96, “Air Force Awards C–17 Multi-Year Contracts,” 31 May 1996, Aspin Files; O’Rourke, *Air Force C–17 Aircraft Procurement: Background and Issues for Congress*, 3.

97. Kennedy, *Acquiring the C–17*, 183; Jenny Gordon, Robins Air Force Base Public Affairs, “Final C–17 Enters AF Inventory,” 13 Sep 2013, http://www.robins.af.mil/news/story.asp?id=123363187, accessed 27 Feb 2015.

I. Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review*, 2:27; USAF organization chart in author files.

II. U.S. Air Force, “Biography: Darleen A. Druyun” (Feb 1995), http://web.archive.org/web/19961129234528/http://www.safaq.hq.af.mil/biography/druyun_bio.html, accessed 5 Nov 2014; U.S. Air Force, “Biography: Darleen A. Druyun” (Oct 2001), https://web.archive.org/

web/20021221215107/http://www.af.mil/news/biographies/druyun_da.html, accessed 9 May 2016; Andy Pasztor and Jonathan Karp, “Career Crash: How an Air Force Official’s Help for a Daughter Led to Disgrace,” *Wall Street Journal*, 9 Dec 2004, A1; DSB, *Report . . . on Management Oversight*, 6–7; Jeffrey Branstetter, “The Darleen Druyun Debacle: Procurement, Power, and Corruption” (thesis, George Washington University Law School, Aug 2005), 4–9.

III. U.S. Air Force, “Biography: Lieutenant General Ronald T. Kadish” (Jun 2004), https://www.af.mil/About-Us/Biographies/, accessed 19 Feb 2020; “Ronald T. Kadish,” Booz Allen Executive Leadership, www.boozallen.com/about/leadership/executive-leadership/Ronald-Kadish, accessed 13 Feb 2015.

IV. “Donald R. Kozlowski,” 2002 Alumni Achievement Awards, Washington University in St. Louis, McKelvey School of Engineering website, Alumni, https://engineering.wustl.edu/offices-services/alumni/McKelvey-Engineering-Award-Years/2002.html, accessed 16 Nov 2020; Donald R. Kozlowski Life Tributes page, http://www.buchholzmortuary.com/obituaries/Donald-Kozlowski, accessed 21 Nov 2020; Kennedy, *Acquiring the C–17*, 138, 272.

CHAPTER XII

The Army and Acquisition, 1989–2001

By 1991, with the end of the Cold War and victory in the Gulf War, Army leaders recognized their service would have to change to meet the requirements of a new international security environment. The heavy formations that had been ready for decades to confront Soviet and Warsaw Pact forces in Europe, and had overwhelmed the Iraqi army after a monthslong deployment to the Middle East, would have to become lighter, more agile, and able to be deployed faster without losing lethality. Such a transformation faced formidable obstacles. The Defense budget, including funds for Army acquisition, continued the decline that had begun in the late 1980s. Furthermore, the Army's inventory was full of the Big Five systems—Abrams tank, Bradley Fighting Vehicle, Apache and Black Hawk helicopters, and Patriot air defense system—that had distinguished themselves in the Gulf War, which made justifying new program starts difficult. To transform the Army and keep pace with rapidly advancing military technologies, especially information technologies, the service's leaders would rely on modifications and upgrades to existing systems and the implementation of a variety of acquisition reforms such as a new program management structure, a reduction of military specifications and standards, teaming, and integrated product and process development.[1]

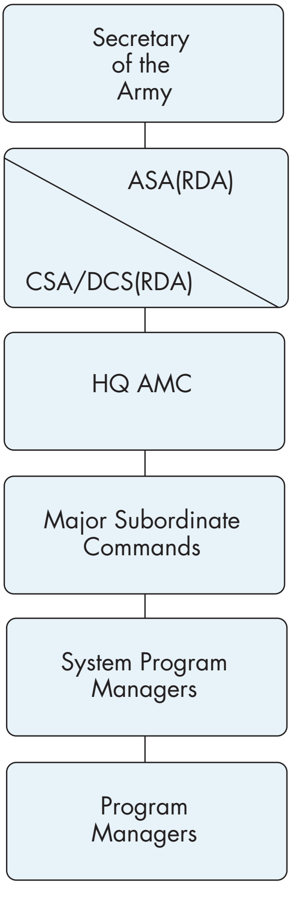
ORGANIZING FOR ACQUISITION

When the Berlin Wall fell in November 1989, the Army was in the middle of a major reorganization of its acquisition system that had been underway for almost three years. This reorganization sought to simplify the acquisition chain of command and strengthen civilian control, in accordance with the recommendations of the Packard Commission and the provisions of the Goldwater-Nichols Act.[2]

Before the reorganization, the uniformed military dominated Army acquisition. At Army headquarters, the civilian assistant secretary of the Army for research, development, and acquisition, supported by a staff of 36, oversaw acquisition policy and management. But that authority was largely formal. The primary responsibility for developing and executing the Army's acquisition program belonged to the uniformed deputy chief of staff for research, development, and acquisition who reported to the Army chief of staff and directed a staff of nearly 240. The deputy chief of staff's office developed policies and procedures for approval by the assistant secretary; planned, programmed, and budgeted for the acquisition of materiel; and managed the service's RDT&E activities. Additionally, the office coordinated actions involving weapon system programs with other headquarters elements and with the Army's major commands.[3]

Among the Army's major commands, Army Materiel Command (AMC) had managed almost all of the service's most important weapon system programs before

Figure 12-1: Army Acquisition Reporting Chain, 1986



ASA(RDA) – Assistant Secretary of the Army for Research, Development, and Acquisition
CSA – Army Chief of Staff
DCS(RDA) – Deputy Chief of Staff for Research, Development, and Acquisition
HQ AMC – Headquarters, Army Materiel Command

Source: Adapted from Figure 6 (Army Acquisition Structure), in Arthur S. Santo-Donato, "Program Executive Officer (PEO) Concept: Is It Functioning As Intended?" USAWC Military Studies Program Paper (Carlisle Barracks, PA: U.S. Army War College, 5 Apr 1991), 25.

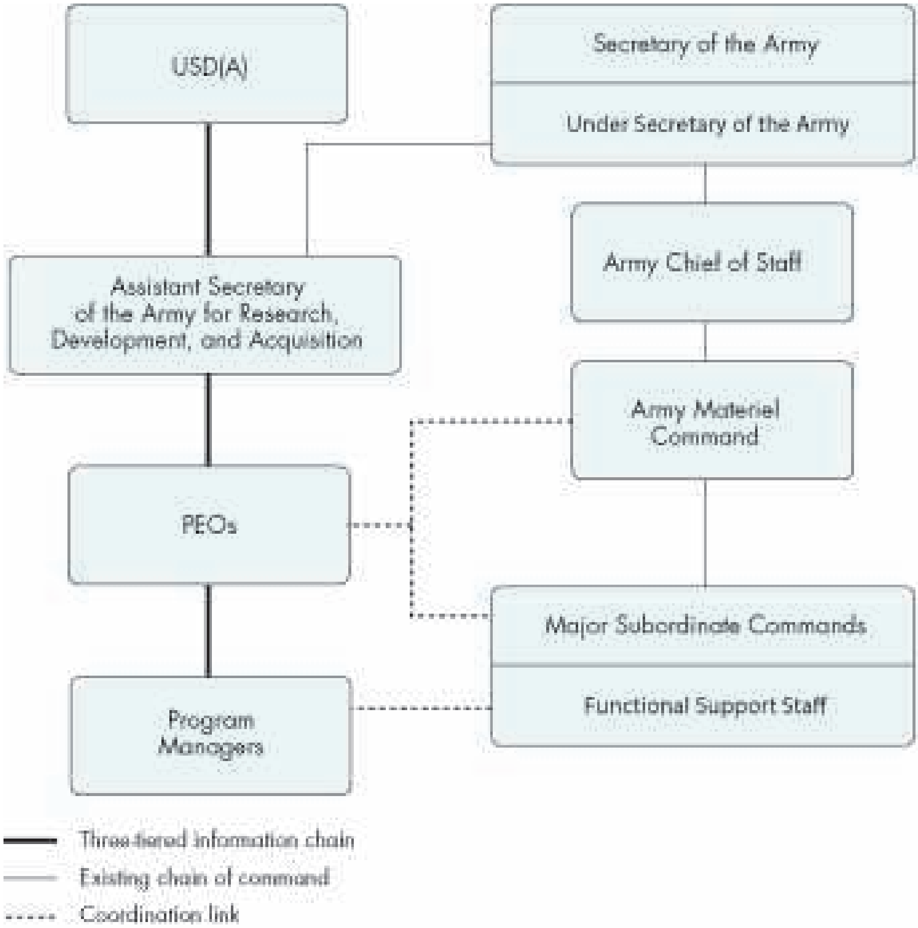
the reorganization, primarily through six of its subordinate commands. These were the so-called commodity commands—Armament, Munitions, and Chemical Command; Aviation Support Command; Communications-Electronics Command; Missile Command; and Tank-Automotive Command—and Laboratory Command. Individual program managers, assigned to one of AMC's subordinate commands, reported along a uniformed chain of command to the Army staff in Washington.[4]

The Army responded to the Packard and Goldwater-Nichols prescriptions quickly and by 1989 had gone far toward implementing them. For example, the Army met a key objective of Goldwater-Nichols by transferring most of the Army chief of staff's acquisition responsibilities and personnel to the service acquisition executive, the assistant secretary for research, development, and acquisition. Consequently, the assistant secretary's staff grew from 36 to 272. A majority—54 percent—were civilians. Of the five major offices of the acquisition portion of the Army secretariat, civilians headed the three most important: procurement, program evaluation, and plans and programs. The lieutenant general who had directed acquisition on the Army staff became the assistant secretary's military deputy.[5]

The Army also adhered closely to the Packard recommendation for a simple, three-tiered acquisition chain of command, in which authority flowed directly from the service acquisition executive at the top to the program executive officers and then to the program managers. Unlike the Air Force and Navy, which tried to change as little as possible by simply designating the leaders of existing organizations as program executive officers, Army PEOs had no other responsibilities. The program executive officer structure was in flux in the early years of implementation as the Army experimented with a workable number of officers and a suitable division of its acquisition programs. Of the original 22 program executive officers in 1987, 15 remained by 1989; two years later the number was down to 10. Each PEO had a relatively small staff of about 25 and supervised five or six programs, receiving monthly status reports from their managers and passing on key information to the assistant secretary for research, development, and acquisition. The program executive officer's staff oversaw and coordinated among the programs. These functions had been lacking in the old organization, yet became increasingly necessary with the rise of interoperable networks and systems of systems, along with the steady decline of acquisition budgets that rendered duplicative efforts unaffordable.[6]

In the reorganized structure, the assistant secretary issued policy and regulations, oversaw the operation of the acquisition system, and supervised weapon system programs through the PEOs and the Army Systems Acquisition Review Council. Cochaired by the assistant secretary and the vice chief of staff and made up of 18 other senior civilian and uniformed officials, the council mirrored the Defense Acquisition Board, reviewing every major program to determine whether it had met its milestone criteria and was ready to continue to the next acquisition phase. For programs designated ACAT IC, the assistant secretary made that decision, based on the council's recommendations (see table 2-1). ACAT ID programs, approved by the council and the assistant secretary, went on to the Defense Acquisition Board for its review and recommendation regarding

Figure 12-2: Army Acquisition Reporting Chain, 1989



PEO – Program Executive Officer
SAE – Service Acquisition Executive
USD(A) – Under Secretary of Defense for Acquisition

Source: Adapted from Figure 3.1 (Post-Packard Commission Army Acquisition Organization Chart), in GAO, *Acquisition Reform: DOD's Efforts to Streamline Its Acquisition System and Reduce Personnel*, GAO/NSIAD-90-21 (Washington, DC: GAO, Nov 1989), 20.

program advancement to the defense acquisition executive, the under secretary of defense for acquisition.[7]

The new system struggled to define Army Materiel Command's role and its relationship with the new three-tiered acquisition reporting structure. In theory, the change in mission was simple enough: Materiel Command would no longer be in the business of managing major programs, but would continue to provide essential support to the program offices and program executive officers in functional areas such as budget and finance, cost and economic analysis, engineering, personnel, procurement (contracting), production, and test and evaluation. All that was left was to work out how to provide the support. Yet resolving those matters became a battleground on which AMC fought for years to regain the power it had lost in 1987.[8]

In the 1987 reorganization, Materiel Command ceded direct control to the program executive officers of all but a handful of the major programs. By 1990 the command managed only 44 of the Army's 291 acquisition programs, all in the lesser important ACATs III and IV.[9] Designing and building major systems had been AMC's primary mission. When the PEOs assumed responsibility for those programs, some senior DoD leaders, including Deputy Defense Secretary Don Atwood, questioned the need for the command. Meanwhile, Materiel Command officials, shorn of the authority they had enjoyed under the old regime, attempted to figure out how they would carry out their remaining responsibilities. They no longer participated in the initial shaping of a program or in its subsequent reviews, did not issue or enforce acquisition regulations, and could not force program managers to provide timely updates or prompt responses to the command's queries. The relentless downsizing following the reorganization and the post–Cold War force drawdown added to the confusion and anxiety within AMC. Defense Secretary Dick Cheney's Defense Management Report demanded further consolidation and staff cuts. By 1990 Materiel Command's civilian strength had dropped 20 percent over three years, from almost 118,000 to 96,000, with nearly half the losses occurring during a seven-month period in 1990.[10]

Materiel Command did not give up its old mission gracefully or accept its new one passively. General Louis P. Wagner, AMC commander during the first two years of the reorganization, had publicly embraced the reforms and pledged his full cooperation in implementing them, but he also waged an aggressive campaign to restore some of the command's authority in the acquisition process. He made his goal plain when he wrote that "as the PEO concept continues to mature, AMC must remain open to change and must contribute *as a full partner* with the PEOs and their PMs"—a clear rejection of a subordinate role for the command. He insisted Materiel Command continue to receive reports from program managers, participate in reviews, sign off on critical documents, and issue and enforce regulations related to functional matters. If Materiel Command was to support the program executive officers and program managers, the price would be a seat at the table.[11]

Materiel Command sought to use its control of resources—including money, personnel, and contracting authority—as levers for reasserting its authority over programs it formerly managed. At first the program executive officers had no resources of their own. Technically, their organizations were part of the AMC subordinate command wherein they resided, and so the PEOs were instructed to negotiate individually with that command. Materiel Command proved obstinate, as if waiting for the program executive officers to come hat in hand for what they needed. Negotiations remained deadlocked for two years, until the Defense Management Report broke the impasse in the PEOs' favor by ordering the services to fund them and their program managers directly, rather than channeling funding through the major commands. The Army therefore removed program executive officers from the organizational structure of its major commands and made them separate field operating agencies supported by the service acquisition executive. To administer this arrangement, the assistant secretary for research, development, and acquisition created and controlled the Army Acquisition Executive Support Agency. Among its other responsibilities, the new organization provided personnel to the program executive officers. Nevertheless, disputes over who controlled the funding continued during the early 1990s and remained a challenge for program executive officers. As one observer noted, the "resource control issue, probably more than any other, made the transition to the PEO concept a struggle."[12]

Materiel Command used its support of program executive officers to chisel out a more active role in acquisition oversight and decision-making. Program managers continued to consult and coordinate with the officials on whom they depended for support and to give them "courtesy" briefings. Keith Charles, the deputy assistant secretary for plans and programs in the Office of the Assistant Secretary of the Army for Research, Development, and Acquisition, noted that a program manager always had the option of bringing an issue directly to the assistant secretary, "but you knew if you went too often you put yourself in jeopardy." In time, these courtesy briefings came to be virtually obligatory. Rather than simplifying the acquisition reporting chain, the Army had complicated matters by creating incentives for maintaining two reporting chains. By 1991 three program executive officers (for Command and Control Systems, Communications, and Standard Army Information Management System) were reporting to a three-star general, the director of information systems for command, control, communications, and computers, who was dual-hatted as a deputy to the assistant secretary. Those PEOs therefore had to report through both the civilian and military chains of command. In this and other ways, the short, clear command channels Packard had mandated became muddied and slow.[13]

MATRIX MANAGEMENT

Although the program executive officers received funding and personnel directly from the service acquisition executive, they still relied almost entirely on the major commands for other essential support, such as facilities, telecommunications equipment, and specialists who provided expertise in budget and finance, contracting, engineering, and test and evaluation. Despite the rivalry between program executive officers and Materiel Command, they had no choice but to work together. They shared responsibility for achieving program success to meet the needs of the Army's operating forces. Matrix management, the organizational structure the command used to provide personnel support, was pioneered by the Digital Equipment Corporation and adopted by numerous companies, including Bechtel, General Electric, and TRW by the 1970s. Its dual project management structure bound PEOs and AMC to each other more tightly but also made their relationship more complicated and difficult to manage. It also gave Materiel Command new opportunities to reassert some measure of control.[14]

In matrix management, an organization such as one of AMC's subordinate commodity commands formed a central pool of functional specialists who were assigned to the system program office for as long as necessary, often for the life span of the program. The specialists reported to the program manager and sometimes worked on-site at the program office, which might be some distance away from the supporting command. However, they were still members of that command, which remained their parent organization. It assigned, paid, promoted, and rewarded or disciplined them, and they reported to a supervisor in that command as well as to the program manager. Once their assignment to the program office ended, they returned to their home organization and were available for reassignment to another program or for training, promotion, or transfer to a different function within the command. This system was a compromise between "project management," in which each program office hired its own functional specialists, and "functional management," in which the command provided in-house personnel support to multiple program offices, so that each specialist divided his or her time among them. Each system had its advantages and disadvantages. Matrix management made the most efficient use of limited funding and personnel expertise. Workers were accountable to the program office but remained only as long as needed. Thus, the office received the services of workers without the burden of administrative overhead or the need to keep them employed during periods of inactivity. Each functional specialist had two bosses, the program manager and the functional supervisor in the supporting command. Differences between the two supervisors often led to conflict and paralysis, and sometimes required resolution at higher levels.[15]

Army Materiel Command had adopted matrix management two years before the reorganization of 1987. Before that, the Army had relied on project management, with every program maintaining a dedicated staff, which could number into the hundreds; but as the number of program offices grew during the Reagan defense buildup the Army could no longer afford that approach. Consequently, the program manager was left with a "core" staff constituting the minimum number necessary to plan, direct, and control the program. How large that core should be was not defined—it was to be negotiated by the program manager and the subordinate commodity command. AMC headquarters suggested that 24 people should be sufficient.[16]

The acquisition reorganization of 1987 began while Materiel Command was still settling into matrix management. The concept was difficult enough to put into practice even when all parties belonged to AMC and the commander could settle disputes. It was much harder to apply when the program managers and functional specialists followed two separate chains of command usually operating independently of each other up to the secretary of the Army. It took years to work out the relationship and resolve key questions such as the size of the program office's core staff, the types of activities performed by the supporting command, who would determine the level of support, and who would rate the performance of supporting personnel. This last question was critical because with two bosses, the worker would naturally give priority to satisfying the supervisor who prepared the performance evaluation. Another important issue was whether the program manager could hire contractors in lieu of using personnel from the supporting command.

Army Acquisition Policy Memorandum #91-4 was the first serious attempt to decide these issues. In August 1990 Materiel Command and Stephen K. Conver, the assistant secretary for research, development, and acquisition, began working together to define the roles and responsibilities of the respective parties. Materiel Command protested Conver's original draft memorandum, which gave program executive officers the upper hand over the supporting commands. After considerable back-and-forth discussion, the command and Conver agreed on a draft that afforded each side an equal role and emphasized cooperation, shared responsibility, and a "mutually supportive partnership." This version provoked objections from the program executive officers, who warned it represented "back to the old business as usual" and might violate the law. Conver quickly reversed himself and unilaterally rewrote the memo in their favor. Once again Materiel Command objected. Finally, after further discussion, Conver and the command settled on a compromise version the assistant secretary signed in February 1991. The agreement was reaffirmed two years later by the long-awaited revision of the Army's basic acquisition policy document, Army Regulation 70-1.[17]

Memorandum #91-4 gave program executive officers and program managers the authority and resources they needed to manage their programs. The program manager would have a small core staff supplemented with "matrixed" personnel who worked at the program office if feasible. The program manager decided the level of support required, but was to consult with the supporting command when doing so. At the start of the program, the program executive officer and supporting commander agreed on a plan, in the form of a memorandum of understanding, specifying the supporting command's tasks and how it would accomplish them. The supporting commander determined the cost of that support, which the program paid with funds provided by the Army Acquisition Executive Support Agency. The plan could be updated as circumstances changed, but neither side could change it unilaterally. The program manager could seek help from contractors as long as the supporting command was unable to provide the same services. The memorandum acknowledged the supporting command's responsibility to rate its own employees but also noted that program executive officers and program managers "must have the ability to influence the performance evaluations of the matrix support." It therefore inserted program executive officers and program managers into the rating chain of collocated matrixed employees for both military personnel and civilians.[18]

Despite the memorandum, problems continued, often because policies were applied unevenly or were unclear. For example, some program managers found themselves shut out of the ratings process and their influence over their matrixed support staff weakened. This led in 1995 to a new policy requiring the program executive officer and the supporting commander to agree on the rating chain. Both were to participate, one as the rater and the other as the senior rater reviewing the rater's evaluation. The official who assigned and monitored the employee's work daily was to be the rater.[19]

ACQUISITION REFORM ORGANIZATION AND TRAINING

Along with adopting a new program management structure, the Army embraced numerous other acquisition reforms in the 1990s—in 1997 Secretary of the Army Togo D. West Jr. called such reforms the service's top priority. In fact, the service had already been working to improve its acquisition policies and processes before the Clinton administration's reform initiatives. As early as 1987, the Army required that weapon system programs consider components available commercially to avoid the cost of specially designed components, an approach advocated by the Packard Commission. Another initiative focused on reducing the time, effort, and overhead required to develop products and systems. The Army Streamlined Acquisition Program, initiated by Materiel Command in 1984, expanded to the other services two years later. Many of this program's ideas and principles also found their way into the 1991 revision of the 5000 series acquisition documents.[20]

When the Clinton administration's acquisition reform program got underway, the Army established the Acquisition Reform Directorate, a 10-person office under the deputy assistant secretary of the Army for procurement. It was responsible for developing, implementing, and assessing reform strategy; planning and coordinating reform activities; and disseminating information by various media, including publishing a newsletter and maintaining a website.[21] In September 1996 the directorate issued its *Guidelines for Army Acquisition Reform Strategic Planning*. Essentially a statement of principles, the document required each organization to prepare its own Acquisition Reform Improvement Plan indicating how it intended to promote Army acquisition goals and measure their progress.[22] Points of contact within each acquisition organization formed the Acquisition Reform Strategy Implementation Network. By summer 1997 many of the improvement plans had been completed and published online. The directorate assessed their quality and gave high marks to six acquisition organizations. The Office of the Assistant Secretary of the Army for Research, Development, and Acquisition supported the directorate's efforts by designating acquisition reform action officers, each responsible for a "thrust area" representing a reform initiative. As of June 1997, there were 19 of these officers.[23]

By 1997, however, a "communications gap" between the directorate and the rest of the Army had become evident. The director of acquisition reform, Col. Elton D. Minney, acknowledged that information on reform was not getting to the field commands. During Acquisition Reform Week that year, responders to a survey overwhelmingly cited poor communication as the foremost barrier to the institutionalization of reform. Consequently, in December the assistant secretary for research, development, and acquisition ordered each Army acquisition organization to designate an acquisition reform advocate. The advocates, who numbered 39 by March 1999, formed a network to improve communication both vertically through the chain of command and horizontally within and across organizations. They were a focal point for information about reform, but they also actively promoted and monitored reform initiatives; formulated and implemented reform metrics; and disseminated best practices, lessons learned, and success stories.[24]

Army Acquisition Reform Logo. *(U.S. Army)*

The Army also recognized the importance of training the workforce in the new acquisition approaches. As early as 1990, Materiel Command began to conduct roadshows, traveling workshops that made the rounds of Army acquisition organizations. The first events focused on building enthusiasm for reform, and so "a bunch of executives [went] out and made one-day speeches about how they believed in it," recalled Lt. Gen. Leo J. Pigaty, later the deputy commander of Materiel Command. According to Dale G. Adams, AMC's principal deputy for acquisition from 1995 to 1998, the problem was that these early events "weren't teaching, they were preaching." When leaders claimed that the Army would be doing things differently from then on, they were met with skeptical mutterings of "yeah, yeah, yeah." The command therefore retooled the concept, revised the pitch, and instituted a three-day training course that not only provided useful information but also showed workers the Army was serious about reform. The new approach was unveiled in spring 1992. As time went on the courses improved and the roadshows became "extremely valuable," Adams concluded.[25]

The roadshow concept caught on rapidly. Materiel Command conducted two more during the next 18 months, the first at seven sites, the second at eight. It then sponsored a Roadshow for Industry during 1993 and 1995, as well as a Roadshow Lite covering topics from previous events for 25 smaller organizations. Three more roadshows took place between 1994 and 1998, with Roadshow V open to the entire Army. Small organizations left out of the roadshow circuit sometimes conducted their own internal events. All told, Roadshows II through VII visited 55 sites, with a total attendance of 7,415. The Navy and Air Force copied the roadshows; they were also a model for the OSD-sponsored Acquisition Reform Day in 1995 and the subsequent annual acquisition stand-down days.[26]

Each roadshow focused on a particular theme or subject. Roadshows II and III addressed MILSPEC reduction; Roadshow IV added best value contracting. Number V covered contract and acquisition management, and VII total ownership cost reduction. Typically, roadshows lasted several days and included lectures and hands-on exercises. Senior officials, the assistant secretary for research, development, and acquisition often among them, gave pep talks and even taught some of the sessions. The rest of the training, which lasted from two-and-a-half to three days, consisted of four-hour, facilitator-led workshops. The sponsoring activity or customer was offered eight modules from which to choose; each option could be tailored to meet the needs of the activity. The presence of high-level officials reinforced the prestige of the roadshows. "I go on the Roadshows . . . [because] it ensures more interest in the training and better participation," Lieutenant General Pigaty stated. "I don't go on the Roadshow to beat up people or to micro-manage them, I teach a class."[27]

The Army conducted other popular training programs besides the roadshows. Basic Acquisition Reform Training, a three-day workshop, addressed changes in contracting procedures resulting from the Federal Acquisition Streamlining Act of 1994 and the Clinger-Cohen Act of 1996. Twenty-seven workshops were scheduled, including events in Hawaii and Korea. The Army also made use of acquisition reform stand-down days for training.[28]

Developing an Army acquisition reform training program was a difficult process that required multiple approaches. A 1997 assessment of reform implementation in AMC found that training varied in quality among its major subordinate commands, causing some dissatisfaction in the workforce. Some commands had the idea acquisition reform applied only to the contracting community and did not offer training to other acquisition workers. No command had a plan to provide systematic reform training to its entire workforce. But annual follow-up reviews after the assessment showed the situation steadily improving. By 1999 the commands had plans in place to make training available for all of their acquisition workers and were setting aside funds for the required 80 hours of training every two years. When training resources were not available within the Army, the commands sought assistance from Defense Acquisition University, purchased training from private contractors, or sent personnel to attend courses at the university or civilian educational institutions.[29]

Following OSD's example, the Army sought to develop metrics to evaluate the effectiveness of its acquisition reform program. In 1997 a process action team with members drawn from the assistant secretary's office, other acquisition organizations from across the service, and from the Air Force began to search for appropriate metrics but encountered problems. As every organization was different, the team had trouble finding metrics that could be applied to all. Also, some proposed reform metrics were amorphous and nearly impossible to measure objectively. For example, one organization wanted to use "customer satisfaction." Additionally, the data was difficult to collect and track. Thus the Acquisition Reform Directorate wanted to keep the metrics simple, leading to complaints it oversimplified the acquisition process and left out many hard-to-measure but vital activities. Moreover, field organizations often ignored requests for suggestions about metrics or failed to report data. To overcome some of these problems, the directorate instituted an Internet-based metrics reporting system in which organizations and individual program managers posted data in a standardized format. For at least a year it tracked and published some results, using metrics such as the annual rate of program cost change for major programs; breaches in cost, schedule, and performance for major programs; and Defense Acquisition Workforce Improvement Act certifications.[30]

In addition to the metrics initiative were reviews conducted by Materiel Command's Acquisition Reform Implementation Assessment Team (ARIAT). The command initially chartered the team in 1997 to review the preparation of requests for proposal by its subordinate commands for programs in ACATs III and IV. Two years later it extended the reviews to include major weapon system programs. Although the reviews concentrated on RFP preparation, they also assessed more broadly how an organization was implementing acquisition reform. The reviews were nonthreatening and well received by organization management. In a typical site review, the team studied documents, received briefings, and conducted interviews. It then rated the organization in several categories, such as workforce training and risk management. The organization received the results but was not required to take any action. Recommendations were intended solely to help the command improve its operations, and results were not shared with others. Low marks were not a cause for retribution, so the commander, the staff, and the workers were more candid in their interviews. The ARIAT published only an annual report that gave Materiel Command a rating based on the categories it had evaluated and presented a general discussion of the status of acquisition reform implementation.[31]

The ARIAT's first review in 1997 found implementation of reform uneven. Some commanders paid little attention to the subject and strategic planning was weak: "The team found few instances of an operative acquisition reform strategic plan that was truly providing guidance and direction." Training was haphazard, as were the use of computer modeling and simulation and integrated product teams. By 1999, however, the team found improvement in most areas, especially in teaming, training, strategic planning, and management support for acquisition reform.[32]

MILSPEC REDUCTION AND TEAMING

MILSPEC reduction, the adoption of teaming and integrated product and process management, and reinvention were among the significant Army acquisition reform initiatives in the 1990s. The Army had been actively working to reduce its reliance on military specifications and standards in favor of commercial and performance specifications since the 1980s. In 1991 the service made adopting commercial practices a principal component of its acquisition strategy and began converting MILSPECs into commercial standards.[33]

When the secretary of defense all but banned the use of MILSPECs in June 1994 (see chapter VII), the Army readily complied. The Army implementation plan of November 1994 set as its goal the review, disposition, and conversion of the service's 12,350 standardization documents within four years. Army Materiel Command directed the effort through a management structure headed by the Army standards improvement executive (AMC's principal deputy for acquisition) and the Army Departmental Standardization Program Office. The standards improvement executive also worked with a Defense Standards Improvement Council to formulate new policy. Each of the 31 Army acquisition organizations appointed its own standards executive who prepared a three-year master plan laying out how that organization would reduce the number of MILSPECs. Acquisition organizations submitted master plans and quarterly reports to the departmental standardization program office.[34]

The Army was such an enthusiastic proponent of reducing MILSPECs that it took the step, unique among the services, of expanding the effort beyond ACAT I and II systems, as OSD mandated, to smaller programs and the acquisition of spare parts and services. It also included systems already in production. At the end of four years the Army had cut the number of specifications and standards documents in half, with only 14 percent still available for use in new designs.[35]

This is not to say MILSPEC reduction had gained universal acceptance. In 1995 Gilbert F. "Gil" Decker, the assistant secretary for research, development, and acquisition, noted that the implementation was going well in major system development but not in the smaller programs. "Beware of individuals advertising 'commercial specifications' that are merely the same rubber-stamped Military Specifications/Standards we are trying to eliminate," Decker warned. Evidently some Army officials were asking industry standards groups to declare their MILSPECs to be performance specifications and standards, a practice, said Decker, that "is unethical, violates DoD and Army policy, wastes taxpayers' dollars and dilutes modernization efforts for our soldiers." Despite Decker's stern warning and the Army's reform efforts, MILSPEC use persisted. A survey published in 2000, almost six years after the initiative began, found that 65 percent of the Army acquisition workforce agreed with and adhered to the policy, but 35 percent did not.[36]

The Army also began early to adopt teaming and integrated product and process development. Like the Air Force, the Army had shown a strong interest in concurrent engineering, an approach popularized in industry during the 1980s, in which multidisciplinary teams of managers, engineers, and functional specialists formulated the system design and oversaw its execution (see chapters VII and XI). In October 1990, Army Materiel Command created the position of deputy chief of staff for concurrent engineering, and not long afterward the command formed a working group and sponsored a series of workshops to explore and promote the concept. In 1992 Materiel Command issued a white paper describing concurrent engineering as an "essential element" of the various acquisition strategies then being adopted by the Army. That same year the AMC commander and the assistant secretary for research, development, and acquisition requested all major acquisition programs to adopt a team approach and to include industry personnel: "[W]hile we recognize the need to maintain an 'arm's length' relationship with the contractor team, we will nonetheless strive to avoid the adversarial relationship that has characterized many government/contractor arrangements in the past."[37] The Army, therefore, was already in the process of implementing the principles of integrated product teams and integrated product and process development—which it called integrated product and process management—when OSD mandated their use in 1995. In January that year, the service assembled a team to overhaul the acquisition oversight process using integrated product teams. The overhaul deliberately mirrored the changes the under secretary of defense for acquisition and technology adopted for the Defense Department. To streamline oversight, the team reduced the required documentation, the number of committees, and the number and length of formal reviews by the Army Systems Acquisition Review Council. In their place were more informal reviews conducted by an overarching integrated product team, the ASARC Coordinating Team, comprising key members of the council. The coordinating team was assigned to work with each program throughout the acquisition cycle to catch problems early and to make the council principals more familiar with the status of the program. Ideally, this ongoing involvement with the program would allow the assistant secretary for research, development, and acquisition to substitute a review of program documents, a "paper ASARC," for the traditional meetings. Assistant Secretary Decker supported the initiative and endorsed the Army team's plan. The new streamlined process was first applied that spring with favorable results to the Joint Surveillance Target Attack Radar System Ground Station Module, which analyzed and disseminated data collected by JSTARS aircraft.[38]

Meanwhile, the Army applied the integrated product team and integrated product and process management concepts to program management. It sponsored workshops to explain the new tools and sent 69 secretariat and Materiel Command officials, program executive officers, and program managers to an OSD-sponsored meeting on the subject. In 1995 AMC published detailed guidance on implementing integrated product and process management and four years later issued a guidebook, *The Art of Teaming*. Gradually, the culture changed as Army personnel learned through training and experience how to organize multidisciplinary teams and work within them. A survey of 40 ACAT I and II program managers in 1997 found that 94 percent had formed integrated product teams, and 63 percent of those teams had been active for more than a year.[39]

Even some of the older programs successfully adopted teams. The Longbow Apache helicopter program used a temporary team with a specific task. The Army organized a special working group to prepare the program for its upcoming Milestone III review, which would decide whether it should enter production. The group included department staff, ASARC principals, officials from designated agencies, and the program managers and program executive officers of the two development efforts involved, the Longbow Fire Control Radar and the AGM–114L Longbow Hellfire, a radar-guided, air-to-surface missile. OSD subsequently directed the working group to transform itself into an overarching integrated product team cochaired by an OSD official and including OSD staff and Defense Acquisition Board members. Using the new oversight procedures, Longbow Apache avoided the need for full ASARC and DAB reviews and easily won production approval in October 1995.[40]

The program offices applied the teaming concept in different ways. A Materiel Command survey of eight programs of various sizes found a wide range of practices among them. Contracts might or might not specify the use of teams, depending on the age of the program. Sometimes the program office took the lead in forming them, and other times contractors took the initiative. Army teams might or might not include personnel from the contractor side, and vice versa. The variation in team organization and operation reflected efforts by the program offices to tailor integrated product and process management to the needs of each program and take into account the views of program participants on how teaming should work.[41]

The decision whether to adopt joint-industry teams is an example of how program offices differed in applying integrated product and process management. Some major development programs, including the UH–60 Black Hawk helicopter, the Comanche helicopter, and the Patriot Advanced Capability–3 missile system, formed such teams. Others did not, including the two ACAT I programs surveyed by the Materiel Command working group, upgrades to the Bradley Fighting Vehicle and the Longbow Apache helicopter. In the Bradley upgrade program, both the program office and the prime contractor, United Defense Limited Partnership (later United Defense Industries), employed separate teams. Although not required by its contract, United Defense had begun using "product development teams" by 1993. Two years later it adopted a more comprehensive proprietary management system purchased from Texas Instruments, which included a hierarchy of teams similar to those used in integrated product and process management. Government personnel attended some of the weekly team meetings at company headquarters in San Diego, but with the program office in Detroit, the physical separation complicated their attendance.[42]

Similarly, in the Longbow Apache upgrade program, McDonnell Douglas Helicopter Systems established a team-oriented management structure at its own expense, although the contract did not require it. This structure included eight teams, each focused on a particular subsystem under redesign, with a high-level IPT serving as system integrator. Each subsystem team comprised members from all functional areas, and the integration team included representatives of the eight subsystem teams. The government did not participate in the McDonnell Douglas teaming process. Aside from the overarching integrated product team the Army and OSD imposed on the program, the program office followed the traditional approach to management and oversight and did not send representatives to the contractor's team meetings. The company did not push for government involvement, believing any effort to include program officials would meet with employee resistance. McDonnell Douglas thought the program's leadership would be unlikely to cede decision-making authority over functional issues to team members, a central feature of integrated product and process management. Incompatible technology also hindered communication between the two sides. McDonnell Douglas used a computer-aided design system with a standardized format that allowed its teams to send designs electronically to each other and to outside suppliers, but neither the program office nor AMC's Aviation and Troop Command could read that format.[43]

CONTINUOUS MODERNIZATION

In summer and fall 1991 the Army basked in the afterglow of Operations Desert Shield and Desert Storm, where the Big Five and other weapon systems had received good reviews for their performance. The virtually indestructible M1A1 Abrams tank proved far superior to the Soviet-made Iraqi tanks. AH–64A Apache helicopters opened the air campaign by slipping over the Iraqi border at night and destroying two radar stations, allowing the remaining air assault forces to fly in unharmed. The helicopters also mounted attacks against Iraqi ground forces. As noted in chapter V, the Patriot air defense system was one of the war's most remarkable stories. When Israel came under attack from Iraq's Scud missiles, the United States rushed Patriot batteries to defend the Jewish state and deter it from entering the war, thereby eliminating one reason for Arab states to break from the allied coalition. Along with the performance of the Big Five, victory had been achieved with the Cold War Army's large, ponderous divisions and "iron mountains" of stockpiled supplies and munitions, all of which took months to deploy. Many defense analysts believed no such window would exist in a future conflict; regional commanders needed rapidly deployable forces, which suggested air and naval power rather than mechanized ground forces.[44]

The Army would have difficulty creating a new force. The post–Cold War drawdown struck the service particularly hard. Its procurement budget authority had already taken a pounding during the latter half of the 1980s, falling from a high (in constant 2001 dollars) of $27.8 billion in FY 1985 to $16.9 billion in FY 1990, a drop of 39 percent. During the next five years it plunged even more sharply to a low of $7.1 billion in constant dollars—a drop of 58 percent. For two years in a row, 1991 and 1992, procurement was cut 25 percent annually. Altogether, the Army lost three-quarters of its procurement budget in 10 years, the worst percentage loss of the three services. After that, the procurement budget leveled off and then began to improve—with a 28 percent increase in 1999—to end the decade at $10.4 billion in FY 2000.[45]

During the late 1970s and 1980s the Army had accumulated a substantial inventory of modern conventional weapons. It had procured large numbers of the Big Five: 807 Apache helicopters, 1,121 Black Hawk helicopters, 6,724 Bradley Fighting Vehicles, and 7,788 M1 Abrams tanks, as well as 6,416 Patriot missiles. This inventory had been intended to fight the mass of Warsaw Pact forces, but with the end of the Cold War the Army had far more of these systems than it would need in the foreseeable future. Procuring more of them essentially stopped. From 1992 to 1995 the Army bought 18 M1s, 14 Apaches, 97 Patriots, but no new Bradleys. It continued quantity production of Black Hawks, however, and bought 175 during that time. Most of the Big Five systems were still early in their service lives; previously planned upgrades then underway would keep them state of the art, so there was no urgent need to replace them. The Army had a difficult time justifying major new programs, and Congress showed little enthusiasm for funding any.[46]

By 1993 the RAH–66 Comanche helicopter—the "bright star of the Army's modernization program," according to an Army official history—was the only major developmental system in the Army's portfolio that remained on the Defense

Two UH–60 Black Hawk helicopters wait to follow another Black Hawk into the air during Operation Desert Shield, January 1991. *(NARA)*

Department's list of its top 20 programs. From the Big Five, the Army was effectively down to the "Big One." Comanche would remain the Army's top acquisition priority until the program was canceled in 2004.[47]

Over the next few years Comanche was joined by a few new starts, notably a light tank called the M8 Buford Armored Gun System (terminated in 1996) and a self-propelled howitzer known as Crusader (see case study below). However, money remained so tight that in fall 1996 Army leaders required program managers to find ways to squeeze 20 percent out of their budgets to boost high-priority acquisition programs. Wholesale weapons replacement was out of the question.[48]

The service turned instead to what it called "continuous modernization," in which every class of major weapon system would have a system in production or under upgrade, or with the next generation in development. This approach relied heavily on modifications and upgrades to existing systems and only a few new starts, while the technology base conceived, refined, and tested concepts for next-generation weapons that could be built when circumstances permitted.[49]

The reliance on modifications and upgrades offered several significant benefits. Many improvements would involve information technologies, including computers, sensors, and voice and data networks. Such technologies could potentially provide advances in capability out of proportion to their cost, making the weapons more effective, promoting interoperability among the branches of the Army and with the other services, and giving operational commanders more options. The Army saw it would benefit from these technologies much sooner if they were inserted into existing systems rather than held until a new system was fielded. Given the rapid development cycle in high technology, the Army could not afford to wait 12 to 15 years, the average acquisition cycle for major weapon systems. Information technology upgrades, especially those involving new software, usually required less reengineering of the basic platform hardware than, say, a new engine or warhead. Even if a technology proved difficult to develop, the risk of installing an upgrade was still less than if it were being integrated into an entirely new system with other advanced but untried technologies. Employing modifications and upgrades would mean more predictable cost and schedule estimates for the program.[50]

To make the best of a difficult situation, Army leadership in the years immediately after the Gulf War decided that an upgrade strategy offered an opportunity to improve the capabilities of both its individual systems and the Army as a whole. Several new technologies, including targeting systems, night vision devices, and information displays, were potentially useful to other Army weapons, such as tanks, helicopters, artillery, and air defense systems. Integrating technologies "horizontally" across the force—that is, in all the elements comprising a given combat organization, such as a task force—would increase the effectiveness of the entire force. However, because acquiring the systems cut across the jurisdiction of the Army's various branches—not always in the habit of working with each other—it would require central planning and guidance. To break out of the old stovepiped "vertical" approach to acquisition, the Army in 1993 adopted a strategy it called horizontal technology integration (HTI). A general officer working group, cochaired by senior officials in the secretariat and on the Army staff, directed the effort. It met twice each year to select potential upgrades and review the progress of the work. The Army initially selected three HTI initiatives: Own the Night, to allow its forces to operate better in the dark; Battlefield Combat Identification, to reduce the risk of fratricide (a significant problem during Desert Storm); and Battlefield Digitization, to promote the emerging system of systems concept underlying much of the service's planned redesign of its operating forces, called Force XXI (see below). The Army later added initiatives to promote survivability, diagnostic capabilities, and power management. Candidates for horizontal technology integration were not necessarily products of larger initiatives; any organization could recommend a technology for consideration. Successful candidates were assigned to a program manager for development, either as part of a larger program or, when warranted, as a separate effort.[51]

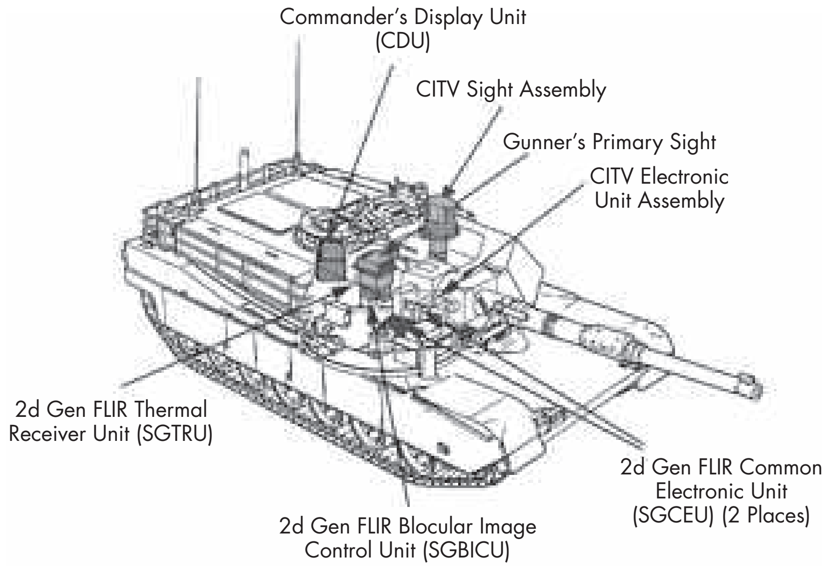
Horizontal technology integration acquisitions were complex, and the work had to be managed carefully. In addition to the development of the technology itself, parallel engineering efforts had to be undertaken for the weapon systems that were to receive it. The usual approach was to develop separate "kits." The B-Kit, the technology itself, would be designed and built as a module with standardized interfaces, while a custom A-Kit would be built for each host platform. The HTI program manager was responsible for the B-Kit; the host system programs were responsible for developing their own A-Kits. There were thus two or more technically independent acquisition programs, one for each kit, although only the B-Kit was conducted and funded as a separate program.[52]

Programs applying horizontal technology integration were not streamlined in the same sense as advanced technology demonstration programs (see chapter VIII). HTI programs had to follow regular acquisition procedures, including milestone reviews by the Army Systems Acquisition Review Council or OSD's Information Technology Overarching IPT. However, they had priority and followed an accelerated process. For example, the first horizontal technology integration program, the Second Generation Forward-Looking Infrared Radar (FLIR) system, offered significant new capabilities for operating in the dark. The initial effort began with a special task force created in March 1993; by the end of the year the Army had approved the Operational Requirements Document and released a request for proposal for the contract. In July 1994 the new infrared system—which had been designated an ACAT II program—passed the Army Systems Acquisition Review Council for both Milestones I and II and went directly into engineering and manufacturing development. That same month the Army awarded a contract to the only bidder on the solicitation, a team composed of Texas Instruments and Hughes Aircraft. The HTI program then proceeded to develop the B-Kit while the Abrams, Bradley, and other platforms were approved for the upgrade and received additional funds to develop A-Kits (see figure 12-3).[53]

Despite initial doubts, the Army acquisition community eventually embraced horizontal technology integration. For example, the PEO for Armored Systems Modernization, who recognized HTI's significance, created a horizontal technology integration directorate, which in 1995 became a full program management office for Armored Systems Integration. This office was a focal point for horizontal technology integration, not just for its own program executive officer but for other organizations as well, providing specialized managerial and engineering expertise, support, and oversight. The office performed a central coordinating function by ensuring commonality across all platforms.[54]

Another approach to conducting upgrades, called modernization through spares, was an outgrowth of the MILSPEC reduction effort. This initiative applied performance-based specifications to spares—including parts, components, subassemblies, and complete assemblies—thereby improving the performance of the larger system. Freed from the strictures of MILSPECs, suppliers could find the most inexpensive means to meet the performance specifications and could adopt current technology. Allowing suppliers to redesign and modernize spares could effectively upgrade the system incrementally without significant reengineering or the creation of a new acquisition program. It also reduced sustainment costs and could be applied at any point in a system's life cycle. For systems undergoing development, the "designing for modernization" focus helped ensure spares could be upgraded in the future, through the use of open systems, modular design, and software partitioning. For systems in production or in the field, the emphasis was on using performance specifications to enhance the design baseline and thus promote the modernization of the system during the process of repair and maintenance. Modernization through spares became especially important because many of the systems fielded in the 1980s used parts, components, subassemblies, and complete assemblies that were

Figure 12-3: 2d Generation FLIR on the M1A2 Abrams Tank



CITV – Commander's Independent Thermal Viewer
FLIR – Forward-Looking Infrared Radar

Source: Adapted from Lon E. Maggart and John E. Longhouser, "Tank Modernization Plan," United States Armor Center, Fort Knox, KY, 9 Sep 1996.

obsolete and no longer available. These aging systems were themselves in danger of obsolescence and subject to higher failure rates unless they were upgraded.[55]

The Army launched the initiative in January 1996, with four pilot programs to test the concept: the Black Hawk helicopter, the Paladin/M109 family that included a self-propelled howitzer and ammunition resupply vehicle, the M8 Buford Armored Gun System, and the High Mobility Multipurpose Wheeled Vehicle (HMMWV, or Humvee). The idea spread rapidly through the Army. A "very successful" workshop on modernization through spares in May 1997 led to the initiative's full launch the following January simultaneously with the publication of a how-to guide, *Army Strategy for Modernization Through Spares*. The Army ordered all programs to adopt the approach and required program executive officers and commanders of major commands and Materiel Command's subordinate commands to prepare their own strategies and post them on the Internet. An overarching integrated product team evaluated the posted strategies and commended organizations with well-considered and innovative plans. The first 15 modernization through spares programs were identified by October 1998; their program managers reported improved quality and performance, and millions of dollars saved.[56]

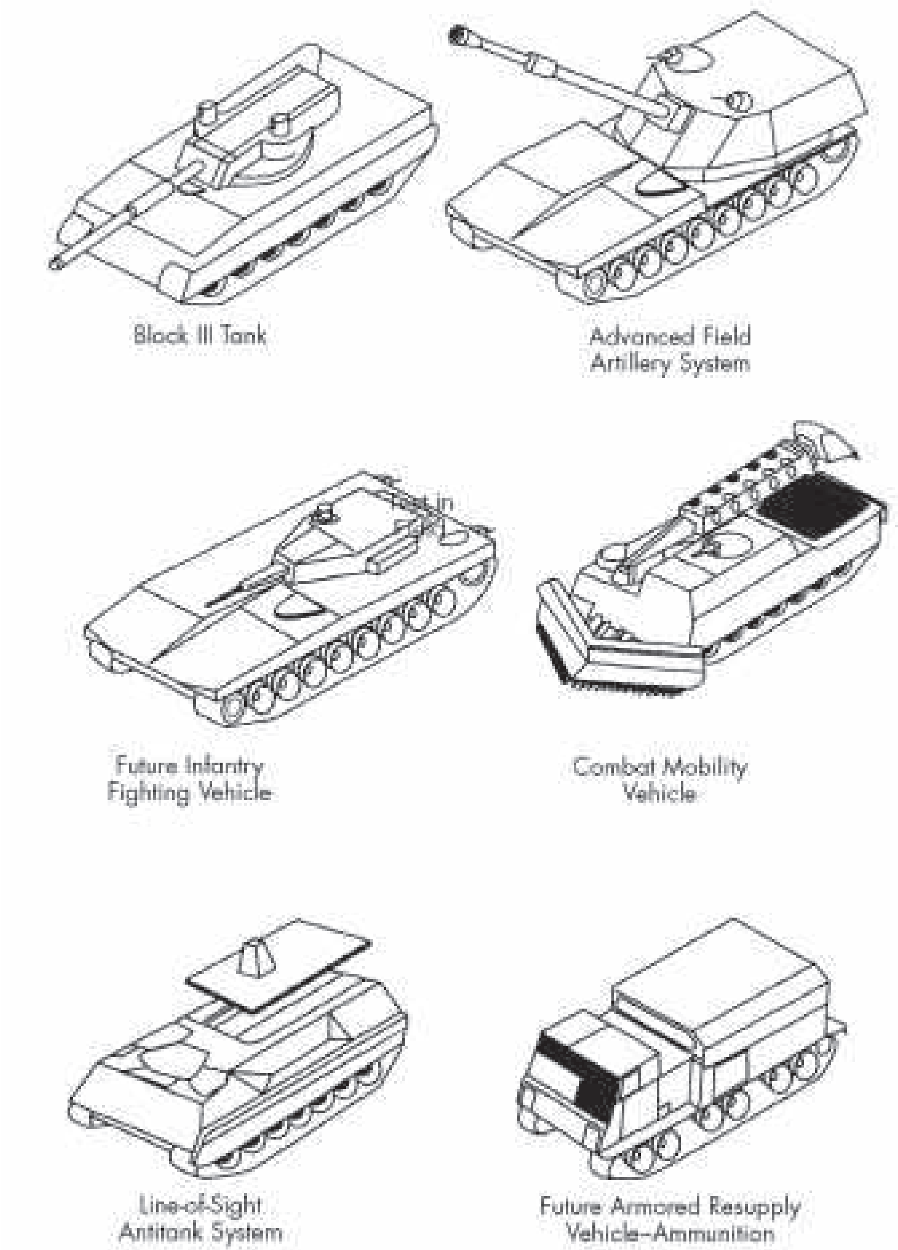
MODERNIZING ARMOR

The fate of its plan to modernize its armored systems made clear the fiscal reality facing the Army. Planning had begun in the late 1970s for the systems, at one time 24 ground combat vehicles that would someday replace the Big Five, which had not even entered production at that point. By 1989 plans for the next-generation armored systems had evolved into the Heavy Force Modernization program consisting of a family of six state-of-the-art tracked vehicles—a heavy tank, an infantry fighting vehicle, an antitank system, a self-propelled 155-millimeter (mm) howitzer, an ammunition supply vehicle, and an engineering support vehicle—all sharing two common chassis (see figure 12-4). The program proposed an innovative acquisition strategy that would adopt common, modular designs for the vehicles and hire a contractor as a systems integrator to keep the separate vehicle development efforts on track. It also envisioned replacing military specifications and standards with performance specifications that would tell the contractor what capabilities were needed but not how to achieve them. Full system prototypes would substitute for test beds and technology demonstrators. The demonstration/validation phase would be eliminated, thus cutting three years off the development time.[57]

The Heavy Force Modernization program ran into opposition from OSD, which considered the demonstrators insufficient for reducing technological risk and for providing the information needed by the Defense Acquisition Board to make a decision on the program. OSD demanded the Army add full demonstration/validation prototypes to the program. Congress, too, was concerned about the program's acquisition strategy as well as its potential cost. In 1990, to appease critics and to win approval for entry into Milestone I's demonstration/validation phase, the Army revised and renamed the program. Called the Armored Systems Modernization program, it included prototypes and a light tank. However, the critics did not stay silent for long. The renamed program faced renewed criticism from Congress, OSD, the testing community, and from within the Army itself. The service gave the critics plenty of ammunition. As late as mid-1991, the Army persisted in defending the requirements on the basis of a Soviet threat that no longer existed. It gave higher priority to a new tank and infantry fighting vehicle, despite the strong performance of the Abrams and the Bradley in Desert Storm, than to the new mobile howitzer, even though the campaign had revealed deficiencies in artillery. The service stubbornly proclaimed the modernization program's affordability in the face of skeptics who juxtaposed the explosion of its downstream costs with the implosion of the Army's procurement budget. To resolve these issues, the Army made two attempts to overhaul the struggling program in fall 1991, but OSD rejected the Army's plans, and the program was broken up the following January.[58]

Elements of the armored systems modernization family of vehicles survived, at least temporarily—the light tank became the Armored Gun System and the howitzer

Figure 12-4: Armored Systems Modernization Family of Vehicles, 1991



Source: GAO, *Armored Systems Modernization: Program Inconsistent with Current Threat and Budgetary Constraints*, GAO/NSIAD-91-254 (Jul 1991), 9, 11.

became Crusader—but the end of the program ensured that the Abrams would remain the Army's main battle tank for the foreseeable future. The Abrams had been designed to be upgraded from the start, an unusual approach for the 1970s. The improvements took the form of block changes in which several upgrades were installed during a single overhaul. By the late 1980s the Army was planning the second major block modification, the M1A2. While the M1A1 modification had focused on hardware—including a larger gun and better armor—the second focused more on improved electronics. Whereas the M1A1's systems had been 90 percent analog and only 10 percent digital, in the M1A2 the proportion was reversed. The change would include two computer systems, for redundancy, that would relieve the crew of much routine data processing for fire control, navigation, tactical operations, communications, and diagnostic self-tests. The Commander's Independent Thermal Viewer allowed the gunner to engage one target while the commander searched for another. The Intervehicular Information System (IVIS) showed the crew the location of enemy and friendly forces and their vehicle's location in relation to them. Instead of following the traditional method of installing and hardwiring the new subsystems individually, the Army took advantage of the inherent flexibility of digital systems by creating a central backbone, called the "core tank," that integrated the subsystems using common hardware and software components. This digital architecture not only reduced the engineering work on the tank itself but also promised to simplify future upgrades, some of which would require only new software.[59]

The first of the M1A2 prototypes arrived in 1990, and after several years of testing and correcting deficiencies the model proved to be quite successful. One tank company commander raved it was a "revolutionary" system with "incredible potential" and "an absolute superstar." Even though the computer hardware was obsolete by several generations before it was fielded, the new capabilities it provided made the M1A2 "a very different tank than the M1A1." The main difficulty with the M1A2, the commander concluded, was in training the crews to take advantage of the new capabilities.[60]

Because of budget limitations, the defense drawdown, and reduced requirements—the M1A2 had been sold as a short-term response to a new Soviet tank that never appeared—in 1990 the Army scaled back its planned procurement to 62 vehicles. These were all to be new-builds, but Congress, concerned that all tank production would cease, began pressing the Defense Department to convert some M1A1s to M1A2s as a cost-effective way to keep the production lines open, and provided money for that purpose in the FY 1991 and FY 1992 budgets. In keeping with its new modernization policy—not to mention the will of Congress—the Army accepted upgrades of the M1A1s even though it would have preferred new-manufacture M1A2s. By 1993 it had manufactured the 62 M1A2s and upgraded 368 M1s and M1A1s. By the end of the decade almost a thousand tanks had been converted.[61]

M1A2 tanks maneuver on a combat patrol in the city of Tal Afar, Iraq, 3 February 2005. *(U.S. Army)*

"CHANGING THE WAY WE CHANGE," FORCE XXI, AND THE DIGITIZED BATTLEFIELD

Operation Desert Storm had a profound impact on the Army. The conflict stood at the crossroads between the Cold War and the post–Cold War eras—a "Janus War," General Frederick Franks, then Desert Storm's VII Corps commander, would later call it, referring to the two-headed Roman god who simultaneously looked backward into the past and forward into the future. The war was the last battle of the Cold War Army, with heavy formations organized and equipped to fight the Soviet Union in Central Europe. At the same time Desert Storm was the first war of the post–Cold War era. It offered a vision of future warfare in which information technologies and systems, ranging from satellites to handheld Global Positioning System receivers, would be as important weapons of war as bombs and bullets. The televised images of "smart bombs" striking targets were but the most visible illustrations of how the military applied high technology to military operations. The participants themselves saw the more important applications behind the scenes—the use of satellites for reconnaissance and communications, aerial surveillance, the networking of hundreds of personal computers, and the electronic preparation and transmission of orders. The information revolution had begun, though it was still in its early stages, and where it would lead was far from clear. All that was certain was that in some way or other, future wars would be digitized.[62]

On 21 June 1991, less than four months after the Gulf War cease-fire, General Gordon Sullivan became the Army's 32d chief of staff. He was concerned about the Army in a post–Cold War environment and spoke often about the human and technological dimensions of war, especially technology's impact on military operations. Sullivan recognized that information technology would alter warfare. However, he did not blindly adhere to the central premise of the revolution in military affairs—the theory that high technology, in the form of precision weapons, advanced sensors, data networks, and high-speed command and control systems, would decide the wars of the future (see chapter I). "The digitization of the battlefield is a major leap ahead in the conduct of warfare," he said, "but not a break from the past." For example, Sullivan rejected the idea popularized by Admiral William Owens and others that the "fog of war" could be dispelled by "perfect information," because, he wrote, the "very nature of war consists of fear, fog, danger, uncertainty, deception, and friction." He summed up his thinking on information technology's relationship to the Army and to the nation's military strength in a 1995 letter to the service's general officers, noting the United States' competitive edge "rests on quality soldiers . . . armed with the power of the microprocessor."[63]

Sullivan was particularly impressed with the potential impact of "integrative technology" that linked the various components of a military force, revolutionizing command and control and enabling a commander to leverage scarce assets, especially in joint operations. The technology would be a "force multiplier"; that is, it would give a military force a combat power disproportionately greater than its size. If properly organized and equipped, the Army might have defeated the Iraqi army of 1991 with far fewer than the 540,000 coalition troops deployed to the Gulf. Having a smaller army in the field could have its advantages: A smaller force would be easier to deploy overseas, support logistically, and command during combat operations. To Sullivan, the limiting factor in applying technology effectively "will not be the hardware, it will be human and organizational."[64]

General Gordon R. Sullivan, U.S. Army chief of staff, 1991–1995. *(DoD)*

His views on the application of technology to warfare would be at the heart of his effort to reshape the Army. Accommodating the new technology would require new doctrine, new organization, and new training for the troops. Sullivan recognized—unlike many of his colleagues—that simply maintaining a scaled-down version of the Cold War Army would not be enough to meet the challenges of future warfare. "Keep this in mind," he would tell a subordinate: "Smaller is not better. Better is better."[65]

Sullivan rejected using the Army's established organizational structure and processes for planning the changes he wanted. The Army staff and major commands were consumed by day-to-day affairs and had their own interests and agendas. Additionally, the then-in-use Concepts-Based Requirements System, a Cold War legacy, was intended to modernize the force in a slow, deliberate, and orderly manner that would not disrupt its readiness to fight. Innovation tended to be incremental and evolutionary, a suitable approach for the standoff with the Soviets but not for what Sullivan had in mind for the future Army. But he did not intend to force his ideas on the Army unilaterally. While refusing to be held back by the existing bureaucracy and requirements system, he did not want to disrupt the Army or impair its readiness. He therefore sought consensus, especially among the senior commanders.[66]

For Sullivan, establishing a process for change was essential—"to change the way we change," as he liked to put it—because neither he nor anyone else knew precisely what the post–Cold War Army should look like. The solution was to conduct experiments that would test both hardware and operational concepts, enabling them to evolve and the Army to evolve with them. Field maneuvers were expensive in the 1990s. Furthermore, testing technological options normally would be difficult without first building prototypes, also a slow and expensive proposition. However, an experimental approach was now more feasible because of the availability of digital simulation. Networks of "distributed interactive simulators" could allow widely dispersed units to participate and interact with each other and with simulated equipment. Computer simulators would allow the rapid and relatively inexpensive consideration of different technological and organizational possibilities. For example, Sullivan explained that through simulation "a tank can be made to weigh 50 tons, instead of 70 tons . . . and then [you can] change the number of people in the tank from four to three."[67]

Sullivan's ideas crystallized in fall 1991 when he read a history of the Louisiana Maneuvers. A series of field exercises conducted in 1941 under the auspices of Chief of Staff General George C. Marshall, the maneuvers allowed the Army to study tanks and tank doctrine and helped lay the basis for the Army's successful armored campaigns in World War II. Sullivan formally announced his new approach in March 1992. Evoking Marshall's spirit, he also called it the Louisiana Maneuvers (LAM).[68]

The key to Sullivan's Louisiana Maneuvers was the "LAM process," a method for identifying, analyzing, and prioritizing issues coming from the field that were relevant to the Army's reorganization. A general officer working group, composed primarily of one- or two-star officers representing the commands that identified the issues, met once or twice per year to sift through proposals and select about 20 for possible implementation. The group forwarded those proposals to the Board of Directors, a top-level body comprising the Army's four-star commanders and chaired by Sullivan, which made the final selection. (In 1994, for example, the board approved 9 of the 15 proposals it received.) The board then assigned each of the proposals selected to a "proponent"—Materiel Command, Training and Doctrine Command (TRADOC), or Forces Command (FORSCOM)—which was responsible for evaluating it and then reporting the results to the board.[69]

To run the process, Sullivan created the LAM Task Force of about 50 young officers and civilian Army employees under a director who reported to Sullivan personally. He stationed the task force at TRADOC headquarters in Fort Monroe, Virginia. Its first director, Brig. Gen. Tommy Franks, former assistant commander of the First Cavalry Division during Desert Storm (and who would lead the 2003 invasion of Iraq), recalled that Fort Monroe "was close enough to Washington for easy access to the Pentagon, while still far enough from the intrigues of the Beltway to allow the . . . Task Force to ponder the Army of the 21st century in a relatively tranquil setting." But Sullivan also chose Fort Monroe because the task force mission was similar to TRADOC's. In addition to conducting training and writing doctrine, TRADOC was responsible for what was known in the Army as "combat development," that is, the development of tactical concepts governing service doctrine, organization, and materiel acquisition. The command's combat developers also formulated the materiel requirements that defined the weapons the Army would seek to acquire. Each acquisition program was assigned a TRADOC system manager who was responsible for overseeing the work of the materiel developers (Materiel Command or the program executive officers) and keeping an eye on the program. The system manager represented the interests of the user in the process and held power and authority comparable to that of the program manager. Finally, TRADOC adjusted the service's tactical organization to match the weapons being acquired.[70]

General Frederick Franks took charge of the command just two months after Sullivan became chief of staff. Franks had extensive combat experience both in the Persian Gulf and Vietnam, where he had lost a leg. Personal friends, Franks and Sullivan talked frequently, often brainstorming long into the night.[71]

General Frederick M. Franks Jr., commanding general of the Army Training and Doctrine Command, 1991–1994. *(DoD)*

Franks shared Sullivan's outlook and vision regarding future warfare. He had been greatly influenced by his experience with the new technologies while commanding VII Corps, both before and during the Gulf War. During an exercise in Europe in fall 1990, he observed the operation of JSTARS, then under development, and was so impressed with what he saw that when he arrived in the Middle East with his corps he raved about the system to the coalition commander, General Norman Schwarzkopf, who arranged to have the two JSTARS aircraft prototypes brought to the Persian Gulf in time to participate in Desert Storm (see chapter V). Years later Franks reflected that the Gulf War had shown him the "glimmerings of a new dawn, perhaps the beginning of a revolution in battlefield information exchange."[72]

Like Sullivan, Franks believed in the need for a fundamental revamping of the Army and in the importance of experimentation and simulation. Even as the Louisiana Maneuvers were taking shape in Sullivan's mind, Franks was thinking about a methodology for experimentation that led to the creation of Battle Laboratories. Battle Labs were Training and Doctrine Command organizations that complemented the LAM process but remained officially separate from it. They performed experiments on problems of interest to the Army, including, but not limited to, LAM issues. TRADOC established six Battle Labs at its facilities around the country; it later added three more after the concept proved to be successful. Each concentrated on a warfare area considered to be particularly ripe for change, called a "battlefield dynamic"—a concept invented by Franks. The labs analyzed technologies and mission needs to develop tactics and materiel requirements, with emphasis on providing future capabilities through technology insertions and modifications of existing systems. The labs were nonhierarchical and among the first Army organizations to link their members through email accounts and online file-sharing systems. Participants were encouraged to communicate with each other irrespective of the chain of command.[73]

Testing began with extensive simulations as a relatively quick and easy way to furnish "proof of principle" of new technological concepts. Promising concepts and technologies then went through a series of additional experiments, culminating in an advanced warfighting experiment (AWE), the centerpiece of the Battle Lab testing process. AWEs were large-scale, comprehensive exercises intended to examine a broad problem, testing not just the technology itself but also its impact on the various factors contributing to a unit's fighting capability such as doctrine and training. Advanced warfighting experiments usually involved one or more of three types of simulations: virtual simulations, in which participants interacted with computer-generated mock-ups of weapons, often in realistic "virtual reality" environments; constructive simulations—computer-modeled war games—in which participants made decisions and interacted with each other and computer-generated opponents; and live simulations, in which participants operated real equipment, usually against a highly skilled opponent. Live simulations were expensive, but they provided vital insights that could not be obtained through digital simulators. Every

Battle Labs "Janus" Logo

Janus is the Roman god of beginnings who is identified with doors and gates. Janus is depicted as looking rearward (to the past) and forward (to the future). Janus symbolizes the Battle Labs in several ways. Battle Labs look both rearward to the operational experiences of history and recent operations and look forward to new ideas, concepts, and technologies. . . . Battle Labs symbolize a new beginning, a new way of doing business. . . .

—from TRADOC website, 1999.

simulation involved military personnel—Franks insisted that "real soldiers in real units" carry out the experiments; thus, they were often conducted in conjunction with training exercises, with the more extensive experiments held at the National Training Center, Fort Irwin, California.[74]

The early LAM issue with the highest profile was known as Battle Command, which focused on the impact of digitizing the combat forces. The Mounted Battlespace Battle Lab at Fort Knox, Kentucky, conducted a series of progressively larger advanced warfighting experiments on this issue. The first, in fall 1992, examined whether the new Intervehicular Information System displays would distract the crews of the M1A2 Abrams tanks equipped with them. After crews trained extensively on workstations that accurately simulated those displays, a tank platoon exercised with units of the 1st Cavalry Division at the National Training Center. The new technology was so effective that follow-on experiments in 1992 and 1993 tested the idea of installing IVIS-like technology in other platforms—including helicopters and artillery, again with positive results. These experiments culminated in April 1994 with a larger, more comprehensive advanced warfighting experiment on digitization involving both an armored and an infantry brigade, conducted as part of a regularly scheduled training rotation (NTC 94-07). The exercise, called Operation Desert Hammer, involved two weeks of intense maneuver, simulated combat, and live-fire training to test digitization in an environment made as realistic as possible.[75]

The LAM–Battle Lab experimentation process revealed that the Army lacked a way to acquire successful technology rapidly, a common problem of technology demonstration programs. Training and Doctrine Command itself could not acquire any technology the Labs found promising. At Franks's request, the assistant secretary for research, development, and acquisition established the Rapid Acquisition Tiger Team in 1994 to develop a process that could quickly reap the benefits of Battle Lab experiments. Franks incorporated the tiger team's process in TRADOC regulations in September 1994, and two years later it was formalized as the Warfighting Rapid Acquisition Program (WRAP). Under the new process, a Battle Lab conducting an advanced warfighting experiment passed the results to a senior-level review board called the WRAP Council, also known as the WRAP ASARC because it mimicked the organization and function of the Army Systems Acquisition Review Council. If approved, the new technology would be assigned a program manager and staff and would go through an accelerated acquisition process that included milestone reviews by the council. One of the first programs approved by the WRAP Council was a Bradley air-defense upgrade. Like the high technology insertion programs discussed earlier, these were small acquisitions in and of themselves—the Bradley upgrade was ACAT IV—but cumulatively they had a significant impact and became important elements of the Army's upgrade strategy. The WRAP process was seen as a prototype for a possible alternative to the standard major systems acquisition process as it was then practiced.[76]

FORCE XXI BATTLEFIELD COMMAND, BRIGADE AND BELOW

The LAM process provided a methodology for testing concepts, technology, and organization for the digitized Army of the 21st century—the Army of 2010, called Force XXI.[77] General Sullivan announced the campaign to create the new Army in March 1994. It would proceed on three interconnected axes: redesign of the operational Army—its battalions, brigades, and divisions; redesign of the institutional Army—the training and sustaining base that generated and supported the field forces; and the development and fielding of technologies "needed for information-age battle command." The Army Digitization Office, established in July 1994, would lead the digitization effort. Located in Washington, D.C., and reporting to the chief of staff, the office would interface with industry to identify technologies to be acquired and then ensure that the technologies would be fielded "horizontally across the force in a synchronized manner."[78]

The Force XXI digitization effort sought to apply information-based technologies to battlefield command, control, and communications at all levels, from the theater-level ground force component commander to the lowest tactical echelons, including the individual soldier. In late 1994 the Army identified the 2d Armored Division at Fort Hood, Texas (replaced a year later by the 4th Infantry Division, Mechanized), as the test bed for digitization. The service hoped to field 16 high-priority command, control, and communications systems with three of the division's four brigades by December 2000.[79]

Most of the systems were located in division, brigade, and battalion tactical operations centers. But one of the systems—Force XXI Battlefield Command, Brigade and Below (abbreviated FBCB2)—was designed to share information with soldiers operating weapon platforms who did not have access to data available in tactical operations centers and give those troops greater situational awareness. Composed of a computer, monitor, and keyboard, the FBCB2 system displayed a picture of the battlefield with icons identifying friendly and enemy forces. Its software integrated GPS, intelligence, and platform data such as the status of fuel and ammunition. FBCB2 also included interfaces to a common communications infrastructure called the Tactical Internet made up of computers, radios, satellite terminals, switches, and software.[80]

As noted previously, in 1992–1994 the Army had experimented with information sharing displays installed in tanks and other platforms. In August 1994 the program executive officer for command, control, and communications systems released a request for proposal for what would become the FBCB2 system. The following January the Army awarded a cost-plus-incentive-fee contract to TRW to develop the FBCB2 software and hardware. TRW, the prime contractor, assembled a team that included nine other companies to perform system engineering and integration.[81]

Initially designated ACAT III, the relatively small FBCB2 program employed a "build a little, test a little" spiral development acquisition approach. In 1997 the Army selected FBCB2 as one of its 11 warfighting rapid acquisition programs intended to jump-start new technologies. As the program expanded in terms of dollar cost, its acquisition category—and with that the level of oversight and milestone approval—changed. In 1997 FBCB2 became an ACAT II program. Two years later the under secretary of defense for acquisition, technology, and logistics designated it ACAT ID, which required the secretary of defense, assisted by the Defense Acquisition Board, to make milestone decisions.[82]

In line with the spiral development approach, the FBCB2 program fielded and tested several versions of the system's hardware and software in increments. Following each increment, the program incorporated system improvements into the next increment, or "spiral." This iterative process continued from 1996 through the beginning of full-scale production in 2004.[83]

FBCB2's first major test took place in an advanced warfighting experiment conducted in 1996–1997 at Fort Hood and at Fort Irwin. After initial training with the system in Texas, 4th Infantry Division units, totaling about 5,000 soldiers and including mechanized infantry, light infantry, armor, field artillery, aviation, and engineer battalions, deployed to the National Training Center in March to exercise Force XXI concepts and equipment, especially the FBCB2 system and the Tactical Internet communications infrastructure. About 900 platforms were equipped with the initial version of the FBCB2 system's software and one of three versions of its hardware—a commercial off-the-shelf version, a ruggedized COTS version, and a MILSPEC version. "For the first time," write the authors of a study of the Army's accelerated acquisition of digital command and control systems, "soldiers at the platform level . . . could see what was happening around them." As a result of FBCB2's performance in the advanced warfighting experiment and other evidence, in July 1997 the Army approved the system for engineering and manufacturing development.[84]

The Central Technical Support Facility at Fort Hood was critical to streamlining the acquisition of FBCB2 and other Force XXI digitation initiatives. At the facility, soldiers using the FBCB2 system provided feedback on its operation to program personnel and contractors. Their assessments were crucial in determining changes that should be made to each new version of the hardware and software. In a joint statement in 1998 before a subcommittee of the Senate Armed Services Committee, the military deputy to the Army assistant secretary for research, development, and acquisition and the deputy commanding general of TRADOC emphasized the facility's importance to Force XXI: "The Central Test [*sic*] Support Facility allowed us to develop the technology, evolve the tactics, and develop the training simultaneously—a truly integrated approach to 'spiral development,' with immediate feedback from users to developers to continuously improve both materiel and training."[85]

Production and fielding of the FBCB2 system occurred at a fast pace. In 1999 the Army authorized TRW to manage a competition for a low-rate initial production contract for 5,952 units of FBCB2 hardware. The General Accounting Office was critical of the Army's decision to go ahead with low-rate production, arguing that the system had not undergone sufficient testing. The GAO concern, however, did not prevail. In January 2000 the Army awarded a fixed-price-incentive-fee letter contract (definitized the following June) split between Paravant Computer Systems and Litton Data Systems; both

During an exercise at the National Training Center, Sergeant First Class Kenneth R. Dawson, 3d Infantry Regiment, checks an FBCB2 flat panel display installed in the antitank guided missile vehicle he commands. *(DIMOC)*

hardware products would operate software version 3.3. While in low-rate production, the system's development and testing continued in operational environments. An early version deployed to the Balkans in 2000, and an enhancement known as FBCB2–Blue Force Tracker was used in Afghanistan and Iraq before entering full-scale production in 2004. Two years later more than 25,000 units of the system had been fielded.[86]

So successful was the FBCB2 program that it received several awards while still under development, including recognition from *CrossTalk: The Journal of Defense Software Engineering* as one of the top five U.S. government software projects in 2001. In its study of methods for achieving effective acquisition of information technology in the Department of Defense, the National Research Council identified FBCB2 as exemplifying the "type of decentralized agile development approach" it favored.[87]

CRUSADER: ACQUISITION IN AN AGE OF ARMY TRANSFORMATION

The development of the Crusader self-propelled howitzer system showcases the threefold struggle of Army acquisition in the 1990s. First, the Army wanted to retain its capability, demonstrated during the Gulf War, to dominate the high-intensity battlefield. Second, the Army wanted to reform its acquisition process to maximize its value-for-money in a period of declining budgets, while preserving the service's supporting slice of the defense industrial base. Third, the Army's leadership understood the service needed to improve the balance between the firepower of heavy forces and the quick deployment capabilities of light forces. As one of the Army's highest priority acquisition programs, Crusader ultimately attempted to achieve all of these objectives simultaneously. The features envisioned for Crusader that made it a desirable system for the Army, however, also made it too difficult to deploy to the post–11 September 2001 battlefields envisioned by Secretary of Defense Donald Rumsfeld, who canceled the program in May 2002.

While the fielding of the M1 Abrams and M2 Bradley provided the Army's tankers and armored infantry with a generational leap in capability, the service's modernization of its mobile tube artillery took an incremental approach. To provide a high volume of long-range fire to counter the Warsaw Pact's superior numbers of artillery and air defense systems, the Army had fielded the self-propelled M270 Multiple-Launch Rocket System (MLRS) in 1983. The MLRS supplemented the mobile fire support provided by the M109 155-mm self-propelled howitzer. First introduced in 1963, the M109 had performed effectively against Soviet bloc systems during the 1973 Arab-Israeli War and enjoyed a good reputation in the NATO artillery community. To free up funds for new systems, especially the MLRS, during the 1980s, the Army chose to upgrade the M109 incrementally rather than build a new platform. These upgrades culminated in the 1994 fielding of the M109A6 Paladin, featuring improvements such as a longer-range gun, more ammunition storage, and the ability to employ "shoot-and-scoot" tactics. Paladin, however, lacked the speed to keep up with the Abrams- and the Bradley-equipped units it supported. The newest artillery systems possessed by rivals and allies also had even longer-range guns and auto-loading cannons that could deliver a higher rate of fire than Paladin. An artillery piece with a rapid-fire capability represented a potentially attractive acquisition because it could deliver both the "burst" capability of a rocket launcher and the steady stream suppressive fire required to support troops in contact with the enemy. To remedy the M109's disadvantages and deliver these new capabilities, the Army included the development of a new self-propelled howitzer and a companion armored resupply vehicle, the Advanced Field Artillery System (AFAS), in the Heavy Force Modernization program.[88]

The termination in early 1992 of the Armored Systems Modernization program (the renamed Heavy Force Modernization program) did not end the Advanced Field Artillery System. A 1991 GAO report found that the artillery portion of the program could remedy a shortfall in the Army's capability in that area. Thus, AFAS survived the breakup of the program. In September 1992 the system entered Milestone 0's concept exploration and definition phase, and in June 1993 its Operational Requirements Document was approved. The initial plan called for the production of 824 artillery pieces and an equal number of ammunition carriers at a cost of approximately $18 billion.[89]

Under pressure from prime contractors, and to preserve the industrial base, the Army adopted a noncompetitive acquisition process for the Advanced Field Artillery System, an approach approved by Acting Under Secretary of Defense for Acquisition and Technology R. Noel Longuemare Jr. in July 1994. In this arrangement, United Defense Limited Partnership was the prime contractor with Martin Marietta as the developer of the liquid propellant gun, Teledyne as the systems engineer for the chassis, and General Dynamics as the developer of the vehicle's turret, hull structure, and communications equipment. Together the firms formed "Team AFAS." In a less diplomatic characterization, the group was a collection of wary "scorpions in the bottle" made up of former competitors who were now forced to cooperate. Indeed, internal debates among the team plagued the program's early development. In September 1995 both Lockheed Martin and Teledyne complained to Assistant Secretary Decker about unresolved disputes with United Defense as the team attempted to put together a proposal for a demonstration/validation contract.[90]

The Advanced Field Artillery System program's leadership wanted Army personnel to work closely with the contractors. A newly assigned member of the program office, Lt. Col. William Henry, had graduated from the project management course at Defense Systems Management College in December 1991. One of his classmates was an Air Force colonel affiliated with the F–22 program, which had used concurrent engineering and integrated product teams (see chapter XI). Henry therefore was familiar with the Air Force's experience with integrated product development programs, so the program office assigned him to find out more about their application in the Defense Department and industry. After spending much of 1992 studying military and commercial programs, including the Comanche helicopter, General Motors' Saturn automobile, and the Boeing 777 commercial airliner, Henry and his colleagues concluded that the Air Force's integrated product development pioneered by the F–22 offered the best model. The Crusader program adopted integrated product development in early 1993 and, in its request for proposal released in July 1994, required the contractor to participate in the integrated product teams.[91]

The use of noncompetitive acquisition solved one problem for the Army, preserving the industrial base, but it also forced the service to consider the ramifications of Crusader's technological choices in light of the Army's modernization plans as a whole. General John H. Tilelli Jr., the Army's vice chief of staff, emphasized this point in the Field Artillery branch's professional journal in December 1994:

> Now as one of the Army's highest priorities, we must not view Crusader parochially, as just a Field Artillery system. In fact, the development of Crusader will provide the leading-edge technologies for ground systems Army-wide: embedded training, liquid propellants, modular armor, information technologies, capabilities that reduce the number of crew members and more. Furthermore, producing Crusader brings the armor industrial base forward and retains this crucial production capability.

With so much of Crusader's promise residing in its spin-off technologies, Army acquisition managers had to consider technologies under development for the program in light of both the Crusader's needs and the Army's R&D program. For example, the trade-off between selecting a diesel versus a gas turbine engine for the howitzer required not only evaluating performance but also maintaining a competitive industrial base for heavy vehicle engines, "a tremendous load to carry," in the words of one Defense Department official.[92]

One of the program's early innovations, replacing bagged charges of solid propellant with a liquid propellant, encountered obstacles managers could not resolve quickly or cheaply. Dispensing a precise volume of liquid propellant into the gun tube before firing offered a number of advantages: It was lighter, cheaper, less wasteful, and safer than solid propellant. But by spring 1996, problems in developing a liquid propellant gun appeared to make it impossible for the Army to keep the Crusader program on schedule and under budget. In addition, an internal Army study found there was only a "marginal difference" between the effectiveness of a liquid propellant and a solid propellant Crusader force. Therefore, in March 1996 the Army decided to terminate liquid propellant development because of higher than expected technical risks and the expectation that the solid propellant alternative could meet key performance parameter requirements at lower cost and less risk to the program. A new competition was held for the gun, and in November 1996 United Defense and the Army's Armament Research, Development and Engineering Center at Picatinny Arsenal in New Jersey formed a partnership to deliver a cannon with a conventionally propelled projectile for Crusader. Unlike earlier howitzers, where the cannon was provided as government furnished equipment (GFE) to the prime contractor, United Defense and Picatinny worked together from concept definition through prototype integration. United Defense claimed under the new arrangement, "We'll save time and money because any problems or changes to the gun's design will be addressed long before we start bending metal."[93]

Despite problems with the new contracting structure and the abandonment of the liquid propellant gun, by early 1997 the Army was optimistically reporting the Crusader program was on-track. Indeed, the Army claimed projected costs had declined to $16.3 billion from the program's initial $18 billion estimate thanks to the increased use of commercial components and computer-aided design and manufacturing. Paul Kaminski, the under secretary of defense for acquisition and technology, was sufficiently convinced of the program's progress to tell the Army in February 1997 that "he concurred with the Army's findings that an unmodified PzH 2000, the German 155-mm self-propelled artillery system seen by some observers as a potential substitute for Crusader, is not a suitable alternative to meet the Army's Crusader requirement." The Quadrennial Defense Review report, released in May 1997, affirmed Crusader as "necessary to the Force XXI concept," but "reducing currently projected peak procurements" might be necessary to afford the howitzer alongside the Comanche helicopter and the Army's other acquisition priorities. The General Accounting Office, however, was more skeptical. It noted in a June 1997 study that "developing and integrating the Crusader system to meet all the Army's requirements will be technically challenging because it depends heavily upon the accomplishment of many technological firsts for U.S. field artillery systems. These included the automated ammunition loading and handling system, automated ammunition and fuel transfer system, and actively cooled cannon barrel." In March

1998 Crusader passed the in-progress review between Milestone I and Milestone II, paving the way for building early prototypes for powertrain testing. Members of the program thought the use of an integrated industry and government team, along with computer-aided design systems linked together between suppliers for real time data exchange, would enable substantial cost savings and more rapidly achieve program milestones. As Maj. Gen. John F. Michitsch, the Crusader program executive officer phrased it, "We're reinventing the acquisition business—a blueprint, or perhaps I should say a CAD [computer-aided design] file, for the future." In June 1999 United Defense rolled out what it described to the press as the first prototype vehicle. It lacked a gun and ammunition handling system, however, so it was designated a "mobility test bed" designed to test the integration of Crusader's drivetrain components, including a Caterpillar C12 diesel engine and the General Dynamics transmission. It also included the capability to test the new "drive-by-wire" vehicle control software.[94]

The use of advanced technology, however, also created new difficulties for program managers. With 1.7 million lines of computer code, journalists described Crusader as "only slightly less software intensive than the F–22 fighter." With its experience rooted in metal bending rather than coding, United Defense did not appreciate the difficulty of managing the Crusader's complex software development process. By fall 1999 software development had slipped as much as a year behind schedule and United Defense brought in Honeywell to help right the program. The Army's efforts to correct the system's deficiencies could not, however, squelch a steady stream of questions about the need for Crusader.[95]

The development of Crusader—a technologically sophisticated, heavy, and expensive system—did not always seem compatible with the shift by the Army toward an expeditionary force that could be quickly deployed from the continental United States. The December 1997 report of the bipartisan, congressionally chartered National Defense Panel singled out Crusader, along with Comanche, as programs that the Army should consolidate and limit while "transitioning the balance of the Army (force structure and programs) to the Army After Next concept [the Army's vision for the service beyond 2010, the successor to Force XXI]." One defense observer, a retired Army officer, described Crusader in May 1999 as "a leviathan artillery system that will be difficult to deploy, hard to re-supply, and irrelevant to the most frequent threats the Army will face." This argument, that continued development of Crusader was out of step with the Army's program of transformation, became the basis for the restructuring, and ultimate termination, of the program.[96]

In June 1999 General Eric K. Shinseki became the Army's chief of staff. As former commander of the United States Army Europe (1997–1998), where he commanded NATO forces in Bosnia, Shinseki was thoroughly familiar with the need to increase the service's mobility and flexibility. The Army's difficulties in deploying Task Force Hawk to Albania during Operation Allied Force in spring 1999 had further emphasized the need for transformation. Shinseki did not waste time in his push to accelerate the process. In a speech at the annual Association of the United States Army (AUSA) symposium in October 1999, Shinseki outlined his vision of Army units "light enough to deploy, lethal enough to fight and win, survivable enough to return safely home . . . and lean and efficient enough to sustain themselves whatever the mission." His ultimate goal was to field the Future Combat System (FCS), a new family of armored vehicles that were smaller and lighter, but with no less combat power than the Army's then-current force. To bridge the gap between the updated systems of the Legacy Force, such as the Abrams and the Bradley, and the Objective Force based on the FCS, Shinseki planned an Interim Force using off-the-shelf equipment. By November 2000 the Army had announced its selection of the Canadian Light Armored Vehicle III as the basis for what became the Stryker family of vehicles in the Interim Force. Crusader, at least as the system had progressed up to that point, did not clearly fit with any of these three categories. The Army's transformation had begun, but was outpacing Crusader's ability to adapt to it.[97]

Nonetheless, Shinseki continued to see significant value in pursuing Crusader, if the howitzer and the resupply vehicle could be made lighter and smaller. Such modifications would turn a niche Legacy Force system into one that could be used with the Objective Force. "We've definitely said that at 110 tons, we're not happy with what that presents us as a deployment platform," Shinseki told a group of defense writers in November 1999. "I've registered our description of the future requirements, and it's up to them [United Defense] now to decide whether or not they can help meet them." The Army subsequently revised Crusader's Operational Requirements Document to state that Crusader vehicles could not exceed 42 tons at curb weight and 50 tons at combat weight and that any combination of two Crusader vehicles, at curb weight, had to be air transportable on both C–5 and C–17 aircraft.[98]

In June 2000 "Team Crusader" announced it had redesigned the vehicle to meet the Army's new requirements. The redesigned Crusader used a smaller gas turbine engine and transmission (both shared with the Abrams) rather than the 12-cylinder diesel initially selected, made greater use of lighter-weight titanium and composite materials, and carried modular armor. A new, wheeled resupply vehicle would complement the existing, heavier, tracked resupply vehicle. The number of projectiles carried by the Crusader was reduced from 60 to 48. The gun barrel was shortened by a foot and a half and made four inches narrower. "The real story is that we have been able to turn a program this size nearly on a dime and have a verifiable path forward in which we have great confidence," stated Major General Michitsch, the program executive officer. "Getting to this point is truly a tribute to the government-industry partnership represented in Crusader. Integrated Product Development (IPD) and Simulation and Modeling in Acquisition Requirements and Training (SMART) really work." While the lighter version of the howitzer held promise, the Army's FY 2001 budget submission reduced the planned Crusader buy from 1,148 to 480 guns, plus resupply vehicles, in order to fund the transformation objectives of the Interim and Objective Forces, namely Stryker and FCS. The reorganization offered a path forward for Crusader to fit into a transformed Army, but significant technical and political obstacles remained.[99]

As the Crusader program reoriented itself, the advent of the George W. Bush administration, which had campaigned on a program of military "transformation" and the outbreak of a global war on terrorism, led to the termination of the program. In fall 1999, just before Shinseki's address to the AUSA, then-Governor Bush spoke at The Citadel where he described a "revolution in the technology of war" that opened a "window of opportunity to skip a generation of technology" to create a military prepared for "information age battles." Donald Rumsfeld, Bush's choice for secretary of defense, also supported a similar vision of military transformation. As early as May 2001, OSD considered canceling Crusader and other expensive legacy programs, such as the V–22 Osprey, in order to fund next-generation systems. In April 2001 one of Rumsfeld's strategy review panels suggested canceling Crusader. In the words of one official, "The Crusader effectively got the ax from the panel because it didn't fit the agenda. It's a wonderful system—for a legacy world." The Army's leadership, however, continued to support Crusader. But the 11 September terrorist attacks and the beginning of operations in Afghanistan in October further solidified the direction of transformation away from Crusader. The toppling of the Taliban by local forces fighting alongside U.S. Special Forces and light infantry, supported by airpower armed with precision-guided munitions, called into question additional major investments in the Army's heavy legacy forces. The ground had shifted from under Crusader's tracks.[100]

As controversy swirled around the program, system development continued. In February 2000 a prototype howitzer "firing platform," SPH1, which contained a chassis, fully functional cannon, and an ammunition handling system, but lacked an engine and transmission, was sent to the Yuma Proving Ground for testing. By February 2002 the SPH1 prototype had fired over 5,400 rounds of ammunition and had demonstrated the ability to fire at a maximum rate of 11.1 rounds per minute and at a range of 40 kilometers. In addition to the performance of the gun and autoloader in live-fire tests, the program's weight reduction efforts had yielded the prospect of a more deployable system. By early 2002 the General Accounting Office found that

The Crusader self-propelled 155-millimeter howitzer prototype. *(U.S. Army Field Artillery Museum)* the troubled software development process had improved. Software development had progressed sufficiently by that point for United Defense to integrate its armament and ammunition handling test stands with prototype crew stations, electronics, and tactical software into a Crusader Integration Test Station.[101]

Despite these improvements in the program, Crusader's halting progress and mismatch with OSD priorities led to cancellation. When asked at a congressional hearing in March 2002 whether Crusader's weight could be reduced below 40 tons, Shinseki acknowledged that "you just can't overcome the mechanics" of a long-range artillery piece. In addition, the redesign had introduced new risks into the program. The General Accounting Office had determined in its February report that 10 of the Crusader's 16 key technologies had not been demonstrated at a component or subsystem prototype level. It also noted the Army planned to begin fielding both Crusader and the Future Combat System in FY 2008—suggesting an overlap in capabilities between the two. Implicitly this analysis brought into question the need to procure Crusader. By spring 2002 Deputy Secretary of Defense Paul Wolfowitz became convinced the Army was downplaying the potential of alternative sources of future fire support for ground forces, especially through the use of precision-guided munitions. Further, terminating Crusader fit neatly into Secretary Rumsfeld's desire for aggressively implementing "transformation" of the U.S. military. In May of that year Rumsfeld canceled Crusader. Instead the Army would continue developing the precision-guided Excalibur 155-mm artillery round and produce M30 Guided MLRS rounds. "Crusader is a good system," said Wolfowitz. "It's definitely an advance over our current artillery. [But] it's not the kind of transformational leap that really brings us the forces we need to fight the wars of the 21st Century." It appeared that after a decade of post–Cold War uncertainty, OSD had found a clear vision of the Army's future. Crusader did not fit into that vision.[102]

* * * * *

While the international security environment underwent rapid change in the 1990s, the Army sought to remodel itself to keep pace. Reform of its acquisition system was an important element of that transformation. Despite the new approaches to weapon system development and other reforms adopted by the Army, program failures continued. The application of integrated product and process management and integrated product teams did not save high-visibility programs such as Crusader and Comanche. Still the Army fashioned an acquisition system sufficiently flexible for the service to meet its needs. Crusader's cancellation, for example, did not necessarily imply the failure of the Army's artillery acquisition effort. During the 1990s the Army successfully developed the M142 High Mobility Artillery Rocket System, a truck mounted MLRS pod, which, along with the M109A6 Paladin, provided effective artillery support during Operation Iraqi Freedom in 2003, with considerably fewer guns in the field than during Desert Storm. Similarly, the Longbow Apache, the upgrade of the AH–64A Apache, which entered service in 1998, proved itself in combat in Iraq and Afghanistan. The acquisition of FBCB2 with the program's application of numerous reforms—spiral development, use of commercial off-the-shelf products, and close cooperation between developers and users—demonstrated how major systems meeting mission requirements could be developed and fielded rapidly.[103]

Endnotes

1. For the transformation of the Army in the 1990s, see John Sloan Brown, *Kevlar Legions: The Transformation of the U.S. Army, 1989–2005* (Washington, DC: CMH, 2011), chaps. 2–4.

2. Delos W. Anderson, "The Army's Program Executive Officer (PEO) Concept: Who Is in Charge?" (individual study project, U.S. Army War College, Carlisle Barracks, PA, 24 Feb 1989), 6–7.

3. GAO, *Military Departments' Response to the Reorganization Act*, 17–18. Other elements in the secretariat and on the Army Staff also performed acquisition functions: The Office of the Deputy Chief of Staff for Logistics was responsible for contracting, while the assistant chief of staff for information management and the assistant secretary for financial management shared responsibility for activities related to information management. Ibid.

4. GAO, *Military Departments' Response to the Reorganization Act*, 16–17; Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review*, 2:12–13. The other Army major commands involved in acquiring materiel were Information Systems Command, Intelligence and Security Command, Medical R&D Command, Military Traffic Management Command, and Strategic Defense Command. See *Defense Acquisition Structures and Capabilities Review*, fig. 2-4 (Army Acquisition Organization Changes: 1987 to 2006), 2:15.

5. GAO, *Military Departments' Response to the Reorganization Act*, 3, 16–22, 27; GAO, *Reorganization of the Military Departments' Acquisition Management Structures*, 15–16. Many on the staff of the assistant secretary of the Army for research, development, and acquisition continued to reside physically with the Army staff. Another 149 acquisition personnel worked for the secretariat's director for information systems, a lieutenant general. In early 1987, at the outset of the reorganization, the secretary of the Army named the under secretary to be the service acquisition executive, but in May 1989 transferred that responsibility to the assistant secretary for research, development, and acquisition. See GAO, *Military Departments' Response to the Reorganization Act*, 20, 22; and GAO, *DoD's Efforts to Streamline Its Acquisition System*, 21.

6. Historical Office, HQ U.S. Army Materiel Command, *U.S. Army Materiel Command Annual Historical Review, Fiscal Year 1987* (n.p.: AMC, Aug 1989), 177 (hereafter *AMC AHR)*; *AMC AHR FY 1988* (n.p.: AMC, Apr 1990), 135; Arthur S. Santo-Donato, "Program Executive Officer (PEO) Concept: Is It Functioning as Intended?" Military Studies Program Paper (Carlisle Barracks, PA: U.S. Army War College, 5 Apr 1991), 10–12; GAO, *Military Departments' Response to the Reorganization Act*, 24–25.

7. Army Regulation 70-1 (Army Acquisition Policy), 31 Mar 1993, sec. 3-4.

8. Other functional areas in which Materiel Command was to provide support were capstone policy, facility design review, guidance for developmental and non-developmental item acquisition, integrated logistics support, intelligence, master planning, and safety. See *AMC AHR FY 1987*, 140.

9. *AMC AHR FY 1987,* 176; *AMC AHR FY 1990*, 135. Of the 291 total program managers in 1990,
   - 206 reported to the program executive officers
   - 44 reported to Army Materiel Command
   - 20 reported to Information Systems Command
   - 9 reported to the Surgeon General
   - 7 reported to Deputy Chief of Staff for Operations
   - 2 reported to Military Traffic Management Command
   - 1 reported to the National Guard

- 1 reported to Force Development Support Activity
- 1 reported directly to the service acquisition executive

10. General William G. T. Tuttle, interview by Robert G. Darius and Herbert A. Leventhal, AMC Headquarters, Alexandria, VA, 14 Feb 1992, 4–6; *AMC AHR FY 1987*, 1, 19–20; *AMC AHR FY 1989*, 5; *AMC AHR FY 1990*, 11; *AMC AHR FY 1991*, 15. At least 2,400 of the employees slated to be cut in 1990 were retained, at least temporarily, as a result of Operation Desert Shield.

11. *AMC AHR FY 1987*, 2–5, 139–140; *AMC AHR FY 1988*, 4 (quote, emphasis added); *AMC AHR FY 1989*, 2, 4–5.

12. Santo-Donato, "PEO Concept," 16–20; Cheney, *Defense Management*, 9; HQDA, General Order No. 14 (Establishment of the United States Army Acquisition Executive Support Agency [AAESA]), 20 Sep 1990; Section 800 Panel Report, addendum, app. A, 4–5.

13. Santo-Donato, "PEO Concept," 20–22, 24–28 (quote, 21); Anderson, "Army's Program Executive Officer," 14–17; *AMC AHR FY 1987*, 140. Resentment over the loss of the program offices lingered long in Army Materiel Command. It showed itself after a new reorganization of the program executive officer structure 10 years later. In 1997 the Army decided to reduce the number of PEOs from nine to seven by consolidating three into one immediately and then eliminating another altogether the following year. As part of this change, 19 programs were transferred to Materiel Command. Some were sizable programs—not the large ACAT I, but ACATs II and III. The command hailed this as a great victory and at least a partial reversal of the Packard Commission reforms. One of its officers crowed the move "re-establishes AMC as a major (integral) player in the systems acquisition and development process." See Maj. Gen. Roy E. Beauchamp, interview by Michael Bellafaire and Jeffrey Hosmer, AMC Headquarters, Alexandria, VA, 20 Jun 1997, 14–17; and Dale G. Adams, interview by Robert G. Darius and Michael Bellafaire, 6 Feb 1998 (Alexandria, VA: AMC Historical Office, Sep 1999), 1, 2–3: copies of both in author files, OSD/HO; Leon A. Parker III, "PMs Begin Transfer to the Army Materiel Command," *Army RD&A* 70, no. 2 (Mar-Apr 1997): 2–5 (quote, 5); Marlu W. Vance, "FY98 Streamlining of the Program Executive Officer Structure," *Army RD&A* 70, no. 1 (Jan-Feb 1997): 7–9.

14. For the origins and spread of matrix management, see Edgar H. Schein and Paul Kampas, *DEC Is Dead, Long Live DEC: The Lasting Legacy of Digital Equipment Corporation* (San Francisco: Barrett-Koehler Publishers, 2003); Peter Petre, with Alan Farnham, "America's Most Successful Entrepreneur," *Fortune Magazine*, 27 Oct 1986, http://archive.fortune.com/magazines/fortune/fortune_archive/1986/10/27/68216/index.htm, accessed 28 Mar 2019; and Stanley M. Davis and Paul R. Lawrence, "Problems of Matrix Organizations," *Harvard Business Review* 56, no. 3 (May-Jun 1978): 131–142.

15. GAO, *Military Departments' Response to the Reorganization Act*, 24–25. For the matrix organizational concept, see Przemieniecki, *Acquisition of Defense Systems*, 53–56, and Paul Adam Ostrowski, "Matrix Organizational Structure and Its Effect on Army Acquisition Program Management Offices" (master's thesis, Naval Postgraduate School, Jun 1996), 9–17.

16. Herbert A. Leventhal, *Project Management in the Army Materiel Command*, *1962–1987* (Alexandria, VA: AMC Historical Office, 1992), 61–64; *AMC AHR FY 1985*, 191, 198; *AMC AHR FY 1986*, 93; *AMC AHR FY 1987*, 198; Gen. Richard H. Thompson to Maj. Gen. Robert D. Morgan, CG CECOM, 12 Jun 1985, file Corps PMs, box Ac Corps; Thompson to VCSA Gen. Maxwell R. Thurman, 15 Jan 1985; point paper, Lt. Col. Holmes, 12 Aug 1985, subj: Matrix PM Organizations, file1985 Product Manager's Conference: copies of all in author files.

17. *AMC AHR FY 1990*, 173–174; *AMC AHR FY 1991*, 162–163; memo, Brig. Gen. Otto J. Guenther, PEO Communications Systems, and Maj. Gen. William E. Harmon, PEO C2 Systems, for Director of Information Systems for Command, Control, Communications, and Computers, 2 Nov 1990, subj: Draft policy memorandum on matrix support dated Oct. 25, 1400 hrs, file Ac Policies from AAE, box PEOs, Ac Corps, copy in author files; AR 70-1 (Army Acquisition Policy), 31 Mar 1993, sec. 3-5. Prior to becoming assistant secretary in 1990, Conver had been on the staff of the House Armed Services Committee. Before then, he had been deputy assistant secretary

of the Air Force for program and budget, and had held several posts in the Nuclear Regulatory Commission, including chief of analysis and planning. A 1966 Air Force Academy graduate, he resigned his commission in 1975. See "Nomination of Stephen Kay Conver To Be an Assistant Secretary of the Army," www.presidency.ucsb.edu/ws?pid=17866, accessed12 Jun 2017.

18. AAE Stephen Conver, memo for distribution, 28 Feb 1991, subj: Army Acquisition Executive (AAE) Policy Memorandum #91-4, "Matrix Support Policy for Program Executive Officer Managed Systems," file AAE, DISC4 Memos, PEO Guidance, copy in author files.

19. Memo, AAE Gilbert F. Decker for the Army Acquisition Community, 23 Jan 1995, subj: Matrix Support Personnel Management for Program Executive Officer (PEO) Managed Systems, file Ac Policies from AAE, box PEOs, Ac Corps, copy in author files; AR 70-1 (Army Acquisition Policy), 15 Dec 1997, chap. 4, sec. II, para. 4-5, 13.

20. "Acquisition Reform an Army Top Priority," *Army Acquisition Newsletter*, issue 54, n.d.; *AMC AHR FY 1987*, 157; *AMC AHR FY 1985*, 133–136; DoD Directive 5000.43 (Acquisition Streamlining), 15 Jan 1986. See also *Army Streamlined Acquisition Process* (ASAP) (AMC, Apr 1987), copy in file Acq Streamlining, copy in author files; Richard A. Stimson and Frank Doherty, "Acquisition Streamlining: Striving to Increase Cost-Effectiveness of DoD Acquisition Requirements," *Program Manager* 14 (Jan-Feb 1985): 15–18; *AMC AHR FY 1989*, 157; *AMC AHR FY 1990*, 174–175; *AMC AHR FY 1991*, 167–168.

21. "Welcome to the Army Acquisition Reform (AR) Directorate," and "Acquisition Reform Action Officer Roster (6/10/97)," archived web pages.

22. *Acquisition Reform Acceleration Day Summary Report*, 26–32; *Guidelines for Army Acquisition Reform Strategic Planning* (ASA[RDA]), 9 Sep 1996. The Acquisition Reform Directorate updated *Guidelines* and reported on the effort in spring 1998 [*Acquisition Reform Strategic Planning* (HQDA, Acquisition Reform Directorate, 30 Apr 1998)]. The "Updated Guidelines for Army Acquisition Reform Strategic Planning" are at app. A. It should be noted that the Acquisition Reform Improvement Plan —ARIP—was not the same thing as the Acquisition Reform Implementation Plan. The latter was issued on 22 Nov 1995 to track the progress of initiatives briefed to the chief of staff. The original plan included five initiatives tracked in three phases, but in February 1997 the phases were replaced by the six thrust areas mentioned above.

23. "AR Strategy Implementation Network, 10 Sep 1997," archived web page; Acting ASA(RDA) Kenneth Oscar, memo for distribution, 6 Aug 1997, subj: Implementing the Army Acquisition Reform Strategy. The organizations were Forces Command; Army Materiel Command; Space and Strategic Defense Command; PEO Air and Missile Defense; PEO Intelligence, Electronic Warfare and Sensors; and PEO Tactical Missiles.

24. Comments of Col. Elton Minney, ODASA(P), in minutes of an Army Metrics PAT meeting, 26 Mar 1997, archived webpage; Oscar, memo for distribution, 11 Dec 1997, subj: Acquisition Reform Advocacy Program; Acquisition Reform Advocacy Program Concept of Operations, n.d.; *AR Advocate* Update nos. 1 and 2, Office of the Acquisition Reform Directorate, 1998; personnel list dated 15 Mar 1999.

25. Lt. Gen. Leo J. Pigaty, interview by Robert G. Darius and Herbert A. Leventhal, 2 May 1994 (Alexandria, VA: AMC Historical Office, Jan 1996), copy in author files; Adams interview, 13.

26. *Army MilSpec Reform, A New Way of Doing Business: The First Four Years* (Alexandria, VA: AMC Headquarters, Feb 1999); "Army Roadshow Program," archived web page updated 24 Feb 1998; "Streamlining Acquisition Organizations," Army briefing to the Commission on Roles and Missions, n.p., n.d., slide 67; AMC Acquisition Reform Implementation Assessment Team (ARIAT), *FY97 Final Report*, 2 Sep 1997. It should be noted Roadshow VI was held at AMC only (and was later renamed Roadshow '97), but the Roadshow for Industry was never numbered, so there were still six follow-on roadshows.

27. James W. Brown, "U.S. Army on the Road Again for AR," *Acquisition Reform Today* 1, no. 2 (Mar-Apr 1996): 6; "Army Roadshow Program," archived web page updated 24 Feb 1998; Pigaty interview, 15.

28. "Basic Acquisition Reform Training," archived web page; *Acquisition Reform Acceleration Day Summary Report* (DAU, 23 Jul 1996), 26, 32; ARIAT, *FY97 Final Report*.

29. ARIAT, *FY97 Final Report*, 6–8; ARIAT, *FY98 Final Report*, 18 Sep 1998, 9–10; ARIAT, *FY99 Final Report*, 15 Sep 1999, 10–11.

30. Minutes of the Army Metrics PAT, 26 Mar 1997; "Comments on Army Metrics," 19 May 1997, archived web page; "Tools and Suggestions for Metrics," n.d., archived web page; "Army Enterprise Metrics on the Web," 14 Apr 1997, archived web page.

31. ARIAT, *FY97 Final Report*, 1, 21; Lamar W. Hickman, Janice L. McKenzie, and Nannette M. Ramsey, "Assessment of the Army Materiel Command's Acquisition Reform Efforts," *Army RD&A* (Mar-Apr 1998): 28–29.

32. ARIAT, *FY97 Final Report*, 6 (quote); ARIAT, *FY98 Final Report*; ARIAT, *FY99 Final Report*.

33. *AMC AHR FY 1991*, 171.

34. *Army Implementation Plan: Implementing the Report of the DoD Process Action Team on Military Specifications and Standards* (Washington, DC: OASA[RDA], 23 Nov 1994).

35. *Army Implementation Plan*, 4-5; OASA(RDA), memo for distribution, 22 Oct 1997; Dale G. Adams, Army SIE [standards improvement executive], memo for distribution, 27 Feb 1998, subj: Army Guidance for the Implementation of Processes in Solicitations and Contracts; AMC Pamphlet 715-17, *Guide for the Preparation and Use of Performance Specifications* (Alexandria, VA: AMC Headquarters, 11 Feb 1999); *Army MilSpec Reform, A New Way of Doing Business*; Gary A. Tull, Army SIE, memo for distribution 11 May 1999, subj: Cancellation of Requirement to Submit Master Action Plans (MAPS).

36. Decker, memo for distribution, 9 May 1995, subj: Reiteration on [*sic*] Military Specifications and Standards Policy; Conrad Peter Schmidt, *Changing Bureaucratic Behavior: Acquisition Reform in the United States Army*, RAND Report MR-1094-A (Santa Monica, CA: RAND, 2000), 34. Just prior to becoming assistant secretary in 1994, Decker had been president and CEO of Acurex Corporation, president and CEO of Penn Central Federal Systems Company, head of the New Ventures Department of TRW, and president of ESL. He served six years on active duty as an Army aviator and then entered the Army reserve, retiring as a colonel. See Decker, "Military Operations Research and Army Force XXI Objectives," *Phalanx* 29, no. 4 (Dec 1996): 35; and Gilbert F. Decker, ZoomInfo, www.zoominfo.com/p/Gilbert-Decker/356324, accessed 20 Jun 2017.

37. *AMC AHR FY 1991*, 168–169; G. B. Langford, "Concurrent Engineering (CE) Strategy," white paper (HQ AMC, 6 May 1992), in AMC Pamphlet 70-27, *Guidance for Integrated Product and Process Management*, vol. 3: *Tools and Practices*, 25 May 1995, app. A, file IPT Offsite, Jul 95 w/Kaminski, box PEOs, Ac Corps, copy in author files; Jim Luedeke, "Team Concept for Program Management," Deputy Assistant Secretary of the Army for Plans, Programs and Policy, *Bulletin*, 16 Nov 1992, 1.

38. "Minutes from the AMC Integrated Product and Process Management (IPPM) Working Group Meeting, 3–5 Feb 1998 at STRICOM [United States Strike Command]"; AAE Decker, memo for distribution, [14 Jul 1995]; "What Did We Do?" briefing slide in Defense Systems Management College, "DoD IPT Offsite, 20 Jul 1995," file OSD IPT Offsite, 20 Jul 1995, box Ac Corps, PEO Days, copy in author files.

39. DSMC, "DoD IPT Offsite, 20 Jul 1995"; "Army Offsite Invitees," fax from "Col Gels" (?) to all PEOs, 14 Jul 1995; AMC Pamphlet 70-27, *Guidance for Product and Process Management*, 3 vols., 25 May 1995, file IPT Offsite, Jul 1995 w/Kaminski, box PEOs, Ac Corps: copies of both in author files; *The Art of Teaming Guidebook*, U.S. Army IPPM Working Group, Jun 1999; U.S. Army Materiel Systems Analysis Activity, *Army Implementation of Integrated Product & Process Management (IPPM) in Small Systems: Successful Management Practices* (AMC IPPM Working Group, Feb 1999), 14.

40. Christina M. Patterson, *Integrated Product and Process Development* (IPPD) *Case Examples*, IDA Document D-2223 (Alexandria, VA: IDA, Dec 1998), III-1–III-5.

41. AMC Integrated Product & Process Management Working Group, *Army Efforts to Implement Integrated Product & Process Management (IPPM)*, Study Report, Jun 1995, 1–12.

42. Ibid., app. A, 23–25. United Defense Limited Partnership was formed in January 1994 from a combination of the defense sectors of FMC Corporation and Harsco Corporation. It became United Defense Industries in 1997, as part of the Carlyle Group.

43. Ibid., 11–13. In a survey of Army acquisition workers taken during the Acquisition Reform Acceleration Stand-Down Day in 1996, many respondents did in fact complain they were not empowered to make decisions as the IPT concept required. See *Acquisition Reform Acceleration Day Summary Report* (Alexandria, VA: DAU, 23 Jul 1996), 29.

44. John L. Romjue et al., *U.S. Army Training and Doctrine Command Annual Command History, 1 January to 31 December 1991* (Fort Monroe, VA: Office of Command History, TRADOC, Jun 1992), 118, 121, 123 (hereafter *TRADOC ACH*).

45. By comparison, the research, development, and test and evaluation account fell only 8 percent in real terms during the 10 years from 1985 to 1995, but then dropped 10 percent in one year. It remained flat thereafter. See DoD Comptroller, *National Defense Budget Estimates for FY 2001*, 169–171. The figures are for the Army's budget authority; inflation calculated by the DoD comptroller.

46. CBO, *Total Quantities and Unit Procurement Cost Tables, 1974–1995* (Washington, DC: CBO, Apr 1994), A-4, A-7, A-10, A-12, A-14, A-16, A-23, A-24, A-25, https://www.cbo.gov/publication/18099. See also William Joe Webb et al., *Department of the Army Historical Summary, Fiscal Years 1990 and 1991* (Washington, DC: CMH, 1997), 81.

47. *TRADOC ACH 1992*, 83–84; *TRADOC ACH 1993*, 95. At least a few of the Army's own analysts suggested Comanche was not essential to the service's mission; a value added analysis of the service's acquisition programs by the Army Concepts Analysis Agency found the helicopter expendable. See *CAA Annual Report, Fiscal Year 1992* (Bethesda, MD: U.S. Army Concepts Analysis Agency [CAA], Nov 1992), 3: 21–22.

48. Memo, General Johnnie E. Wilson, CG, AMC, and Decker for PEOs et al., 2 Oct 1996, subj: Cost Reduction in Army Acquisition Programs; memo, Lt. Gen. Ronald V. Hite, MilDep ASA(RDA), for PEOs et al., 31 Oct 1996, subj: Army Cost Reduction and Reinvestment Initiative; *Army Cost Reduction and Reinvestment Initiative Implementing Guidance*, 31 Oct 1996, file Cost Reductions & Reinvestment of 20% Study, box DA, DoD Initiatives/Ac Reform/CAIV: copies of all in author files; George I. Seffers, "U.S. Army Cost-Cutting Initiative Will Save Billions," *Defense News*, 19 May 1997, 24.

49. *TRADOC ACH 1991*, 115–116; *TRADOC ACH 1992*, 83; *TRADOC ACH 1993*, 95; *United States Army Modernization Plan Update (FY95–99)* (Deputy Chief of Staff for Plans, Policies and Operations, U.S. Army, May 1994), 1–5; Thomas R. Evans, Kathleen M. Lyman, and Michael S. Ennis, *Modernization in Lean Times: Modifications and Upgrades*, Report of the 1994–1995 DSMC Military Research Fellows (Fort Belvoir, VA: DSMC Press, Jul 1995), chap. 3:3–4. A distinction existed between modifications and upgrades. According to Defense Department and Army policy, a *modification* was a change made to a system while it was still in production. Modifications were considered to be a part of the original acquisition program. An *upgrade* was a change made to a system that was out of production. Upgrades were considered to be new starts and were required to go through the full acquisition review process. A *major modification* was one that itself met the criteria for an ACAT I or II program. The Army Science Board estimated in 1993 that 80 percent of the Army's programs would be upgrades. See Army Science Board, *1993 Summer Study Final Report on Innovative Acquisition Strategies for the 90s* (Washington, DC: Office of the ASA[RDA], Jul 1994), 28.

50. Evans, Lyman, and Ennis, *Modernization in Lean Times*, chap. 1:1, chap. 3:4.

51. *United States Army Modernization Plan*, 1995, Annex D; Army Regulation 70-1 (Army Acquisition Policy), 15 Dec 1997, chap. 5, sec. III, para. 5-6, 18; archived HTI web pages from the ASA(ALT) website, 1999; Karl Scott Flynn, "Analysis of the Army's Horizontal Technology Integration Policy: A Case Study of the Second-Generation Forward-Looking Infrared Program" (master's thesis, Naval Postgraduate School, Mar 1995), 13. For the HTI approval process, see DA Pamphlet 70-3, *Army Acquisition Procedures* (Washington, DC: HQ Department of the Army, 15 Jul 1999), 265–272. The cochairs of the general officer working group were the deputy for systems management and horizontal technology integration in the secretariat and the deputy chief of staff for operations and plans, force development on the Army staff.

52. Flynn, "Analysis," 9–10.

53. Ibid., 17, 25–42.

54. Ibid., 20–21. For ASA(ALT) support of HTI, see Lt. Gen. William H. Campbell, DISC4, and Lt. Gen. Paul J. Kern, MilDep to ASA(ALT), memo for distribution, 27 Sep 1999, subj:

Formalization of Horizontal Technology Integration (HTI) Process in Program Executive Office (PEO)/Deputy for Systems Acquisition (DSA); Kern, memo for distribution, 27 Sep 1999, subj: Additional Army Systems Acquisition Review Council (ASARC) Requirements for Horizontal Technology Integration (HTI) Programs.

55. *Army Strategy for Modernization Through Spares* (AMC, Feb 1998), secs. 1–3; Decker and General Leon E. Salomon, memo for distribution, 22 Jan 1996, subj: Modernization Through Spares: copies of both in author files.

56. Decker and Salomon memo, 22 Jan 1996; General Johnnie E. Wilson, CG, AMC, memo for distribution, 24 Jun 1997, subj: Modernization Through Spares; General Wilson and Acting ASA(RDA) Oscar, memo for distribution, 12 Jan 1998, subj: Implementation of Army Strategy for Modernization Through Spares (MTS): copies of both in author files; *Army Strategy for Modernization Through Spares; Army MilSpec Reform, A New Way of Doing Business,* archived web page, "MTS Strategies Posted on Web Sites," 3 Feb 2000. Congress did show some concern that certain statutory requirements relating to competition and contracting be followed for the pilots; see *National Defense Authorization Act for FY 1997*, sec. 312. Decker and General Wilson, memo for distribution, 13 Nov 1996, subj: Modernization Through Spares and the FY 97 National Defense Authorization Act, file DA Policy Memos, copy in author files; memo, Oscar for General Wilson and Lt. Gen. Edward G. Anderson III, CO, USA, Space and Strategic Defense Command, 18 Jun 1997, subj: Modernization Through Spares.

57. Ross Dennis Boelke, "A Historical Summary of the Armored Systems Modernization Program and the Lessons Learned from Its Interaction with the Acquisition Environment" (master's thesis, Naval Postgraduate School, Jun 1992), 66–67, 84, 86–89, 93–94.

58. Ibid., 95–144; GAO, *Armored Systems Modernization: Program Inconsistent with Current Threat and Budgetary Constraints*, GAO/NSIAD-91-254 (Jul 1991), 8–27; *TRADOC ACH 1991*, 121; *TRADOC ACH 1992*, 85. For a good description of the armored systems modernization vehicles, see Eric C. Ludvigsen, "Armor's Future: From One, Many," *Army Magazine* (May 1991): 32–42.

59. Robert S. Cameron, "Pushing the Envelope of Battlefield Superiority: American Tank Development from the 1970s to the Present," *Armor* (Nov-Dec 1998): 10–12; Wes Glasgow, Christopher Cardine, and David Latson, "The M1A2: Current and Future Program Plans," *Armor* (May-Jun 1996): 11–15; GAO, *Abrams Tank: Block II Modifications Not Ready to Enter Production*, GAO/NSIAD-90-57 (Feb 1990), 12–15, 26. The M1A2 was planned as a modification and not an upgrade because the new design was to take the place of the M1A1 on the production line; none of the existing A1s was to be altered. Some improvements were planned to be retrofitted onto the A1s, such as a new fire control system, but these were not part of the A2 block modification. See GAO, *Abrams Tank: Block II Modifications*, 15.

60. Cameron, "Pushing the Envelope," 12; John Basso, "M1A2: One Year Later," *Armor* (Jan-Feb 1998): 31, 32, 34 (quoted material). See also Clancy and Franks, *Into the Storm,* 509–510. The Intervehicular Information System used an archaic processor modeled on the mid-1980s Intel 80286, making it, according to Basso, "a 286-like system in a Pentium-like tank" (Basso, 33).

61. DoD IG, *Review of the M1A2 Abrams Tank Program As a Part of the Audit of the Effectiveness of the Defense Acquisition Board Review Process—FY 1992*, Audit Report 92-104 (Washington, DC: DoD, 16 Jun 1992), 1; CBO, *Total Quantities*, A-25; Cameron, "Pushing the Envelope," 12; Glasgow, Cardine, and Watson, "M1A2: Current and Future Program Plans"; DOT&E, *Annual Report FY 2000* (Washington, DC: DoD, Feb 2001), III-1.

62. Clancy and Franks, *Into the Storm*, 498 (quote).

63. Gordon R. Sullivan and James M. Dubik, "Land Warfare in the 21st Century" (paper presented at the U.S. Army War College Fourth Annual Conference on Strategy, 24–25 Feb 1993 (Carlisle Barracks, PA: Strategic Studies Institute, Feb 1993), 17–18 ("digitization of the battlefield," "fog of war"); Sullivan, "Letter to the Army's General Officers: Force XXI—America's 21st Century Army," 2 Jun 1995, *The Collected Works of the Thirty-Second Chief of Staff, United States Army: June 1991–June 1995* ([Washington, DC]: Department of the Army, [1996]), 442. See also Sullivan, "Force XXI: Digitizing the Battlefield," *Army RD&A Bulletin* (Nov-Dec 1994): 2–3.

64. Sullivan and Dubik, "Land Warfare," 18.

65. Quoted in Tommy Franks, with Malcolm McConnell, *American Soldier* (New York: Regan Books, 2004), 167.

66. Yarrison, *Modern Louisiana Maneuvers*, 9–10, 12, 17–19.

67. Ibid., 8; quoted in *TRADOC ACH 1993*, 148; quoted in *TRADOC ACH 1992*, 21.

68. Yarrison, *Modern Louisiana Maneuvers*, 13, 19.

69. Ibid., vi–vii, 35–36; *TRADOC ACH 1992*, 177.

70. Franks and McConnell, *American Soldier*, 166–167 (quote); *Transforming the Army: TRADOC's First Thirty Years, 1973–2003* (Fort Monroe, VA: TRADOC Military History Office, 2003), chap. 3; TRADOC Regulation 71-12 (TRADOC System Management), 19 Nov 1990, 2–3; Clancy and Franks, *Into the Storm*, 491.

71. Clancy and Franks, *Into the Storm*, 493; U.S. News and World Report, *Triumph Without Victory*, 290–291; Yarrison, *Modern Louisiana Maneuvers*, 12–13.

72. Grier, "Joint STARS Does Its Stuff," *Air Force Magazine*, Jun 1991; *TRADOC ACH 1993*, 129 (Franks quote).

73. Clancy and Franks, *Into the Storm*, 503–506; *Battle Labs: Maintaining the Edge* (Fort Monroe, VA: HQ TRADOC, May 1994), 8–9. The initial six Battle Labs were:

- Depth and Simultaneous Attack Battle Lab
- Early Entry, Lethality and Survivability Battle Lab
- Battle Command Battle Lab
- Combat Service Support Battle Lab
- Dismounted Battlespace Battle Lab
- Mounted Battle Space Battle Lab

The three follow-on Battle Labs were:

- Air Maneuver Battle Lab
- Maneuver Support Battle Lab
- Air & Missile Defense (Provisional) Battle Lab

74. *TRADOC ACH 1993*, 92–94; TRADOC Pamphlet 71-9, *Requirements Determination*, 5 Nov 1999, chap. 8, paras 3, 5–8; Clancy and Franks, *Into the Storm*, 506–507; Hugh M. Bell III, "What Are Battle Labs—Do We Still Need Them?" Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, 2003), 3–9. See also *How to Do Business with Battle Labs: A Guide for Industry*, 2d ed. (Alexandria, VA: AMC, 1993); Julian Cothran, "Battle Labs: Tools and Scope," *Acquisition Review Quarterly* 3, no. 1 (Winter 1996): 51–62; John R. Wilson, "Battle Labs: What Are They, Where Are They Going?" *Acquisition Review Quarterly* 3, no. 1 (Winter 1996): 63–74. The Battle Lab concept proved to be so successful it spread outside TRADOC to other Army commands (Special Operations Command and Space and Missile Command) and even to the other services. The Air Force, Navy, and Marine Corps established their own Battle Labs (the Air Force had seven), and by the late 1990s all were conducting their own warfighting experiments.

75. Yarrison, *Modern Louisiana Maneuvers*, 41; Walter Jones, "Case Analysis of the U.S. Army Warfighting Rapid Acquisition Program: Bradley Stinger Fighting Vehicle—Enhanced Weapon System" (master's thesis, Naval Postgraduate School, Jun 1996), 23.

76. Lt. Gen. William H. Forster, MilDep to ASA(RDA), memo for distribution, 25 Oct 1994, subj: PM and PEO Roles in Tiger Team Rapid Acquisitions, file Streamlining PAT at OSD, box PEOs, Ac Corps; AAE Decker and General Ronald H. Griffith, VCSA, memo for distribution, 11 Apr 1996, subj: Policy for Warfighting Rapid Acquisition Program, file PEO Day Issue Papers, Nov 98, box PEO Days: copies of both in author files; Jones, "Case Analysis of the U.S. Army Warfighting Rapid Acquisition Program," 26–31; Jed A. Sheehan, "The First Warfighter Rapid Acquisition Process (WRAP) Program," Executive Research Project (Washington, DC: Industrial College of the Armed Forces, NDU, 1997), 1–7; James A. Naudain, "Institutionalizing the Warfighter Rapid Acquisition Program (WRAP)," U.S. Army War College Strategy Research Report (Carlisle Barracks, PA: U.S. Army War College, 1999); George I. Seffers, "U.S. Army Devises Revolutionary Acquisition Plan," *Defense News*, 14 Oct 1996, copy in author files.

77. Director, Louisiana Maneuvers Task Force, Office of the Chief of Staff, Army, *America's Army of the 21st Century: Force XXI, Meeting the 21st Century Challenge*, 15 Jan 1995, 6–7. Sullivan did not intend the LAM Task Force to be a permanent vehicle for organized change. He refocused it on Force XXI, moved the task force to Washington, and assigned it to oversee the new initiative. However, the Army bureaucracy, especially the Office of the Deputy Chief of Staff for Operations and Plans, closed in, pushed the task force aside, and assumed control. Sullivan, preoccupied by a succession of contingency operations and his other duties, including a few months as acting secretary of the Army, did not prevent it. General Dennis J. Reimer, Sullivan's successor, saw little need for the LAM Task Force, especially with the Force XXI initiative well underway. He kept the task force going for another year out of respect for his predecessor and then quietly disbanded it. See *TRADOC ACH 1992*, 20, and Yarrison, *Modern Louisiana Maneuvers*, 77–83.

78. Yarrison, *Modern Louisiana Maneuvers*, viii, 42, 49, 122–123,126n35; Director, Louisiana Maneuvers Task Force, *America's Army of the 21st Century*, 11 (quoted material); General William W. Hartzog, commanding general TRADOC (address, Orlando Air Force Association Symposium, "Force XXI," 15 Feb 1996), copy in author files.

79. U.S. Army Digitization Office, *U.S. Army Digitization Master Plan*, 1 Mar 1996, chaps. 1, 5, and 6; "Origins of Force XXI" in *TRADOC ACH 1994*, 5:13; Benjamin King, *Victory Starts Here: A Short 40-Year History of the US Army Training and Doctrine Command* (Fort Leavenworth, KS: Combat Studies Institute Press, U.S. Army Combined Arms Center, May 2013), 21; GAO, *Battlefield Automation: Performance Uncertainties Are Likely When Army Fields Its First Digitized Division*, GAO/NSIAD-99-150 (Jul 1999), 1.

80. GAO, *Battlefield Automation*, 8; "Force XXI Battle Command, Brigade and Below (FBCB2)," DOT&E, *Annual Report 1999*, III-71–III-72; Mark Hanna, "Task Force XXI: The Army's Digital Experiment," Strategic Forum No. 119, NDU, Institute for National Strategic Studies, Jul 1997, 2.

81. Yarrison, *Modern Louisiana Maneuvers*, 123; Army RDT&E Budget Item Justification (R-2 Exhibit), Budget Activity (Operational System Development), PE Number and Title (0203759A, Force XXI Battle Command, Brigade and Below, FBCB2), Project D120, Feb 2000, 1413–1417, www.dtic.mil/descriptivesum/Y2001/Army/0203759A.pdf, accessed 20 Jun 2017 (hereafter Army RDT&E, Feb 2000); "Next Generation FBCB2 JCR on the Test Bench," *Defense Update*, Dec 2009, www.defense-update.com/products/f/fbcb2_jcr.html, accessed 20 Jun 2017; TRW Systems Integration Group, "Force XXI Battle Command Brigade-and-Below (FBCB2)," 1997, https://cpb-us-e1.wpmucdn.com/sites.usc.edu/dist/a/54/files/2018/01/100343-1x72x1x.pdf, accessed 20 Jun 2017. In addition to TRW, the team included Computing Devices Canada, Hughes, Information Technology Solutions, Litton, Phoenix Group Inc., Sikorsky, United Defense LP, UnixPros, and VGS. Ibid.

82. James L. Conatser and Vincent E. Grizio, *Force XXI Battle Command Brigade and Below—Blue Force Tracking (FBCB2-BFT): A Case Study in the Accelerated Acquisition of a Digital Command and Control System during Operations Enduring Freedom and Iraqi Freedom* (MBA Professional Report, Naval Postgraduate School, Monterey, CA, Dec 2005), 8, 15, 18; Army RDT&E, Feb 2000, 1415; GAO, *Army Modernization: The Warfighting Rapid Acquisition Program Needs More Specific Guidance*, GAO/NSIAD-99-11 (Nov 1998), 1, 5, 16–17.

83. Conatser and Grizio, *Force XXI Battle Command Brigade and Below*, 13–20, 22; Committee on Improving Processes and Policies for the Acquisition and Test of Information Technologies in the Department of Defense, Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences, National Research Council, *Achieving Effective Acquisition of Information Technology in the Department of Defense* (Washington, DC: National Academies Press, 2010), 127–128.

84. Hanna, "Task Force XXI: The Army's Digital Experiment," 1–2; Conatser and Grizio, *Force XXI Battle Command Brigade and Below*, 13–15 (quote, 14). Milestone II approval for entry into engineering and manufacturing development was conditional on completion and approval of the program's Operational Requirements Document (ORD) and Test and Evaluation Master Plan (TEMP). The Joint Requirements Oversight Council approved the ORD in August 1998, but OSD

did not approve the TEMP until December 1999, just prior to awarding the contract for low-rate initial production. See DOT&E, *Annual Report FY 2000*, III-72.

85. Col. Steven A. Emison, "Post Task Force XXI Advanced Warfighting Experiment," *Army RD&A* (Sep-Oct 1997): 3–4; Statement of Lt. Gen. Paul J. Kern, Military Deputy to the Assistant Secretary of the Army for Research, Development, and Acquisition, and Lt. Gen. John N. Abrams, Deputy Commanding General, United States Army Training and Doctrine Command, SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1999 and the Future Years Defense Program, Hearings . . . on S. 2057*, 105th Cong., 2d sess., 4, 11, 25 Mar 1998, S. Hrg. 105-605, pt. 4:69–71; Committee on Improving Processes and Policies for the Acquisition and Test of Information Technologies in the Department of Defense, *Achieving Effective Acquisition*, 127–128.

86. Army RDT&E, Feb 2000, 1415; Army RDT&E Budget Item Justification (R-2 Exhibit), Budget Activity (Operational System Development), PE Number and Title (0203759A, Force XXI Battle Command, Brigade and Below, FBCB2), Project D120, Feb 2004, 216, www.dtic.mil/descriptivesum/Y2005/Army/0203759A.pdf, accessed 20 Jun 2017; GAO, *Battlefield Automation: Performance Uncertainties Are Unlikely When Army Fields Its First Digitized Division*, GAO/NSIAD-99-150 (Jul 1999), 10–11. In the 1990s GAO criticized what it considered insufficient testing before the services initiated low-rate production of their weapon systems. See GAO, *Low-Rate Initial Production Used to Buy Weapon Systems Prematurely*, GAO/NSIAD-95-18 (Nov 1994); "U.S. Army Awards TRW $57 Million Contract for Latest Battlefield Computers," *Business Wire*, 24 Jul 2000, www.thefreelibrary.com/U.S.+Army+Awards+TRW+$57+Million+Contract+for+Latest+Battlefield+Computers-a063648166, accessed 20 Jun 2017; Conatser and Grizio, *Force XXI Battle Command Brigade and Below*, 19, 27–29, 38; Northrop Grumman, "Force XXI Battle Command Brigade and Below—FBCB2," *Defense Update*, Year 2005, Issue 3, updated 22 Nov 2006, https://defense-update.com/products/f/FBCB2.htm, accessed 20 Jun 2017.

87. "*CrossTalk* Honors the 2001 Top 5 Quality Software Projects Finalists," *CrossTalk* 15, no. 1 (Jan 2002): 4, 14–15; Committee on Improving Processes and Policies for the Acquisition and Test of Information Technologies in the Department of Defense, *Achieving Effective Acquisition*, 128.

88. Discussion of M109 performance characteristics is in J.B.A. Bailey, *Field Artillery and Firepower* (Oxford: The Military Press, 1989), 274, 288–289. For the evolution of Army artillery acquisition strategy, see Boyd L. Dastrup, *Modernizing the King of Battle, 1973–1991* (Fort Sill, OK: Office of the Command Historian, U.S. Army Field Artillery Center and School, 2003), 11–12, 18–20.

89. GAO, *Armored Systems Modernization: Program Inconsistent with Current Threat and Budgetary Constraints*, 4–5; DoD IG, *Acquisition of the Advanced Field Artillery System*, Audit Report 94-111 (Washington, DC: DoD, 25 May 1994), 2–3; "Army Reviewing AFAS as 'Non-Competitive' Acquisition Program," *Defense Daily*, 18 Apr 1994, 93.

90. "Longuemare Approves Acquisition Strategy for AFAS/FARV," *Defense Daily*, 11 Jul 1994, 43; "Retired Army General to Oversee AFAS for United Defense," *Defense Daily*, 21 Dec 1994, 407; Sheila Foote, "Decker Intervenes to Get Artillery Program Back on Track," *Defense Daily*, 25 Sep 1995, 412.

91. Science Applications International Corp., *Acquisition, Streamlining and Lessons Learned Report for Crusader Self-Propelled Howitzer (SPH) and Resupply Vehicle (RSV)* (Falls Church, VA: U.S. Army Cost and Economic Analysis Center, 30 Nov 1995), I:4–5, 19–22.

92. Quoted in Patricia Slayden Hollis, "The Army and FA Challenges of Designing Force XXI," *Field Artillery*, Dec 1994, 7; Sheila Foote, "Contractor Faces Tough Choice in Selecting AFAS Engine," *Defense Daily*, 17 Jan 1995, 63.

93. Bailey, *Field Artillery and Firepower*, 322; Sheila Foote, "Lockheed Martin Wants More Time On LP Gun; Outlook Looks Bleak," *Defense Daily*, 19 Jan 1996, 79; Greg Caires, "Army Prepared to Drop Liquid Propellant Gun from Crusader," *Defense Daily*, 14 Mar 1996, 388; Greg Caires, "Development of New Crusader Gun Won't Delay Program—Decker," *Defense Daily*, 20 Mar 1996, 425; Greg Caires, "Army, United Defense Ink Crusader Cannon Deal," *Defense Daily*, 8 Nov 1996, 225.

94. Greg Caires, "Army Cuts Crusader Howitzer Costs by $4.7 Billion," *Defense Daily*, 13 Mar 1997, 395 (Kaminski quote); Cohen, *Report of the Quadrennial Defense Review*, 48; GAO, *Army*

Armored Systems: Meeting Crusader Requirements Will Be A Technical Challenge, GAO/NSIAD-97-121 (Jun 199), 2; "Crusader Clears Review; Moves Closer to First Prototype," *Defense Daily*, 17 Mar 1998, https://pentagonlibrary.idm.oclc.org/login?url=https://search.proquest.com/docview/233566609?accountid=6768, accessed 26 Jun 2020; Rick DeMeis, "Electronically-linked Teams Design the Defense Systems of the Future," *Design News*, 18 May 1998, S23 (Michitsch quote); "Crusader Team Rolls Out First Prototype," *Defense Daily*, 21 Jun 1999, https://pentagonlibrary.idm.oclc.org/login?url=https://search.proquest.com/docview/234067629?accountid=6768, accessed 26 Jun 2020; "Team Crusader Completes First Crusader Prototype," *PR Newswire*, 18 Jun 1999, 1418.

95. Ron Laurenzo, "Crusader Software: A Year Behind Schedule, Budget Cut," *Defense Week*, 18 Oct 1999, https://link-gale-com.pentagonlibrary.idm.oclc.org/apps/doc/A56701019/AONE?u=wash92852&sid=AONE&xid=5d361ee2, accessed 26 Jun 2020.

96. The National Defense Panel, *Transforming Defense: National Security in the 21st Century* (Washington, DC: Dec 1997), 49; Ralph Peters, "A Shining, Irrelevant Legacy," *Palm Beach Post*, 23 May 1999, 1E (quote). For a similar critique, see George C. Wilson, "Stuck on Super Weapons," *Washington Post*, 29 Sep 1998, A17.

97. Brown, *Kevlar Legions*, 169–171, 191–193, 197–198, 202–204; Christopher G. Pernin et al., *Lessons from the Army's Future Combat Systems Program* (Santa Monica, CA: RAND Corporation, 2012), 1 (Shinseki quote).

98. Bradley Graham, "Army's Big Gun Must Lose Some Weight," *Washington Post*, 25 Nov 1999, G01 (Shinseki quote); Michael Kilian, "Smaller, Faster, but Above All, Smarter; Congress and the Army's Big Guns, a Love Story," *Chicago Tribune*, 30 Jun 2002, 2.1.

99. "Crusader Howitzer and Resupply Vehicle," DOT&E, *Annual Report FY 2000*, III-61; Kilian, "Smaller, Faster," 2.1; "Crusader Has a Clear Path Forward on New Design," *PR Newswire*, 6 Jun 2000, 1 (Michitsch quote); Quentin E. Hodgson, *Deciding to Buy: Civil-Military Relations and Major Weapons Programs* (Carlisle Barracks, PA: U.S. Army War College, 2010), 69–70.

100. Hodgson, *Deciding to Buy*, 63 (Bush quote), 71–72 (strategy review panel quote); Greg Jaffe, "Trial by Fire: New Battle Theory Would Be Tested in an Iraq Invasion," *Wall Street Journal*, 27 Nov 2002, A1.

101. Ron Laurenzo, "Crusader Arrives In Yuma for Live-Fire Tests," *Defense Week*, 7 Feb 2000, 1–2; United Defense, "Crusader Completes Milestone B Firing Requirements One Year Ahead of Schedule," 28 Feb 2002, http://web.archive.org/web/20020808101212/http://www.teamcrusader.com:80/briefing/pressrel_2-28-02.html, accessed 28 Sep 2017; Edward F. Bruner and Steve Bowman, *Crusader XM2001 Self Propelled Howitzer, Background and Issues for Congress*, CRS Report RS21218 (Washington, DC: CRS, 2002), 5; GAO, *Defense Acquisitions: Steps to Improve the Crusader Program's Investment Decisions*, GAO-02-201 (Feb 2002), 14; "Crusader Howitzer and Resupply Vehicle," DOT&E, *Annual Report FY 2002*, 73–74.

102. Hodgson, *Deciding to Buy*, 74 (Shinseki quote); GAO, *Steps to Improve the Crusader Program's Investment Decisions*, 11, 20; Donald Rumsfeld, *Known and Unknown: A Memoir* (New York: Sentinel, 2011), 649–652; Kilian, "Smaller, Faster," 2.1 (Wolfowitz quote).

103. For the Army artillery program, see Janice E. McKenney, *The Organizational History of Field Artillery* (Washington, DC: CMH, 2007), 319–322. For the Apache Longbow, see Col. Shane Openshaw, "The AH–64 Apache Helicopter: Evolution—Certainly. Revolution—Absolutely," *Army AL&T* (Oct-Dec 2010): 40–42.

CHAPTER XIII

Acquisition in the Navy and Marine Corps, 1989–2001

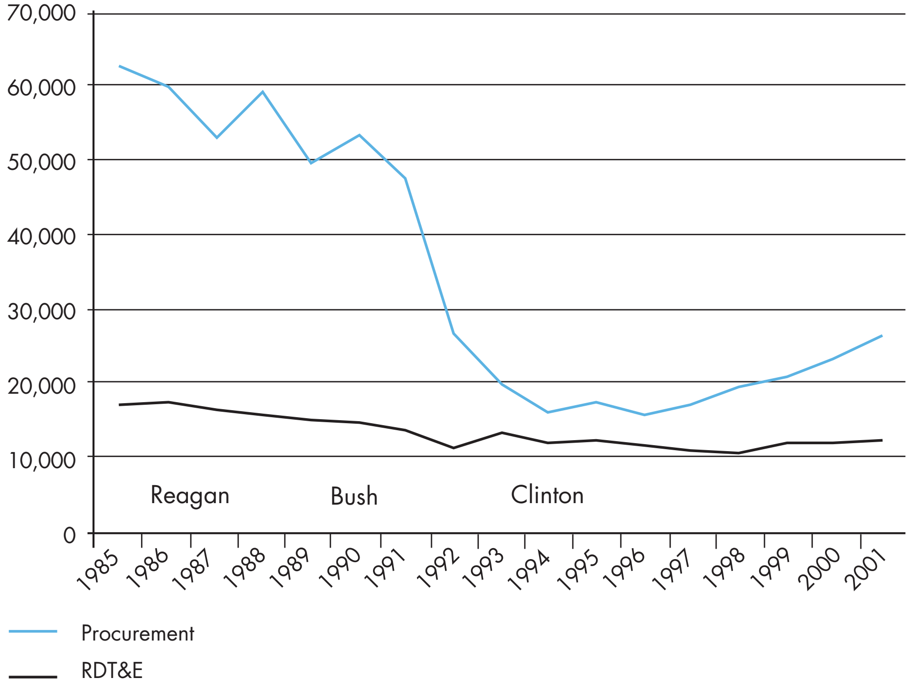
In the 1990s the Navy and Marine Corps devised and refined an operational concept for employing naval forces to support the national military strategy, which since the collapse of the Soviet Union had shifted from opposing a single, major global threat to countering regional dangers. In . . . *From the Sea: Preparing the Naval Service for the 21st Century*, the Navy Department emphasized projecting power across the seas to the nearshore (littoral) regions of the world. Developing the capabilities to implement the concept would be challenging for the Navy. In the nine years after the fall of the Berlin Wall, the Navy's budget authority fell from $100 billion to $80 billion, representing a real decline of 33 percent. During that time funds for research, development, and test and evaluation dropped from $9.5 billion in 1990 to a low point of $7.8 billion in 1998, a 28 percent fall in real terms. The procurement budget had reached its nadir two years earlier, having declined precipitously from $34.4 billion in 1990 to $15.8 billion in 1996. (For a representation of this decline in constant dollars, see figure 13-1.) In the face of such sharp declines, Navy leaders hoped to cut costs and get the most out of available funds by reforming acquisition's organization, processes, and practices. These changes would fundamentally alter the Navy's acquisition system and culture.[1]

ACQUISITION ORGANIZATION

In 1989 the Navy was in the midst of a significant reorganization that had begun several years earlier. By the time the Packard Commission issued its recommendations and Congress passed the Goldwater-Nichols Act, the Navy had already adopted many, but not all of their reforms.

Initially, the Navy designated the under secretary as the service acquisition executive. Two civilian officials with acquisition responsibilities reported to the under secretary. The assistant secretary of the Navy for research, engineering, and systems established policy, administered the R&D appropriation, managed the technology base, formulated major program decisions, oversaw Navy test and evaluation, and

Figure 13-1: Navy Acquisition Budgets, 1985–2001
(in thousands of constant 2014 dollars)



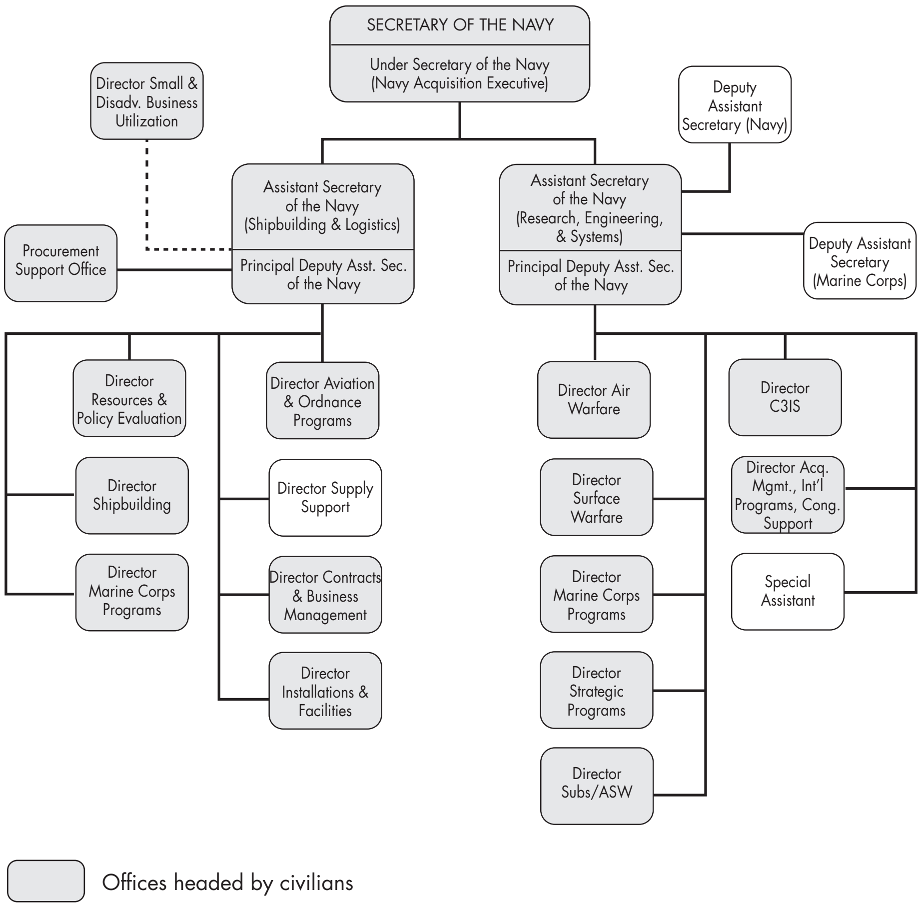
Source: Graph prepared from data in OSD Comptroller, *National Defense Budget Estimates for FY 2014,* table 6-20.

negotiated foreign program initiatives. This official was also responsible for all aspects of non-shipbuilding acquisition programs up to full-scale production. The assistant secretary was supported by a staff of 114 organized into seven directorates, all but one representing the Navy's major warfare communities—air, surface, submarine and ASW, strategic, information and space, and the Marine Corps (see figure 13-2).[2]

The assistant secretary of the Navy for shipbuilding and logistics, the service's senior procurement executive, was responsible for overseeing ship design; the integration of shipboard components, subsystems, combat systems, and life-cycle support; and managing acquisition programs following the full-scale production decision. The assistant secretary's 218-member staff, organized into seven offices, reviewed and approved business strategy, including contracting policy, and procured logistics and life-cycle support items (see figure 13-2).[3]

The chief of naval operations (CNO), the Navy's senior uniformed officer, and his staff, known as OPNAV (Office of the Chief of Naval Operations), established the operational requirements that formed the basis for the service's acquisition programs. The staff prepared and reviewed program documentation, provided input into decisions at review forums, and directed operational test and evaluation. The CNO

Figure 13-2: Navy Secretariat Acquisition Organization, 1989



Source: Adapted from chart (Organization of the Navy's Acquisition Secretariat), in GAO, *Acquisition Reform: Military Departments' Response to the Reorganization Act*, GAO/NSIAD-89-70 (Jun 1989), 47.

was also in charge of the major organizations that executed acquisition programs: Naval Sea Systems Command (NAVSEA) and Naval Air Systems Command (NAVAIR) carried out most of the service's acquisition activity. Space and Naval Warfare Systems Command (SPAWAR) acquired many of the information systems, including those for command, control, communications, and intelligence, or C3I, while the Office of Strategic Systems Programs was responsible for strategic missiles.[4]

Each of these organizations managed the life cycle of their systems, from R&D to production to logistics support to disposal. Naval Sea Systems Command, for example, oversaw acquisition and life-cycle support for submarines and surface ships, and supervised shipyards and engineering activities. It also directed a number of field activities. These included Naval Surface Warfare Center and Naval Undersea Warfare Center—each with divisions located across the country where critical research, engineering, and test and evaluation took place. For example, the David Taylor Model Basin, a Naval Surface Warfare Center field activity in Maryland, assisted with ship hull design. In other NAVSEA field organizations like shipyards, Navy supervisors of shipbuilding, conversion, and repair, known as SUPSHIPs, shepherded the ships from design through construction, launch, and testing, and administered contracts for shipbuilding and repair.[5]

In 1989 OPNAV comprised eight warfare offices called program sponsors that developed requirements, determined the resources for each mission area, and coordinated program-related information for assigned systems. The sponsors provided direction and funds for the systems commands executing the programs. OPNAV officers known as program coordinators were the links to the program directors in the systems commands. They monitored the programs assigned to them and coordinated program budget and planning documents.[6]

The Marine Corps, part of the Navy Department, controlled little of its own acquisition directly. The Navy service acquisition executive had formal charge of its programs. Most of the Marines' acquisition budget—$3.1 billion of $4.46 billion in FY 1988 went through the systems commands: Naval Air Systems Command acquired and managed Marine Corps aviation systems, and Naval Sea Systems Command managed the amphibious shipbuilding program. The respective heads of these commands served as program executive officers. Most of the remaining $1.3 billion in the budget purchased ground combat, communications, and electronic systems developed in programs managed by the other services, especially the Army, which accounted for two-thirds of that amount. Only about $169 million—or 13 percent—of the Marine Corps acquisition budget went to programs run by the Corps itself, largely ground combat systems such as land vehicles.[7]

The Marines managed their programs through the Research, Development and Acquisition Command (MCRDAC), established in 1987 by Marine Corps Commandant General Alfred Gray. The command was home to nine program managers and two directors of smaller offices, each overseeing projects of similar types, such as communications and navigation systems, intelligence systems, combat support systems, and ammunition. MCRDAC's commanding general was the program executive officer for all command programs and was dual-hatted as a deputy assistant secretary of the Navy for research, engineering, and systems. In 1992 the command was revamped to include logistics support functions and was renamed Marine Corps Systems Command, with responsibility for system life cycles, from development through disposal. A second organization created by Gray in 1987, Marine Corps Combat Development Command, generated requirements and developed doctrine, concepts, and operational plans. It was also the sponsor for acquisition programs during the preparation of Marine Corps program plans and budgets.[8]

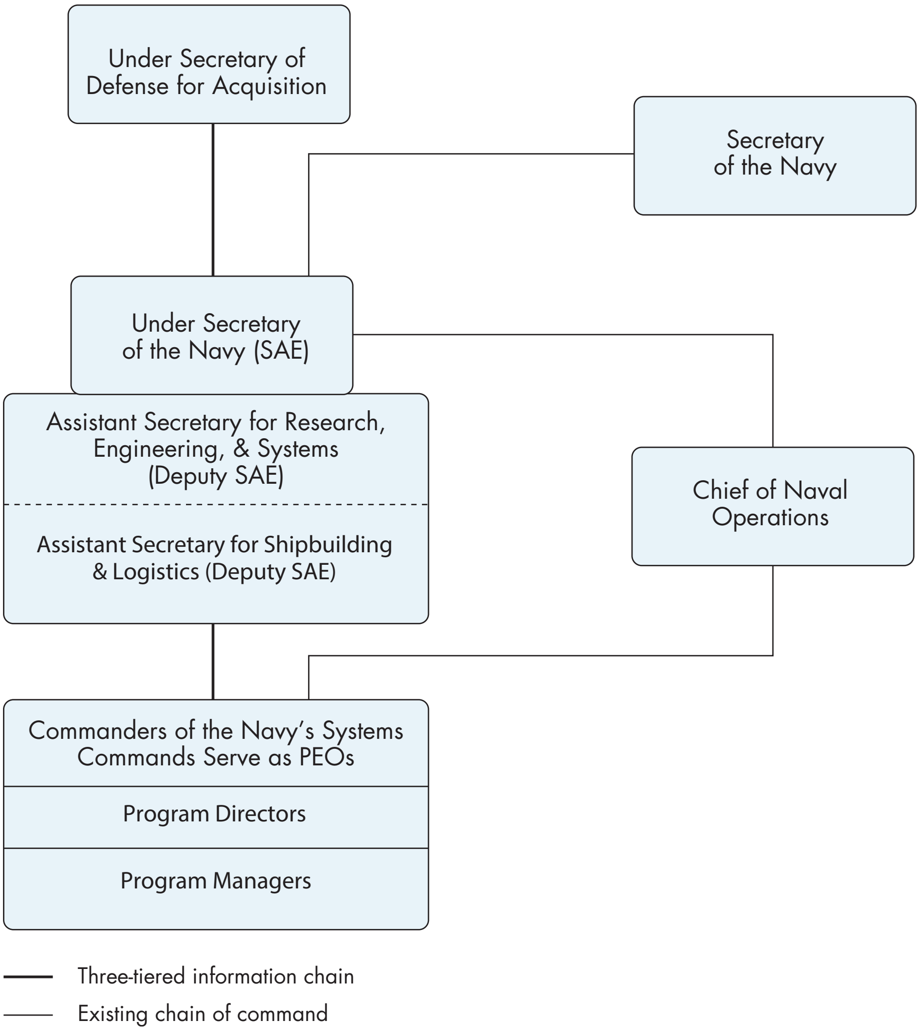
As noted earlier, in 1989 the Navy had not implemented all of the Packard and Goldwater-Nichols reforms. The General Accounting Office pointed out that instead of locating responsibility for acquisition in one official as the reforms intended, the Navy divided it among the under secretary and two assistant secretaries. Goldwater-Nichols also mandated that the secretariat have responsibility for research and development. In response, the Navy dual-hatted the vice admiral who directed the CNO's R&D office as a deputy to the civilian assistant secretary for research, engineering, and systems, and transferred some of his staff to the secretariat. But the vice admiral continued to report to the CNO on issues related to requirements and test and evaluation, and the staff and functions of his office that transferred with him were slow to integrate into the secretariat.

The framework of program sponsors and program coordinators linking OPNAV and the program offices in the systems commands also reflected the CNO's continuing influence on acquisition; which, according to a GAO report, undercut the Packard and Goldwater-Nichols goal of strengthening civilian control.[9]

The GAO also maintained that the Navy's implementation of the three-tiered acquisition reporting chain—program managers, program executive officers, and service acquisition executive—worked against the reforms. The Navy had named the commanders of the systems commands, its buying organizations, as PEOs—for Naval Sea Systems Command, Naval Air Systems Command, Space and Naval Warfare Systems Command, and Office of Strategic Systems Programs—each responsible for the programs already under their authority. The commander of Marine Corps Research, Development and Acquisition Command served as the PEO for Marine Corps programs. Each program executive officer therefore had two reporting chains, one to the Navy's civilian service acquisition executive and one through the chief of naval operations (see figure 13-3). This structure did not follow the Packard Commission recommendations, which intended that uniformed officer or civilian PEOs work full-time overseeing their programs and be independent of the buying commands. Their new status as program executive officers did not change the role of the chiefs of the systems commands at all. The heads of systems commands continued to direct all of the programs in their organizations. Thus, the Naval Sea Systems Command PEO oversaw the program managers for 10 major systems but also supervised the managers and organizations for 250 other programs as NAVSEA commander. Similarly, the Naval Air Systems Command PEO supervised 12 program managers of 14 major systems, but as the NAVAIR commander, was also responsible for over 100 other programs.[10]

Because they held responsibility for so many programs, the systems command program executive officers relied on so-called program directors. Most program managers reported directly to a program director who advised them, reviewed their requests and reports before submitting them to the program executive officer, briefed the PEO on the status of the programs, allocated personnel and equipment to the program offices,

Figure 13-3: Navy Acquisition Reporting Chain, 1989



Note: The Commanding Officer of Marine Corps Research, Development and Acquisition Command also serves as a PEO. The Director of Strategic Systems Command also serves as a PEO and Program Manager.

Source: Adapted from chart (Navy's Acquisition Reporting Chain, 1989), in GAO, *Acquisition Reform: DoD's Efforts to Streamline Its Acquisition System and Reduce Personnel,* GAO/NSIAD-90-21 (Nov 1989), 32.

and drafted the program managers' performance ratings for the PEO's signature. The program directors represented a fifth management layer in the acquisition reporting chain because the program executive officers reported to the Navy service acquisition executive, the under secretary, through one of the assistant secretaries.[11]

In the wake of the 1989 Defense Management Report, OSD ordered the Navy to bring its acquisition organization more closely in line with Packard and Goldwater-

Nichols. Specifically, OSD told the Navy to combine the offices of the two assistant secretaries, appoint new program executive officers independent of the systems commands, shift the systems commands from managing the programs to supporting them, and create an acquisition corps.[12]

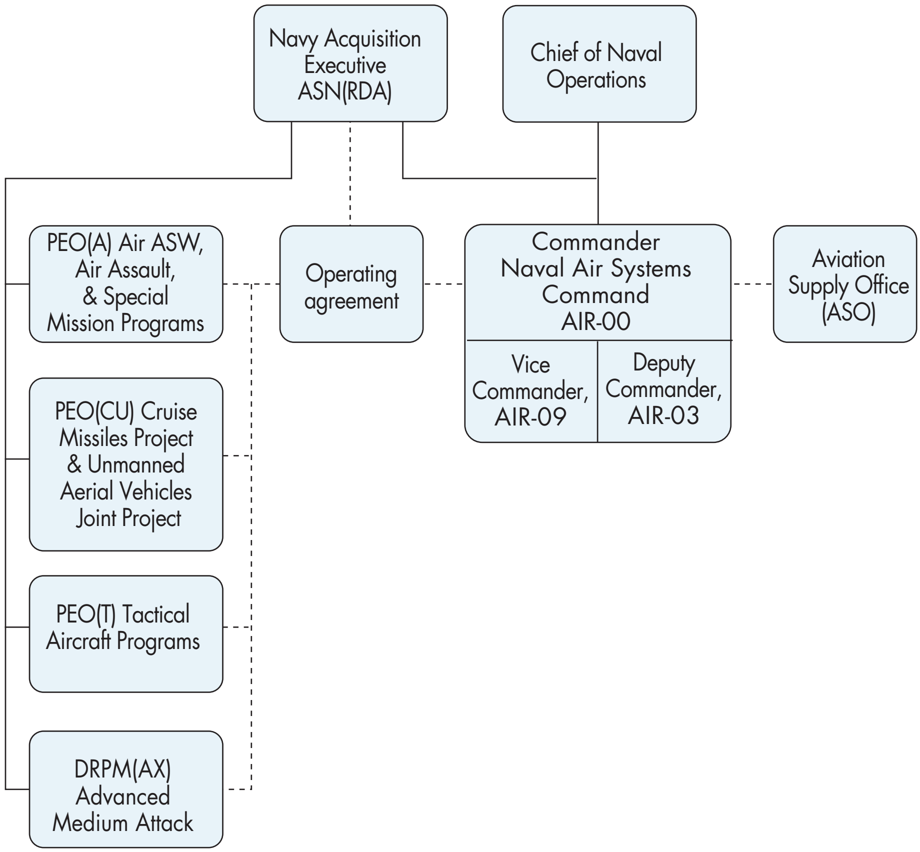
Despite opposition from the chiefs of the systems commands, Secretary of the Navy H. Lawrence Garrett made the changes OSD wanted. In the past, systems commands usually won their battles, but this time they were up against an immovable secretary and deputy secretary of defense. The new reorganization plan merged the two assistant secretaries into a single office, headed by the assistant secretary of the Navy for research, development, and acquisition, who would also be the Navy service acquisition executive. This official was supported by a number of deputy assistant secretaries for particular platforms and warfare areas. By 1997 there would be five deputies covering programs for aviation, expeditionary forces, mine warfare, ships, and C4I (command, control, communications, computers, and intelligence) that encompassed electronic warfare and space systems. The systems commands were reorganized into a matrix management structure (see chapter XII), which enabled them to provide functional specialists and logistics support to the program executive officers. The Navy also established the Material Professional Program to designate members of the acquisition corps and provide intensive training for acquisition professionals.[13]

The Navy succeeded in forging a compromise with OSD concerning the program executive officer structure. The service created seven full-time PEOs with their own staffs. The Marine Corps, however, lost its only program executive officer; its programs reported directly to the Navy service acquisition executive or the PEOs of other services. It would not have another one of its own until 2006. Navy PEOs reported to the assistant secretary for research, development, and acquisition, as did three direct reporting program managers. (For the aircraft program reporting chain, see figure 13-4.) These 10 officials supervised 78 programs of varying sizes formerly managed by the systems commands. However, the heads of the systems commands received special authorization from OSD to retain 21 of the Navy's 51 ACAT I programs. These major programs were supposed to be "mature," in stable production, not subject to any planned major upgrades, and not involved in any issue of concern to OSD. Examples were aircraft carriers and other shipbuilding programs, the *Los Angeles*-class attack submarines, and the Phoenix and Sparrow air-to-air missiles. The Navy assigned higher-risk programs early in their development to program executive officers but expected to move those programs to the systems commands when they reached full-scale production.[14]

REORGANIZING OPNAV: INTEGRATING THE WARFARE COMMUNITIES

In 1992, following the reorganization of acquisition, the Navy restructured OPNAV. Admiral Frank B. Kelso II, the CNO, initiated the change to address the competition among the warfare communities—especially aviation, surface

Figure 13-4: Navy Aircraft Program Reporting Chain, 1990



Note: Certain Program Executive Officers and Direct Reporting Program Managers report neither to NAVAIR nor NAVSEA, but rather to ASN(RDA). Dashed lines indicate reporting relationship.

ASN(RDA) – Assistant Secretary of the Navy for Research, Development, and Acquisition
DRPM(AX) – Direct Reporting Program Manager Advanced Medium Attack
NAVAIR – Naval Air Systems Command
NAVSEA – Naval Sea Systems Command
PEO – Program Executive Officer

Source: Adapted from chart (Naval Air Organizations and Reporting Relationships for RDA), in Eric V. Larson and Adele R. Palmer, *The Decision-Making Context in the U.S. Department of the Navy: A Primer for Cost Analysts* (Santa Monica, CA: RAND, 1994), 107.

warfare, and undersea warfare—that had long defined the Navy. The Air Force, then dominated by fighter pilots, could avoid this kind of conflict, while the Army, under the rubric of maintaining a "balanced force," kept institutional peace by dishing out more or less equal shares of the acquisition pot to its major branches. In the Navy, the rival warfare communities slugged it out for supremacy. Given the self-absorption of these communities and their long tradition of autonomy, such as the submariners under Admiral Hyman Rickover, there was little coordination among them or with the Marine Corps. The resource sponsors in OPNAV—three-star vice admirals who controlled much of the Navy's budget—generally advocated their own community's platforms, such as attack submarines, strike aircraft, or destroyers. Furthermore, these "platform barons" supported incremental improvements and tended to favor follow-on versions of familiar ships and aircraft. Warfare areas without their own baron, such as mine warfare, antisubmarine warfare, and to some degree the Marine Corps, received less consideration, however critical they might be in naval operations. Rather than mediate disputes and protect the weak programs, the CNO often tipped the balance in favor of the community from which he came. The communities therefore sought to have one of their own selected as chief.[15]

The state of mine warfare illustrates the weaknesses that resulted when a warfare community lacked a strong advocate. With a historical focus on open-ocean operations, the Navy had long neglected mine countermeasures (MCM), which were typically required only when ships operated in littoral regions. Despite the sobering experience of World War II and Korea, the service left much of the countermine mission to NATO allies. The Navy was therefore underprepared to conduct these operations during the Gulf War. Mine countermeasures ships were inadequate in both numbers and capabilities, forcing the United States to rely on the more modern assets of coalition partners, especially the British, who were stunned at the Americans' lack of preparedness. The Navy did not know where the Iraqis had laid their mines and had difficulty locating them. Consequently, ships unknowingly steamed within the main minefield for up to 24 hours. Two struck mines and nearly sank, including, embarrassingly enough, the amphibious assault ship *Tripoli* assigned to direct MCM operations. Only Iraqi incompetence at minelaying prevented more losses. The threat posed by these cheap and simple weapons—some of them Iraqi copies of pre–World War I designs—helped deter General Norman Schwarzkopf from launching a major amphibious assault, a proposed invasion of Kuwait by 17,000 Marines.[16]

Even before the mine warfare embarrassment in the Persian Gulf, pressure to change the way the Navy allocated its resources was starting to build. The defense drawdown and post–Cold War strategic uncertainty, however, intensified intra-service rivalry and made correcting resource imbalances more difficult. Even within the warfare communities, the subcommunities, intensely loyal to a specific platform, fought with each other over funding for their preferred system. Among the aviators, for example, F–14 advocates accused the proponents of its replacement, the F/A–18E/F Super Hornet, of engaging in political gamesmanship to favor the new program.[17]

By 1992 Navy leadership had trouble reaching a consensus on the force structure and acquisition program needed to meet the service's post–Cold War requirements. In July, Acting Secretary of the Navy Sean O'Keefe approved Admiral Kelso's dormant plan for overhauling OPNAV. "One of my primary concerns is ending rivalries and jealousies between the various key warfare fighting communities in the Navy," O'Keefe stated at the time. "We believe there can be no jealousy among the fingers of a strong fist." One expert described the changes as "the most far-reaching reorganization of U.S. Navy headquarters in almost 50 years." The new organization downgraded the platform barons from three-star assistant chiefs of naval operations to two-star division directors under a single vice admiral, a newly established deputy chief of naval operations for resources, warfare requirements, and assessment (OPNAV Code N-8, in Navy organization-speak). Instead of specific platforms, the new divisions represented warfare areas: air warfare, surface warfare, submarine warfare, and Marine Corps "expeditionary warfare," the new term for amphibious warfare. Now, for the first time, the warfare communities spoke with "one voice." The platform barons were subordinated to a uniformed officer tasked with taking a comprehensive view of Navy requirements, adjudicating the barons' demands, and achieving—or forcing—some measure of consensus on them.[18]

The new requirements and resources chief acquired significant power within the Navy staff. The first N-8, Vice Adm. William Owens, used that power to weaken the barons further and force OPNAV to adopt a broad Navy and joint-service perspective. He created a process for assessing and prioritizing Navy programs to ensure they supported the newly announced strategy that emphasized joint littoral operations. Called the Joint Mission Areas Assessment Process, it required programs to contribute to one of six joint mission areas or two support areas, such as combat, surveillance, sealift, and training. Whereas previously only a few offices within OPNAV provided input into programming decisions, now teams led by one-star rear admirals on the staff from across the warfare spectrum guided those decisions and brought a wider range of viewpoints to the discussion. Representatives of the Marine Corps and the fleet commanders in chief also participated. The teams held seminars and wargames, commissioned studies by federally funded research and development corporations such as the Center for Naval Analyses and the Institute for Defense Analyses, and sought the advice of other experts. By ending what he called the "stovepipe dialogue"—in which OPNAV staff members talked with their superiors and subordinates, but not with their peers in other communities—Owens sought to broaden their outlook and break down the exclusive focus on their own warfare areas and platforms. He hoped that exposing the staff to the viewpoints, activities, and needs of other parts of the Navy, the Marine Corps, and the other services would lead to a consensus on the Navy's priorities. Owens later applied a variation of this process to the Joint Requirements Oversight Council when he became vice chairman of the Joint Chiefs of Staff in 1994 (see chapter I).[19]

The system did not work as well as Kelso and Owens had hoped. N-8 proved to be too powerful. Instead of lessening the influence of the platform barons, now transformed into "warfare barons," and imposing a joint perspective on them, N-8 became an advocate for them and reinforced their traditional preferences. Meanwhile, the Joint Mission Areas Assessment Process, which depended heavily on Owens's vision and leadership, lost importance after he left, as his successors relied increasingly on internal discussion. In 1998 CNO Admiral Jay L. Johnson replaced the Joint Mission Areas with Integrated Warfare Architectures and made other organizational and process changes, but historically lower-priority areas still fought to be heard. Despite more investment in a few key technologies, mine warfare continued to struggle for funding until Defense Secretary Cohen and a Congressional Mine Warfare Caucus ordered the Navy to boost funding for countermine programs. The Marine Corps, too, had difficulty obtaining funds for some of its priority capabilities, such as fire support from surface warships.[20]

Even worse, N-8, influenced by the warfare barons, arguably skewed the allocation of resources in favor of modernization, at the expense of readiness, because there was no similarly powerful advocate for readiness to provide a counterbalance. By the end of the decade the Navy, especially in aviation, was deep in a "readiness crisis," marked by shortages of spare parts, deferred maintenance, and training shortfalls. Aircraft were being cannibalized for parts and frustrated maintenance personnel were quitting the service. Strike aircraft crews were not allowed to conduct live-fire training; many used smart bombs and missiles for the first time during combat. This lack of experience contributed to Navy aviators hitting fewer than half their targets in Kosovo and Iraq in 1999. Although this situation was largely blamed on Defense budget cutbacks in the late eighties and early nineties, some in the Navy also faulted the requirements and programming process. In 2002 CNO Admiral Vernon E. Clark scrapped the process and also largely dismantled N-8.[21]

A–12 FALLOUT STIMULATES REFORM: THE F/A–18E/F SUPER HORNET PROGRAM

The collapse of the A–12 medium-range stealth attack aircraft program shook the Navy's acquisition community. It was not just the loss of the service's only new attack aircraft that made the cancellation so shocking, but also public allegations that some civilian and uniformed Navy officials had exhibited poor judgment at best and malfeasance at worst. In particular, the November 1990 report issued by the principal deputy general counsel for the Navy, Chester Paul Beach Jr., following his administrative inquiry into the program, rocked the Pentagon and Naval Air Systems Command (see chapter III).

The Beach report found significant failings in A–12 program oversight and management. It faulted both the Navy and contractor program offices for not addressing early on the unrealistic cost and schedule estimates resulting in cost overruns and delays. The service's acquisition chain of command failed to recognize many signs of impending problems and to appreciate the significance of those they did, manipulated the presentation of program data, and neglected to pass along critical information. Additionally, the program's classified status hindered effective oversight. Beach found plenty of blame to spread around: the contractor team, the program manager, the program executive officer, the service acquisition executive's staff, and Naval Air Systems Command. Culpability also extended beyond the Navy to the on-site plant representatives of the Defense Contract Management Command and the auditors of the Defense Contract Audit Agency.[22]

Individual officials and organizations were not the only ones singled out for errors of omission or commission. The report also cited the Navy acquisition system for systemic problems that required more than enforcing accountability and strengthening a few procedures. Beach faulted the acquisition system's culture, which promoted program advocacy over objective oversight and, he argued, resulted in over-optimism and the suppression of bad news. Foreshadowing an argument the General Accounting Office would make three years later, he maintained that the fundamental problem with the culture was a system that lacked incentives to motivate its members to provide realistic estimates and objective oversight.[23]

Beach offered 20 recommendations to correct the problems revealed by the A–12 debacle, most directed to the Navy Department for action. Several called for the department to take "appropriate administrative and/or disciplinary action" for the transgressions of the individuals he named, but most addressed systemic and cultural problems in acquisition. He recommended that the Navy and OSD conduct additional reviews of the A–12 program and of certain aspects of the acquisition process, such as the financial health of contractors; that they publish new instructions on the roles and responsibilities of program managers and program executive officers; and that the Defense Systems Management College prepare a case study to teach the lessons learned.[24]

The Navy moved quickly to implement some of the recommendations. For example, in January 1991 Gerald A. Cann, assistant secretary for research, development, and acquisition, directed program managers to include additional information about cost and risk in the quarterly Defense Acquisition Executive Summary (DAES), the Defense Department's primary internal vehicle for reporting the status of major programs. Each program manager was to provide a full range of cost estimates and explain variations; indicate the program's top five challenges and their potential impact on cost, schedule, and performance; and produce a list of remedial actions. The program executive officer would review the DAES submission and assess changes in the program's risk, the significance of the problems identified by the program manager, and the risk associated with the program manager's action plans. Additionally, the program executive officer was to understand that "he will be held accountable for the factual accuracy of his comments."[25]

The Navy's need for a new long-range fighter made reforming aircraft acquisition more urgent. By the end of the 1980s the service had three aircraft under consideration: the remanufactured D model of the F–14 Tomcat, the F/A–18 E and F models of the Super Hornet, and a navalized version of the Advanced Tactical Fighter, which the Navy was studying under congressional pressure. Against heavy resistance in Congress, Defense Secretary Cheney succeeded in killing the F–14D. In January 1991—the same month the A–12 was canceled—the Advanced Tactical Fighter, now deemed to be unaffordable, was also dropped. The Navy then went headlong for the F/A–18E/F, which offered long-range fighter and attack capabilities and some commonality with the existing Hornet force. Indeed, the Navy described the aircraft as a "modification" of the C/D Hornet already in service. This designation allowed the Navy to cut certain regulatory and statutory corners, such as preparing a mission need statement, conducting a cost and operational effectiveness analysis, building competitive prototypes, and performing full live-fire testing. Calling the Super Hornet a modification, although not a false characterization as some argued, was not entirely true either—the aircraft needed a completely new airframe. Congress subsequently required the Navy to perform some of the analyses and provide information the service had omitted. Although it raised some questions, the modification designation permitted a rapid start to the program. In May 1992 the Defense Acquisition Board approved the program's entry directly into engineering and manufacturing development. In December the Navy signed a sole-source contract with McDonnell Douglas, which had manufactured the previous F/A–18 models.[26]

After the failure of the A–12, the Navy and McDonnell Douglas were determined to make the F/A–18E/F a success. The program office closely monitored the contractor, with daily telephone calls between the Navy and McDonnell Douglas program managers and weekly video or teleconferences with the major subcontractors. The company developed management information systems and databases that allowed corporate and government personnel to access the latest status reports. The oversight was strict and careful but not oppressive, and McDonnell Douglas responded promptly to problems. As one former program manager later recalled, "Post A–12 there was recognition that we were going to sink or swim together." When the Navy program office complained that McDonnell Douglas was using too many subjective measures of progress, the company quickly adopted more objective criteria. McDonnell Douglas also implemented an integrated product and process development approach—three years before OSD mandated it for Defense Department acquisition programs—that used integrated product teams to design the aircraft, resolve issues, identify risks, and prepare risk management plans.[27]

In 1995 the Navy and McDonnell Douglas instituted an innovative process by forming an "integrated test team" with representatives from both to conduct developmental tests. Under the traditional approach, the contractor would perform testing for two years and then hand the aircraft over to the Navy for another two years of testing. The team approach shaved a year off this process by bringing in members of the Navy operational testing community relatively early to strengthen their understanding of the program. The Defense Department's director of operational test and evaluation, Philip E. Coyle III, praised the execution of the integrated test team concept to Congress, saying, "I want to compliment the Navy on their management of the combined test team, and on the forthright and open way in which they have worked with my office and the operational test force."[28]

The F/A–18E/F program office also adopted integrated product teams. This had the effect of breaking the power of the functional organizations that had wielded considerable influence over the design of new aircraft. Functional specialists had promoted a particular characteristic or feature of the aircraft, such as weight, engine power, or fuel capacity, while the program manager played the role of "cat herder." This situation could produce impracticable and unwieldy designs. After the A–12, the Navy strengthened the role and authority of the program manager over the functional specialists. Instead of allowing them to remain with their parent organizations, specialists were now collocated with the program office. As part of an integrated product team, they were forced to work with other team members and to make trade-offs between different features to produce an acceptable design.[29]

Coming up with an affordable compromise design was critical for the success of the Super Hornet program. Congress capped the development cost of the E/F at no more than 25 percent above that of the C/D Hornet, so the program had $4.88 billion to spend. Determined not to exceed this amount, program officials focused heavily on cost and risk reduction, starting with the selection of the contractor, McDonnell Douglas. The Navy believed the company, having built the earlier F/A–18 models, had the knowledge and experience to produce the required design. The major subcontractors—Northrop (Northrop Grumman beginning in 1994) for part of the airframe and some key subsystems, General Electric for the engines, and Hughes for the radar—had performed the same roles on the A/B/C/Ds and had maintained relationships with their own subcontractors and suppliers. During the course of the program, McDonnell Douglas and its subcontractors worked hard to prevent holdups in the supply chain that might delay development.[30]

The F/A–18E/F design process took a conservative approach that reflected the need to avoid cost growth and schedule delays in a period of constrained budgets. The program adopted cost as an independent variable, a methodology that considered cost along with performance and schedule and that was aggressive in keeping costs down. This meant sacrificing some performance capabilities. When serious planning began with a "mini program review" in summer 1991, the design teams pressed for the highest possible performance specifications for their particular area. As one McDonnell Douglas official noted, "Everybody was protecting their own rice bowls. The electronic warfare team wanted the best of the best. The low observables team wanted the stealthiest aircraft possible. The cockpit displays team wanted the very best and so on." As a result, the projected aircraft was overweight and over budget, developments that jeopardized the program.[31]

Using his new authority, the Navy's Super Hornet program manager, Capt. Craig E. Steidle, convened a lengthy meeting with the McDonnell Douglas leadership in St. Louis in 1991 that became known as the "twelve days of August." The F/A–18C/D design was used as a baseline, and the group measured the new design against it. According to the Operational Requirements Document specifying the system's essential capabilities, the new design's highest priority was greater internal fuel capacity, followed by improved carrier suitability, increased mission radius/payload and carrier recovery payload, and improved survivability. The teams were cloistered and compelled to make the trades necessary to achieve cost, schedule, and performance goals. For example, designers sacrificed stealth capabilities but still managed to give the aircraft a fairly low radar cross section.[32]

The result was a conservatively designed evolution of the older C/D model that did not push the technological state-of-the-art or the performance envelope, but was an improvement over what the Navy already had and essentially "good enough" for mission requirements. The design was deliberately low-risk and made use of existing technology and processes as much as possible—90 percent of the avionics system, a major source of risk in recent aircraft acquisitions, came from the C/D. Thus the avionics were a relatively small part of the development budget compared with other aircraft programs. The design teams also adopted a modular, evolutionary approach

Two F/A–18E/F Super Hornets on the flight deck of the nuclear-powered aircraft carrier USS *Carl Vinson* deployed to the western Pacific, December 2011. *(U.S. Navy)*

that permitted the installation of upgraded subsystems. The initial low-risk design was gradually improved during development, but in a way that did not threaten the program's schedule. For instance, in contrast to the Air Force F–22 program, which was developing an integrated avionics system that fused the avionics functions into a single, unitary system, the F/A–18E/F maintained the older "federated" approach of the C/D, which kept the avionics functions as individual subsystems that could be replaced without reintegrating the entire system.[33]

Like many programs, the F/A–18E/F had its share of difficulties during development. The most significant was the "wing drop" problem, that is, a loss of lift on one of the wings during high-speed maneuvers, which caused the aircraft to suddenly roll laterally. After extensive analysis, the program came up with a fix that did not require a costly redesign of the wing. The solution to the wing drop problem and other cost saving measures helped the program avoid appreciable cost growth, but so did an unusually generous management reserve, 10 percent of the budget at the start of the program—a benefit of being a high-priority program. Nor did the schedule slip much, except for achieving initial operational capability. When the F/A–18E/F finally passed its final tests and operational evaluation and entered full-scale production in February 2000, the program was, remarkably, on time and within budget. The aircraft's development had taken less than eight years.[34]

Improvements in the acquisition process did not mean the Super Hornet escaped controversy. The Navy's claim that the E/Fs were modifications of the C/D models, which the service used to obtain exemption from certain statutory and regulatory requirements, bothered some analysts including the Pentagon's inspector general. Many considered the Super Hornet a new aircraft; one of its program managers later admitted as much. Acquisition reformer Chuck Spinney believed it was badly designed. Pointing to the Super Hornet's high cost and projected overlap in service with the F–35 (the Joint Strike Fighter), critics asked if the F/A–18E/F was worth the money in a time of tight budgets. The General Accounting Office warned that the aircraft suffered from technological shortcomings and predicted it would not perform well during operational tests. It believed the Navy would do better purchasing more C/D models or waiting for the F–35, which, at the time, the GAO expected to be a less costly and more effective alternative. Years after the Super Hornet went into production critics persisted in comparing the aircraft unfavorably with the F–14D and railing against the "Super Bug" and the "Hornet Mafia" promoting it.[35]

The critics, however, ignored the fact that one of the major goals of the program was to meet its cost and schedule objectives, which required some reduction in performance. In this respect, the F/A–18E/F was just the sort of program sought by reformers who argued that the quest for leap-ahead performance led to cost growth and schedule slips like those experienced by the F–22 and the F–35 programs. As for performance, the F/A–18E/F passed its operational tests quite easily and received the highest rating on its operational evaluation. DoD's inspector general was satisfied with the tests and Philip Coyle, even more so. The rigorous testing demonstrated the strengths and deficiencies of the aircraft but revealed no unexpected problems. Coyle acknowledged that in certain performance areas, such as maximum speed and sustained turn rate, "the aviator prefers more," and that "barring major aerodynamic redesign or reengineering, these are performance limitations that must be lived with." But on the whole, "the Navy is getting the aircraft it wanted," and the F/A–18E/F was "in most respects . . . substantially better than the F/A–18C/D" in terms of operational performance, flexibility, and survivability.[36]

NAVY ACQUISITION REFORM ORGANIZATION AND INITIATIVES

Like the other services, the Navy adopted acquisition reform measures championed by the Office of the Secretary of Defense. This is not surprising given that then-Deputy Secretary of Defense William Perry handpicked the Navy's acquisition executive and those for the other services and that a reformist mindset was a key qualification for the job. Assistant Secretary for Research, Development, and Acquisition Nora Slatkin, the first Navy acquisition executive appointed by the Clinton administration, was a member of Les Aspin's congressional staff who followed him to the Pentagon. She possessed considerable background in defense acquisition, having been the lead staff member for the procurement and military nuclear systems subcommittee of the House Armed Services Committee. Her first assignment at the Pentagon was as special assistant to Under Secretary of Defense for Acquisition John Deutch. In October 1993 Congress confirmed her appointment to

Nora Slatkin, assistant secretary of the Navy for research, development, and acquisition, 1993–1995. *(Courtesy of Central Intelligence Agency)*

John W. Douglass, assistant secretary of the Navy for research, development, and acquisition, 1995–1998. *(NARA)*

the Navy acquisition post. She served in that capacity a year and a half and then went with Deutch, who had been appointed director of the Central Intelligence Agency, to be its executive director.[37]

Slatkin's successor, John W. Douglass, was confirmed as assistant secretary in October 1995. A retired Air Force brigadier general, he was an acquisition expert, a reform advocate, and a close friend of Secretary Perry, who had succeeded Aspin, and Paul Kaminski, Deutch's successor. Before retiring from the Air Force in 1992, Douglass served in acquisition-related assignments, including a tour on the staff of the under secretary of defense for research and engineering and as director of defense programs for the National Security Council, where he was responsible for R&D and weapons acquisition issues. He also participated in the Packard Commission study.[38]

During their tenures as Navy acquisition executives, Slatkin and Douglass promoted and implemented acquisition reforms. In June 1994 Slatkin chartered the Navy Acquisition Reform Senior Oversight Council (NARSOC). Consisting of approximately 75 members of the Navy's acquisition, requirements, and financial communities, it mirrored OSD's Acquisition Reform Senior Steering Group (see chapter VII) and served the same purposes. The council provided a forum for discussion about reform policy and disseminated information, including lessons learned regarding reform initiatives. A nine-member executive council comprising senior officials of the secretariat and the systems commands gave guidance to the council.[39]

Slatkin also appointed an acquisition reform executive. This official, the Navy's equivalent of OSD's deputy under secretary for acquisition reform, reported directly to the assistant secretary, advised on acquisition reform, managed reform programs and initiatives, acted as a liaison to counterparts in OSD and the other military departments, chaired the Navy Department's Acquisition Reform Steering Group, and served as the executive director of NARSOC. Dan E. Porter, the civilian program executive officer for undersea warfare who had earned a number of service and Defense Department awards during his 21-year career in Navy acquisition, became the first reform executive. When Porter was appointed the Navy's chief information officer in 1998, Eileen Roberson, the deputy program manager in the Aircraft Carrier Program Office, succeeded him in the reform executive post.[40]

The Navy Acquisition Reform Office (ARO) supported the acquisition reform executive. The office originally belonged to the deputy assistant secretary for acquisition and business management. In 1995 Slatkin raised its importance by placing it directly under the reform executive. Its small staff of about 17 personnel came from the systems commands, the program executive offices, and other acquisition organizations. Their professional backgrounds were deliberately diverse so that the office could function as an integrated product team and a test bed for integrated product and process development. The ARO produced the assistant secretary's Strategic Plan and the Acquisition Reform Management Action Plan (MAP)—"the MAP to acquisition excellence." The latter established 13 reform goals such as pursuing program stability, institutionalizing integrated product teams, creating workforce incentives for reform, and forming partnerships with industry. While she was the acquisition reform executive, Roberson emphasized a coordinated, "total-systems approach" to reform instead of scattershot initiatives.[41]

ARO's Acquisition Center of Excellence was the hub of the Navy's reform effort. The service understood that cultural change was critical to the success of reform and established the center to be part laboratory for testing "world class business practices," part demonstration project to show what worked, and part training tool to teach best practices to the workforce. It was also intended to foster collaboration among programs and organizations. Located in the Washington Navy Yard, D.C., the center promoted these goals by using advanced computer and networking technologies and by providing technical experts, computer workstations, audio and video links, and specially designed spaces for training and for experience working in collaborative groups such as integrated product teams.[42]

The center opened its doors in mid-1997, but its days as an acquisition laboratory were numbered. The president's FY 2001 budget request transferred most of the center's funding to Navy operation and maintenance accounts. By 2006 the Acquisition Center of Excellence had been renamed the Admiral Gooding Center (after Vice Adm. Robert C. Gooding, a former NAVSEA commander) and transformed into a meeting and teleconferencing facility.[43]

The Acquisition Reform Office proved to be too small to do its job, so by 1996 the Navy had supplemented it with the Acquisition Reform Team Working Group. This group comprised 28 members drawn from the service's acquisition workforce, including at least two from each systems command. Led by an ARO staff member, the group planned how to implement the department's outreach efforts, organized major events like acquisition reform stand-down days, and conducted workforce surveys. Its members represented their home organizations and helped ensure that the reform message and practical assistance reached frontline workers where it was needed.[44]

The systems commands had their own acquisition reform organizations. Space and Naval Warfare Systems Command, Naval Air Systems Command, and Naval Supply Systems Command each had an acquisition reform office. Naval Sea Systems

Command hosted a forum, with members representing its directorates, warfare center divisions, and affiliates, including program executive officers and program managers. The forum met frequently and disseminated news, documents, and briefings coming out of NARSOC.[45]

In October 1994 Secretary of the Navy John H. Dalton held a kick-off meeting for a department-wide acquisition reform campaign that encompassed an aggressive education and training program. The campaign's basic principles—the "ABCs" of acquisition reform—were Advanced Technology Insertion, Best Commercial Practices, and Cost Reduction.[46]

The Acquisition Reform Office was the focal point for the program; it had a communications and outreach director performing only those functions. In addition to a website, the office published two periodicals, the biweekly *DoN Acquisition Reform Update* and the weekly *Navy Acquisition Reform Info-Alert*; produced numerous CD-ROMs and videos; and issued manuals and how-to guides. The ARO also sponsored roadshows and workshops that were essentially training events tailored to meet the needs of each host systems command. They included government and industry participants.[47]

When he became assistant secretary, John Douglass took a highly visible role in the outreach effort. During the annual acquisition reform stand-down day in 1996, in which 41,000 Navy acquisition workers took part, Douglass prerecorded a video message and attended five Change Through Ex-Change forums, in which participants swapped tips, ideas, and experiences. In 1997 and 1998 he hosted "virtual" town hall meetings, in which officials in the secretariat, program executive officers, and heads of the systems commands discussed acquisition reform and fielded questions from viewers (workers) around the country.[48]

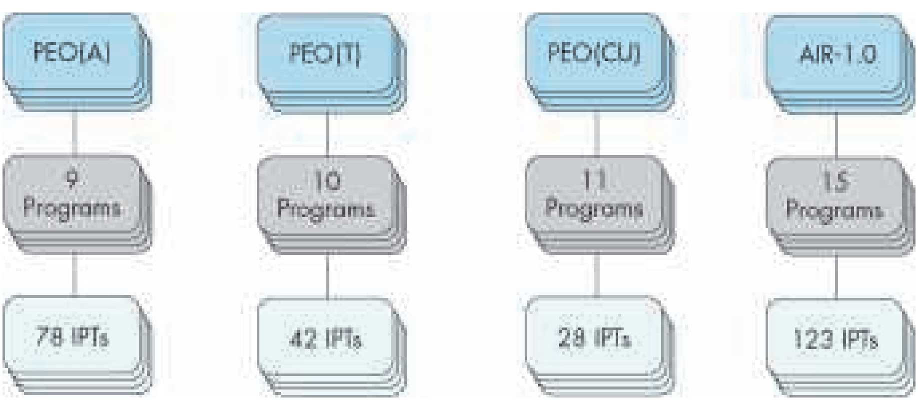
In response to requests from acquisition workers for more field training, Douglass initiated a study to see how this might be done. The result was the Field Integration Program, first implemented in 1997 by Naval Sea Systems Command in a two-day event, in which program managers acted as coaches encouraging innovation and change. Program Assist Visits, a concept similar to the Field Integration Program and possibly an outgrowth of it, involved teams of experts identified by the Acquisition Reform Office who visited program offices to provide advice, hands-on training, and other support on subjects ranging from systems engineering and risk management to financial management and contracting techniques. During 2000, the program's first year, the Acquisition Reform Office responded to 16 requests for help and established partnerships for longer-term assistance with at least six program offices.[49]

APPLYING ACQUISITION REFORMS TO AIRCRAFT, SHIP, AND SUBMARINE PROGRAMS

With its acquisition budget in steep decline after the end of the Cold War and remaining low throughout the 1990s, the Navy looked to reform its acquisition processes and practices to cut program costs. The service thus embraced OSD reform initiatives, including eliminating military specifications and standards, buying commercial off-the-shelf products, and reducing total ownership costs. The Navy adopted integrated product and process development and integrated product teams for both program oversight and execution that promised more efficient and effective management. In 1994 the service created oversight bodies known as acquisition coordination teams, one of which was assigned to each ACAT IC program. The teams represented key Navy staff functions—requirements generation, acquisition, test and evaluation, and planning, programming, and budgeting—and advised the service acquisition executive concerning the status of the programs at milestone reviews. The acquisition coordination teams were quite similar to the overarching integrated product teams instituted by OSD for ACAT ID programs.[50]

The programs adopted integrated product teams often before OSD ordered their use in May 1995. Naval Air Systems Command issued an IPT manual for its programs in June 1994. Each program manager assumed responsibility for the system's life cycle, also well before OSD required managers to do it. A "program team" assisted the program manager in carrying out this responsibility. It operated through a hierarchy of integrated product teams overseen by a top-level "leadership team" headed by the program manager. By 1996 the 45 program managers assigned to NAVAIR or its three program executive officers oversaw 271 integrated product teams. The command noted at the end of that year that its experience in implementing the teams had been "very positive."[51]

Figure 13-5: NAVAIR's Program Management Structure, July 1996
(45 Programs; 271 IPTs)



AIR-1.0 – Assistant Commander for Program Management
IPT – Integrated Product Team
NAVAIR – Naval Air Systems Command
PEO – Program Executive Officer
PEO(A) – Air ASW, Air Assault, and Special Mission Programs
PEO(CU) – Cruise Missiles and Unmanned Aerial Vehicles
PEO(T) – Tactical Aircraft Programs

Source: *Integrated Program Team Manual Update* (NAVAIR, Dec 1996), 4.

Naval Air Systems Command underwent a major reorganization to adapt itself to the integrated product team concept. Under pressure from the loss of personnel and facilities due to workforce downsizing and the government's Base Realignment and Closure (BRAC) process—and with the F/A–18E/F program's encouragement—NAVAIR decided in early 1993 to shift from matrix management to a more program-oriented approach called Competency Aligned Organization. The new management approach broke up the geographically based functional organizations and dispersed their personnel among the program offices. This change enabled the functional specialists to provide more immediate support to the integrated product teams in eight major competencies, such as research and engineering, logistics, and contracting. No longer isolated in their own organizations, the functional specialists participated in program integrated product teams with people from other organizations and disciplines. Each program was assigned a "competency leader" who was responsible for ensuring the teams received support as they focused on accomplishing their program's mission. This reorganization, completed in 1997, proved to be surprisingly painless given the fundamental cultural change.[52]

Naval Air Systems Command developed another innovation called alpha contracting. Awarding sole-source contracts, even without a review of several competitive proposals, usually took a year. Alpha contracting applied what amounted to integrated product and process development and was able to cut sharply the time needed to award a contract. When NAVAIR experienced delays in initiating an upgrade to the Light Airborne Multi-Purpose System Mark III antisubmarine system, only four and a half months were left to obligate the funds with a signed contract; failure to award a contract would have jeopardized the funding and consequently the program itself. Normally in this situation the program office would award a "letter contract" that allowed the contractor to start work before agreeing to a price, even though this put the government at a significant disadvantage during subsequent negotiations. NAVAIR tried instead to beat the deadline by bringing together interested parties, compressing the schedule, and running some contract award activities concurrently. Its officials showed the draft solicitation to the prospective contractor, IBM, before it was issued so the company could get a head start on preparing a response. In turn, IBM submitted draft sections of its proposal to the Navy evaluators to give them a similar head start. During an intense two-week evaluation period, IBM made its personnel available to answer questions in person. Members of other organizations, including the Defense Contract Audit Agency and the Navy's "Price Fighters," a team dedicated to ensuring the government received the best possible value, participated as they normally did but on an accelerated schedule. Naval Air Systems Command succeeded in reducing the time required to prepare and evaluate the proposal from six months to two, and awarded the contract in only 108 days instead of the usual 364.[53]

Alpha contracting represented the sort of government-industry partnership the Clinton administration advocated. Critics argued that any relaxation of the so-called arm's-length relationship between the two parties, such as through alpha contracting, could lead to the appearance of collusion. Naval Air Systems Command, however, insisted the government's interests were well protected and all parties involved saved money. But it did acknowledge that the process was difficult to organize, stressful for the participants, and presented the potential for serious mistakes. Nonetheless, the rest of the Navy took an interest in alpha contracting, as did the other services, especially the Army, which used it in acquiring the Bradley Fighting Vehicle, the High Mobility Multipurpose Wheeled Vehicle, or Humvee, and the RAH–66 Comanche helicopter.[54]

With the Navy's shipbuilding program under budgetary pressure, Naval Sea Systems Command adopted acquisition reforms it thought might reduce costs. These initiatives involved management organizations and procedures, acquisition strategies, procurement methods, and naval engineering technologies and techniques. NAVSEA intended the LPD 17 *San Antonio* amphibious transport dock ship and the New Attack Submarine, later named the *Virginia* class—the first two major shipbuilding programs to begin development under acquisition reform—to be showcases for reform and models for the future of shipbuilding. The integrated product and process development approach for *San Antonio* included total ship integration, in which the hull, combat system, communications, and other key elements of the ship were designed concurrently, with the emphasis on integration. To aid in this process, the contractor team included two shipbuilders, a combat systems builder, and a firm specializing in computer-aided engineering tools. The Avondale Alliance, named after the Avondale Shipyard near New Orleans, was a "full-service contractor" that provided support

LPD 17, the amphibious transport dock ship USS *San Antonio*, under construction at the Northrop Grumman Ship Systems Avondale Operations near New Orleans, Louisiana, August 2002. *(U.S. Navy)* throughout the ship's life cycle. The team was intended to be permanent—"Team once, team forever," was how the program put it. For the first time in a shipbuilding program, the Navy program office and the contractor were collocated, and a special NAVSEA detachment was assigned to the shipyard to speed up communications. The contractor team took on tasks traditionally performed by the Navy, such as supplying and integrating the subsystems. This allowed the service's program office to focus on general planning and oversight—an attractive alternative given the ongoing downsizing of the Navy acquisition workforce.[55]

The LPD 17 program also employed innovative design tools and processes. The program simulated the building process in a "virtual shipyard" and used advanced computer-based tools that allowed engineers to create three-dimensional models and even a virtual ship that both the testers and the future users—sailors and Marines—could examine. The program's design for ownership concept included users in order to avoid costly rework later. In the LPD 17 War Room at the Expeditionary Warfare Training Group Atlantic Headquarters in Little Creek, Virginia, Marines could study plans, models, program documents, and other reference materials and watch videos about the ship. Approximately 20 times during the first two years of the program, the Navy brought 35 Marines to the war room for two-day conferences to obtain feedback. The program also scrutinized operations and maintenance costs for potential savings to reduce total ownership costs. One of the largest costs was the ship complement. The estimated cost for each crew member was $50,000 per year; the program calculated that for every position eliminated, the Navy could save $24 million over the 40-year expected service life of the 12 ships planned. To study the potential for automating ship systems, the Navy had converted the cruiser *Yorktown* and the amphibious ship *Rushmore* into the test beds Smart Ship and Gator 17, respectively. By 1998 *San Antonio*'s projected crew size had been reduced from 450 to 400, avoiding an estimated cost of $1.2 billion. By the time of its first deployment in 2009, the ship carried a crew of 340. Even the cost-plus-award-fee contract, which allowed the contractor to recoup its costs and receive a fee based on performance, was an innovation in shipbuilding. The LPD 17 program's application of acquisition reform ideas and practices impressed the Pentagon's ever-skeptical inspector general.[56]

The attack submarine *Virginia* was designed and built using similar tools, principles, and organization. The program began in 1991–1992 when the secretary of the Navy directed a study of a new attack submarine design, the CNO established the system's requirements, and the under secretary of defense for acquisition approved concept studies (Milestone 0). The new system was to be less costly than the boats of the *Seawolf* class, a program that ended in 1996, with funding approved for the third and last boat of an originally projected 30 submarines. Yet the new submarine would have to perform a wider range of missions than its *Seawolf* or *Los Angeles* predecessors. In addition to undersea combat, the submarine would have other missions, such as inserting Special Forces teams onto a hostile shore. Thus the New Attack Submarine would require a design that emphasized flexibility and the potential for upgrades.[57]

In designing and constructing the SSN 774 *Virginia* class, the Navy sought to apply lessons learned from the truncated *Seawolf* class and thereby avoid the schedule delays and cost growth afflicting the earlier program. *Seawolf* had pursued cutting edge technologies. To reduce program risk, *Virginia* would rely primarily on proven systems. The Navy had employed two shipbuilders—Electric Boat of Groton, Connecticut, and Newport News Shipbuilding in Virginia—to design *Seawolf*. This division of responsibility created coordination and compatibility problems. For *Virginia*, the Navy selected Electric Boat to be the single, lead design and construction prime contractor. Newport News was a major subcontractor, building some of the new submarines. Construction had begun on *Seawolf* with less than 10 percent of its design complete. This resulted in numerous change orders, increased costs, and schedule slips. In contrast, construction did not start on *Virginia* until the design was mature.[58]

Electric Boat implemented an integrated product and process development approach in the *Virginia* program, basing it on the observations of Navy and company personnel who visited government projects employing the concept. Electric Boat's system included a hierarchy of integrated product teams led by "major area teams," each of which was made up largely of industry personnel and was responsible for one of 15 major parts of the submarine. The Navy program office provided a few people to promote government-industry communication, but otherwise gave the contractor leeway to fulfill its responsibilities. *Virginia* also used the latest design technologies and techniques, such as three-dimensional modeling and visualization tools.[59]

Like the earlier *Ohio*-class ballistic missile submarines and then the *Seawolfs*, the *Virginias* employed modular design and construction. Whereas traditionally

Module being inserted into the hull of a *Virginia*-class submarine. *(Navy Live blog)* a submarine was built with a unitary hull into which the combat system, communications, sensors, and other electronics were custom-fit, *Virginia* was divided into seven modular sections that were built separately and then welded together during final assembly. These modules used an open architecture with standard interfaces so the installed systems could literally plug into each other. Follow-on boats in the class could be reconfigured for different missions by incorporating alternate modules during construction. The modules were more accessible than a completed hull for the work crews installing the subsystems. Standardization simplified the problem of adapting commercial off-the-shelf technology. For example, the combat system was integrated electronically and tested in a separate facility outside of the hull. Then the control system module was placed on the building way, the hull sections welded around it, and the whole assembly integrated into the rest of the hull. In general, the design promoted technological upgrades and "refresh" by allowing subsystems and components to be added or replaced more easily. *Virginia* would focus on mature technology; the follow-on boats would receive more advanced technology as it matured, an approach similar to preplanned product improvement, or P3I (see chapter X).[60]

Generally, acquisition reformers saw much to admire in the acquisition of *Virginia*-class submarines. The Defense Department bestowed its prestigious David Packard Award for Acquisition Excellence on the program twice during the submarine's development, in 1996 and 1998. The director of operational test and evaluation also praised the program for its "aggressive and systematic" use of the lessons learned from the development of *Seawolf* and for being "innovative, aggressive, and initially

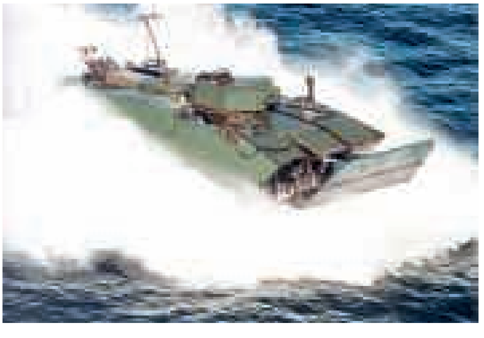
USS *Virginia* (SSN 774) at Electric Boat, Groton, Connecticut, in August 2003, just prior to christening. *(U.S. Navy)* successful in its development of usable Commercial-Off-the-Shelf computer systems." The General Accounting Office, however, disagreed with these optimistic assessments and believed much of the technology was less mature and riskier to develop than the Navy and its contractors claimed. The GAO argued that rising costs would mean the *Virginia* class would cost about as much as the *Seawolfs*.[61]

Acquisition reform was not just for new programs. The DDG 51 *Arleigh Burke*-class of Aegis air-defense destroyers adopted reforms during what would be a decades-long production run. The DDG 51 was the Navy's most prolific shipbuilding program, laying two to four keels per year—five in 1994 alone—while also developing block upgrades known as Flight II, starting with *Mahan* (DDG 72), launched in June 1996, and Flight IIA, starting with *Oscar Austin* (DDG 79), launched in November 1998. Although well managed, the program was under considerable budgetary pressure and faced significant cuts because it was one of the Navy's most expensive acquisition programs during years of declining budgets. The Navy's original plan to build four to five per year was cut to three during the George H. W. Bush administration and then to two late in the Clinton administration. As early as 1991, the program executive officer for the Surface Combatants/Aegis Program began a rigorous cost reduction effort, the DDG 51 Class Affordability Program, which encouraged the identification of "affordability cost candidates," with the goal of reducing the cost of each hull by $30 million (out of a unit cost of approximately $800 million). In 1994, as acquisition reform was starting to ramp up, the DDG 51 program also increased its cost-cutting efforts, focusing on adopting new processes, reducing its reliance on

The *Arleigh Burke*-class guided missile destroyer USS *Oscar Austin* (DDG 79) in the Atlantic, October 2002. *(U.S. Navy)* military specifications and standards, and reengineering the ship to make greater use of commercial off-the-shelf products.[62]

To control costs, the DDG 51 program used many elements of the teaming approach. The program involved industry closely in the reform efforts and the contractors responded enthusiastically. Teaming encouraged closer ties between the government and the shipyards and between the shipyards and their subcontractors. In September 1994 a government-industry "integrated process/product development team" began discussing ways to cut costs. The team met monthly or, later, bimonthly, usually at a contractor's facility, where representatives of the host company described the measures it had taken to reduce costs and the results achieved. The group also assigned tasks to organizations or subteams and followed up to ensure implementation. For example, subteams reviewed each major military specification or standard to see whether it could be canceled or replaced. In 1996 the communications subteam created the Aegis Communicator, an online information repository and discussion forum. That same year the Surface Combatants/Aegis Program PEO established the Aegis Program Quality Management Board to review acquisition reform initiatives, adapt and incorporate those that could be useful to the program, and transmit information up and down the chain of command.[63]

The Marine Corps demonstrated its enthusiasm for acquisition reform in its Advanced Amphibious Assault Vehicle program. The Marines intended the new vehicle, a replacement for the 1970s-vintage Amphibious Assault Vehicle–7, to launch farther offshore, move through the water faster, and provide additional fire support when it operated on land. After a troubled, seven-year concept exploration phase, in 1995 the program finally passed Milestone I review and entered the demonstration and validation phase. Determined to complete a prototype in only three years, the Marines applied several reform initiatives, including cost as an independent variable, virtual prototyping with modeling and simulation tools, and integrated product and process development. In particular, integrated product teams were to form "the very backbone of the AAAV program," according to *Program Manager* magazine. The program office became the first major program to collocate the principal full-time government and industry staff, including the program management office, the contracting officer, the contractor, major subcontractors, and personnel of the



Advanced Amphibious Assault Vehicles. *(U.S. Marine Corps)*

Defense Contract Management Command. All set up shop in a General Dynamics facility established in Northern Virginia. Putting the personnel in one place reduced the time required to resolve design decisions from one to three months to days. The program manager, Col. James M. Feigley, believed that locating everyone under one roof would also smooth the relationship between government and industry, traditionally marked by confrontation and an "us vs. them" mentality. In the past, he said, government personnel had little respect for their industry counterparts and talked about "beating the contractor down," while the contractors in turn described the government people as "weenies"—"guys with their feet upon the desk reading the paper." Close interaction between the two groups sought to promote mutual understanding and trust.[64]

The Advanced Amphibious Assault Vehicle program's embrace of acquisition reform impressed observers. The DoD inspector general praised the program office's "strong commitment" to implementing reform and the alacrity with which the program corrected deficiencies once they were identified. The AAAV was, the inspector general raved, a "superbly managed program that totally embraced the ideas of acquisition reform and industry best practices." DoD's director of operational test and evaluation commended the involvement of testers early in the design process and the employment of "user juries" that provided feedback to the designers. Such innovative practices earned the program a number of honors, including the Packard Award in 1998 and 2000.[65]

THE ARSENAL SHIP

While many of its ship programs were technologically conservative follow-ons to existing designs, the Navy sought to develop innovative warships to support its operational concept for the earth's littoral regions. The amphibious community had put forward *San Antonio*, the submariners had *Virginia*, and the aviators were planning CVX, "the Aircraft Carrier of the Future." The surface warfare community, for its part, was faced with the impending retirement of a number of older ships, including the *Oliver Hazard Perry*-class frigates, the *Spruance*-class destroyers, and the four *Iowa*-class battleships, and wanted to improve upon its *Arleigh Burke*-class destroyers and *Ticonderoga*-class cruisers. In the wake of a Twenty-First Century Destroyer Technology study in 1992, the Navy established the Surface Combatant for the 21st Century (SC 21) program. It envisioned a new generation of ships still called destroyers and cruisers, but bearing little resemblance to their predecessors in terms of shape, size, and role. As fleshed out by a cost and operational effectiveness analysis, SC 21 was to be a family of ships designed for a variety of missions, including amphibious assault, land attack, and command and control. Equipped with the latest high-technology combat systems, sensors, and communications systems and designed to be stealthy, they would have a radically different appearance from traditional designs. The first was to be the Twenty-First Century Destroyer (DD 21), also called the land-attack destroyer because of its emphasis on projecting power ashore. The Arsenal Ship originated as a "power projection" variant of the SC 21 family.[66]


The Northrop Grumman proposal for the Arsenal Ship. *(Courtesy of Northrop Grumman Corporation, printed with permission)*

The Arsenal Ship came to life with the strong support of Assistant Secretary Douglass and CNO Admiral Jeremy M. Boorda. The concept was a relatively inexpensive way to throw massed firepower against targets on land, especially to halt an invasion by a Saddam Hussein-like aggressor against a Kuwait-like neighbor. The Navy envisioned the Arsenal Ship as a "missile barge" that would wield great firepower but also be inexpensive to build and operate. Simpler than DD 21, it would have a small crew, or none at all; a limited combat system with most offensive and defensive capabilities provided or controlled electronically from outside the ship; minimal on-board sensors, but with extensive electronic links to those on other platforms; modest self-defense capabilities; a stealthy design; and at least 500 vertically launched missiles, like the Tomahawk cruise missile but preferably less expensive. It would also have room for some kind of yet-to-be-invented extended-range gun system. The specific weapons were not significant—the ship would fire whatever guns and missiles could do the job, whenever they became available. To achieve these goals, the ship would leverage the advances made by technology development efforts then underway, including the Smart Ship program, theater ballistic missile defense, and the Cooperative Engagement Capability, a program to create a network of sensors and weapons across the various air, sea, and space platforms. The combination of these advances meant that, if built, the Arsenal Ship would be an innovative and unique type of warship.[67]

The need for, and desirability of, such a platform could be debated—and was, at great length—but an equally important aspect of the Arsenal Ship was its acquisition strategy. The program was a joint effort between the Navy and the Defense Advanced Research Projects Agency to build demonstrators (prototypes). DARPA joined the project because of its interest in finding new approaches to transitioning novel technologies and systems from the laboratory to the field, a process for which it had been criticized. The agency had gained experience managing streamlined acquisition programs, especially two advanced concept technology demonstrations, the Global Hawk and DarkStar unmanned aerial vehicles, and it wanted to pass on the benefits of its experience to the Navy. DARPA could also make use of the other transaction authority Congress had granted it in 1993 to acquire prototypes by entering into agreements outside of acquisition laws and regulations (see chapters VIII and XIV). At the time, no other agency held that power. For its part, the Navy hoped to learn the DARPA process, the agency's long-standing practice of assigning much program responsibility to industry within the context of a competitive environment. DARPA and the Navy used other transaction authority, and the flexibility built into the 1996 revision of the 5000 series documents, to launch a different kind of acquisition program. The Arsenal Ship was not assigned an acquisition category. It was custom-made and not bound by traditional practices. There was no mission need statement, no Operational Requirements Document, no analysis of alternatives, no detailed specifications or standard contract clauses or request for proposal—in fact, very few hoops to jump through for an acquisition program. The contractors would design the ship, not the Navy—another radical departure from traditional practice. The Arsenal Ship was, in short, an innovation-minded program manager's dream and a one-of-a-kind experience for Capt. Charles S. Hamilton II, who managed the program from beginning to end.[68]

Modeled on the Global Hawk program, the Arsenal Ship applied many approaches characteristic of acquisition reform. These included using performance rather than how-to specifications, cost as an independent variable, and commercial off-the-shelf technology. The oral presentation of proposals allowed evaluators to ask questions and obtain information on the spot. Industry bidders were encouraged to form teams with other companies instead of adopting the traditional prime contractor-subcontractor arrangement. All six bidders did so. The program mandated employing integrated product and process development as well as Total Ship Systems Engineering, the approach used by LPD 17 and *Virginia* in which all parts of the ship were designed together to form a single coherent system. The joint program office included only nine people at the outset, extraordinarily small for a program expected to cost billions. It eventually grew to about 20, which was still far smaller than the hundreds employed at most major system program offices. Communications between the government and its contractors were more open than usual during the solicitation and contract negotiation process. The use of an alpha contracting approach in a competitive acquisition was only possible because other transaction authority allowed the program office to suspend the bidders' right to protest the contract award as specified in the Federal Acquisition Regulation. The program office believed the discussions improved and accelerated the design process and described other transaction authority as "common sense acquisition."[69]

Funding for the program drove the design, not vice versa, a pure application of cost as an independent variable. The nine-page solicitation, released in May 1996, described the government's vision for the Arsenal Ship and asked the bidders to propose a system to meet that vision and to agree to build five working demonstrators. The solicitation posed only one firm requirement: Each demonstrator had a target cost of $450 million, but under no circumstances could the cost exceed $550 million. The government later stipulated each ship could have no more than 50 crew members. Everything else was on the table: hull forms, propulsion, communications, sensors, weapons, and combat system. It was up to the bidders to decide the design trade-offs that would meet the parameters. Their proposals then described the ships they would build and how they would build them. This was a revolutionary approach for the Navy, which traditionally prepared its own design and specifications and handed them to the shipbuilder to execute. The program sought to have the first Arsenal Ship demonstrators out to the fleet by 2000—only four years away.[70]

The acquisition strategy for the Arsenal Ship consisted of a series of design competitions, a key element of the "DARPA approach." The program was to run in six phases. In the first, the government would award contracts to several teams to perform concept studies. Two more rounds of competition would winnow the field to a single team that would receive construction contracts for the five demonstrators, with the possibility of a subsequent full production run. Five of the six teams responding to the solicitation received six-month, $1 million Phase I contracts. All but one of the team leads was a major defense contractor and all included at least one shipyard on their team, but only one of the leads had significant shipbuilding experience. Four months into the first phase, the contractors presented their concepts. Less than two months later, in January 1997, the program office announced the winners. It had intended to award two, Phase II contracts but decided to award three because the third design team had unique capabilities and could contribute useful ideas. These teams received $15 million for one year to convert their general concepts into functional engineering designs. At the end of that year, the winning team would receive a 33-month, $389 million contract to prepare detailed designs for both a demonstrator and a production model and to build the demonstrator.[71]

The selection of the Phase III contractor, scheduled for January 1998, never occurred. The Arsenal Ship had been canceled three months earlier. From the start, the program met strong resistance from the other services and their backers in Congress, especially from the Air Force, which saw the ship as a threat to its B–2 bomber. There was also considerable opposition within the Navy. Other warfare communities, especially the aviators, saw it as a threat to their budgets. Some feared the Arsenal Ship would replace aircraft carriers, despite the denials of Admiral Boorda and other proponents of the program, who instead called it the "battleship of the 21st Century." Submariners pushed their own form of "arsenal submarine" in the conversion of *Ohio*-class ballistic missile submarines to carry conventional weapons. Within the surface warfare community, backers of SC 21 opposed diverting funds from the DD 21. Only the Marine Corps supported the program; and even the Marines worried that, with the concept's emphasis on deep-strike missions, they would not receive the close fire support they would need in an amphibious operation.[72]

The program's streamlined approach also posed a threat to the Navy's acquisition corps and to Naval Sea Systems Command and its constituent organizations. It marginalized the offices and warfare centers that traditionally designed ships and furnished the systems installed in them. As a perceptive post-mortem RAND Corporation review noted, "The Arsenal Ship acquisition approach was structured specifically to exclude the Navy's ship-design power centers from the process." As the presumed model for future shipbuilding, the Arsenal Ship endangered their control, their budgets, and their jobs.[73]

The Arsenal Ship may in fact have been doomed even before the solicitation was released after Boorda's death in May 1996. Congress could not have failed to note the tepid support for the program from Boorda's successor as CNO, Admiral Jay Johnson—an aviator—and the rest of the Navy's uniformed leadership. Assistant

Secretary Douglass continued to back the Arsenal Ship, but he was fighting a losing battle against the admirals who had control over the formulation of requirements and whose opinions carried more weight on Capitol Hill than his did. The lack of an Operational Requirements Document for the ship became a serious handicap. When properly validated by the Joint Requirements Oversight Council, this document specified a clear military need for a weapon system or capability that justified the start of an acquisition program. Indeed, preparing one was the first and most important step in launching a program. Bypassing that step had saved time, but left the program vulnerable to questions about whether the ship was really needed.[74]

The program also suffered internal problems. From the start, it had been underfunded. During Phase II, the contractors probably spent double the $15 million allotted, meaning they essentially matched the government funding with their own. Phase III was going to be worse—there was simply not enough money to build the demonstrators. Apparently the shortfall resulted from a mistake: The program office had requested from the Navy $350 million and an *Arleigh Burke*-class destroyer to use as a demonstrator, but somehow the request for the destroyer became lost in the paperwork. Therefore the contractors assumed they would have to build the demonstrators from scratch. Overly optimistic estimates for construction costs compounded the mistake. For example, the program office had described certain components as off the shelf, even though they were not completely developed. Everyone involved with the program knew about the funding deficiency but no one said anything publicly. A RAND review suspected the program office kept silent for fear congressional opponents would call the mistake a cost overrun and use it as an excuse to cancel the program.[75]

Even as the program was encountering political resistance and funding shortfalls, the program manager insisted to the contractors that the Arsenal Ship would be executed as planned. As Phase II proceeded, the program ran into trouble. In April 1997 the Navy effectively merged the Arsenal Ship into the SC 21 program, renaming its projected prototype the Maritime Fire Support Demonstrator and designating it to serve the SC 21 program as well. DARPA apparently was not consulted, nor was the program office. The program manager stubbornly insisted that the Arsenal Ship would continue as planned, but the contractor teams could see it was unlikely any production models would be built beyond the demonstrators. Fearing they would have to commit to building their designs with insufficient funding, the contractors began jettisoning critical but expensive features, eliminating many of the capabilities that made the ships worth building. The program's cancellation, formally announced at budget hearings in February 1998, disappointed its supporters, but the termination should not have been surprising.[76]

ACQUISITION REFORM'S MIXED RESULTS

Ultimately much of the Arsenal Ship's technology, such as the weapon systems and data links, and its acquisition strategy lived on in the DD 21 program, which proceeded apace. Captain Hamilton became the program manager and then the program executive officer. Like the Arsenal Ship, DD 21 used a streamlined acquisition approach employing other transaction authority, which had been extended to the rest of DoD in 1996, and relied on contractor teams to perform most of the design work, with a winning design to be selected competitively. The potential contractors were wary after their experience with the Arsenal Ship, and only with difficulty, and after considerable delay, was the Navy able to cajole them into forming two teams, each with a shipyard and a system integrator. To sweeten the deal, the Navy guaranteed each shipyard on the competing teams a share of the planned 32-ship construction program. The Navy released the solicitation and awarded ship-design contracts in 1998.[77]

The contractors were right to be cautious. Despite the Navy's full support, DD 21 also encountered difficulty. Facing opposition from the Bush administration, which did not consider the ship to be sufficiently "transformational," the Navy delayed the final design competition, restructured the program it now called the DD(X), and cut procurement in half to 16 ships. However, the Navy added two new ship types: a larger air defense ship, CG(X); and a smaller coastal ship with the evocative name "Streetfighter," renamed the Littoral Combat Ship (LCS). Several times over the next few years, the Navy changed the acquisition strategy for DD(X) and again reduced the planned procurement. By the time construction began on the lead ship, *Zumwalt* (DDG 1000), in 2009, the program was down to three ships, less than a tenth of the originally planned 32 DD 21s. The procurement reduction raised the unit cost.

The guided missile destroyer USS *Zumwalt* (DDG 1000) in the Atlantic during acceptance trials, April 2016. *(U.S. Navy)*

The following year the Navy announced a Nunn-McCurdy Act cost breach (cost growth over a specified threshold requiring a report to Congress) and restructured the program again. *Zumwalt* was delivered to the Navy in 2016. The first ships of the two LCS variants, *Freedom* and *Independence*, were delivered in 2008 and 2009, respectively. The CG(X) program, however, was canceled.[78]

Meanwhile, the *Virginia* program's application of *Seawolf* lessons learned and acquisition reforms was paying dividends. Thanks to rigorous design control, *Virginia* used one-fifth the number of system-unique parts found in the *Seawolf* class, and with implementation of integrated product and process development, 50 percent of *Virginia*'s construction drawings were finished when building began compared with 5 percent for *Seawolf*. Improvements to the modular construction process, especially testing components on land or at sea before workers inserted them into the hull, had positive effects. The boat was 81 percent complete when the hull was closed, compared with 57 percent for *Seawolf*, and required 80 percent fewer design changes than *Seawolf*—12,000 versus 70,000. Moreover, according to a RAND study, Electric Boat involved its construction workers in the design process. Consequently, *Virginia* was built "with efficiency close to that of the third ship in a class."[79]

The application of improved design and acquisition management practices, however, did not eliminate significant cost escalation from the *Virginia* program. By 2005 program cost had grown to $95.8 billion, an increase of almost 35 percent, more than enough to trigger a Nunn-McCurdy breach. The Navy had estimated that the cost to procure the follow-on boats would eventually drop below $2 billion each, but by 2005 the service had projected that the 11th boat, *North Dakota* (SSN 784), slated for procurement in 2009, would cost over $3 billion. This was despite the fact that the first four submarines and most of the follow-on boats were multiyear procurements in which the Navy and Congress committed to funding several submarines over a specified number of years, a measure that was supposed to save money by allowing economies of scale. The General Accounting Office found that cost growth stemmed largely from underestimating labor hours and the cost of materials. According to the GAO, the service was limited to the funding available for the program in negotiating the price. The shipyards had agreed to that price, which was $748 million less than their own cost estimates, knowing their cost-plus contract would force the government to make up the difference. Amid angry accusations by OSD that the shipyards were "gouging" the Navy, the program office initiated a cost-reduction plan to hold the cost of each submarine to $2 billion, partly through redesign that reduced the number of separate sections from 10 to 4. The Navy also accelerated production by buying two submarines per year instead of one, arguing such a move would help reduce unit cost.[80]

The boat also had design and technical construction difficulties. Despite reliance on computerized design and visualization tools, the boat's layout provoked complaints of its being too cramped, especially in the berthing area on the upper deck, where the passageways had been reduced to 18 inches. There were other problems, such as with fasteners and welding, but the most serious was the tendency of the special stealth coating on the submarine's hull to come loose (debond), sometimes in large sections hundreds of square feet in size. The Navy claimed debonding was limited to three boats, but it was also observed in others. In 2009 an OSD review found that the *Virginias* experienced significant reliability problems, including multiple subsystem failures, debonding, and other issues that could potentially prevent them from deploying on schedule.[81]

The *Virginia* class overcame these difficulties to become one of the more successful of the systems that began development during the 1990s. Director of Operational Test and Evaluation Coyle, who revealed the results of the OSD review in a memorandum critical of the program, also acknowledged in his 2009 annual report that "*Virginia* is an effective, suitable, and survivable replacement for the *Los Angeles* submarine." By then the program office had begun to bring costs under control and reduce construction time, which led to its third Packard Award in 2008. An OSD report in 2011 stated: "Each of the eight delivered submarines has demonstrated improved performance and an overall reduction in production schedule. The remaining ships under construction are demonstrating improved cost and schedule efficiency. . . . Significant improvements in production processes continue to drive cost reduction progress and acceleration of delivery schedules." *Virginia* had been delivered in October 2004, four months behind schedule, and *Texas* (SSN 775), the second boat in the class, was almost a year late. However, the ninth boat, *Mississippi* (SSN 782), was completed almost a year ahead of schedule. Indeed, in 2016, *Illinois* (SSN 786), 13th in the class, was the ninth consecutive *Virginia* to be delivered early.[82]

Praise for the Marine Corps Advanced Amphibious Assault Vehicle, however, came to an end soon after the program entered full-scale development in 2001. As

USS *Illinois* (SSN 786), the 13th boat of the *Virginia*-class fast-attack submarines, during sea trials, August 2016. *(U.S. Navy, General Dynamics Electric Boat)* noted earlier in the chapter, the program had won many accolades—more than a dozen acquisition awards over the years—by the time it completed its risk reduction design phase and passed its Milestone II review in November 2000. The following year the Marine Corps awarded a $712 million cost-plus contract to General Dynamics Land Systems to conduct full-scale development and build prototypes. The program immediately began to experience schedule delays, cost growth, and technical problems that only worsened with time. It opted for a costly "test-fix-test" approach that dealt with problems as they came up. Not surprisingly, all sorts of flaws appeared requiring design and rework. The vehicle's two-year development schedule was too optimistic and slipped repeatedly—in 2002 auditors concluded that "management does not have a handle on reality." By 2007, when the Navy reported the program's Nunn-McCurdy breach, the Advanced Amphibious Assault Vehicle—renamed the Expeditionary Fighting Vehicle (EFV) in 2003—was four years behind schedule, and its unit cost had climbed almost 34 percent.[83]

Cost and schedule were by no means the worst problems to beset the program. It did not deliver a satisfactory product. In 2006 the vehicle failed a series of operational assessment tests. On average, it broke down every 4½ hours and required almost 3½ hours of repair work for each hour of operation. The turret broke during routine cross-country movement. On the whole, the vehicle suffered 117 "operational mission failures" and 645 "unscheduled maintenance actions," which overwhelmed the three Marines assigned to perform maintenance during the tests. Based on these performance shortfalls, the Marine Corps concluded that the design was unfixable and decided to scrap it and begin anew, in effect restarting the entire development phase and adding nearly $950 million to the $1.2 billion already spent. The Expeditionary Fighting Vehicle would now be eight years behind schedule. Projections of program cost rose to $13.2 billion, 50 percent above the original estimates. With its acquisition budget increasingly consumed by this program, the Marine Corps could now afford to buy only half of the planned 1,025 EFVs. This caused the unit cost to double to a projected $22 million. Even when adjusted for inflation, this represented a 168 percent increase in unit cost in just six and half years. Five new prototypes were built, but they were found to be vulnerable to the improvised explosive devices (IEDs) that U.S. forces were encountering in Iraq and Afghanistan. This problem did not exist when the program began and defied an easy solution. Representative Henry A. Waxman (D-CA), chairman of the House Oversight and Government Reform Committee, described the program as "badly mismanaged" and "an embarrassment." Finally, after 10 years and $3 billion spent, even the Marines had had enough, and the secretary of defense terminated the program at their request in May 2011.[84]

The failure of the Expeditionary Fighting Vehicle was not entirely attributable to problems with the design and engineering process. It was also a prime example of how faulty requirements can damage an acquisition program. The EFV requirements called for a hybrid design that combined two distinctive capabilities—high speed and long range on both land and water. This combination went well beyond the state of the art. Interestingly enough, the other top Marine Corps acquisition priority, the

V–22 Osprey, was also a hybrid that combined fixed-wing and rotary-wing flight (see chapter IV). Both systems struggled during development. The AAAV/EFV also suffered from a conceptual problem: Was it an armored personnel carrier for transporting troops onshore while under fire or an infantry fighting vehicle built for directly engaging the enemy? Future users of the AAAV, participating in wargames held in 1996 to test the new doctrinal concepts of Operational Maneuver From the Sea (OMFTS) and Ship-To-Objective Maneuver (STOM) had found themselves unable to "definitively resolve the issue." Arguably, had the Expeditionary Fighting Vehicle program been given greater latitude to make trade-offs between speed, armor, range, and other performance specifications, not to mention cost, it might have chosen a different suite of technologies.[85]

In addition to the problems created by ambitious requirements and IEDs, naval mines posed a threat to the AAAV/EFV, contributing to the program's failure. The Marines had long been aware of the threat that conventional land and sea mines posed to their vision of conducting maneuvers from ships directly against major objectives ashore. The lack of mine countermeasures capability had prevented consideration of a major amphibious assault during Desert Storm. It was at least partly the fear of mines that had prompted the Navy and Marine Corps to seek an amphibious vehicle that could be launched farther out to sea to reduce fleet exposure. Service planners expected potential enemies to follow old Soviet doctrine by sowing sophisticated mines, not just at sea but close inshore and on the beaches. By itself, the AAAV would be almost defenseless against these mines. The system's planners only required protection against antipersonnel landmines. The Marines noted the importance of being able to locate minefields at sea and on the beach and to breach them without pausing. However, the Operational Requirements Document prepared for the program's Milestone II review did not require these capabilities, only that the vehicle "*should be able to integrate*" available systems for detecting and countering mines and other obstacles in the water. The Marines then prepared a concept of AAAV operations, which assumed the detection and breaching capabilities would exist.[86]

Despite the need, countermine capabilities would not be forthcoming. In the wake of the Gulf War, the Navy, with some prodding from Congress, took mine warfare more seriously. Even so, the Navy primarily concerned itself with deep-water mines. In addition to defeating offshore minefields, the Marine Corps needed systems to locate and neutralize inshore mines that threatened landing operations. Locating shallow-water mines, especially those in the surf and on the beach, was a difficult problem. Yet research and development programs on shallow-water mine countermeasures proceeded in fits and starts. They lacked top priority and adequate funding. Two of the most promising near-term systems, the Shallow Water Assault Breaching system and the Distributed Explosive Technology did not meet Marine Corps requirements because they were to be mounted on vulnerable, unarmored landing craft that would precede the AAAVs during a landing. Both programs were canceled in 2001 because of high costs and technical difficulties. Indeed, 10 years after the Gulf War, there was still no means to deal with inshore mines, and none was in sight. According to a National Research Council study that year, "Capability for inshore mine and obstacle clearance today is only slightly better . . . than it was in preparation for the Normandy landing during World War II."[87]

Without shallow-water mine countermeasures, amphibious vehicles faced serious risks in transit from ship to shore. This became clear during wargames in 1996. Dealing with mines was such a problem participants did not even try. "Mine warfare was not played in the wargames because it would have stopped the games," they reported. "Had the adversary seeded the waters and beaches with mines, the assault force would have been unable to go ashore in AAAVs. The game would have been over." They concluded that "without an in-stride breaching capability the AAAV could not execute" Ship-To-Objective Maneuver, and "until the mine breaching problem is solved, the forcible entry capability advertised in OMFTS is severely limited." So even if the Expeditionary Fighting Vehicle had overcome its engineering challenges and become operational, the absence of the required countermine capabilities would likely have forced the Marines to restrict its operations to low-threat environments.[88]

While the failure of the Expeditionary Fighting Vehicle resulted from problems with requirements definition and system development, the ships of the *San Antonio* class struggled with poor program execution. Troubles came into the open in 1999—the year the program received its second Packard award—when the Navy added 10 months to the ship's development schedule because of problems with its much-heralded computer-aided design tools. Two years later the ship was two years behind schedule and its cost had risen 22 percent, to $836 million. When the Navy announced the program's Nunn-McCurdy breach in 2002, the cost for the 12 planned ships was up 75 percent, from $8.8 billion to $15.4 billion. *San Antonio* was christened in 2003, but Avondale Shipyard performed so poorly that the following year the ship had to be towed from New Orleans to Northrop Grumman's Ingalls shipyard in Pascagoula, Mississippi. The ship was still incomplete in 2005, but the Navy accepted delivery anyway because procurement funding had run out. Construction was finished at less-expensive repair yards using an account intended only for post-delivery work. General Dynamics also delivered the second ship, *New Orleans*, unfinished. The Navy had considered canceling the ship but concluded it could not afford the shut-down costs.[89]

Problems continued after the ships entered the fleet. *San Antonio* was commissioned in January 2006 but reportedly had "thousands" of construction deficiencies and was in such poor shape that it was unable to complete sea trials in March 2007. The propulsion system was unreliable, the communications system did not work, and the ship's air defense missile launchers each broke down after firing just one missile. The ship suffered a complete systems failure off North Carolina that shut down navigation, propulsion, and steering, leaving it adrift for 18 hours. *San Antonio* finally made its first deployment in August 2008, two and a half years after being commissioned. The mission began inauspiciously when a mechanical failure prevented it from departing for two days, forcing the task force to leave it behind. The rest of the voyage went no better. The ship was riddled with so many defects that every time the crew fixed one, another would crop up. Substandard welds caused pipes to

USS *San Antonio* (LPD 17) on the Mississippi River the day of its christening at Northrop Grumman Ship Systems Avondale Operations near New Orleans, Louisiana, 19 July 2003. *(U.S. Navy)*

rupture and spew oil around the engine room, so the ship spent a month at Bahrain in the Persian Gulf while a repair team flown in from the United States replaced 1,000 feet of piping. In November 2009, as *San Antonio* transited the Suez Canal with two of its four screws running at full speed, one suddenly shifted into full reverse, causing the ship to careen wildly. Fortunately the crew, which by then was used to such unexpected problems, acted quickly to bring the ship under control before it could run aground or collide with an oncoming vessel. Not long after, inspections found tiny metal shavings in the lubricating oil that threatened to wear out the engines. As the engines were being worked on, they were found to be misaligned. Repairing this problem forced the ship's planned 2011 deployment to be canceled. Meanwhile, the DoD director of operational test and evaluation noted that the ship could not adequately protect itself from attack by any of several widely available weapons. The ship was "not effective, [not] suitable and not survivable in a combat situation."[90]

Construction defects did not afflict only *San Antonio*. The follow-on ships had many of the same problems, most embarrassingly the fifth ship of the class, *New York* (LPD 21), which included steel salvaged from the World Trade Center after 9/11 and which Northrop Grumman proclaimed to be one of the best ships it had ever built. Sloppy construction and poor oversight by the Navy accounted for many of the class's difficulties, but the ships also exhibited design flaws in spite of the "design for ownership" approach. For example, berthing for the crew and embarked Marines was found to be unsatisfactory. The Navy also acknowledged it had gone too far in reducing the manning. "What we found out was that sometimes automation fails," said *San Antonio*'s commanding officer, Cdr. Thomas C. Kait Jr. By 2011 his ship's crew complement had grown from 340 to 385, and the Navy was extending the manning increase across the class.[91]

* * * * *

From the late 1980s on, the Navy Department reorganized and made other changes in its acquisition system to shape its force structure for post–Cold War missions and to adjust to continuing declines in the Defense budget. To help control weapon system program costs, meet delivery schedules, and achieve system performance objectives, the Navy implemented reforms—integrated product teams, integrated product and process development, cost as an independent variable, off-the-shelf purchasing, performance-based specifications in place of MILSPECs, innovative contracting methods, and computer simulation and modeling. To improve support to program offices and to involve the acquisition workforce more effectively in program outcomes, the service conducted an extensive education and training campaign. The application of reforms benefited some programs, such as the F/A–18E/F Super Hornet, the already-in-production *Arleigh Burke*-class air-defense destroyer, and the *Virginia*-class attack submarine. But in others—the LPD 17 *San Antonio* amphibious transport dock ship and the eventually terminated Marine Advanced Amphibious Assault Vehicle—the extensive use of reforms failed to prevent technological setbacks, cost overruns, and schedule delays.

Endnotes

1. Department of the Navy [DoN], . . . *From the Sea: Preparing the Naval Service for the 21st Century*, Sep 1992, www.au.af.mil/au/awc/awcgate/navy/fromsea/fromsea.txt, accessed 15 Jan 2015; DoN, *Forward . . . From the Sea* [1994], www.globalsecurity.org/military/library/policy/.../forward-from-the-sea.pdf, accessed 15 Jan 2015; Admiral Jay L. Johnson, *Forward . . . From the Sea: The Navy Operational Concept*, Mar 1997, www.navy.mil/navydata/policy/fromsea/ffseanoc.html, accessed 15 Jan 2015; DoD Comptroller, *National Defense Budget Estimates for FY 2014*, table 6-20.

2. GAO, *Military Departments' Response to the Reorganization Act*, 46–48. The directorates were Air Warfare, Surface Warfare, Marine Corps Programs, Strategic Programs, Submarines/ASW, C3IS (Command, Control, Communications, Intelligence and Space), and Acquisition Management, International Programs, and Congressional Support.

3. Ibid., 49–50. The offices were Air and Ordnance Programs, Supply Support, Contracts and Business Management, Installations and Facilities, Resource and Policy Evaluation, Shipbuilding, and Marine Corps Programs.

4. Ibid., 51; and GAO, *DoD's Efforts to Streamline Its Acquisition System*, 33. The other organizations were Naval Supply Systems Command and Naval Facilities Engineering Command.

5. "NAVSEA Fact Sheet" and "NAVSEA Command Structure," archived web pages in author files, OSD/HO.

6. GAO, *Military Departments' Response to the Reorganization Act*, 51.

7. Ibid., 52–53.

8. Ibid., 54–55; [Rod Bowers], *U.S. Marine Corps Tactical Systems Acquisition: An Overview of the Process and Participants* (Washington, DC: Marine Corps Research, Development and

Acquisition Command, Mar 1989), preface, 10–15; Marine Corps Order 5000.19 (Marine Corps Systems Command), 13 Jan 1992; "Marine Corps Systems Command: Home of the Marine Corps Acquisition Professionals; Command Overview and History," http://www.marcorsyscom.marines.mil/AboutUs/OverviewandHistory.aspx, accessed 21 Apr 2020.

9. GAO, *Military Departments' Response to the Reorganization Act*, 45–46, 48–49, 52, 56, 58; GAO, *DoD's Efforts to Streamline Its Acquisition System*, 33.

10. GAO, *Military Departments' Response to the Reorganization Act*, 53, 55; GAO, *DoD's Efforts to Streamline Its Acquisition System*, 34.

11. GAO, *DoD's Efforts to Streamline Its Acquisition System*, 33–34.

12. "Garrett Would Remove System Commands from Acquisition Policymaking," *Inside the Navy*, 24 Jul 1989; Stephen C. LeSueur, "New Documents Outline Plans for Massive Changes in Navy Acquisition Processes," *Inside the Navy*, 7 Aug 1989, 1; John Grano, "Navy Presses Garrett to Soften Cheney-Triggered Acquisition Overhaul," *Inside the Navy*, 25 Sep 1989, 5.

13. Grano, "Navy Presses Garrett," 5.

14. H. Lawrence Garrett, testimony before the HCA, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1991: Hearings*, 101st Cong., 2d sess., 22 Feb 1990, pt. 1: 500–503; DoD telephone directory, Dec 1997, O-76; GAO, *Defense Management: Efforts to Streamline Acquisition Management Structure*, GAO/NSIAD-91-15 (Dec 1990), 6–7; Glenn W. Goodman Jr., "Interview: Col. William E. Taylor, USMC, Program Executive Officer for Land Systems," *Program Executive Officer Land Systems, Marine Corps*, 2008/2009 ed., 12–14.

15. Roger Thompson, *Brown Shoes, Black Shoes and Felt Slippers: Parochialism and the Evolution of the Post-War U.S. Navy*, Research Report 5-95, Occasional Papers of the Center for Naval Warfare Studies (Newport, RI: Strategic Research Department, Naval War College, 1995), 27–39, 48–51; Frederick D. Thompson and Christopher A. Trenholm, "OPNAV Functional Reorganization Study: Final Report," CRM 90-16 (Alexandria, VA: Center for Naval Analyses, Feb 1990), 3–5; William B. Stedman, "Determining the Future of Naval Aviation: An Institutional Perspective" (unpublished paper, Marine Corps War College, Quantico, VA, 1992), https://www.globalsecurity.org/military/library/report/1992/SWB.htm, accessed 21 Apr 2020.

16. Tamara Moser Melia, *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777–1991* (Washington, DC: Naval Historical Center, 1991), 117–118, 128–138; James F. Dunnigan and Austin Bay, *From Shield to Storm: High-Tech Weapons, Military Strategy, and Coalition Warfare in the Persian Gulf* (New York: William Morrow, 1992), 313–317; H. Dwight Lyons Jr., "The Mine Threat: Show Stoppers or Speed Bumps?" Center for Naval Analyses Occasional Paper (Alexandria, VA: Center for Naval Analyses, Jul 1993), 6–10; Edward J. Marolda and Robert J. Schneller Jr., *Shield and Sword: The United States Navy and the Persian Gulf War* (Washington, DC: Naval Historical Center, 1998), 148–151, 205, 210–212, 223–226, 247–256, 258–268, 289, 358–359, 361, 378–380; Ronald J. Brown, *U.S. Marines in the Persian Gulf, 1990–1991: With Marine Forces Afloat in Desert Shield and Desert Storm* (Washington, DC: History and Museums Division, Headquarters, U.S. Marine Corps, 1998), 117, 118, 120, 125–126, 130–133, 136–138, 143, 149–154, 167; DoD, *Conduct of the Persian Gulf War: Final Report to Congress*, 273–274, 282–286, 295–299, 304; Atkinson, *Crusade: The Untold Story of the Persian Gulf War*, 237–240; Schwarzkopf, testimony before the SCAS, *Operation Desert Shield/Desert Storm: Hearings*, 102d Cong., 1st sess., 12 Jun 1991, 325; Committee for Mine Warfare Assessment, Naval Studies Board, Division on Engineering and Physical Sciences, National Research Council, *Naval Mine Warfare: Operational and Technical Challenges for Naval Forces* (Washington, DC: National Academies Press, 2001), 159–160.

17. Thompson and Trenholm, "OPNAV Functional Reorganization Study: Final Report," 1–2. William Stedman argues that during the decade preceding the 1992 reorganization, the platform barons had already lost much of their power to the programming, budgeting, and acquisition staffs in OPNAV and the Navy secretariat. Stedman, "Determining the Future of Naval Aviation: An Institutional Perspective," https://www.globalsecurity.org/military/library/report/1992/SWB.htm, accessed 21 Apr 2020.

18. Norman Polmar, *Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*, 18th ed. (Annapolis, MD: Naval Institute Press, 2005), 30–31 (quotes); Peter M. Swartz, with Michael C.

Markowitz, *Organizing OPNAV (1970–2009)*, rev. 2 (Alexandria, VA: Center for Naval Analyses, 2010), 54–58; William A. Owens, *High Seas: The Naval Passage to an Uncharted World* (Annapolis, MD: Naval Institute Press, 1995), 125–126; Evans, Lyman, and Ennis, *Modernization in Lean Times*, chap. 4:1–2. OPNAV traditionally used its own unique "OP codes": The various officials on the staff had designations such as OP-6 and OP-61. Kelso replaced these with letter "N codes," to match the "G" and "J" letter codes used by the Army and the Joint Staff, respectively. See Swartz and Markowitz, *Organizing OPNAV*, 54, 63.

19. Swartz and Markowitz, *Organizing OPNAV*, 56, 58–59, 63; "'. . . From the Sea' Update: The OPNAV Assessment Process," DoN Policy Paper, Navy Public Affairs Library, May 1993, https://www.navy.mil/navydata/policy/fromsea/ftsuoap.txt, accessed 21 Apr 2020; Owens, *High Seas*, 126–132.

20. Swartz and Markowitz, *Organizing OPNAV*, 59–61, 63; Ronald E. Ratcliff, "CNO and OPNAV Reorganization," in *Case Studies in Policy Making & Implementation*, ed. David A. Williams, 6th ed. (Newport, RI: Naval War College, 2002), 327–332; Sandra I. Erwin, "Navy Faulted for Slow-Going in Fielding Anti-Mine Systems," *National Defense*, 1 Jan 1999, https://www.nationaldefensemagazine.org/articles/1999/1/1/1999january-navy-faulted-for-slowgoing-in-fielding-antimine-systems, accessed 21 Apr 2020; Gregory J. Cornish, "U.S. Naval Mine Warfare Strategy: Analysis of the Way Ahead," Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, 7 Apr 2003), 10, 15.

21. Robert J. Caldwell, "We Have a Big Problem in Naval Aviation," 24 Sep 2000, copy in author files; Ratcliff, "CNO and OPNAV Reorganization," 326–328; Swartz and Markowitz, *Organizing OPNAV*, 80, 84–87.

22. Memo, Chester Paul Beach Jr., for SecNav via ASN(RDA), 28 Nov 1990, subj: A–12 Administrative Inquiry, 28–30, file 452, box 73, Acc 330-92-0097, OSD Records, WNRC (hereafter A–12 Administrative Inquiry).

23. A–12 Administrative Inquiry, 35.

24. Ibid., 30–33.

25. ASN(RDA) Cann, memo for distribution, 17 Jan1991, subj: Interim Changes in the Defense Acquisition Executive Summary (DAES), SecNav file, 5000 Series 1991 Revision Files, OSD/HO.

26. GAO, *Naval Aviation: F/A–18E/F Acquisition Strategy*, GAO/NSIAD-94-194 (Aug 1994), 1–7; DoD IG, *F/A–18E/F Program as a Part of the Audit of the Effectiveness of the Defense Acquisition Board Review Process—FY 1992*, Audit Report 92-097 (Washington, DC: DoD, 5 Jun 1992), 2–3, 6–8, 12–13; Obaid Younossi et al., *Lessons Learned from the F/A–22 and F/A–18E/F Development Programs* (Santa Monica, CA: RAND/Project Air Force, 2005), 23 and n12. The E model would have a single seat, while the F model would be a two-seater.

27. Younossi et al., *Lessons Learned*, 22–23, 25–27; Springsteen et al., *Integrated Product and Process Development Case Study*, ES-1, 17–18, 29–32; Vice Adm. Joe Dyer, USN (Ret.), interview by J. Ronald Fox, David Allen, and Philip Shiman, Harvard Business School, Boston, MA, 17 Sep 2008, 14, OSD/HO.

28. Springsteen et al., *Integrated Product and Process Development Case Study*, 9–10; Coyle, statement before the SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1999 and the Future Years Defense Program: Hearings*, pt. 4: *AirLand Forces*, 105th Cong., 2d sess., 25 Mar 1998, S. Hrg. 105-605, 150.

29. Dyer interview, 10–12.

30. Younossi et al., *Lessons Learned*, 24; Springsteen et al., *Integrated Product and Process Development Case Study*, 24–25.

31. Dyer interview, 10–11.

32. Younossi et al., *Lessons Learned*, 23; Springsteen et al., *Integrated Product and Process Development Case Study*, 7–9; Rob Niewoehner, "The F/A–18E/F Super Hornet: A Test Pilot Dispels the Myths," 14 Apr 1999, http://fas.org/man/dod-101/sys/ac/docs/990414-ART-Super-Hornet.htm, accessed 8 Apr 2020; Dyer interview, 8.

33. Younossi et al., *Lessons Learned*, 22–23, 30–31, 43–45; Niewoehner, "F/A18–E/F Super Hornet."

34. Younossi et al., fig. S.1 (F/A–22 Experienced Schedule Slips and Cost Growth, While the F/A–18E/F Completed Development on Time and on Cost), *Lessons Learned*, xvii, 38–39, 50–52; U.S. Navy Fact File, "F/A-18E/F Hornet Strike Fighter," 26 May 2009, www.navy.mil/navydata/fact_display.asp?cid=1100&tid=1200&ct=1, accessed 3 Mar 2020; Dyer interview, 23.

35. GAO, *Naval Aviation: F/A–18E/F Acquisition Strategy*, 2; DoD IG, *F/A–18E/F Program*, 5–13, 38–39, 44; Dyer interview, 9; Stan Crock, "The (Not So) Super Hornet," 12 Dec 1999, Bloomberg, www.bloomberg.com/news/articles/1999-12-12/the-not-so-super-hornet; Chuck Spinney, listserve commentary, 2 Apr 1998, subj: F/A–18E/F – Good to Go? fas.org/man//dod-101/sys/ac/docs/980402-f18.htm, accessed 19 Mar 2020. For other examples of the GAO position, see GAO, *Navy Aviation: F/A–18E/F Will Provide Marginal Operational Improvement at High Cost*, GAO/NSIAD-96-98 (Jun 1996); and GAO, *Navy Aviation: F/A–18E/F Development and Production Issues*, GAO/NSIAD-98-61 (Mar 1998). For a good view of the debate, see Bob Kress and Paul Gillcrist, "Battle of the Super Fighters: F–14D Tomcat vs. F/A–18E/F Super Hornet," *Flight Journal* (Feb 2002), www.freerepublic.com/focus/fr/595147/posts, accessed 8 Apr 2020.

36. DoD News Release 067-00, " 'Super Hornet' Operational Evaluation Results Announced," 15 Feb 2000; transcript of DoD News Briefing, 15 Feb 2000, subj: "Super Hornet" Operation Evaluation Results: both in author files; DoD IG, *Operational Testing and Evaluation of the F/A–18E/F Super Hornet*, Audit Report 99-205 (Washington, DC: DoD, 7 Jul 1999); Coyle, statement before the SCAS, AirLand Forces Subcommittee, 22 Mar 2000, copy in author files.

37. *Nominations Before the Senate Armed Services Committee, First Session, 103d Congress*, 23 Sep 1993, S. Hrg. 103-414, 1321–1324; Stan Crock, "Nora Slatkin's Mission Impossible: The CIA," *BusinessWeek*, 26 Feb 1996 (updated 14 Jun 1997), https://www.bloomberg.com/news/articles/1996-02-25/nora-slatkins-mission-impossible-the-cia, accessed 21 Apr 2020.

38. *Nominations Before the Senate Armed Services Committee, First Session, 104th Congress*, 1996, S. Hrg. 104-669, 348, 372–376; U.S. Air Force, "Biography: Brigadier General John W. Douglass" (Mar 1990), http://www.af.mil/AboutUs/Biographies/Display/tabid/225/Article/107198/brigadier-general-john-w-douglass.aspx, accessed 21 Apr 2020; "Brig. Gen. John Douglass," *Defense News*, 24 Apr 1989, 30; "John Douglass, Assistant Secretary of the Navy for Research, Development, & Acquisition Speaks to *Program Manager*," *Program Manager* 25, no. 6 (Nov-Dec 1996): 3–4, 7.

39. "NARSOC Catalyst," DoN, *Implementation of Acquisition Reform*, 19 Mar1997, n.p., copy in author files; archived NARSOC agendas and briefings in author files.

40. "NARSOC Catalyst"; DoN ARO Charter, effective 1 Jan 1995; DoN ARO Concept of Operations, rev. 31 Jul 1995; "Acquisition Reform Executive: D. E. Porter," archived web page: copies of all in author files; "New Leader Takes the Helm at AR Office," *Acquisition Reform Update* 5, no. 4 (Sep 1998): n.p.

41. "Acquisition Reform Office Catalyst," DoN, *Implementation of Acquisition Reform; "DASN(ACQ)'s Roots"—A Brief Organizational History* (n.p., n.d.); DoN, ARO Charter; DoN, ARO Concept of Operations; "ARO Provides Learning Opportunities," *Acquisition Reform Update* 4, no. 3 (Jul 1997): copies of all in author files; "Strategic Plan Catalyst" and "Management Action Plan," DoN, *Implementation of Acquisition Reform*; "Charting the Course to Acquisition Excellence: Department of the Navy's Acquisition Reform Management Action Plan," DoN briefing, n.d., slides 6–19; "DoN Focuses on Accelerating Acquisition Reform," *Acquisition Reform Update* 5, no. 5 (Oct/Nov 1998).

42. DoN, *1997 Posture Statement*, sec. VII, http://www.navy.mil/navydata/policy/fromsea/pos97/pos-pg07.html, accessed 21 Apr 2020; "Acquisition Center of Excellence," DoN, *Implementation of Acquisition Reform*, 19 Mar 1997, n.p.; "Acquisition Center of Excellence Catalyst," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; "ACE Gaining Momentum," *Acquisition Reform Update* 4, no. 1 (Jan 1997): n.p.

43. "ACE Gaining Momentum," n.p.; "ACE and ONR Kick Off—Mentor Protégé Meeting," *Acquisition Reform Update* 4, no. 3 (Jul 1997): n.p.; DoN, *FY 1999 Amended Budget Estimates: Justification of Estimates*, RDT&E, Feb 1998, Exhibit R-1, line item 138; DoN, *Fiscal Year (FY) 2001 Budget Estimates: Justification of Estimates*, O&M, 9–10, 480: copies of all in author files.

44. "Training and Education Catalyst," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; "Acquisition Reform Team Working Group," 15 Sep 1997, https://web.archive.org/web/19981212022506/http://www.acq-ref.navy.mil/artwg.html, accessed19 Mar 2020; and minutes of ARTWG meeting of 17 Nov 1999, copy in author files.

45. *The Streamliner* (NAVSUP Acquisition Reform Office newsletter) 1, no. 1 (Jan-Mar 1997): 5, reprinted in DoN, *Accelerating Acquisition Reform: Actions in Response to Feedback from Acquisition Reform Acceleration Day, 31 May 1996* (Arlington, VA: Acquisition Reform Office, 10 Mar 1997), sec. 9; "NAVSEA Acquisition Reform Forum," archived web pages in author files.

46. DoN, *The ABCs of Acquisition Reform*, ver. 1.3 [8 Aug 1995], Module 1, p. 2.

47. DoN, *Standards Improvement Program Plan*, Dec 1994, 30–32, copy in author files; "Roadshows Catalyst," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; "Charting the Course to Acquisition Excellence: Department of the Navy's Acquisition Reform Management Action Plan," briefing [11 Jul 1995], https://web.archive.org/web/20000226203839/http://www.acq-ref.navy.mil/pdf/sapp.pdf, accessed 21 Apr 2020; Navy Acquisition Reform Roadshow Schedule, archived web page rev. 18 Jun 1996, https://web.archive.org/web/19970201215257/http://www.acq-ref.navy.mil/nirsched.htm; "AR Road Shows Slated for 1998," *Acquisition Reform Update* 5 (Feb 1998): n.p.; "Acquisition Reform RoadShows," *Navy Acquisition Reform Info-Alert* 118 (28 Sep 1998): 1; "Navy AR 1998 RoadShows," archived web page rev. 22 Sep 1998, https://web.archive.org/web/19990128085810/http://www.acq-ref.navy.mil/rdshow98.html, accessed 21 Apr 2020; "Acquisition Reform RoadShow, 19 November 1998," archived web page rev. 10 Dec 1998, http://web.archive.org/web/20010302110211/http://www.acq-ref.navy.mil/rdshow99/albany/albany99.html, accessed 21 Apr 2020; "Marine Corps Hosts First Roadshow in FY99," *Navy Acquisition Reform Info-Alert* 125 (30 Nov 1998): 1; *Acquisition Reform Update* (1994–2001) and *Navy Acquisition Reform Info-Alert* (1998–2001), copies in author files; "Communications Catalyst" and "Training and Education Catalyst," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; "New Turbo Streamliner Introduced," *Navy Acquisition Reform Info-Alert* 212 (29 Mar 2000): 1–2; Turbo Streamliner, http://web.archive.org/web/20001008101839/http://www.acq-ref.navy.mil/turbo2/index_ie.html, accessed 26 Jun 2020.

48. "Acquisition Reform Week Catalyst," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; "Navy AR Acceleration Day Data Sheet," archived document revised 29–30 Apr 1996, https://web.archive.org/web/19980425065448/http://www.acq-ref.navy.mil/arad.html, 21 Apr 2020; Virtual Town Hall, 20 Mar 1997, https://web.archive.org/web/19990427021127/http://www.acq-ref.navy.mil/townhall.html, accessed 21 Apr 2020; Douglass, memo for distribution, 6 Mar 1998, subj: ASN(RDA) Virtual Town Hall Meeting, https://web.archive.org/web/19990203143759/http://www.acq-ref.navy.mil/pdf/arwk98m7.pdf; undated list of Virtual Town Hall Meeting invitees, https://web.archive.org/web/19990203143759/http://www.acq-ref.navy.mil/pdf/arwk98m7.pdf, accessed 21 Apr 2020; "Questions and Answers, 1997 & 1998 Virtual Town Hall Meeting" [*sic*], https://web.archive.org/web/19981202203945/http://www.acq-ref.navy.mil/vth/index.html, accessed 20 Apr 2020; T. A. Demas, SpecAsst for Acquisition Reform, Naval Sea Systems Command, memo for distribution, 12 Aug 1996, subj: Change Through Exchange Video Dated 31 May 1996, copy in author files.

49. "Field Integration Program Initiative," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; Douglass, memo for distribution, 29 Aug 1997, subj: AR Field Integration Program, with attached Field Training Working Group Report on the Establishment of a Field Integration Program, n.d.; Roberson and Rear Adm. Gwilym H. Jenkins Jr., Deputy for Acquisition and Business Management, memo for distribution, 9 Dec 1999, subj: Program Assist Visits: copies of both in author files; DoN, *Navigating the Course for Acquisition Reform: Year in Review 2000*, 1, 4–5; "Program Assist Visits," *Navy Acquisition Reform Info-Alert* 216 (13 Jun 2000): 1–2.

50. SecNavInst 5420.188E (Acquisition Category [ACAT] Program Decision Process), 11 Dec 1997, 2; SecNavInst 5000.2B (Implementation of Mandatory Procedures for Major and Non-Major Defense Acquisition Programs and Major and Non-Major Information Technology Acquisition Programs), 6 Dec 1996, sec. 1.2. ACAT IC programs were those for which the Navy acquisition executive was the milestone decision authority. For ACAT ID programs, the defense acquisition executive (the under secretary for acquisition and technology) was the milestone decision

authority; since an overarching IPT was assigned to those programs they did not need an acquisition coordination team.

51. *Integrated Program Team Manual Update* (Naval Air Systems Command, Dec 1996), iii, 1–5, 11–12, 19. In NAVAIR, IPT stood for "integrated *program* team."

52. NAVAIR AIR-1.1C, *Naval Aviation Systems Team Acquisition Guide*, 13th ed. (NAVAIR, 4 Dec 1997), 3–4; *Integrated Program Team Manual Update*, 5–7; James M. Rebel, *Systems Engineering Management Training at Naval Air Systems Command* (n.p., [NAVAIR, Jan 2000]). For the role of the F/A–18E/F program manager, see Benjamin P. Stinson, "Understanding How Program Managers Successfully Manage Innovation in Major Defense Acquisition Programs (MDAPs): An Exploratory Study" (master's thesis, Naval Postgraduate School, 2001), 27–28, 31–36. The competencies were program management, contracts, logistics, research and engineering, test and evaluation, industrial, corporate operations, and shore station management.

53. John G. King, "Acquisition Streamlining and Reform: An Analysis of Alpha Acquisition at the Naval Air Systems Command" (master's thesis, Naval Postgraduate School, Dec 1994), 18–29. NAVAIR originally named the process "alpha contracting," then changed it to "alpha acquisition" to emphasize that the approach could be applied to other parts of the acquisition process. However, alpha contracting became the accepted name, and is the term used here.

54. Ibid., 28–33. See also Andrew F. Clements, "A Study of the Alpha Contracting Process and Its Effects on Integrated Product and Process Development (IPPD) Within Selected Army Acquisition Programs" (master's thesis, Naval Postgraduate School, Mar 2002), 23–45; Connie M. Goodwin, "Acquisition Reform Through Alpha Contracting" (master's thesis, Naval Postgraduate School, Dec 2002), 23–30; Steven Liss et al., "From Approved J&A to Contract Award in 16 Weeks," *Defense AT&L* 34, no. 1 (Jan-Feb 2005): 18–21.

55. Jim MacStravic, "LPD 17 Acquisition Strategy" (presentation, 32d Annual DoD Cost Analysis Symposium, 4 Feb 1999) (quote), copy in author files; L. D. Simmons, *Assessment of Options for Enhancing Surface Ship Acquisition*, IDA Paper P-3172 (Alexandria, VA: IDA, Mar 1996), 64; Howard Fireman et al., "LPD 17 on the Shipbuilding Frontier: Integrated Product & Process Development" (paper presented at the Association of Scientists and Engineers' 35th Annual Technical Symposium, 17 Apr 1998), 3, 10, 14, copy in author files; William H. Luebke, "Leading the Way in Ship Design: The *San Antonio*-Class LPD 17," *Sea Power* 42, no. 11 (Nov 1999): 36–40; B. Tibbitts and R. G. Keane Jr., "Acquisition Reform: It All Starts with Design," *Naval Engineers Journal* 111, no. 1 (Jan 1999): 42–43.

56. Simmons, *Assessment*, 72, 91–94; Fireman, "LPD 17," 8–15; Maurice Gauthier and Connie Gragan Clavier, "LPD 17 Designing for Ownership" (paper presented at the Association of Science and Engineering 33d Technical Symposium, 26 Apr 1996), 620–625, copy in author files; Naval Sea Systems Command and LPD 17 Team 17, "Smart Ship Impact on LPD 17 Design: Final Systems Engineering Report," 30 Nov 1997, copy in author files; DoD IG, *Acquisition of the Amphibious Landing Transport Dock 17 Class of Ships,* Audit Report 98-078 (Washington, DC: DoD, 18 Feb 1998), 4–12.

57. Navy report on New Attack Submarine, published in the *Congressional Record*, 21 Jul 1992, S10054; Ryan Peeks, "A Submarine for the 21st Century": "Seawolf, the End of the Cold War, and the Politics of Program Cancellation," unpublished working paper, OSD/HO, 1–2, 32–36; John F. Schank et al., *Learning from Experience*, vol. 2: *Lessons from the U.S. Navy's Ohio, Seawolf, and Virginia Submarine Programs* (Santa Monica, CA: RAND, 2011), 115.

58. Schank et al., *Lessons from the U.S. Navy's Ohio, Seawolf, and Virginia Submarine Programs*, 2:xviii, xxiii (n13), 5–58, 70–71, 90–92, 94.

59. Winner, *New Attack Submarine Program*, 8–16; Michael S. Brown, "Electronic Visualization of the New Attack Submarine Design," *Change Through Exchange Innovations* (conference proceedings, Crystal City Marriott, Arlington, VA, 4 May 1998), 38–39, copy in author files.

60. Schank et al., *Lessons from the U.S. Navy's Ohio, Seawolf, and Virginia Submarine Programs*, 2:23, 50; Paul G. Kaminski, "Affordability in the Submarine Force" (address, Submarine Technology Symposium 1996, Johns Hopkins APL, Laurel, MD, 16 May 1996), copy in author files; *Secretary of Defense Report on Nuclear Attack Submarine Procurement and Submarine Technology*, Mar 1996, app. B, 4–5, 19, 21, 22; Linda Haines, "Technology Refreshment Within DoD," *Program Manager* 30, no.

2 (Mar-Apr 2001): 25–26; *The Virginia Class Submarine Program: Defense Standardization Program Case Study* (n.p., n.d.), copy in author files; Richard F. Burns, "NSSN C3I Systems—Integration by Lockheed Martin," *Sea Technology* 37, no. 7 (Jul 1996): 64–65; Edward J. Walsh, "Submarine Designers Rely on COTS To Broaden Undersea Warfare Missions," *Military & Aerospace Electronics,* 1 Mar 2000, http://www.militaryaerospace.com/articles/print/volume-11/issue-3/features/special-report/submarine-designers-rely-on-cots-to-broaden-undersea-warfare-missions.html, accessed 24 Apr 2020; DOT&E, *Annual Report FY 2002*, 213.

61. Memo, USD(A&T) Jacques Gansler for ASN(RDA), 9 Apr 1998, subj: David Packard Excellence in Acquisition Award, https://web.archive.org/web/19980425053535/http://www.acq-ref.navy.mil/packdae.html, accessed 24 Apr 2020; "1998 David Packard Excellence in Acquisition Award Winner: NAVSEA . . . ," announcement at https://web.archive.org/web/19990202164316/http://www.acq-ref.navy.mil/pack98n3.html, accessed 24 Apr 2020; "Virginia (SSN 774) Class Attack Submarine," DOT&E, *Annual Report FY 1998* ("aggressive and systematic"); "Virginia (SSN 774) Class Attack Submarine," DOT&E, *Annual Report FY 1999* ("innovative"); GAO, *New Attack Submarine: Program Status*, GAO/NSIAD-97-25 (Dec 1996), 1–14.

62. Knox, "Ten Years' Worth of Procurement Reforms," 88; Ronald O'Rourke, *Navy DDG-51 Destroyer Procurement Rate: Issues and Options for Congress*, CRS Report 94-343F (Washington, DC: CRS, 25 Apr 1994), 11; "PEO Surface Combatants (PEO SC) Acquisition Reform Realizers," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; PMS 400G, "Acquisition Reform Accomplishments: AEGIS Production Program," briefing, 30 Jul 1997, 1, 4, copy in author files.

63. PMS 400G, "Acquisition Reform Accomplishments: AEGIS Production Program," 4–6; PMS 400G/Industry Integrated Process/Product Development Team Charter, 16 Nov 1994, archived web page; archived minutes of the IPPDT, 1996–2000; the IPPDT Communications Subteam archived web pages; *The Communicator*, archived website; memo, G. A. Huchting, Chairman, PEO SC/AP Executive Steering Group, for Capt. H. D. Covert, 18 Dec 1996, subj: Establishment of a PEO SC/AP Quality Wagement [*sic*] Board (QMB) for Acquisition Reform (AR): copies of all in author files.

64. "Marine Corps Acquisition Reform Realizers," DoN, *Implementation*, 1998; Collie J. Johnson, "AAAV—At the Brink of Prototype," *Program Manager* 27, no. 6 (Nov-Dec 1998): 3–6, 7, 10–16 (IPT quote, 3); Scott R. Adams, "A Case Study of the Advanced Amphibious Assault Vehicle (AAAV) Program from a Program Management Perspective" (master's thesis, Naval Postgraduate School, 1999), 85–90; Travis L. Sutton, "Investigation of IPPD: A Case Study of the Marine Corps AAAV" (master's thesis, Naval Postgraduate School, 1998), 30–35 (Feigley quote, 30–31); DoD IG, *Acquisition of the Advanced Amphibious Assault Vehicle*, Audit Report 99-054 (Washington, DC: DoD, 15 Dec 1998), 5; web pages on the archived website of the Direct Reporting Program Manager, Advanced Amphibious Assault, ca. 2000, https://web.archive.org/web/20001208000500/http://www.aaav.usmc.mil/mainhome.html, accessed 24 Apr 2020.

65. DoD IG, *Acquisition of the Advanced Amphibious Assault Vehicle*, 4; "Advanced Amphibious Assault Vehicle," DOT&E, *Annual Report FY 1997*, http://web.archive.org/web/20020202181753/http://www.dote.osd.mil/reports/FY97/97tocmain.html, accessed 24 Apr 2020; Direct Reporting Program Manager Awards, archived web page ca. 2002, https://web.archive.org/web/20021021061620/http://www.aaav.usmc.mil/program/awards.html, accessed 26 Jun 2020.

66. "Naval Sea Systems Acquisition Reform Realizers," DoN, *Implementation of Acquisition Reform*, Apr 1998, n.p.; Norman Friedman, *U.S. Destroyers: An Illustrated Design History*, rev. ed. (Annapolis, MD: Naval Institute Press, 2004), 434–435, 438–442, 446; Glenn W. Goodman Jr., "Reengineering the Fleet: U.S. Navy Rewrites the Book in Developing Its New Surface Warships," *Armed Forces Journal International* 134 (Mar 1997), https://web.archive.org/web/19970418020723/http://sc21.crane.navy.mil/afji.htm, accessed 24 Apr 2020.

67. Friedman, *U.S. Destroyers*, 440–443; Eric Schmitt, "Transcript of an Interview with Admiral J. M. Boorda, Chief of Naval Operations," 24 Aug 1995, http://www.fas.org/man/dod-101/sys/ship/docs/boor0824.htm, accessed 24 Apr 2020; Norman Polmar, "The U.S. Navy: More Bang for the Buck," U.S. Naval Institute *Proceedings* 122, no. 1 (Jan 1996): 87; Scott C. Truver, "Floating Arsenal To Be 21st Century Battleship," *Jane's International Defence Review* 29, no. 7 (Jul 1996): 44–47.

68. Robert S. Leonard, Jeffrey A. Drezner, and Geoffrey Sommer, *The Arsenal Ship Acquisition Process Experience: Contrasting and Common Impressions from the Contractor Teams and Joint Program Office* (Santa Monica, CA: RAND, 1999), 7–8, 23–40; Van Atta et al., *Transformation and Transition*, 2:3–4; Charles S. Hamilton, *Arsenal Ship Lessons Learned*, tab E (n.p.: n.p., 31 Dec 1997); Giles Smith, Jeffrey Drezner, and Irving Lachow, *Assessing the Use of "Other Transactions" Authority for Prototype Projects*, Documented Briefing (n.p.: RAND, n.d.), 1–6; Richard L. Dunn, "Injecting New Ideas and New Approaches in Defense Systems—Are 'Other Transactions' an Answer?" *Proceedings of the Sixth Annual Acquisition Research Symposium, 13–14 May 2009* (Acquisition Research Program, Graduate School of Business and Public Policy, Naval Postgraduate School, 2009), 2:32–36.

69. Leonard, Drezner, and Sommer, *Arsenal Ship*, 25–28, 30–31, 44–45 (quote, 45).

70. Ibid., 7–10, 24–26, 28–30.

71. Leonard, Drezner, and Sommer, *Arsenal Ship*, 7–17. The teams awarded contracts were:
- General Dynamics Marine/Bath Iron Works (lead), General Dynamics Marine/Electric Boat, Raytheon Electronic Systems, and Science Applications International Corp.
- Hughes Aircraft Co. (lead), Avondale Shipyard, Advanced Marine Enterprises, Booz Allen Hamilton, and McDonnell Douglas
- Lockheed Martin Government Electronic Systems (lead), Litton Industries' Ingalls Shipbuilding, and Newport News Shipbuilding
- Metro Machine Corp. (lead), Rockwell International's Collins International, Trinity Marine Group, Composite Ships, and Marinex International
- Northrop Grumman (lead), National Steel and Shipbuilding Co., Vitro Corp., Solipsys, and Band Lavis and Associates Inc.

72. Eric Schmitt, "Aircraft Carrier May Give Way to Missile Ship," *New York Times*, 3 Sep 1995, 1; "Arsenal Ship is B–2 Alternative in Major Regional Contingency Role," *Inside the Navy*, 30 Oct 1995, 5–6; Katherine McIntire Peters, "Ship Shape," *Government Executive*, 1 Aug 1997, http://www.govexec.com/magazine/1997/08/ship-shape/5773/, accessed 24 Apr 2020; Leonard, Drezner, and Sommer, *Arsenal Ship*, 85–89.

73. Leonard, Drezner, and Sommer, *Arsenal Ship*, 64–68, 85 (quote).

74. Ibid., 83–84.

75. Ibid., 80–83.

76. Ibid., 68–74, 76–77; Friedman, *U.S. Destroyers*, 446.

77. Friedman, *U.S. Destroyers*, 448; Van Atta et al., *Transformation and Transition*, 2:23–24; "DD–21 Zumwalt," Federation of American Scientists web page, copy in author files; USD(A&S), *Other Transactions Guide*, app. B.

78. Robert Holzer, "Panel Head: DD–21 Recommendation Misunderstood," *Defense News*, 25 Jun 2001, 18; Ronald O'Rourke, *Navy DD(X) and CG(X) Programs: Background and Issues for Congress*, CRS Report RS21059 (Washington, DC: CRS, 31 May 2005), 1–5; O'Rourke, *Navy DDG–51 and DDG–1000 Destroyer Programs: Background and Issues for Congress*, CRS Report RL32109 (Washington, DC: CRS, 14 Mar 2011), 23–32. The Nunn-McCurdy Act, also called the Nunn-McCurdy Amendment (Title 11, sec. 1107 of P.L. 97-252, the 1982 Department of Defense Authorization Act [96 Stat. 741–744 codified at 10 USC §2433]), required DoD to report cost growth that crossed certain specified thresholds. If the breach exceeded 25 percent of the program's original baseline estimate, DoD's under secretary for acquisition was required to certify that the system was essential to national security, that there were no alternatives that would provide the same capability at lower cost, that the new unit-cost estimate was reasonable, and that the program's management structure was adequate to manage and control the costs in the future. See Moshe Schwartz, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, CRS Report R41293 (Washington, DC: CRS, 21 Jun 2010), 1–27. For an analysis of the effectiveness of the measure, see Jacques S. Gansler, William Lucyshyn, and Adam Spiers, *The Effect of the Nunn-McCurdy Amendment on Unit-Cost-Growth of Defense Acquisition Projects*, rev. ed., UMD-AM-10-155 (n.p.: University of Maryland Center for Public Policy and Private Enterprise, Jul 2010), 16–62; U.S. Navy Chief of Information, "US Navy Accepts Delivery of Future USS *Zumwalt* (DDG 1000)," Story No. NNS160520-06, 20 May 2016, www.navy.mil/submit/display.asp?story_id=94794, accessed 24 Apr

2020; U.S. Navy Fact File, "Littoral Combat Ship Class-LCS," 15 Dec 2011, http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=1650&ct=4, accessed 24 Apr 2020.

79. Schank, et al., *Lessons from the U.S. Navy's Ohio, Seawolf, and Virginia Submarine Programs*, 2:76 (quote), 80, 82.

80. DoN, *Fiscal Year 2000/2001 Biennial Budget Estimates: Shipbuilding and Conversion, Navy*, Feb 1999, sec. 4:1; DoN, *Fiscal Year 2006/2007 Budget Estimates: Shipbuilding and Conversion, Navy*, Feb 2005, sec. 2:1; GAO, *Defense Acquisitions: Improved Management Practices Could Help Minimize Cost Growth in Navy Shipbuilding Programs*, GAO-05-183 (Feb 2005), 65–66; Gansler, Lucyshyn, and Spiers, *Effect of the Nunn-McCurdy Amendment*, 47–50; Dan Morgan and Renae Merle, "6 Nuclear Submarines to Cost $8.7 Billion," *Washington Post*, 15 Aug 2003, E-1; Ronald O'Rourke, *Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress*, CRS Report RL32418 (Washington, DC: CRS, 24 Feb 2011), 5; Grace V. Jean, "Shipyards Speed Up Submarine Production Amid Concerns About Navy's Future Budgets," *National Defense*, Jul 2010, https://www.nationaldefensemagazine.org/articles/2010/7/1/2010july-shipyards-speed-up-submarine-production-amid-concerns-about-navys-future-budgets, accessed 24 Apr 2020.

81. DOT&E, *Annual Report FY 2002*, 214; DOT&E, *Annual Report FY 2003*, 202; Christopher P. Cavas, "New Va.-Class Sub Construction Problem," *Navy Times* (20 Aug 2009), 1–2; "Peeling Submarine Skin Prompts Inquiry," *Military.com*, 21 Sep 2010; Craig Hooper, "Virginia Class: When Does Hull Coating Separation Endanger the Boat," nextnavy.com, 6 Sep 2010, http://nextnavy.com/virginia-class-when-does-hull-coating-separation-endanger-the-boat/, accessed 24 Apr 2020; Hooper, "*Virginia* Class: Announcing the USS Hawaii MIP SHT Failure Watch," nextnavy.com, 25 Sep 2010: copies of all in author files.

82. DOT&E, *Annual Report FY 2009*, 176; 2008 David Packard Excellence In Acquisition Awards Ceremony, 5 Nov 2008, https://www.dau.edu/about/Documents/08%20David%20Packard%20Award.pdf, accessed 24 Apr 2020; Team Submarine Press Release No. NNS081108-15, "Navy's Virginia Class Program Recognized for Acquisition Excellence," 8 Nov 2008, http://www.navy.mil/submit/display.asp?story_id=40781, accessed 24 Apr 2020; SSN 774 Selected Acquisition Report as of 31 Dec 2011, 4, downloaded from the Defense Acquisition Management Information Retrieval System; SSN Virginia Class Submarine Selected Acquisition Report as of 31 Dec 2012, 5; U.S. Navy Chief of Information, "PCU Illinois (SSN 786) Delivered Early to the Navy," Story No. NNS160829-17, 29 Aug 2016, www.navy.mil/submit/display.asp?story_id=96426, accessed 24 Apr 2020.

83. House Committee on Oversight and Government Reform, Majority Staff, *The Expeditionary Fighting Vehicle: Over Budget, Behind Schedule, and Unreliable*, 29 Apr 2008, 1–4 (quote, 3); Andrew Feickert, *The Marines' Expeditionary Fighting Vehicle (EFV): Background and Issues for Congress*, CRS Report RS22947 (Washington, DC: CRS, 18 Jan 2011), 1–3; GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-07-406SP (Mar 2007), 71.

84. Majority Staff, *Expeditionary Fighting Vehicle*, 7–11; Feickert, *Marines' Expeditionary Fighting Vehicle*, 3–7; DOT&E, *Annual Report FY 2006*, 123–124; DOT&E, *Annual Report FY 2007*, 119–120; House Subcommittee on National Security and Foreign Affairs and the Committee on Oversight and Government Reform, *Oversight of Defense Department Acquisitions: Joint Hearing . . .* , 110th Cong., 2d sess., 29 Apr 2008, 22, 23 (quotes); memo, USD(AT&L) Ashton B. Carter for SecNav, 16 Feb 2011, subj: Expeditionary Fighting Vehicle (EFV) Program (FOUO); memo, Carter for SecNav, 13 May 2011, subj: Expeditionary Fighting Vehicle (EFV) Acquisition Decision Memorandum (ADM) (FOUO): copies of both in author files.

85. OMFTS called for expeditionary forces to use the sea to maneuver and strike at key strategic objectives; STOM called for those forces to proceed from their ships directly against the objectives without stopping to form a beachhead. See Marine Corps Capabilities Plan (MCCP) 1, *Operational Maneuver from the Sea*, Marine Corps Combat Development Command, 4 Jan 1996, 10–20, http://www.marines.mil/Portals/59/Publications/MCCP%201%20Operational%20Maneuver%20from%20the%20Sea.pdf, accessed 24 Apr 2020; Paul K. Van Riper, *Ship-To-Objective Maneuver* (concept paper,

Marine Corps Combat Development Command, 25 Jul 1997), 3–24, http://www.globalsecurity.org/military/library/policy/usmc/stomfinal.pdf, accessed 24 Apr 2020; Director, Concepts Division (C4I), Marine Corps Combat Development Command, *Operational Maneuver From the Sea (OMFTS) Implementation Study Executive Summaries for Volumes 1 & 2* (Quantico, VA: U.S. Marine Corps, 24 Feb 1996), vol. 1: *Executive Summary*, 1-5 (quote).

86. Direct Reporting Program Manager, Advanced Amphibious Assault, *Advanced Amphibious Assault Vehicle (AAAV) Operational Mode Summary/Mission Profile* (Quantico, VA: Marine Corps Combat Development Command, 24 Feb 1997), app. B, 11–12, published with Director, Concepts Division (C4I), Marine Corps Combat Development Command, *Operational Maneuver From the Sea (OMFTS) Implementation Study (1996–2016): Final Report* (Quantico, VA: U.S. Marine Corps, 24 Feb 1996), vol. 3: *Operational Requirements Document for Advanced Amphibious Assault Vehicle (AAAV), ACAT I-D, Prepared for Milestone II Decision*, 13 Sep 2000, 21, 31, 38, 39, https://web.archive.org/web/20040124075432/http://www.efv.usmc.mil/operations/OPERATIONAL%20REQUIREMENTS%20DOCUMENT.doc, accessed 24 Apr 2020; *Advanced Amphibious Assault Vehicle Concept of Employment* (Quantico, VA: Marine Corps Combat Development Command, 20 Dec 2000), "Large Scale Ship-to-Objective Maneuver (STOM) Scenario," secs. 5.2, 5.4, 5.6, 5.7, https://web.archive.org/web/20030425051959/http://www.aaav.usmc.mil/operations/AAAVCOE/Section%205%20Large%20Scale%20STOM%20Scenario.htm, accessed 24 Apr 2020; and "Issues," sec. 6.4, downloaded from https://web.archive.org/web/20030425052500/http://www.aaav.usmc.mil/operations/AAAVCOE/Section%206%20Issues.htm, accessed 24 Apr 2020.

87. HCAS, Seapower and Strategic and Critical Materials Subcommittee, *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006 . . . Seapower*, 102d Cong., 2d sess., 7 Apr 1992, HASC No. 102-43, 93–95, 99–107, 109; "Charter for the Program Executive Office (PEO[MUW])," http://web.archive.org/web/20001019021306/http://peomiw.navsea.navy.mil/charter.htm, accessed 24 Apr 2020; Lyons et al., *Mine Threat*, 1–4, 23, 25; SCAS, *National Defense Authorization Act for Fiscal Years 1992 and 1993: Report*, 102d Cong., 1st sess., 19 Jul 1991, S. Rep. 102-113, 9–10, 44–46, 110, 112–113, 119–120; HCAS, *National Defense Authorization Act for Fiscal Years 1992 and 1993: Conference Report to Accompany H.R. 2100*, 102d Cong., 1st sess., 13 Nov 1991, H. Rep. 102-311, 484–485; *National Defense Authorization Act for Fiscal Years 1992 and 1993*, sec. 216 (105 Stat. 1317); Admiral Jeremy M. Boorda, *Mine Countermeasures—An Integral Part of Our Strategy and Our Forces*, white paper (Washington, DC: Office of the Chief of Naval Operations, Dec 1995), http://fas.org/man/dod-101/sys/ship/weaps/docs/cnopaper.htm, accessed 24 Apr 2020; Ivan Eland, *Putting "Defense" Back into U.S. Defense Policy: Rethinking U.S. Security in the Post–Cold War World*, Praeger Security Series (Westport, CT: Praeger, 2001), 186; Erwin, "Navy Faulted for Slow Going in Fielding Anti-Mine Systems"; John Hamre, interview by Al Goldberg and Rebecca Cameron, Washington, DC, 15 Aug 2001, OSD/HO; GAO, *Navy Mine Warfare: Budget Realignment Can Help Improve Countermine Capabilities*, GAO/NSIAD-96-104 (Mar 1996), 3–4, 20–23, 35, 38; GAO, *Navy Mine Warfare: Plans to Improve Countermeasures Capabilities Unclear*, GAO/NSIAD-98-135 (Jun 1998), 1–9; Sandra I. Erwin, "Shallow-Water Mines Remain 'Achilles' Heel' of U.S. Navy," *National Defense*, 1 Jan 2002, https://www.nationaldefensemagazine.org/articles/2001/12/31/2002january-shallowwater-mines-remain-achilles-heel-of-us-navy, accessed 24 Apr 2020; Committee for Mine Warfare Assessment, *Naval Mine Warfare*, 3, 19, 25, 35–37, 101–103, 116–117, 120–121 (quote, 102). "Shallow water" referred to the zone in which the water ranged from 40 to 200 feet deep, while the "very shallow water zone" represented water 10 to 40 feet deep, and the "surf zone," the water from 10 feet deep to the beach. The beach itself was the "craft landing zone."

88. Director, Concepts Division (C4I), Marine Corps Combat Development Command, *Operational Maneuver From the Sea (OMFTS) Implementation Study Executive Summaries for Volumes 1 & 2*, vol. 1: *Executive Summary*, 3; vol. 1, sec. 4.2.7; vol. 3, sec. 4.4.1.

89. Ronald O'Rourke, *Navy LPD–17 Amphibious Ship Procurement: Background, Issues, and Options for Congress*, CRS Report RL34476 (Washington, DC: CRS, 16 Mar 2011), 17–19;

GAO, *Improved Management Practices*, 55–61; Hunter Keeter, "Navy Delays LPD–17 Delivery, Cost Increases," *Defense Daily*, 16 May 2001, 1; Harold Kennedy, "LPD 17 Readies for Oct. '04 Sea Trials," *National Defense*, 1 Oct 2003, https://www.nationaldefensemagazine.org/articles/2003/10/1/2003october-lpd-17-readies-for-oct-04-sea-trials, accessed 24 Apr 2020.

90. Corinne Reilly, "Shipshape? The *San Antonio*, Finally, Almost Is There," *Norfolk Virginian-Pilot*, 27 Feb 2011, copy in author files; "LPD–17 Reliability Issues Surface Again," *Defense Industry Daily*, 9 May 2011, http://www.defenseindustrydaily.com/lpd17-reliability-issues-surface-again-03235/, accessed 24 Apr 2020; Christopher P. Cavas, "'We Thought We Had It Licked': LPD–17 Woes Vex U.S. Navy, Northrop," *Defense News*, 25 Jan 2010, http://www.defensenews.com/article/20100125/DEFFEAT04/1250314/, accessed 24 Apr 2020; "A Leadership Culture That Selectively Applies Accountability," *Information Dissemination* (blog), 29 Oct 2010; Tony Capaccio, "Northrop Navy Ships 'Not Survivable' in Combat, Official Says," *Bloomberg*, 28 Oct 2010, https://www.bloomberg.com/news/articles/2010-10-28/northrop-navy-ships-not-survivable-in-combat-u-s-defense-official-says, accessed 20 Apr 2020. For a detailed and comprehensive rundown of press reports relating to the LPD 17, see O'Rourke, *Navy LPD-17,* 19–51.

91. Cavas, "'We Thought We Had It Licked,'" 1–4; O'Rourke, *Navy LPD–17*, 22; Reilly, "Shipshape," 1–6 (quote, 5); "LPD–17 Reliability Issues Surface Again."

CHAPTER XIV

Restructuring the Defense Industry, 1989–2001

There was a time when the United States relied heavily on federal government arsenals and shipyards to produce weapons and warships, at least on a relatively small scale during peacetime. But those days were long over. During the Cold War, much arsenal and shipyard activity went to private industry. Arsenals found themselves restricted to research and development on a few technologies and manufacturing processes, and shipyards were relegated to repair, maintenance, and modernization. A number of government facilities were closed. Industry and its champions in Congress fought fiercely to acquire the remaining work in those installations. Although the Defense Department continued to play an essential role in the acquisition of major weapon systems—setting policy, determining acquisition strategies, allocating resources, formulating requirements, issuing contracts, monitoring development and production, and testing the products—industry performed the day-to-day, nuts-and-bolts work of making them.[1]

By the end of the Cold War, the defense industry had begun to decline and suffer some of the same competitive weaknesses that had hampered civilian industry for more than a decade. The George H. W. Bush and Clinton administrations viewed the state of the defense industry much differently. Under Dick Cheney, the Defense Department saw limited potential impacts from the industry's weaknesses and favored a minimal level of government intervention. In contrast, the Clinton administration considered the problems in the industrial base to be so serious as to warrant active intervention. It broke down barriers between the defense and commercial sectors of the economy and promoted dual-use technologies that would benefit both to shore up the base. The administration also did not oppose mergers and takeovers that would preserve critical defense research, development, and manufacturing capabilities.

DECLINE AND RESTRUCTURING

By the 1990s the characteristics of the defense industry were well established. An industrial base of manufacturers and suppliers supported the acquisition of major weapon systems. Large firms, known as prime contractors, received contracts to develop and build a complete weapon system. Because of the specialized work and the complexity of government contracting, prime contractors focused almost entirely on the government market, often just defense, or were defense-oriented divisions of large companies. Sometimes two or more of these companies formed a team to win a contract, a practice dating back to the late 1950s that was increasingly encouraged by the Defense Department. The primes assembled and integrated the various elements of a weapon system, a task becoming more difficult as weapon systems were combined into systems of systems. The primes could either produce their own hardware or leave that work to others. Whether they decided to "make or buy," however, the primes were still responsible for producing the complete system.[2]

Typically the primes subcontracted a large proportion of the work—often 60–70 percent. The subcontractors produced the subsystems and major components of a weapon system. For example, the illustration of the F–22 program's prime contractors and major subcontractors shows the companies providing airframe components to or performing specialized manufacturing processes for Boeing Military Aircraft and Lockheed Martin Fort Worth, the subcontractors responsible for the aircraft's aft fuselage and wings and mid-fuselage, respectively. Subcontractors could also contract separately with the Defense Department, which then supplied their products to the weapon system program as government furnished equipment. Subcontractors ranged from small manufacturers such as machine shops to large corporations, often companies holding prime contracts in other programs.[3]

Subcontractors in turn were fed by suppliers of parts, materials, and machine tools. These companies varied in size but typically employed fewer than 100 workers. Some were commercial firms producing items for the open market that were generic in nature, such as metal fasteners. Others focused entirely on the defense market, producing highly specialized goods with no civilian application.[4]

The number of subcontractors and suppliers in a given program could be quite large. For example, a Department of Commerce study found that as of 1988 the High-speed Anti-Radiation Missile program, developing a system designed to destroy enemy radar units, included one prime contractor (Texas Instruments), five major subcontractors, 765 subcontractors making components, and 6,053 parts and materials suppliers. The industrial base of the three weapons in the study—HARM, the Mark 48 torpedo, and the Verdin Communications System—included 4 primes, 8 major subcontractors, 1,169 lesser subcontractors, and 10,469 suppliers. Because nearly 40 percent of these provided more than one product, the total included 7,074 individual companies.[5]

By the time the Bush administration took office, contraction had affected all levels of the industrial base. Fewer firms remained to execute prime contracts, as a number had merged with other companies, left the defense business, or ceased operations altogether. The Center for Strategic and International Studies estimated that between 1982 and 1987 the number of companies providing goods to the Defense Department in key defense sectors dropped 67 percent, from 118,489 to 38,007. In some sectors the losses were huge. The number of suppliers of non-powered valves, for example, dropped from 1,310 to 420, and those for navigational

F–22 Fighter Prime Contractors and Major Subcontractors as of 1997

Aircraft Prime Contractor: Lockheed Martin
Propulsion Prime Contractor: Pratt and Whitney

Airframe

Two principal subcontractors to Lockheed Martin prime

- Boeing Military Aircraft—Aft Fuselage and Wings
- Lockheed Martin Fort Worth—Mid Fuselage

Major subcontractors

- Alliant Technologies—Composite Pivot Shaft
- Howmet Castings—Titanium Castings
- Dow Chemical-United Technologies—Resin Transfer Molded Struts, Spars
- Lockheed Martin Skunk Works—Machining
- Wyman-Gordon—Forgings
- Chemtronics—Chemical Milling
- Aerojet—Electron Beam Welding
- Pratt and Whitney—Nozzles

Avionics

Two principal subcontractors to Lockheed Martin prime

- Boeing Military Aircraft
- Lockheed Martin Fort Worth

Major subcontractors

- Northrop Grumman/Texas Instruments—Radar
- Texas Instruments Defense Systems and Electronics Group—Power Supplies
- Lockheed Sanders—Electronic Warfare
- TRW Military Electronics and Avionics Division—Communication/Navigation Identification (CNI) Electronics
- Motorola Communications Division—Data Processor
- Hughes Aircraft Company Radar and Communications Systems—Common Integrated Processor (CIP)
- Harris Government Aerospace Systems—Fiber Optics
- Fairchild Defense—Data Transfer Equipment/Mass Memory
- Lockheed Sanders Avionics Division—CNI Apertures, Hard Disk Drives, Graphics Processor Video Interface
- General Electric Corporation–Marconi—Head-Up Display
- Flight Controls: Lockheed Sanders—Hard Disk Drives; General Electric Corporation–Marconi—Head-Up Display

Weapons

- Lockheed Martin—Tactical Aircraft Systems
- EDO Corporation—Advanced Medium Range Air-to-Air Missile Launcher
- General Dynamics Burlington—Gun
- Curtiss Wright—Door Drive[1]

instruments from 668 to 166. Meanwhile, 4,000 companies stopped selling airframe structural components, and 600 left the antifriction bearing business. During the 1980s the number of shipyards fell by 50 percent and the shipbuilding industry's skilled labor force contracted by 30 percent.[6]

Some of the contraction was a consequence of the cumbersome procedures regulating the relationship between the government and industry. Companies stopped selling to the government because they deemed the cost of doing business too high. The barriers to entry into the defense marketplace included the number and complexity of federal and DoD-specific acquisition regulations, the use of military specifications and standards, the requirement to release technical and cost data to the government, and differing accounting procedures and standards. Furthermore, the distrust and even hostility between government and industry, caused largely by scandals and public accusations of waste, fraud, and abuse, led to a tightening of contracting regulations and policies, including a reduction in progress payments, expanded use of fixed-price contracts for R&D, and the imposition of more restrictive ethics laws and regulations. All this made defense contracting less attractive to corporate leaders than selling to private customers (see chapter VI).[7]

The economic globalization underway since the 1970s also affected the industry's decline. Foreign manufacturers, often using more modern tools and processes, had become increasingly competitive with American industry. Writing in 1989, Jacques Gansler, who would become the acquisition under secretary in the second Clinton administration, noted that "most weapon systems and subsystems today are dependent on offshore producers for numerous critical components." In some cases, overseas competition drove American commercial firms out of the defense market. This development had the potential to leave important technologies in the hands of foreign companies and make them the sole suppliers. This was the case in the semiconductor industry. Although U.S. firms had invented semiconductor technology and still led the world in microprocessor research and development, by the end of the decade the nation "was losing out in the semiconductor field." U.S. companies had also lost leadership in other critical technologies such as numerically controlled machine tools and precision optics.[8]

Aging equipment and lack of capital investment to improve efficiency and cut costs limited the competitiveness of established defense firms. A 1987 investigation found that Grumman Corporation, for example, used equipment with an average age of 34 years and employed largely manual processes to produce the F–14 fighter. This resulted in a high rate of defective parts, wasted materials, and schedule delays—all adding up to higher costs. In general, defense contractors invested in modern manufacturing equipment at only about half the rate of commercial sector firms. The Defense Department and its contractors usually considered the need to produce the best weapons at the most economical price to be more important than sustaining U.S. industry by purchasing lower quality or more expensive items. This was particularly true of the primes and other contractors that were open to buying overseas or subcontracting with foreign companies to meet cost, schedule, and performance requirements.[9]

Pentagon budget reductions added to the pressures on the defense industry. Beginning in 1986, defense spending, adjusted for inflation, started to decline from the big budgets of the early 1980s. The end of the Cold War and the subsequent demands of the American public for a peace dividend promised more cuts. The Bush administration was determined to decrease the Defense budget, especially procurement funds. It was steadily—and frequently—revised downward: four times in one year, 1989. The "Year of the Four Budgets" was an unmistakable warning of what was to come. (See chapter I for Defense budget totals in the 1990s.)[10]

The defense industry responded in a variety of ways to an uncertain future. In a wave of consolidation, a number of companies sold off defense divisions to focus on civilian product lines. The acquiring firms, generally large prime contractors, began to consolidate the defense market. Ford Motor Company sold Ford Aerospace to Loral in 1990; LTV sold LTV Aircraft Division to Northrop in 1990 and LTV Missiles Division to Loral in 1992; General Electric sold GE-Aerospace to Martin Marietta in 1992; and General Dynamics sold GD-Missiles Systems to Hughes that same year.[11]

Mergers and acquisitions were some of the strategies businesses pursued to adapt to the shrinking defense market. Other companies diversified outside of military sales or converted to commercial production altogether. Some firms exported arms and some formed teams with other companies when bidding on and executing contracts in order to pool resources and technical talent. These strategies carried their own risks; it could be difficult to shift from defense to commercial production. Firms went out of business or merged with their competitors. Of the 12 manufacturers supplying gears in 1988 for the three weapon systems examined in the Commerce Department study, one was bought by a British company, one left the defense industry, and four went out of business or were in bankruptcy proceedings by the end of 1991.[12]

Meanwhile industry survivors hunkered down to await better days. They found ways to trim costs, such as downsizing their workforce, reducing capital expenditures, and cutting back investments in research and development. A study of 25 large prime contractors showed they reduced employment by 608,000 workers, a quarter of their total workforce. Only three expanded their workforce.[13]

Exacerbated by continuing cutbacks in the budget, vulnerabilities in the defense industrial base raised concerns in the 1990s. For one, a decrease in the number of defense-oriented prime contractors and subcontractors increased the risk of loss of sources for critical items and technologies. A 1994 estimate held that the drop in the number of subcontractors for any given program ranged from 50 percent to 80 percent. Many components and parts were so specialized and produced in such small quantities that only a handful of companies made them—sometimes only one or two. The loss of a single firm could jeopardize the Defense Department's ability to acquire the product. The case of Avtex Fiber Inc. illustrates the problem. Avtex was the sole source for a rayon material used in rocket and missile nozzles. Already in a weak financial state, Avtex was charged with violations of state safety and environmental regulations. Lacking the resources to correct the deficiencies, it shut down the plant producing the rayon material in November 1988. The crisis demanded quick action because end-item production schedules were disrupted and the liquid wood pulp began to harden in the idled production equipment. Ultimately the government—the Air Force and NASA—had to step in to prop up the company. The assistance, totaling $44 million, included advance product orders, increased unit prices, and a $20 million direct payment under the National Defense Commerce Act to resume production.[14]

Even if suppliers remained in business, a smaller industrial base diminished competition, leading to potentially higher prices for the Defense Department. Moreover, the government's ability to increase production in an emergency, or during a surge in demand, might be endangered. It would, for example, be more difficult to expand the production of munitions to replace those expended during a conflict. These problems occurred throughout the industrial base but especially with primes and subcontractors.[15]

The shrinking industrial base created a situation of special concern—the growing dependence of the United States on foreign manufacturers and the vulnerability that might result if access to an essential product were lost. If American firms were driven out of a product market or refused to sell to the government, the Defense Department would be dependent on overseas suppliers. This dependency could be critical in wartime if the product or raw material was available only from a single supplier or country that refused to sell to the United States.

A couple of factors could ameliorate the problem of foreign dependence and consequent vulnerability. Overseas suppliers were usually located in allied countries that were unlikely to cut off sales of defense equipment to the United States. During the Gulf War, the Defense Department encountered little difficulty in this respect, although there were rumors that Japanese companies were reluctant to divert critical microchips away from the commercial market and were persuaded to do so only by pressure from the United States and Japanese governments. Additionally, globalization had the advantage of promoting the use of common technology among American allies, an exceptional benefit in an era when coalition warfare was expected to be the norm. Nonetheless, potential vulnerabilities caused by dependence on foreign suppliers naturally made many nervous.[16]

Determining the impact of foreign dependence or even the number of foreign or domestic suppliers was difficult. Don Fuqua, president of the Aerospace Industries Association, referred to the defense industrial base as an "iceberg," with the prime contractors the visible tip and the great bulk of subcontractors hidden beneath the surface. Neither the federal government nor the primes tracked the size of the pool of potential suppliers. In its study of the supply chain for three weapon systems, the Commerce Department found that of the 7,074 companies involved, 327, or less than 5 percent, were foreign-owned, and foreign purchases represented between 4.7 percent and 39.8 percent of the total procurement dollars spent on these programs. Even with data on the supply chain, the Defense Department lacked an efficient way to determine soft spots caused by a limited number of domestic suppliers. During the Avtex crisis, the department had to review program and budget documents manually to determine technology requirements and vulnerabilities because its information systems did not contain data on requirements or industrial capabilities. During the early 1990s, as attention focused on the condition of the industrial base, Congress required DoD to provide the information necessary to assess potential weaknesses.[17]

THE BATTLE OVER INDUSTRIAL BASE POLICY

As worries about the defense industrial base intensified in the late 1980s and early 1990s, the Defense Department, Congress, industry trade groups, and private research organizations began investigating its condition. Two themes ran through the analyses. First, the government needed to know more about the status of critical industries and technologies, the extent of U.S. dependence on foreign sources and the effect on DoD vulnerabilities, and the impact of program and budget decisions on the industrial base. The information was a prerequisite to effective action. Second, armed with up-to-date and comprehensive data, the administration needed to offer a vision for the future of the defense industrial base and explain how it intended to achieve that vision. Many analysts argued government had to participate in the process of restructuring the defense industry.

The studies and reports suggested direct and indirect tools the government could use to strengthen the defense industrial base. One approach would make contracting with the government more attractive for both defense and commercial firms through deregulation, changes to tax laws, an increase in progress payments, and reimbursement of industry-funded R&D. A second approach would remove barriers restraining companies from participating simultaneously in commercial and defense markets and encourage them to design and develop dual-use technologies. A third approach would adopt an interventionist policy for the defense sector that would include subsidies to maintain critical production capabilities and protect trusted defense firms threatened by international competition. These approaches were not mutually exclusive. Together they offered policymakers a range of options to support the defense industry.[18]

In response to congressional direction, the Defense Department (and others, including Commerce) in the late 1980s began putting together lists of "critical technologies" and identifying the investments required to develop them. A DoD report, mandated by Congress and issued in 1990, described the state of the industrial and technology base for each critical technology.[19]

Congress subsequently expanded the information-gathering requirement to include industrial base assessment. It asked the Defense Department to evaluate the ability of businesses "to maintain a viable production base in critical areas of defense production and technology" at current and projected spending levels. Responding in November 1991, the department focused almost entirely on major prime contractors, for which published data was readily available. It acknowledged budget cuts were causing hardships. In the military aircraft industry, for example, five of the six major aircraft makers had experienced drastic drops in net earnings and capital investment and a sharp rise in corporate debt in relation to equity. Nonetheless, claimed DoD, even a reduced industrial base in the aircraft, missiles and space, electronics, shipbuilding, and combat vehicle sectors would be adequate for future requirements. The companies could potentially make up for lost business through export sales and conversion to commercial work. The department did concede that international competition would limit overseas sales and that conversion would be

DoD Critical Technologies

Technology Areas

- Air-Breathing Propulsion
- Composites
- Machine Intelligence
- Passive Sensors
- Photonics
- Semiconductors
- Sensitive Radars
- Superconductivity

Technology Areas of Lesser Focus

- Biotechnology
- Computational Fluid Dynamics
- Data Fusion
- High Energy Density Materials
- Hypervelocity Projectiles
- Parallel Computer Architectures
- Pulsed Power
- Signal Processing
- Signature Control
- Simulation & Modeling
- Software Producibility
- Weapon System Environment[II]

difficult for many parts of the industrial base, except electronics. In some industries, such as military shipbuilding, there was no civilian market for their products. But DoD asserted it could take adequate steps to mitigate the impact of production line closures: "Even where facilities are not needed or cannot be economically operated under prevailing conditions, some potential for them to reenter the defense market to meet future needs will exist and where necessary, those facilities can be retained in a mothballed status."[20]

The Defense Department had taken limited actions to support its industrial base. These included an effort to help firms improve their manufacturing technology (known as the ManTech program), to encourage the integration of defense and commercial industrial sectors by promoting the acquisition of dual-use technologies and commercial products, and above all to maintain the RDT&E budget at a relatively high level, especially in critical technologies. The department also believed the newly issued revision of the 5000 series acquisition documents would promote the "maximum practical use of off-the-shelf commercial products." Additionally, the guidance "will give impetus to the modification of other procurement regulations and will result in the adoption of procedures that are more consistent with commercial practice."[21]

The Defense Department remained optimistic its existing authorities would be sufficient to sustain an adequate industrial base despite the decline in military spending. Although noting that cutbacks in shipbuilding had caused the loss of smaller suppliers—25 percent between 1980 and 1990—with the result that some critical products were available from only one source, DoD nonetheless concluded that the industrial base was "adequate" for its shipbuilding requirements and that "oversight of the sector will continue to ensure critical capabilities will be maintained." Similarly, when the government was the sole market for an essential technological or production capability critical to national security, then DoD would "take appropriate action to ensure continued availability."[22]

The department also addressed industrial base policy in congressional testimony and a white paper issued in spring 1992 as part of its "new approach" to defense acquisition (see chapter V). This initiative was intended to support the administration's military strategy, which called for maintaining a relatively small Base Force sufficient to deal with regional threats and the capability to reconstitute a large, Cold War–size force if required to deal with a major global threat. The Pentagon wanted to ensure that industry could support the reduced Base Force and periodic contingency operations efficiently and cost-effectively, and that it could expand its production capacity. DoD had a four-step process to achieve these objectives: continue to procure "cost effective, producible, and necessary systems" superior to those of potential opponents; develop advanced manufacturing technologies to improve the efficiency of production; establish an "industrial base oversight process" to ensure the continued availability of critical products, manufacturing processes, and capabilities; and stimulate competition and efficiency. Industrial base oversight involved monitoring industry for potential shortfalls by tracking the production of critical products or processes. If a critical product or process was expected to be unavailable, and if there were no alternatives, then the Defense Department could choose from a range of actions, such as providing the affected companies with maintenance and repair work then being performed by government facilities or performing the R&D necessary to find a substitute capability. Only in rare circumstances would the department consider directly funding production. For example, nuclear propulsion had no civilian applications and would be hard to maintain if production were shut down; in that instance, DoD was "studying its options." On the other hand, although the Pentagon's proposed five-year plan would halt tank production for several years, "no extraordinary actions beyond prudent shutdown planning and execution [are] required. There are enough tanks available now to meet any perceived contingency, and there is enough time to reconstitute the tank industrial base if a global threat emerges." DoD calculated it would take years for a global competitor to arm itself sufficiently to challenge the United States, giving ample time for the country to rearm, as it had done in crises past.[23]

On the whole, Cheney's Defense Department believed market forces would ensure the survival of the key components of the defense industry, with only limited government intervention. The Bush administration, led by White House Chief of Staff

John H. Sununu, Office of Management and Budget Director Richard G. Darman, and Council of Economic Advisers Chairman Michael J. Boskin, shunned any kind of "industrial policy," considering that it amounted to "picking winners and losers" among competing businesses or technologies. The free market would determine the proper size and structure of the defense industry, as it did for the American economy as a whole. "In a broad context," the Defense Department informed Congress, "free market forces will guide the industrial base of tomorrow. The ability of the base to meet future DoD needs will depend in large measure on the ability of individual companies to shift from defense to commercial production—and then back again, when required."[24]

The Bush administration's generally laissez faire attitude toward the defense industrial base came in for criticism. Advocates of an interventionist industrial policy pointed out the defense market was not "free" in the usual sense because there was only one buyer. The government set the rules for transactions and chose the sellers, not just through competitions for contracts but by the very act of making decisions on what systems to acquire, what their characteristics would be, and how many of them to buy. Additionally, the critics questioned the assumptions that defense companies could easily convert to commercial production and that they could then be persuaded to reconvert during a crisis. They doubted that expanding the purchase of commercially produced dual-use products could make up for any materiel shortfalls that might occur.[25]

The premise that production capabilities would be available whenever needed seemed dangerous to critics of the hands-off approach. Commercial firms might be able to produce tank engines—but what if they preferred not to, or what if they were unable or unwilling to sell to the government? "There are no forces in the free enterprise system that encourage corporations to behave in a manner which preserves any particular capability to provide national defense," testified Norman R. Augustine, chairman and CEO of Martin Marietta. "That is, companies which can make greater returns from building plowshares rather than swords, will most assuredly do so." Furthermore, the time required to reopen closed production lines or convert from commercial to military production was undoubtedly far greater than the Defense Department recognized, even if the country had ample strategic warning of an impending conflict. As a 1993 GAO study noted, subcontractors on the M1 Abrams tank program indicated that reconstituting production capabilities would take from six months to five years, depending on whether they had comparable commercial business to keep their lines open. One of the 14 companies the General Accounting Office surveyed stated it would go out of business if tank production ceased; another said it would not reopen its production lines if the program closed and then restarted. "Once lost, it takes years to rebuild a defense industrial base—if it is possible at all," Augustine testified. The key bottleneck, he stated, would be among the smaller suppliers, which "have unique technical capabilities, little financial strength and virtually no motivation to remain in the defense sector if they have any other alternatives." Such firms were "disappearing at an alarming rate."[26]

Congress also rejected the idea that market forces would preserve the defense industrial base and that intervention was largely unnecessary. It was willing to continue the production of certain weapon systems, despite Cheney's objections, in order to preserve the industrial base and their constituents' jobs. At first, Congress was willing to terminate some weapon programs, but by summer 1990 the country had slipped into a recession that, although relatively mild, would be followed by a sluggish recovery. Defense manufacturing represented a sizable proportion of job losses during the downturn. The aircraft and guided missile industries together lost approximately 190,000 jobs between 1989 and 1992. The Congressional Budget Office estimated that projected Defense budget cuts would result in about 1.1 million people—military, DoD civilian, and private sector—losing their jobs in defense-related industries by 1995, a figure frequently mentioned in the press.[27]

In addition to manufacturing, proponents of an aggressive industrial policy were concerned about private-sector research and development. Industry research had declined sharply, especially in work without a short-term payoff. Increased competition from Japan and other countries in current-generation technologies, sometimes aided by government-sponsored research, led some to argue that the government should support additional research to keep American industry competitive and ensure that the U.S. military always had access to the most advanced ideas and capabilities. The Bush administration, however, opposed government funding for research as part of an industrial policy, especially in areas that could influence commercial market competition. For example, the administration attempted unsuccessfully to cut funding for the Semiconductor Manufacturing Technology (SEMATECH) program, a Reagan-era initiative responding to Japanese strength in semiconductor production. It was willing, however, to offer limited support for research in dual-use technology deemed to have military applications.[28]

The issue of government funding for research became a flashpoint in 1990, in part because Congress had authorized DoD through the Defense Advanced Research Projects Agency to support organizations involved in research and development with clear commercial applications. DARPA was the Defense Department's hothouse for the development of high-risk, high-payoff technologies. The agency was not a laboratory in the traditional sense, because it did not perform research itself but instead provided support to academia and industry, usually on a project-by-project basis. DARPA had been funding research on dual-use technologies for many years in such areas as information processing, networking, and materials science. Thanks to its highly talented program managers, lack of bureaucracy (only one layer between the program manager and the director), and an unusual degree of autonomy, the relatively small organization enjoyed some spectacular successes. For example, DARPA had a significant role in developing the Internet. Many observers in Congress and research firms considered the agency the model of what a federal R&D organization should be, and there was considerable talk in the late 1980s and early 1990s about creating a civilian version. Barring that, the next best thing was to let DARPA become more active in promoting the development of technologies for the civilian economy. Congress gave the agency control of the SEMATECH program and responsibility for carrying out some of its initiatives, such as the development of flat panel displays and high-definition television.[29]

DARPA's director, Craig I. Fields, an advocate of government intervention in technologically competitive industries, especially in the electronics industry, was happy to oblige. He owed his appointment as director in spring 1989 to Robert Costello, then under secretary for acquisition, who shared his views. Fields immediately began to work with Congress to implement an activist program. The National Defense Authorization Act for 1990 and 1991 permitted DARPA to enter into "cooperative agreements and other transactions" with any organization, including industry (see chapters VIII and XIII). The provision allowed the agency to receive payment in some form for its support and then keep the money for further use, without having to return the funds to the Treasury Department. This was not a loan, however, but an investment: Like a venture capitalist, the agency could make a profit and apply it to new investments. Congress itself considered these "flexible agreements" an experiment and allowed DARPA to invest up $25 million a year for two years, though it had to do so without additional funds.[30]

In spring 1990 DARPA made its first investment, $4 million in a company called Gazelle Microcircuits. Gazelle was attempting to make microchips out of

Craig Fields, director of the Defense Advanced Research Projects Agency, 1989–1990. *(DARPA)*

Craig I. Fields

After teaching at Harvard for a few years, Craig Fields joined the Defense Advanced Research Projects Agency (then ARPA) in 1974 as a program manager in the information processing techniques office, rising to become the agency's director in 1989. Initially, he worked on the Arpanet (which evolved into the commercial Internet) and in the ensuing years on artificial intelligence, the development of low-cost networked simulators, and quantitative decision-making models.

Fields landed on his feet after his dismissal from the DARPA director post. He entered the private sector, serving from 1990 to 1994 as chairman and CEO of Microelectronics and Computer Technology Corporation, a for-profit R&D consortium of companies active in information technology. For the next quarter century he would be a member of the boards of directors and advisory boards of numerous companies primarily associated with information technology. He also maintained his ties with the Defense Department, holding the chairmanship of the Defense Science Board from 1994 to 2001, and again from 2014 to 2020, and serving on other government advisory boards.[III] gallium arsenide, a semiconductor that was faster and more radiation resistant than silicon, but harder to work with. The agency acted to forestall the Japanese, who had expressed an interest in investing in the company. In true DARPA fashion, the 12-page contract took only two weeks to negotiate and was signed on 6 April. Under the agreement the agency would receive either royalties of 1 percent to 3 percent of net sales over 15 years, or cash payments based on the price of the company's stock. Although DARPA would own no stock in the company itself, the government could veto the sale of the products or even of the company to prevent the technology from falling into hostile hands.[31]

The Bush administration reacted swiftly, abruptly reassigning Fields to a new post elsewhere in the Office of the Secretary of Defense only two weeks after the contracts had been signed. His removal provoked a sharp bipartisan reaction in Congress, which, after all, had created the new authority for DARPA. Fields's reassignment stood, but so did the deal with Gazelle, though the agency was warned to focus on traditional contracting vehicles in the future. "Cooperative agreements and other transactions," in revised form (without the money-making provisions), would become a valuable tool for the Defense Department to promote research throughout the 1990s and beyond. Meanwhile, the debate over DARPA's role in industrial and technology policy continued. Several attempts to establish a civilian version of the agency failed. In 1991, for example, a task force of the Carnegie Commission on Science, Technology, and Government called for transforming DARPA into a National Advanced Research Projects Agency. This initiative failed in Congress.[32]

THE PROMISE AND PERIL OF DUAL-USE TECHNOLOGY

The Clinton administration was determined to take an active approach to the industrial base. It underscored this intention by creating another appointed position—the assistant secretary of defense for economic security who was to formulate policy for matters relating to the defense industry, dual-use technology, infrastructure, base closing, economic adjustment, and international cooperative programs. Additionally, the new assistant secretary was to track the health of the industrial base and act as a liaison between government and industry. The first incumbent, Joshua Gotbaum, was a former congressional staff member and Jimmy Carter appointee who, following his initial government service, had spent 13 years as an investment banker specializing in corporate finance and mergers and acquisitions. He was confirmed in May 1994. The Clinton administration also created the Defense Industrial Base Oversight Council, headed by the assistant secretary for economic security, to act as a "management board of directors" and to conduct a review of the industrial base. Later the council was upgraded to the Industrial Base Executive Committee, chaired by the under secretary for acquisition and technology and comprising senior OSD staff and the service acquisition executives.[33]

The Defense Department's top priority was to ensure its access to the latest technology to maintain the U.S. military edge. While the Bush administration had funded research and development, its successor was more comfortable with an activist industrial policy that would promote technology development in the commercial and defense-oriented sectors of the economy. Ideally, this would strengthen both U.S. military capabilities and civilian competitiveness in global markets. DARPA was to lead the way in promoting the Defense Department's vision for developing dual-use technology as part of a broader program to reduce barriers between defense and civilian technology and production. In fact, for a short time, 1993–1996, the agency was called ARPA again, the "D" being dropped to emphasize that it also had a role in the civilian economy. The vision included three "pillars" representing R&D, production, and technology application. Research and development investments were to be made in technologies chosen for their importance to defense needs and their potential for commercial use. Both the commercial and military products, if different versions were required, would then be produced in the same facilities with the help of new manufacturing technologies. The Defense Department expected a commercial market, if large enough, would lead to increased production runs, economies of scale, and lower overhead costs per unit. These in turn would result in reduced acquisition costs for the government, as compared with maintaining a production base dedicated to, and paid for by DoD. Finally, using modular designs and commercial standards, the technologies were to be inserted into weapon systems, either as part of a new development or an upgrade.[34]

Joshua Gotbaum, assistant secretary of defense for economic security, 1994–1995. *(NARA)*

In FY 1995 the department's investment of more than $2 billion in dual-use technology research represented approximately 25 percent of its total science and technology budget. Of course, DoD and other agencies had long been sponsoring R&D in critical technologies, with commercial applications an incidental spinoff of these investments. This funding was different. Now the government intentionally used defense funds to develop technologies for civilian as well as military use. Furthermore, the government intended to promote the commercialization of the technology and encourage firms to perform R&D through "flexible partnership agreements" that limited the government's right to the results. The idea was to nurture the new industry until it became self-sustaining, enabling the government to remove its support and buy the products commercially. Ultimately, the theory went, the initial investment would be more than recouped by future savings from lower costs. The only technologies the Defense Department would have to develop and manufacture specially would be those unique to the military, such as nuclear propulsion, for which there was no civilian market.[35]

The test case for the new dual-use technology policy was the manufacturing of flat panel displays, which held considerable advantages over cathode-ray tube (CRT) displays, long a standard for televisions and computer monitors. Flat panels were thinner, lighter, and more reliable; used less power; and gave off less heat than CRTs. Their cost was still very high, but dropping fast; their image quality did not match that of CRTs, but it, too, was improving rapidly. Flat panel displays were just starting to become commercially available in quantity at the time of the Gulf War, mostly for use in laptop computers. Operation Desert Storm had shown that future battlefields would likely be swamped with data, suggesting the value of high-quality digital images. Flat panel displays could make information, from maps to aircraft instrument panels and ship navigation systems to intelligence platforms, more accessible to the warfighter. They not only represented a substantial upgrade from CRTs, with considerable savings in maintenance costs and crew space, but also held out the likelihood of new applications previously impossible with CRTs.[36]

Few American companies, however, manufactured flat panel displays. Indeed, for the most common popular types, especially the active-matrix liquid crystal displays (LCDs), there were no producers, save for one small company, Optical Imaging Systems Inc. (OIS), which custom-made a few thousand a year for the military. American companies had invented LCD technology during the 1960s and 1970s but had then decided not to manufacture them. Now, with demand skyrocketing—sales almost tripled from 1986 to 1990, and then doubled again, to $9.33 billion, by 1994—the market had been captured by the Japanese. In 1992 Japanese firms held a 98 percent market share of active-matrix LCDs, and a 92 percent market share overall.[37]

Japanese dominance of the LCD market proved troublesome for the Defense Department, which desired assured access to a supply of custom displays that were "ruggedized" for military activities. Furthermore, the department wanted a peek at the latest technology before it was commercially marketed. The Japanese companies, however, were interested in mass producing the displays and were reluctant to customize them with great effort and for relatively little profit. Sharp Corporation, the largest Japanese manufacturer, with a world market share of 44 percent in 1993, refused to sell displays directly to the Pentagon, though it was willing to sell them to U.S. defense contractors. A preview of prototypes was certainly out of the question.[38]

In April 1993 the National Economic Council, a White House body tasked with coordinating economic policy, asked the Defense Department to lead a task force to examine the problem of American-owned LCD production and suggest a solution. A year later the department announced the National Flat Panel Display Initiative—"national" because it would involve other agencies, especially the Department of Energy, although 90 percent of the funding would go to DoD. In September the task force warned that the lack of domestic producers was a threat to national security. In 1994 the Defense Department projected it would need an average of 15,000 new flat panel displays annually between 1995 and 1999; during the next decade that figure was expected to rise to 25,000 per year, and then perhaps to 90,000 per year thereafter. This was a small quantity in terms of the overall market but more than the tiny domestic industry could deliver. The industry was then composed of about a dozen companies that were largely niche players. No American producer had the resources to compete head-to-head with the Japanese. The task force recommended the National Flat Panel Display Initiative follow the dual-use approach for a number of reasons. Flat panel displays had both civilian and military uses, commercial demand was strong and growing, and DoD would never take up more than a small slice of the market. Barriers to entering the industry were high. To build a modern, active-matrix LCD plant required an enormous investment—$400 million in capital costs alone—that commercial firms were reluctant to make. Government leadership seemed essential to jump-start the industry. The Clinton administration proposed spending $610 million on the initiative over five years.[39]

This National Flat Panel Display Initiative built on earlier ARPA research in high-definition systems, which had begun in 1989. The new program received approximately $75 million per year during fiscal years 1991 and 1992. In 1993 its budget doubled to $152.2 million. By 1994 ARPA added a test bed to study manufacturing technology and processes and give industry additional experience with producing flat panel displays. Optical Imaging Systems, then the only domestic producer of active-matrix LCDs (mostly low-volume, custom-made displays for the military market), was awarded a $48 million matching grant to build a manufacturing facility to use as the test bed. ARPA also organized a consortium of flat panel display developers, manufacturers, suppliers, and customers, commercial and military, modeled on the semiconductor consortium SEMATECH. The agency funded a number of different technological approaches in the hopes at least one would prove technologically and commercially viable and allow American flat panel display producers to leapfrog over the Japanese and their active-matrix LCDs.[40]

Two-thirds of the initiative's budget came from Advanced Research Projects Agency work, with funds providing several more manufacturing test beds and two incentive programs. Of the latter, the R&D program awarded research grants to academic and industry teams with experience in flat panel display production, on condition they match the grant dollar for dollar and commit to investing in high-volume flat panel display manufacturing. The purchase incentive program provided funds to buy flat panel displays from budding domestic producers, thereby stimulating the market. This program made use of Title 3 of the Defense Production Act, which authorized the president to procure "industrial resources or critical technology items essential to the national defense," shortcutting the normal acquisition process. Including both government grants and matching funds, the Defense Department expected the investment in flat panel displays to exceed $1.2 billion.[41]

Even as it undertook the flat panel display initiative, the Defense Department denied it was engaging in "industrial policy." The department justified the program on the basis of military necessity: The armed services needed the technology and this initiative seemed to be the most cost-effective way to acquire it. Successful commercialization and mass production were significant only to the extent they provided a domestic source for the displays and reduced their cost. Furthermore, the government was not "picking winners and losers"; it was offering matching grants to eligible recipients. And the money was to be applied to research, not full-scale production or marketing.[42]

The National Flat Panel Display Initiative was modeled on the Technology Reinvestment Project (TRP) and received support from that program. The Defense Conversion, Reinvestment, and Transition Assistance Act of 1992 established the TRP. This legislation was part of a broad effort to ease the effects of downsizing the defense establishment and transitioning military and defense-industry facilities and personnel into the civilian economy. The act appropriated $1.7 billion, some to be applied to retraining workers and supporting struggling communities, but over half, $927 million, was earmarked for Defense Department dual-use technology reinvestment intended to benefit both the military and commercial sectors. The Bush administration, which did not approve of TRP, left much of the dual-use money unspent. The Clinton administration, however, pushed forward, announcing in March 1993 that it would release the unused funds.[43]

The Technology Reinvestment Project provided funding in the form of matching grants divided into eight categories corresponding to the eight programs the original act mandated. These categories, in turn, were grouped into three main areas. Technology development programs provided seed money to cultivate new dual-use technologies and explore their application to the civilian market and to the military; technology deployment programs assisted small businesses in acquiring or upgrading dual-use capabilities; and manufacturing education and training awards supported academic institutions in teaching manufacturing processes in the classroom.[44]

The Advanced Research Projects Agency organized and managed the TRP. It was overseen by the Defense Technology Conversion Council, a multiagency body chaired by ARPA and also comprising the Departments of Commerce, Energy, and Transportation, the National Aeronautics and Space Administration, and the National Science Foundation. A council working group that included representatives of the services helped ensure the military usefulness of TRP research. The program initially solicited proposals in eight "technology focus areas," such as information infrastructure, electronics design and manufacturing, and health care technology. Later, solicitation grant recipients were restricted to teams of industry or nonprofit institutions (e.g., universities, laboratories). Foreign firms could participate if a reciprocity agreement allowed American companies to join their research programs. Each team was required to put up 50 percent of the money for its effort. From 1993 to 1995, the TRP held three rounds of solicitations and funded 133 projects with 716 participants, for a total cost of $821 million.[45]

To negotiate the agreements with the teams, the Technology Reinvestment Project used both other transaction authority, which was outside of the Federal Acquisition Regulation, and the cooperative agreements specified in the FAR. Other transaction authority provided considerable flexibility in data rights, allowing the companies to retain much of the data as proprietary—a major draw for the program. Most team agreements were for one to three years (most for two). Roughly a third cost less than $4 million, a third between $4 million and $10 million, and a third more than $10 million. Since these figures included the matching grants, the government's portion was half.[46]

A Potomac Institute for Policy Studies report evaluated the Technology Reinvestment Project favorably. The institute noted that by 1999 a third of the projects, 37, succeeded in selling their technologies in the commercial market, with 69 more expected to be marketed. About the same number of projects transitioned products or technologies to the military services. Among these, 7 continued with military science and technology funding, 24 were applied to acquisition programs in the development stage, and 14 were inserted into fielded systems as upgrades—an "extraordinarily high success rate," according to the report. These products included new shipbuilding processes for the *Arleigh Burke*-class destroyer, fiber-optic gyros for the Bradley Fighting Vehicle, and composite materials for the C–17 transport and the Joint Strike Fighter. The report estimated the Technology Reinvestment Project would save the government $900 million over 10 years. Despite the positive outcomes, the report noted some problems: not enough personnel to provide proper management, insufficient attention to the process for transitioning to military use, and a lack of government follow-through when the project ended.[47]

The shortcomings the institute identified stemmed at least in part from the Technology Reinvestment Project's failure to gain long-term political support. The dual-use policy was a long-range effort to integrate the civilian and military economies, but the Clinton administration sold it as a defense conversion effort, implying that it would provide jobs and bring some short-term relief to distressed industries—which it was unable to do. Thus the broad-based political support the TRP enjoyed at the start began to decline.[48]

Critics maintained the TRP represented government intrusion into the civilian economy and a diversion of defense funding. Programs funded with defense money, they argued, had to be justified in terms of their military utility, not their potential commercial value. Under Secretary for Acquisition and Technology Paul Kaminski acknowledged that some projects, especially in the first round of solicitations in 1994, lacked an adequate military focus, and that the Commerce Department probably should have funded the one for manufacturing education. Consequently, projects took on more of a military focus than the planners intended—a common fate for dual-use efforts. Long-standing support existed in Congress for defense R&D efforts that sought to fill military needs and that also resulted in civilian applications. However, Defense Department programs explicitly designed to develop technologies with both civilian and military applications were new and more controversial.[49]

Although the Republican-controlled Congress killed the Technology Reinvestment Project in 1995, projects underway were allowed to continue. Disappointed but undaunted, the administration continued to advance the dual-use strategy. In February 1995 the Defense Department released a report defining its approach to dual-use technology and reiterated its intention to follow it. In spring 1996 the department announced the new Dual Use Applications Program, which had two components. The first, the Science and Technology Initiative, identified dual-use technologies beneficial to the services and with potential for commercial applications. The second, the Commercial Operations and Support Savings Initiative, which Kaminski considered much more important, adapted existing commercial products to fielded weapon systems. In the first stage of a project, the product was fitted to its new purpose and used to create a prototype modification kit, which if successful was manufactured in appropriate quantities and applied to the military system. Although the Joint Dual Use Program Office oversaw the program, the services worked with industry partners, including defense prime contractors and other commercial firms, to create the kits. The program used other transaction authority to accelerate acquisition of the prototype kits and, as in TRP, required industry partners to share the costs. The Defense Department expected this initiative to improve capabilities, lower maintenance costs, and above all give the services experience in buying and using commercial products. DoD asked for $250 million for FY 1997 but received $180 million.[50]

As a model for the Commercial Operations and Support Savings Initiative, Kaminski had cited the national flat panel display program, specifically the insertion of panels into weapon systems under development. The flat panel display effort, however, began to encounter difficulties. A report issued in early 1998 by Kaminski's successor, Jacques Gansler, one of the strongest proponents of civilian and defense economy integration, stated the initiative's objective—to provide affordable flat panel displays through a dual-use supply base—was still valid "but has not yet been achieved." For one thing, the display producers had not established themselves commercially. Nor had they conducted volume manufacturing. Custom-made displays, as most were, required more extensive development and integration work than expected. Moreover, displays were often delivered later than scheduled. "In retrospect," the report noted, "many of the program managers overseeing the insertion of [flat panel displays] have concluded that the difficulties of bringing this technology into production and implementation for defense systems were significantly underestimated."[51]

Despite nurturing by the Defense Department, the domestic flat panel display industry had all but disappeared by the end of the decade. It was the victim of rapidly falling prices, declining federal funding, poor manufacturing processes, and technological dead ends. Most of the small firms producing flat panel displays in the mid-1990s had closed their doors, sold out to a competitor, or left the industry. Optical Imaging Systems, the poster-child of the National Flat Panel Display Initiative, had gone out of business. The company was by far the product's largest domestic manufacturer; by 1998 it was supplying 80 percent of the domestic flat panel displays procured by the military. In April 1998 it won its largest award to date, a $15 million contract from AlliedSignal Defense & Space Systems Division to produce 1,400 displays for the AH–64D Apache Longbow helicopter. Even so, OIS was losing money—more than $15 million over the nine months ending in March 1998. The company had not secured markets large enough to undertake the volume production required to achieve economies of scale and profitability. Unable to obtain additional funding from its principal investor, Guardian Industries, OIS closed in September 1998. The Defense Department's desire to have a single facility meet both military and civilian needs contributed to OIS's demise. One private analyst argued, "The notion that you can produce notebook displays by day and then pump out a few cockpit displays by night" overlooks the reality that they are two different industries.[52]

The Optical Imaging Systems shutdown left but a single domestic supplier of active-matrix LCDs—a partnership between the company dpiX, which manufactured the glass for the displays, and Planar Systems Inc., which added the electronics and ruggedized the units for military use. In May 1999 a consortium of six companies, including Planar Systems, agreed to buy 80 percent of dpiX from its parent company Xerox. The arrangement enabled AlliedSignal and Planar to go forward with the AH–64 contract. The domestic active-matrix flat panel display industry had survived—but not for long. Planar's military contracts proved to be unprofitable, and in September 2000 the company announced that after fulfilling them it would no longer seek Defense Department business. The company's exit forced the department to find alternatives in foreign suppliers or new technologies. The demise of the domestic active-matrix LCD industry clearly demonstrated the difficulty of attempting to produce technologies for military and civilian customers at the same time.[53]

MERGER MANIA

The Clinton administration's policy toward defense industry restructuring was to maintain the sector's key capabilities, preserve some competition, and strengthen the industrial base. When the administration came to office, the decline in spending on weapons production suggested the consolidation in the defense industry that had begun in the late 1980s would continue and perhaps accelerate. DoD's main concern was the loss of key capabilities: If a plant was shut down, could production be restarted? The previous administration, believing there would be adequate strategic warning of hostilities, showed relatively little interest in the problems of restarting production to reconstitute the armed forces. Defense Secretary Les Aspin and Deputy Secretary Bill Perry were more willing to support threatened industries and to approve industry restructuring that would preserve critical capabilities.

Faced immediately with the issue of future submarine construction, Aspin and Perry did not wait long to institute policies to maintain the defense industrial base. At that time the United States possessed 88 nuclear-powered attack submarines, with 11 more under construction at the two remaining submarine yards, Newport News and Electric Boat. Nine of the new boats were in the improved *Los Angeles* class; the other two were in the *Seawolf* class. The Navy designed the latter to meet anticipated advances in Soviet antisubmarine capabilities, which had failed to materialize after the collapse of the Soviet Union. Original plans called for 30 *Seawolfs*, but only three were built. *Seawolf*, the first of the class, had been under construction since 1989. The keel of the second, *Connecticut* (SSN 22), was laid in 1992 with the boat due for completion in 1998. The problem was the Navy did not intend to start a new class of submarines (the New Attack Submarine, later named the *Virginia* class) at least until 1998. Thus there would be a gap of seven and potentially more years between new starts. Indeed, the gap was already two years old, the excess workforce was already scattering, and suppliers were contemplating bankruptcy. Any longer, the shipyards would have to consider packing away their tools or even shutting down their facilities altogether, resulting in a prolonged and costly startup when it came time to build new submarines—if it could be done at all.[54]

Policymakers began to discuss whether production should continue or submarine construction consolidated in a single shipyard, Newport News. The second option meant the permanent loss of competition, Electric Boat's submarine design capability, and at least 6,000 jobs from that shipyard alone. Vendors and businesses in Groton would also suffer severe losses—an issue that was never far from the minds of the White House staff and congressional leaders such as Senator Joe Lieberman, a Democrat from Connecticut. Secretary Cheney admitted the problem had stumped him, so he handed it off to his successor, who ultimately chose to maintain the status quo. Aspin's decision was based on preserving the highly specialized industrial base required to build nuclear-powered submarines. In his Bottom-Up Review in fall 1993, the new secretary chose to produce the third *Seawolf* (*Jimmy Carter*) and the New Attack Submarine, which "will maintain two nuclear-capable shipyards, thereby mitigating the risk to the industrial base."[55]

Aspin also decided after the Bottom-Up Review to begin building a new aircraft carrier, CVN 76 (the future *Ronald Reagan*), in FY 1995, in part to help maintain Newport News, the only shipyard capable of constructing nuclear-powered aircraft carriers. Other Defense Department and congressional decisions, based in part on industrial issues, included plans to modify the F–16 fighter, upgrade the M1 Abrams tank, and maintain the Lima tank plant in Ohio despite no new tank production. Congress also provided $94.7 million in FY 1995 to preserve the production base of the B–2 bomber to be able to resume building it once current production ended.[56]

Deputy Secretary Perry asserted these actions were not an attempt to prop up individual companies but rather an effort to preserve specific manufacturing capabilities. "I explicitly reject the idea of supporting a defense company just to keep it in business," he told reporters. "We aren't doing it to protect jobs or to protect shareholders. This isn't a bailout." He also supported restructuring the defense industry. The procurement budget would continue to fall, and despite consolidation, the defense industry remained too large for the demand. Underused manufacturing plants led to high overhead and increased costs to the taxpayer. Better some plants close and the rest be fully utilized, he argued: "We fully expect several defense companies to go out of business, and we will stand by and watch it happen."[57]

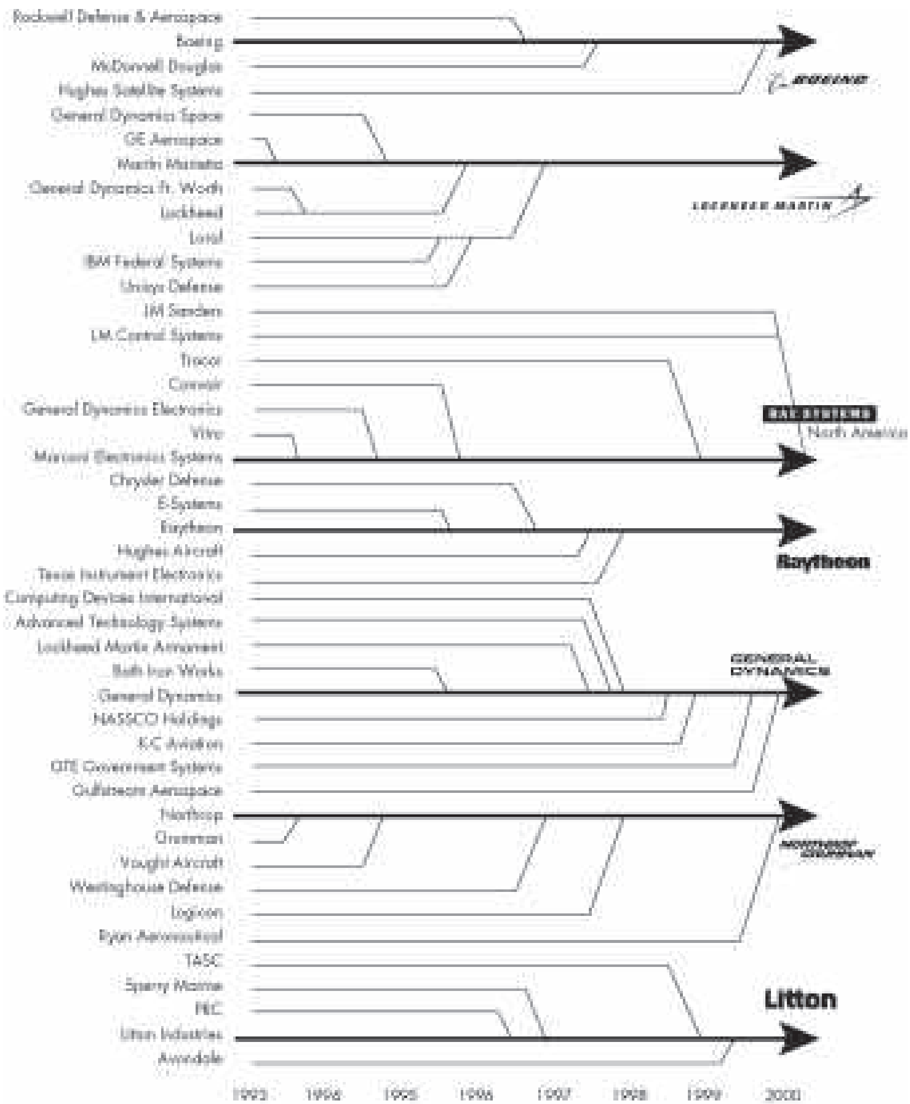
This was the message Perry delivered to industry executives at a dinner hosted by the Aspen Institute at the Pentagon in July 1993, before the announcement of the results of the Bottom-Up Review. Martin Marietta CEO Norman Augustine would later immortalize the event as "The Last Supper." After dinner, Perry gave a blunt presentation on the future of the defense industry, informing executives that by the end of the decade there would be only one manufacturer each for aircraft carriers, submarines, and tanks. There would be only two shipyards remaining of the eight then in operation, and the number of missile and rocket manufacturers would drop from three to two. Perry concluded by saying it was up to the firms themselves to decide what action to take; the Department of Defense would not tell them what to do nor stand in their way, except to ensure compliance with antitrust laws. Perry later recalled that the executives attending the dinner "listened intently" to this "sobering message." Augustine remembered it differently: "No one seemed particularly concerned at the time. CEOs . . . being CEOs, each logically assumed that they would be the 'one.'"[58]

Perry's pronouncements at the so-called Last Supper and elsewhere removed all doubt about DoD's position on consolidation in the defense industry. The Clinton administration had vowed to pursue antitrust policies actively to prevent monopolies from forming. Perry made clear the Defense Department would not do so except in the most egregious cases, giving a green light to restructuring.[59]

A spate of mergers and acquisitions followed. Some observers called it "merger mania." The Defense Science Board cited 37 mergers and acquisitions in the three years from March 1994 to March 1997—and these were just the most significant. Along the way, some of the oldest names in the defense industry disappeared from the ranks of prime contractors: Vought, Hughes Aircraft, Westinghouse Defense, Convair, Rockwell Defense & Aerospace. Companies such as Westinghouse and Rockwell used the sale of their defense operations to exit the sector altogether. A small number of prime contractors took the opposite track and became industry consolidators, buying and integrating the divested operations of other firms (see figure 14-1). Acquisitions represented the overwhelming majority of actions—33 of the 37 cited above—and of those, almost all were by mutual agreement; hostile takeovers were somewhat rare in the defense industry, at least in the 1990s. One exception was Northrop's hostile takeover of Grumman in spring 1994, the former company stepping in unexpectedly with an 11th-hour bid that snatched away a friendly deal Grumman had negotiated with Martin Marietta.[60]

Northrop's acquisition of Grumman shows the often personal nature of such deals, especially among the top executives. Grumman had been actively seeking a buyer but spurned an offer from Northrop after a year of drawn-out negotiations. Northrop CEO Kent Kresa was said to have been angry that Grumman then secretly negotiated a deal with Martin Marietta. Kresa sent a letter to Grumman chairman Renso L. Caporali, complaining that "we were not playing on a 'level playing field'"—though it should be noted Northrop had failed in other attempts to make an acquisition and the company itself was in danger of a hostile takeover. For his part, Norm Augustine was bitter about the loss. An hour after Northrop's bid, Martin Marietta described the intervention as an "attack" that "degrades the entire character of the rational consolidation" of the defense industrial base. The press release also stated cryptically that Martin Marietta would "respond to Northrop's action in an appropriate manner at the appropriate time," which was probably the origin of the rumor that instead of fighting the Northrop-Grumman deal, the company might wait until it was completed and then try to purchase Northrop itself.[61]

Figure 14-1: Consolidation in the Defense Industry, 1993–2000



Note: Some transactions not shown.

Source: American Institute of Aeronautics and Astronautics (AIAA), *A Blueprint for Action: Final Report* (Defense Reform 2001 Conference, Washington, DC, 14–15 Feb 2001), 4, http://web.archive.org/web/20050302195142/http://www.fas.org/asmp/campaigns/control/(aiaa-reforms)feb01.pdf, accessed 29 Apr 2015.

Norman Augustine, in turn from 1987 to 1997, CEO and chairman of Martin Marietta Corporation and CEO and chairman of Lockheed Martin Corporation. *(National Science Foundation)*

Norman R. Augustine

There were few voices on defense acquisition in the 1990s more authoritative than Norman Augustine. In a career spanning more than six decades, he held the highest appointed civilian acquisition positions in the Army and rose to CEO of Lockheed Martin, the corporate leader in value of defense contracts by fiscal year 2000.

Born in Denver, Colorado, in 1935, Augustine earned degrees in aeronautical engineering from Princeton University and joined the Douglas Aircraft Company as a research engineer in 1958. Over the next 40 years, he alternated between industry and government: chief engineer at Douglas; assistant director of defense research and engineering in OSD; vice president of LTV Missiles and Space; assistant secretary for R&D, under secretary and acting secretary of the Army; chairman and CEO of Martin Marietta; and chairman and CEO of Lockheed Martin. Along the way, he also chaired the Aerospace Industries Association, the Defense Science Board, and the National Academy of Engineering; served as president of the American Institute of Aeronautics and Astronautics; and authored or coauthored three books.

After leaving Lockheed Martin in 1997, Augustine continued his dynamic professional life. In the next two decades he taught at Princeton, coauthored another book, and served as a director of several corporations and as a member of public-sector advisory boards.

Among his many honors are the National Medal of Technology, presented by the president, and the Distinguished Service Medal, the Department of Defense's highest civilian decoration, awarded to him five times.[IV]

The role of personalities in the small, closed world of the defense industry could also be seen in the merger of Martin Marietta with Lockheed. Lockheed was the second largest defense prime contractor, Martin Marietta the third; together they made the largest (see table 14-1). This was a true "merger of equals," as the executives who carried it out called it. Lockheed CEO Daniel L. Tellep broached the idea in March 1994 with a call Augustine did not expect. They were friends who knew they could work together. Lockheed was looking for an acquisition when it occurred to Tellep his company might merge with Martin Marietta. Augustine, bruised by the fight with Northrop—the hostile bid had been made just over a week before—was open to the idea. Negotiations between the two companies were closely held. The two CEOs avoided being seen together and used code names. Over the next four months the two companies discussed every essential topic—finances, executive staffing, headquarters location, and which CEO would be in charge of the new company. They decided both would be: Tellep agreed to be CEO for a year, then retire and let Augustine take over. After informing now-Secretary of Defense Perry—again maintaining such extreme secrecy that Tellep first met with the secretary alone and would not say what other company was involved until Perry asked directly—Augustine and Tellep announced the merger on 30 August 1994. The new company, Lockheed Martin, comprised 17 previously independent entities.[62]

DoD, which favored consolidating the defense industry, assessed the Lockheed and Martin Marietta merger's potential impact on acquisition programs and supported it. In April 1994 a Defense Science Board task force had recommended that the Defense Department review each merger or acquisition before the Justice Department and the Federal Trade Commission conducted their own reviews. By 1996 the Defense Science Board recommendation had become policy. According to DoD Directive 5000.62, the department was to

> assess the potential implications for DoD programs resulting from a merger or acquisition involving a major defense supplier. The assessment shall consider the potential loss of competition for DoD contracts and subcontracts, estimated cost savings or cost increases for DoD programs that can be expected to result from the merger or acquisition, and any other factor resulting from the proposed merger or acquisition that may adversely affect the satisfactory completion of a DoD program.

The Pentagon would study company operations and assess the impact of the merger on current and future acquisition programs, with the results forwarded to the agency doing the final review. The Lockheed and Martin Marietta merger was the first of its kind to undergo this process.[63]

The review was a departure from traditional practice. Rarely before had the Defense Department examined or commented on mergers between domestic companies. The purpose of the review was threefold: to help ensure that no harm was done to the government, that the deal was in the interests of national security, and that the reviewing antitrust agencies understood the defense industry's distinctive nature. Those subsequent examinations may have helped clear the way for future mergers and acquisitions. Deferring to the Defense Department, the Justice Department and the Federal Trade Commission gave great weight to national security considerations. No merger or acquisition was challenged in court between 1993 and 1998, although admittedly such challenges were rare at any time. However, the participating firms were sometimes required to sign consent agreements promising to take or avoid certain actions to preserve competition. In some cases the new company was required to divest itself of a business unit. Of the 34 major mergers and acquisitions the Defense Science Board cited, 8 involved consent decrees.[64]

While most of the deals stimulated little if any comment, some of the larger mergers provoked opposition. Such was the case, for example, when Boeing announced in December 1996 its intention to acquire the ailing McDonnell Douglas for more than $13.3 billion, the largest merger ever in the defense industry. In addition to creating a defense giant, it would unite two of the world's three remaining wide-body civil aircraft manufacturers. Critics argued it was "a merger too far." Ralph Nader, the longtime political activist whose name had appeared on the Green Party presidential ticket that fall, worried the new behemoth would stifle competition and wield too much political influence on defense policy. He commented that if the merger did not violate the prohibition against deals that created monopolies or lessened competition, "then the nation's antitrust laws have no meaning." DoD, however, raised no objection, and after an unusually extensive review, the Federal Trade Commission decided, with one dissenter, that the proposed merger did not appear to raise serious antitrust concerns. The commissioners stated what many observers already knew: McDonnell Douglas could no longer compete in the commercial market.[65]

Table 14-1: Top 10 Defense Prime Contractors, FY 1989 and FY 2000

FY 1989

RANK	PARENT COMPANY	VALUE OF DoD PRIME CONTRACTS ($B)
1	McDonnell Douglas	$8.6
2	General Dynamics	7.0
3	General Electric	5.8
4	Raytheon	3.8
5	General Motors	3.7
6	Lockheed	3.7
7	United Technologies	3.6
8	Martin Marietta	3.3
9	Boeing	2.9
10	Grumman	2.4

FY 2000

RANK	PARENT COMPANY	VALUE OF DoD PRIME CONTRACTS ($B)
1	Lockheed Martin Corp.	$15.1
2	The Boeing Co.	12.0
3	Raytheon Corp.	6.3
4	General Dynamics Corp.	4.1
5	Northrop Grumman Corp.	3.1
6	Litton Industries Inc.	2.7
7	United Technologies Corp.	2.1
8	TRW Inc.	2.0
9	General Electric Co.	1.6
10	SAIC	1.5

Source: OSD, Washington Headquarters Services, Directorate for Information Operations and Reports, *100 Companies Receiving the Largest Dollar Volume of Prime Contract Awards, FY 1989* (1989), www.dod.mil/pubs/foi/logistics_material_readiness/acq_bud_fin/189.pdf, accessed 10 Mar 2015; DoD Press Release 25-01, "List of Top 100 Defense Contractors Now Available," 24 Jan 2001, www.defense.gov/advisories/advisory.aspx?advisoryid=597, accessed 10 Mar 2015.

The Defense Department recognized the potential loss of competition through either horizontal or vertical integration. Horizontal integration involves the joining of two firms in the same industry that normally compete against one another. DoD hoped to ensure that contract awards to prime contractors would remain competitive, though each merger reduced that possibility to some degree. Vertical integration occurs when a firm acquires a supplier to its own operations, at any level—for example, an aircraft manufacturer acquiring a firm specializing in avionics or a supplier of titanium parts. An acquisition that increased vertical integration could have the effect of stifling competition among suppliers: Competitors of the acquired firm might be unable to bid for contracts in their specialty and effectively would be shut out of a defense program, even if they could offer superior products or better prices. Furthermore, the parent company might then prevent its new subsidiary from supplying the parent's competitors, or in some other way weaken *their* ability to compete for contracts. When aircraft manufacturer Lockheed merged with Martin Marietta, it gained access to LANTIRN, a navigation and targeting system installed on several military aircraft. Lockheed Martin was now in a position to modify LANTIRN in such a way as to give itself a leg up in competitions for a new fighter program. The Federal Trade Commission issued a consent decree prohibiting the company from making any such alterations to LANTIRN except with DoD's permission.[66]

Vertical integration involving the subcontractor's or the supplier's existing or previous relationships with the acquiring firm's competitors could also become a problem. A subcontractor might possess considerable proprietary information about a competitor's products. By acquiring the subcontractor, the new parent company could have access to that information and the intellectual property of other competitors. This might give the acquiring firm an unfair advantage in competitions for new contracts. Thus, the consent decree regarding the Lockheed-Martin Marietta merger also prohibited certain divisions of the new corporation from obtaining through its other divisions proprietary information about competitors' satellite launch vehicles or military aircraft that might give Lockheed Martin an advantage over those competitors.[67]

Because the hazards of vertical integration were less evident than those of horizontal monopolies, they tended to provoke less public controversy, and DoD did not pay close attention to them initially. In 1997 a Defense Science Board panel concluded that vertical integration had not caused any serious problems, at least not yet, and that many potential difficulties could be addressed at the program level. The panel noted, however, that DoD program managers had little knowledge of or visibility into the supply chain, especially the smaller suppliers, and that the department needed to learn how to work more closely with industry while still maintaining an arm's-length relationship.[68]

By 1998 merger mania was finally ebbing. The department decided consolidation had gone far enough, especially among the prime contractors, and opposed the proposed $9.5 billion purchase of Northrop Grumman by Lockheed Martin, announced in July 1997. The announcement was a surprise—Augustine was still good at keeping a secret. As with the Lockheed–Martin Marietta merger, negotiations included extensive personal involvement by the CEOs, Augustine and Kresa. They expected the acquisition to win approval easily, given the experience of the previous four years.[69]

Yet eight months later, after lengthy reviews, the Defense Department and the Justice Department opposed the acquisition. The problem was not Lockheed's size but the elimination of competition in several defense sectors. By now the number of prime contractors was down to five; this merger would leave four. There would be only one company making early warning radars as well as antisubmarine and antisurface warfare systems. Moreover, highlighting a problem associated with vertical integration, the reviewers found the company could build all of its own avionics for its aircraft, locking out other electronics subcontractors. The government would only approve if Lockheed Martin divested itself of all divisions that manufactured the radar and other electronic warfare systems. Lockheed refused—those systems were some of the main divisions it was after—so the Justice Department filed suit. Finally, in July 1998, more than a year after the announcement of the planned merger, Lockheed abandoned the effort and terminated its agreement with Northrop.[70]

Lockheed Martin's blocked attempt to acquire Northrop Grumman did not end restructuring in the defense industry. That continued, with much of it involving the acquisition of smaller firms in order to build up capabilities and entrée into certain niche markets. But the wave of consolidation among the large prime contractors was over.

* * * * *

When the Bush administration took office, the defense industry faced numerous difficulties. The declining Defense budget meant less spending on weapon systems. Those reductions and increasing foreign competition were in part responsible for a contraction that resulted in fewer American companies available to bid on defense contracts. Despite the problems, Secretary Cheney believed the industrial base was adequate to support national security requirements. Moreover, the administration was reluctant to restructure the defense sector or use military research and development spending to improve civilian industry's competitiveness. In contrast, with increased evidence the industrial base had serious vulnerabilities, the Clinton administration took a more activist approach. It implemented measures for the Defense Department and other cabinet agencies to encourage the development of dual-use technologies that were designed to strengthen the industrial base by simultaneously producing technologies with civilian and military applications. As the case of flat panel displays showed, however, developing technologies with multiple uses would not be easily accomplished. For its part, the defense industry tried to protect and strengthen itself in a variety of ways, especially through mergers and acquisitions, initially supported by the Defense Department, which began in the early 1990s and reached their peak in the middle of the decade.

Endnotes

1. For the privatization of the defense industry after World War II, see Aaron Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy* (Princeton, NJ: Princeton University Press, 2000), 245–295; Mark R. Wilson, *Destructive Creation: American Business and the Winning of World War II* (Philadelphia: University of Pennsylvania Press, 2016), 241–285.

2. Office of Technology Assessment, *Redesigning Defense: Planning the Transition to the Future U.S. Defense Industrial Base*, OTA-ISC-500 (Washington, DC: GPO, Jul 1991), 40–42; Converse, *Rearming for the Cold War*, 474.

3. Two studies released by the Logistics Management Institute in 1992 came up with different averages for the percentage of work subcontracted by prime contractors. One surveyed 9 prime contractors involved in more than 175 defense programs and found those companies kept 57 percent of the dollar value of their work in-house. The other surveyed 32 programs, including 8 aviation, 10 missile, 2 ship, one combat vehicle, 6 ammunition, and 5 others; it found an average of only 40 percent of the work kept in-house, although the actual figures varied according to the types of programs. See Defense Science Board, *Report of the Defense Science Board Task Force on Vertical Integration and Supplier Decisions* (Washington, DC: OUSD[A&T], May 1997), E-1–E-2, https://apps.dtic.mil/sti/pdfs/ADA324688.pdf, accessed 20 Feb 2020.

4. Guy J. Fritchman, "US Procurement of Weapon Components from Foreign Sources: Policy Implications," ACDIS [USAF Research Associate Program in Arms Control, Disarmament, and International Security] Occasional Paper, Jan 1993, 11; Georges Vernez et al., *California's Shrinking Defense Contractors: Effects on Small Suppliers* (Santa Monica, CA: RAND National Defense Research Institute, 1996), 4–5.

5. Department of Commerce, Strategic Analysis Division, *National Security Assessment of the Domestic and Foreign Subcontractor Base: A Study of Three U.S. Navy Weapon Systems* (Department of Commerce, Mar 1992), i, 2, 8, 11, 16–18. The Commerce Department relied on surveys that achieved only a 60–69 percent response rate. See also OTA, *Redesigning Defense*, 42. In 1992 the president of the Textron Lycoming Turbine Engine Division estimated the company's activities at the Stratford Army Engine Plant directly employed 3,300 workers with a supplier base employing 8,700 workers. He also stated that production at the plant was responsible for 24,000 jobs in the community. See statement of David G. Assard, President of Textron-Lycoming, to the Defense Conversion Commission, 17 Sep 1992, in Defense Conversion Commission, *Adjusting to the Drawdown*, annex L, *Transcripts of Regional Hearings Groton* (Washington, DC, Sep 1992), 7.

6. Gansler, *Affording Defense*, 258–262; Center for Strategic and International Studies, *Deterrence in Decay: The Future of the U.S. Defense Industrial Base: Final Report of the CSIS Defense Industrial Base Project* (Washington, DC: CSIS, May 1989), 31, 34–35; "Defense Industry Study No. 7: Shipbuilding," *Defense Industry Study Summaries, Academic Year 1990–1991* (Fort Lesley J. McNair, DC: Industrial College of the Armed Forces, n.d.), 7–12.

7. Gansler, *Affording Defense*, 242–243, 246, 252; "Defense Industry Study No. 8: Aircraft," *Defense Industry Study Summaries, Academic Year 1990–1991* (Fort Lesley J. McNair, DC: NDU, Industrial College of the Armed Forces, n.d.), 8–11; DSB, *Final Report of the Defense Science Board 1988 Summer Study on the Defense Industrial and Technology Base* (Washington, DC: OUSD[A], Oct 1988), 3, 6, 9, 11–13.

8. Gansler, *Affording Defense*, 270–272 (quote, 271); DSB, *Defense Industrial and Technology Base,* 13–14 (quote, 13).

9. Gansler, *Affording Defense*, 251–252, 271–272.

10. Air Force Association, *Lifeline Adrift: The Defense Industrial Base in the 1990s* (Washington, DC: The Aerospace Education Foundation, Sep 1991), 2. Shortly after taking office in January, the Bush administration recalled the Reagan budget for FY 1990, submitted a new budget, revised it in April, and supplanted that revision with the "Thanksgiving Eve Budget" on 25 November.

11. Barry D. Watts, *The US Defense Industrial Base: Past, Present and Future,* Strategy for the Long Haul Series (Washington, DC: Center for Strategic and Budgetary Assessment, 2008), 33.

12. Department of Commerce, *National Security Assessment*, 27–28.

13. OTA, *Redesigning Defense*, 74–77; Michael Oden, "Cashing In, Cashing Out, and Converting: Restructuring of the Defense Industrial Base in the 1990s," in *Arming the Future: A Defense Industry for the 21st Century*, ed. Ann R. Markusen and Sean S. Costigan (New York: Council on Foreign Relations Press, 1999), 82, 86, 88–89.

14. Erik Pages, "Defense Mergers: Weapons Cost, Innovation, and International Arms Industry Cooperation," in *Arming the Future*, 209; Steven R. Linke, *Managing Crises in Defense Industry: The Pepcon and Avtex Cases*, McNair Papers No. 9 (Washington, DC: NDU, Institute for National Strategic Studies, Jul 1990), 18–20, 24–25, 27–29, 42; R. C. Rossi and W. C. Wong, "Availability of Aerospace Rayon for SRM Nozzle Insulators," American Institute of Aeronautics and Astronautics Conference on Missile Sciences (1995), 1–2, www.dtic.mil/dtic/tr/fulltext/u2/a318772.pdf, accessed 11 Mar 2015. Unable to solve its environmental problems, Avtex closed for good in 1990, but by then another rayon source for military and civilian rocket nozzles had been found.

15. Gansler, *Affording Defense*, 263–267.

16. GAO, *Industrial Base: Significance of DoD's Foreign Dependence*, GAO/NSIAD-91-93 (Jan 1991), 1–5; DSB, *Report of the Defense Science Board Task Force on Defense Semiconductor Dependency* (Washington, DC: OUSD[A], Feb 1987), 1–13; DSB, *Report of the Defense Science Board Task Force on Foreign Ownership and Control of U.S. Industry* (Washington, DC: OUSD[A], Jun 1990), 1–8; William J. Norton, "Foreign Military Resource Dependence: Inevitable International Dependency Undermines Tactical and Strategic Sustainment," *Program Manager* 24, no. 5 (Sep–Oct 1995): 35–40.

17. HCAS, *Future of the Defense Industrial Base: Report of the Structure of U.S. Defense Industrial Base Panel*, 102d Cong., 2d sess., 7 Apr 1992, Committee Print No. 10, 11; Department of Commerce, *National Security Assessment*, 18; Linke, *Managing Crises in Defense Industry*, 34–35.

18. For examples of studies of the industrial base, see Center for Strategic & International Studies, *Deterrence in Decay*; DSB, *Foreign Ownership and Control of U.S. Industry*; GAO, *Industrial Base: Significance of DoD's Foreign Dependence*; OTA, *Redesigning Defense*; and Air Force Association, *Lifeline Adrift*.

19. Assistant Secretary of Defense (Production and Logistics), *Report to Congress on the Defense Industrial Base: Critical Industries Planning* (Washington, DC: DoD, Oct 1990), iii–5, https://apps.dtic.mil/dtic/tr/fulltext/u2/a231194.pdf, accessed 20 Feb 2020.

20. Under Secretary of Defense (Acquisition), Assistant Secretary of Defense (Production and Logistics), *Report to Congress on the Defense Industrial Base* (Washington, DC: DoD, Nov 1991), ES-1–3-1 (quote, 3-1).

21. Ibid., 5-1–5-5 (quote).

22. Ibid., 3-12–3-15, ES-7 (quotes, 3-15, ES-7).

23. "Defense Industrial Base," paper attached to memo, USD(A) Don Yockey for distribution, 20 May 1992, subj: Defense Acquisition, file 400.13, box 60, Acc 330-95-0014, OSD Records, WNRC ("cost effective, producible, and necessary systems" and "industrial base oversight process"). See also DepSecDef Donald Atwood, testimony before the HCAS, Subcommittee on Procurement and Military Nuclear Systems, *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006. . .* , 102d Cong., 2d sess., 29 Apr 1992, HASC No. 102-42, 168 ("no extraordinary actions"). A study by the Institute for Defense Analyses reflected administration thinking. See David R. Graham et al., *Reconstitution and Defense Conversion*, IDA Paper P-2813 (Alexandria, VA: IDA, Jan 1993), 12.

24. *National Defense Authorization Act for Fiscal Years 1992 and 1993*, P.L. 102-190 (5 Dec 1991), sec. 807(a); GAO, *Defense Industrial Base: An Overview of an Emerging Issue*, GAO/NSIAD-93-68 (Mar 1993), 7; Jeffrey A. Hart, *Technology, Television, and Competition: The Politics of Digital TV* (New York: Cambridge University Press, 2004), 111–112; *Report to Congress on the Defense Industrial Base*, Nov 1991, ES-7 (quote).

25. Gansler, *Affording Defense*, 243–244, 246–247.

26. HCAS, Procurement and Military Nuclear Systems Subcommittee, *Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement: Hearings*, 102d Cong., 2d sess., 30 Apr 1990, HASC No. 102-42, 342–344 (quotes); GAO, *Industrial Base: Impact of Defense Downsizing on Selected Abrams Tank Subcontractors*, GAO/NSIAD-93-214 (Jul 1993), 6. See also Assard statement, *Adjusting to the Drawdown*, annex L, 8. OSD assumed the warning time would be months in the case of regional and years in the case of global conflicts. See "Defense Industrial Base," draft paper attached to memo, USD(A) for DepSecDef, 1 Dec 1992, box 8, Acc 330-95-0057, OSD Records, WNRC.

27. The Senate Armed Services Committee recommended deferring procurement of *Seawolf* in 1991, and substituting two *Los Angeles*-class submarines "in order to preserve the industrial base." See SCAS, *National Defense Authorization Act for Fiscal Year 1991: Report*, 101st Cong., 2d sess., 20 Jul 1990, S. Rep. 101-384, 26–27; Christopher J. Singleton, "Industry Employment and the 1990–91 Recession," *Monthly Labor Review* 166, no. 7 (Jul 1993): 16, 20–21; Congressional Budget Office, *The Economic Effects of Reduced Defense Spending* (Washington, DC: Feb 1992), 22–26. See also R. Theodore Roth, "The Impact of Decreased Defense Spending on Employment in the United States," *Armed Forces and Society* 18, no. 3 (Spring 1992): 394.

28. Thomas C. Hayes, "Chip Group Is Left with a Solid Base," *New York Times*, 5 Jun 1990, D-4; Mel Levine, "An Alarm Is Ringing, but Few Are Listening," *Los Angeles Times*, 18 Jul 1990, https://www.latimes.com/archives/la-xpm-1990-07-18-me-477-story.html, accessed 14 May 2020; Jonathan Weber, "U.S. Urged to Spend More for High-Tech R&D," *Los Angeles Times*, 21 Mar 1991, https://www.latimes.com/archives/la-xpm-1991-03-21-fi-1059-story.html, accessed 14 May 2020.

29. Evelyn Richards, "Uncle Sam as Venture Capitalist," *Washington Post*, 29 Apr 1990, H1.

30. Frederick Golden, "DARPA Buys into Tiny Computer Chips Firm," *The Scientist* 4, no. 11 (13 May 1990): 8. The National Defense Authorization Act for 1990 and 1991 was an experiment in biennial budgeting.

31. Golden, "DARPA," 8; Breck W. Henderson, "DARPA Invests $4 Million as Venture Capital in High-Technology Companies," *Aviation Week & Space Technology* 132, no. 18 (30 Apr 1990): 25–26.

32. John Markoff, "Pentagon's Technology Chief Is Out," *New York Times*, 21 Apr 1990, https://www.nytimes.com/1990/04/21/business/pentagon-s-technology-chief-is-out.html, accessed 14 May 2020; David F. Bond, "Transfer of DARPA Chief Draws Criticism in Congress," *Aviation Week & Space Technology* 132, no. 18 (30 Apr 1990): 26; William J. Broad, "Pentagon Wizards of Technology Eye Wider Civilian Role," *New York Times*, 22 Oct 1991, https://www.nytimes.com/1991/10/22/science/pentagon-wizards-of-technology-eye-wider-civilian-role.html, accessed 14 May 2020.

33. Gibson LeBoeuf, "*Program Manager* Interviews Joshua Gotbaum, Assistant Secretary of Defense for Economic Security," *Program Manager* 24, no. 6 (Nov–Dec 1995): 30–34; Perry, *Annual Report to the President and the Congress,* Feb 1995, 97; DoD, *Industrial Capabilities for Defense* (Washington, DC: DoD, Sep 1994), 12. Formally established in September 1993, the position of assistant secretary of defense for economic security replaced the position of assistant secretary of defense for production and logistics.

34. OUSD(A&T), *Dual Use Technology: A Defense Strategy for Affordable, Leading-Edge Technology* (Washington, DC: DoD, Feb 1995), 1–9, 17–18, 23–30.

35. Ibid., 6–10.

36. Richard H. Van Atta et al., "Acquisition of flat panel displays for military applications," in *Cockpit Displays V: Displays for Defense Applications*, Proceedings of SPIE [International Society for Optics and Photonics], vol. 3363 (14 Sep 1998), 2; Robert W. Tulis, Darrel G. Hopper, David C. Morton, and Ranganthan Shashidhar, "Review of defense display research programs," in *Cockpit Displays VIII: Displays for Defense Applications*, Proceedings of SPIE, vol. 4362 (7 Sep 2001), 1; Flat Panel Display Task Force Final Report [hereafter FPD TF], *Building U.S. Capabilities in Flat Panel Displays* (Washington, DC: DoD, Oct 1994), III-8–III-15.

37. FPD TF, *Building U.S. Capabilities*, IV-2, VI-16; OTA, *Flat Panel Displays in Perspective*, OTA-ITC-631 (Washington, DC: GPO, Sep 1995), 19, 29, 62–65.

38. FPD TF, *Building U.S. Capabilities*, VI-19, VIII-2–VIII-3; Kenneth S. Flamm, "Flat Panel Displays: Catalyzing a U.S. Industry," *Issues in Science and Technology* 11, no. 1 (Fall 1994): 27–32.

39. FPD TF, *Building U.S. Capabilities*, I-1–I-3; OTA, *Flat Panel Displays*, 66–67, 70, 79. The task force report listed 10 companies in the industry, but there were others; see OTA, *Flat Panel Displays*, 89–104.

40. Claude Barfield, "Flat Panel Displays: A Second Look," *Issues in Science and Technology* 11, no. 2 (Winter 1994): 21–25; OTA, *Flat Panel Displays*, 68–69, 73–78; Tulis et al., "Review," 5, 7–8.

41. OTA, *Flat Panel Displays*, 78–82; FPD TF, *Building U.S. Capabilities*, VIII-5–VIII-8; Flamm, "Flat Panel Displays," 30.

42. Flamm, "Flat Panel Displays," 30–31.

43. Public Law 102-484, Div. D, sec. 4001; William J. Clinton, "Remarks to Westinghouse Employees in Linthicum, Maryland," 11 Mar 1993, *Clinton Public Papers 1993*, 1:269–272; "Press Briefing by Deputy Assistant to the President for Economic Policy Gene Sperling et al.," 11 Mar 1993, *The American Presidency Project*, Gerhard Peters and John T. Wooley, eds., www.presidency.ucsb.edu/ws/?pid=59973, accessed 15 Apr 2015; DoD News Release 100-93, "The Secretary of Defense Marks Start of Private Sector Outreach," 11 Mar 1993, *Aspin Public Statements 1993–1994*, 1:160–163, OSD/HO.

44. CBO, *The Technology Reinvestment Project: Integrating Military and Civilian Industries* (Washington, DC: CBO, Jul 1993), 9–14; Advanced Research Projects Agency, *Program Information Package for Defense Technology Conversion, Reinvestment, and Transition Assistance* (n.p.: ARPA, 10 Mar 1993), 1-1–2-7.

45. CBO, *Technology Reinvestment Project*, 15–18; James J. Richardson et al., *A Review of the Technology Reinvestment Project*, Potomac Institute for Policy Studies (PIPS) Report PIPS-99-1 (Arlington, VA: PIPS, 30 Jan 1999), 15–19, B-4–B-6.

46. Richardson et al., *Review*, B-1–B-2, B-7–B-9.

47. Ibid., vi–xiii, 28–60, 62–66 (quote, 28).

48. Jay Stowsky, "The Dual-Use Dilemma," *Issues in Science and Technology Online* 13, no. 2 (Winter 1996): 56–64. Stowsky had served as a senior economist for the Council of Economic Advisors from 1993 to 1995, and was intimately familiar with the program. This discussion is primarily taken from his thoughtful analysis.

49. Stowsky, "Dual-Use Dilemma," 56–57; SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1996 and the Future Years Defense Program: Hearings . . . on S.1026*, 104th Cong., 1st sess., 17 May 1995, S. Hrg. 104-387, pt. 5:342, 349–350; DoD News Briefing, Dr. Paul Kaminski, 13 Feb 1995, http://archive.defense.gov/Transcripts/Transcript.aspx?TranscriptID=102, accessed 20 Feb 2018; John D. Moteff, *The Difference Between DoD Programs That Develop Dual-Use Technologies and DoD's Dual-Use Technology Development Programs—A Fact Sheet*, CRS-95-738 (Washington, DC: CRS, updated 17 Jan 1997), 1–2.

50. OUSD(A&T), *Dual Use Technology*, 1–5; DoD News Release 015-97, "Dual Use Applications Program Plans Announced," 14 Jan 1997, www.defense.gov/Releases/Release.aspx?ReleaseID=1126, accessed 20 Apr 2015; DoD News Briefing, Dr. Paul Kaminski, 15 Jan 1997, www.defense.gov/Transcripts/Transcript.aspx?TranscriptID=346, accessed 20 Apr 2015; "Dual Use Applications Program," BAA solicitation PA97-12 by DARPA, PSA#1762, *Commerce Business Daily*, 15 Jan 1997, www.gpo.gov/fdsys/bulkdata/CBD/1997, accessed 20 Apr 2015; National Center for Advanced Technologies (NCAT), "An Industry Perspective of the Commercial O&S Savings Initiative (COSSI)" (Washington, DC: NCAT, 31 Jan 1997), www.ncat.com/archive/cossi1.html, accessed 20 Apr 2015.

51. OUSD(A&T), *The Acquisition of Flat Panel Displays for Military Applications* (Washington, DC: DoD, Mar 1998), 3–45 ("significantly underestimated," 34); Chris Chinnock, "Defense Integrators Take Another Look at Asian Flat-Panel Suppliers," *Military & Aerospace Electronics* 8, no. 5 (1 May 1997): 3–4; Chris Chinnock, "North American Flat-Panel Industry Loses a Player," *Military & Aerospace Electronics* 9, no. 1 (1 Jan 1998): 3.

52. Chris Chinnock, "OIS Turns Corner: Wins Apache Longbow Contract," *Military & Aerospace Electronics* 9, no. 7 (1 Jul 1998): 4; "OIS Announces Disappointing Results of Strategic Initiative," *PR Newswire*, 1 Sep 1998; "Threat of OIS Collapse Alarms Military Players," 15 Sep 1998 (quote); "OIS Ceases Manufacturing Operations," *PR Newswire*, 18 Sep 1998; "OIS Throws in the Towel," *Military & Aerospace Electronics* 9, no. 10 (1 Oct 1998): 3–4; Joshua A. Kutner, "Failed Flat-Panel Display Firm Leaves Partners High and Dry," *National Defense* 83, no. 545 (Feb 1999): 30.

53. Kutner, "Failed Flat-Panel Display Firm," 30; Hunter Keeter, "Army Secures Alternate Maker of Key Apache Display Part," *Defense Daily* 202, no. 38 (24 May 1999): 1–2; Jack Robertson, "Planar Systems Quits Unprofitable Military Avionics Market," *EE Times*, 20 Sep 2000, https://www.eetimes.com/document.asp?doc_id=1267591, accessed 2 Mar 2018.

54. A good discussion of the submarine construction problem can be found in John Birkler et al., *The U.S. Submarine Production Base: An Analysis of Cost, Schedule, and Risk for Selected Force Structures* (Santa Monica, CA: RAND National Defense Research Institute, 1994). See also CBO, *Submarine Program Issues* (Washington, DC: CBO, Jul 1995). The keel of the third *Seawolf, Jimmy Carter* (SSN 23), was laid in 1998.

55. Ronald O'Rourke, *Navy Major Shipbuilding Programs and Shipbuilders: Issues and Options for Congress*, CRS Report 96-785 (Washington, DC: CRS, 24 Sep 1996), 81; Miranda S. Spivack, "Aspin: No Promises on Seawolf's Future," *Hartford Courant*, 8 Jan 1993, https://www.courant.com/news/connecticut/hc-xpm-1993-01-08-0000107652-story.html, accessed 14 May 2020; "Aspin Has No Answers to Sub Industrial Base," *Navy News & Undersea Technology*, 11 Jan 1993, 8; Aspin, *Report on the BUR*, 55–57 (quote, 57).

56. Aspin, *Report on the BUR*, 50–54; John D. Morrocco and David A. Fulghum, "Saving Industrial Base Key in Bottom-Up Review," *Aviation Week & Space Technology* 139, no. 10 (6 Sep 1993): 24. See, for example, DSB, *Report of the Defense Science Board Task Force on Tracked Vehicle Industrial Base* (Washington, DC: OUSD[A&T], Apr 1994), E-1; James L. Barefield II, "The Heavy Bomber Industrial Base: A Study of Present and Future Capabilities" (research paper, Air Command and Staff College, Air University, Mar 1997), 24–27.

57. Thomas E. Ricks, "Pentagon's Industrial Policy Isn't Meant to Save Jobs or Aid Firms, Official Says," *Wall Street Journal*, 3 Sep 1993, 3 (quotes); "William Perry: Guarding the Base," *Government Executive* 25, no. 8 (Aug 1993): 40.

58. Robert Holzer and Vago Muradian, "Aspin Shares Plans with Execs," *Defense News*, 26 Jul 1993, 4; John Mintz, "How a Dinner Led to a Feeding Frenzy," *Washington Post*, 4 Jul 1997, https://www.washingtonpost.com/archive/business/1997/07/04/how-a-dinner-led-to-a-feeding-frenzy/13961ba2-5908-4992-8335-c3c087cdebc6/, accessed 14 May 2020; Carter and Perry, *Preventive Defense*, 177–178 (Perry quote, 177); Norman Augustine, "The Last Supper Revisited: Meeting Ignited Inevitable Consolidation," *Defense News*, 26 Jun 2006, 2 (Augustine quote).

59. Jeff Cole and Thomas E. Ricks, "Lockheed, Martin Marietta Are Headed Toward Pentagon Approval of Merger," *Wall Street Journal*, 8 Dec 1994, A6; Stephen Labaton, "Deal's Antitrust Issue Is Test for White House," *New York Times*, 31 Aug 1994, D5.

60. DSB, *Vertical Integration and Supplier Decisions*, D-1–D-5; Philip B. Nelson and Robert D. Stoner, "Defense Industry Rationalization: Lockheed Martin (1995)," in *The Antitrust Revolution: Economics, Competition, and Policy*, eds. John E. Kwoka Jr. and Lawrence J. White, 3d ed. (New York: Oxford University Press, 1999), 430–451.

61. Nancy Rivera Brooks, "Dogfight for Grumman: Northrop's Kresa Defies Caution in Hostile Bid," *Los Angeles Times*, 11 Mar 1994, https://www.latimes.com/archives/la-xpm-1994-03-11-fi-32719-story.html, accessed 14 May 2020 (Kresa quote); Louis Uchitelle, "Company News; Offer by Northrop for Grumman Tops Martin Marietta Bid," *New York Times*, 11 Mar 1994, A1 (Martin Marietta quote); Calvin Sims, "Northrop Bests Martin Marietta to Buy Grumman," *New York Times*, 5 Apr 1994, https://www.nytimes.com/1994/03/11/business/company-news-offer-by-northrop-for-grumman-tops-martin-marietta-bid.html, accessed 14 May 2020 (Martin Marietta quote); Ted Shelsby, "The Lockheed-Martin Marietta Merger: How the Deal Was Done," *Baltimore Sun*, 12 Mar 1995, 1.

62. This account relies on Shelsby, "The Lockheed-Martin Merger," which was based on extensive interviews of the participants, especially Augustine; Norman Augustine, "Reshaping an Industry: Lockheed Martin's Survival Story," *Harvard Business Review* 75, no. 3 (May–Jun 1997): 88.

63. DoD Directive 5000.62 (Impact of Mergers or Acquisitions on Major DoD Suppliers on DoD Programs), 21 Oct 1996. The policy was based on the recommendation of a Defense Science Board task force. See DSB, *Report of the Defense Science Board Task Force on Antitrust Aspects of Defense Industry Consolidation* (Washington, DC: OUSD[A&T], Apr 1994), 1–5.

64. DSB, *Antitrust Aspects of Defense Industry Consolidation*, 5–7, 9–15, 31–32; DSB, *Vertical Integration and Supplier Decisions*, D-3.

65. John Mintz, "Boeing to Buy McDonnell Douglas," *Washington Post*, 16 Dec 1996, A1; Project on Government Oversight, "Boeing McDonnell Douglas: A Merger Too Far," 1 Jan 1997; Nader.org, "Boeing–McDonnell Douglas Merger," 2 Jan 1997; "Statement of Chairman Robert Pitofsky and Commissioners Janet D. Steiger, Roscoe B. Starek III, and Christine A. Varney in the Matter of The Boeing Company/McDonnell Douglas Corporation" and "Statement of Commissioner Mary L. Azcuenaga in The Boeing Company," FTC file 971-0051, 1 Jul 1997: copies of all in author files, OSD/HO; Thomas L. Boeder and Gary J. Dorman, "The Boeing/McDonnell Douglas Merger: The Economics, Antitrust Law and Politics of the Aerospace Industry," *Antitrust Bulletin* 45 (Spring 2000): 1–7, 12–24.

66. DSB, *Vertical Integration and Supplier Decisions*, 2–4.

67. Ibid., 4–5; Federal Trade Commission, "For Your Information, Lockheed Corporation," 12 May 1995, http://www.ftc.gov/.../1995/05/lockheed-corporation, accessed 15 May 2022.

68. Ibid., 29–40.

69. Steven Pearlstein, "Lockheed Martin Agrees to Buy Rival," *Washington Post*, 4 Jul 1997, A1, A16.

70. Leslie Wayne, "Lockheed Cancels Northrop Merger, Citing U.S. Stand," *New York Times*, 17 Jul 1998, A-1; Department of Justice Press Release 98-131, "Justice Department Goes to Court to Block Lockheed Martin's Purchase of Northrop Grumman," 23 Mar 1998, www.justice.gov/atr/public/press_releases/1998/212681.htm, accessed 29 Apr 2015.

I. DSB, *Vertical Integration and Supplier Decisions*, E-5.

II. Assistant Secretary of Defense (Production and Logistics), *Report to Congress on the Defense Industrial Base: Critical Industries Planning*, v.

III. Biography of Craig I. Fields, Remarks of Hon. Frank R. Wolf of Virginia on FBI Science and Technology Advisory Board, House of Representatives, 18 Oct 2005, *Congressional Record* 151, pt. 17:23063–23064; DARPA interview of Craig I. Fields, 15 Mar 2007, DARPA Case No. 13-01968.000225-000250: 000225, 000229, 000230, 000235, 000237, www.esd.whs.mil/Portals/54/Documents/FOID/Reading Room/DARPA/15-F-0751_DARPA_Director_Craig_Fields.pdf, accessed 19 Oct 2017.

IV. Frequently asked for his views on defense acquisition, Augustine maintains that despite the system's serious shortcomings, with respect to weapons capabilities, every country in the world would trade its equipment for that developed and manufactured by the United States. He emphasizes solving acquisition's problems depends on creating a personnel system that produces "competent, dedicated, experienced people" and "delegates authority, rewards success, and penalizes failure." See biography and testimony of Norman R. Augustine on Defense Acquisition Reform before the Armed Services Committee of the United States Senate, 1 Dec 2015, 1–4 (quotes, 3), https://www. armed-services.senate.gov/imo/media/doc/Augistine_12-01-15.pdf, accessed 19 Oct 2015. Biography and Views from Norman R. Augustine, in *Defense Acquisition Reform: Where Do We Go From Here? A Compendium of Views by Leading Experts*, Staff Report, Permanent Subcommittee on Investigations, Committee on Homeland Security and Governmental Affairs, United States Senate, 2 Oct 2014, 11–16, www.govexec.com/media/gbc/docs/pdfs_edit/100714kp1.pdf, accessed 19 Oct 2017.

CHAPTER XV

The Defense Acquisition Workforce, 1989–2001

The preceding chapters have demonstrated the extent and variety of acquisition reforms during the 1990s. Few were as consequential as those directed at reshaping the acquisition workforce. In its 1986 report to the president, the Packard Commission noted that, whatever other changes in acquisition might result from its recommendations, "it is vitally important to enhance the quality of the defense acquisition workforce—both by attracting qualified new personnel and by improving the training and motivation of current personnel." In the 12 years from 1989 to 2001, that workforce experienced remarkable changes. At the beginning of the period, the acquisition workforce was an amorphous concept, with little agreement on what occupations belonged to it and how many civilian and military personnel were in it. Education and training programs existed, but they were not standardized across the Defense Department and were underused. Career development for acquisition workers was haphazard. By the end of the period, through expanded education and training programs, well-defined career development paths, and more opportunities for promotion, department leaders had gone a long way toward creating the professionalized workforce that most believed to be crucial to acquisition success.[1]

DEFENSE ACQUISITION WORKFORCE IMPROVEMENT ACT

Congressional frustration with acquisition reforms over the years inspired the Defense Acquisition Workforce Improvement Act of 1990, or DAWIA. Beginning with the Hoover Commission report of 1955 and spanning three decades, five blue ribbon panels had studied problems associated with acquisition, especially cost growth, schedule slips, and performance shortfalls. All of them discussed professionalization of the defense acquisition workforce as an important factor in correcting the system's deficiencies. The Packard Commission, the last of the panels, was especially firm on this point.[2]

Secretary Cheney's Defense Management Review, established to implement the Packard Commission's recommendations, also focused on professionalizing the acquisition workforce. The subsequent Defense Management Report ordered each military department to organize "a dedicated corps of officers . . . who will make a full-time career as acquisition specialists." The members of these acquisition corps were to receive specialized training through the Defense Systems Management College, public and private academic institutions, rotational assignments to industry, and "a senior level Service School, comparable to the National War College, with a specialized curriculum developed to train the most senior acquisition managers." The report also directed the under secretary for acquisition to establish a central office to manage workforce training, education, and career development and to create a central reporting system and database to track results in those areas. Additionally, the report asked Congress for authority to establish an alternative pay system for acquisition employees and to fund tuition and fees for obtaining an academic degree.[3]

To the legislators, these measures did not go far enough. Spurred on by the results of the three-year investigation into the Navy's Ill-Wind procurement corruption scandal, Representative Nicholas Mavroules, a Democrat from Massachusetts and chairman of the Investigations Subcommittee of the House Armed Services Committee, took the lead in exploring acquisition workforce reform. In 1989 and 1990 his committee held hearings and issued reports on the status of the workforce. The first report examined the practices of major U.S. allies. In *A Review of Defense Acquisition in France and Great Britain*, the committee noted that the French provided high-quality undergraduate and graduate education for their acquisition officials and required years of experience before putting them into program manager positions. The second, *The Quality and Professionalism of the Acquisition Workforce*, concluded that DoD program managers lacked adequate training and the qualifications needed for their jobs. The third, *Life Is Too Short*, looked at the tenure issue and found the turnover rate for program managers had actually *increased* since 1984 when Congress enacted legislation specifying a tenure of at least four years, or until a system entered its next milestone review. Program managers stayed in their jobs an average of 21 months—less than two years. "For all practical purposes, the services have simply flouted the law," the report stated.[4]

Representative Nicholas J. Mavroules (D-MA), a member of Congress from 1979 to 1993. *(Collection of the U.S. House of Representatives)*

In March 1990 Mavroules's committee presented proposals to correct these problems. They called for an acquisition corps in each service similar to those directed by the Defense Management Report, the development of a management structure for the acquisition workforce, and the establishment of a defense acquisition university. After two hearings, in June 1990 Mavroules introduced the Defense

Acquisition Workforce Improvement Act. DoD objected to certain provisions of the bill, arguing that the services were already instituting many workforce reforms mandated in the Defense Management Report. For example, each service had established a prototype acquisition corps, though only for program managers. "We need to give these initiatives an opportunity to work before we decide on changing course again," Under Secretary for Acquisition John Betti told the committee. Betti wrote to Mavroules in early August, detailing concerns about the bill, particularly the provision that civilians fill half of the critical acquisition positions, a requirement he viewed as artificial. Despite these objections, the department found Mavroules's legislation far more acceptable than the alternatives: three bills by the military reform caucus, calling for a single, consolidated acquisition corps separate from the services' acquisition organizational structures. In contrast, under the Defense Acquisition Workforce Improvement Act each service would establish its own acquisition corps. In working with service representatives, the Massachusetts legislator and his committee included many of their comments in the legislation. On 11 September 1990 Congress incorporated DAWIA as an amendment to the National Defense Authorization Act for FY 1991. The House overwhelmingly supported the amendment, passing it by a margin of 413-1. After approval by the Senate, President George H. W. Bush signed DAWIA into law with the rest of the authorization act on 5 November 1990.[5]

The Defense Acquisition Workforce Improvement Act had five main sections. The first charged the secretary of defense with establishing policies for the acquisition workforce. According to the legislation, these policies were to be uniform across the Defense Department "to the maximum extent practicable." The law assigned day-to-day responsibility for workforce issues to the under secretary for acquisition, specifically to a new official in the under secretary's office, the director of acquisition education, training, and career development. Within each service, DAWIA placed responsibility for workforce policy and management of its acquisition corps with the service acquisition executive, assisted by another new official, the director of acquisition career management. An acquisition career program board in each service would advise both officials with respect to managing the accession, training, education, and career development of the workforce and in selecting members of the acquisition corps. DAWIA also directed the secretary of defense to create an acquisition corps and a career program board for acquisition personnel working in the Office of the Secretary of Defense and in defense agencies and field activities.[6]

DAWIA's second section dealt largely with the makeup and qualifications of the acquisition workforce. It directed the secretary of defense to determine which employees were members of the workforce and to specify their qualifications and career paths. Additionally, the act required the secretary to "make every effort" to fill half the senior acquisition positions, particularly those of program manager and division head, with civilians before 1996. The high percentage of program managers in uniform had long been a contentious issue between the Defense Department and Congress, which believed the services reserved too many senior acquisition positions for the uniformed military. The new law prohibited DoD from reserving a position for a uniformed officer, unless the department believed it was necessary and reported each instance to Congress.

At the department's request, the law did not establish a quota of acquisition positions to be filled by civilians. Instead, it specified that workforce policies "provide for the selection of the best qualified individual for a position." The qualifications determined by the secretary of defense for each acquisition position would apply to workers already on board, though a grandfather clause exempted those with 10 years of experience. An acquisition career program board could waive the requirements for particularly promising or capable personnel. The act also required contracting officers to meet the qualifications for their positions. This last provision indicated a growing belief such officials should be treated as professionals and needed more education and training than they had previously received.[7]

The act's third section covered the acquisition corps to be established in each service, including the Marine Corps. Only civilians in grade GS-13 or above and military personnel in grade O-4 (the rank of major/lieutenant commander) and above could belong to the corps. Acquisition corps members must have obtained a bachelor's degree, received certification by an acquisition career program board "as possessing significant potential for advancement to levels of greater responsibility and authority," and have completed 24 semester credit hours, or the equivalent, of study in one of 10 relevant disciplines (e.g., accounting, business, finance, law).[8]

Membership in the acquisition corps was mandatory for assignment to secretary of defense-designated "critical acquisition positions," such as program executive officer and program manager and deputy program manager of a major acquisition program. Personnel in critical positions had to serve in them for at least three years. Program managers and deputy program managers faced even more stringent tenure requirements; they were obligated to remain in their positions "at least until completion of the major [system] milestone that occurs closest in time to the date on which the person has service in the position for four years." At the same time, the act limited position tenure: Members of the acquisition corps were to rotate to new assignments after five years (or, in the case of program managers, the next milestone if longer than five years) in order "to ensure opportunities for career broadening assignments and an infusion of new ideas into critical acquisition positions."[9]

Besides tenure and rotation requirements, the Defense Acquisition Workforce Improvement Act specified a rigorous set of qualifications for those in critical acquisition positions. The managers and deputies of major acquisition programs must have completed the program management course at the Defense Systems Management College or a comparable program and have eight years of experience in acquisition, at least two in a system program office or the equivalent. Program executive officers had to complete the same course at DSMC, have 10 years of experience in acquisition, and have held the position of program manager or deputy program manager. Before flag officers and equivalent civilians could be assigned to a critical acquisition position, they were likewise required to have 10 years of experience in acquisition, including four years in a critical position, such as program executive officer. For senior contracting officials the law required four years of contracting experience.[10]

The fourth section of DAWIA covered education and training. It required the Defense Department to establish "a defense acquisition university structure" that would provide the workforce with professional education and training and conduct "research and analysis of defense acquisition policy from an academic standpoint." DAWIA left details of the institution's administration to the secretary of defense, specifying only that DoD issue regulations governing the university's structure, mission, lines of authority, and oversight bodies, such as a board of visitors and a policy guidance council, by 1 October 1991. The fifth section directed the under secretary for acquisition to report annually on the status of the acquisition workforce and to establish a standardized information system to help manage it.[11]

IMPLEMENTING DAWIA

After DAWIA became law, OSD and the services began to set up the offices and boards it required. Under Secretary for Acquisition Donald Yockey appointed Dr. James McMichael, a former Navy Department personnel manager, as director of acquisition education, training, and career development. Yockey also instructed each service to select a director of acquisition career management and establish a career program board. The services responded in accordance with their individual traditions, past practices, and existing workforce organization. Thus, considerable variations emerged in how the acquisition corps were set up, despite the law's intention to create uniform organizations and standards. For example, the Navy chose a senior civilian as a full-time director of acquisition career management with a staff of 10. The Air Force appointed a senior civilian with a staff of nine in January 1991, but for two years that official served only as acting director of acquisition career management. Meanwhile, the Army, believing that the position required a high-ranking official, assigned its responsibilities to the military deputy to the assistant secretary of the Army for research, development, and acquisition, a three-star general, with a colonel as deputy and a staff of 11.[12]

The services also organized their acquisition career program boards differently. For example, the Air Force used its existing Acquisition Professional Development Council, a body of 12 senior officials (three-star generals or the civilian equivalent) established at the end of 1989. The Navy set up an Acquisition Workforce Oversight Council of senior military officers and civilian executives chaired by the assistant secretary of the Navy for research, development, and acquisition.[13]

As directed by the secretary of defense and the law, the services went about designating acquisition positions, identifying critical positions, and organizing their respective acquisition corps. OSD had identified 14 position categories within seven acquisition functions and designated 12 of those position categories as career fields, meaning that they had their own standards for education, training, and experience (see table 15-1). The other two position categories—Program Management Oversight and Education, Training, and Career Oversight—were filled by members of the other position categories who were each subject to their own career field's standards.[14]

By spring 1993 the services had designated 127,534 acquisition positions subject to DAWIA, including 30,000 in the Army, 32,741 in the Navy, and 37,539 in the Air Force. The other DoD components accounted for the remaining 27,254 (most

Table 15-1: Acquisition Career Development

ACQUISITION FUNCTIONS	POSITION CATEGORIES	CAREER FIELD
Acquisition Management	Program Management	X
	Program Management Oversight	
	Communications-Computer Systems	X
Procurement and Contracting	Contracting	X
	Purchasing	X
	Industrial Property Management	X
Systems Planning, Research, Development, Engineering, and Testing	Systems Planning, Research, Development, and Engineering	X
	Test and Evaluation Engineering	X
Production	Manufacturing and Production	X
	Quality Assurance	X
Acquisition Logistics	Acquisition Logistics	X
Business, Cost Estimating, and Financial Management	Business, Cost Estimating, and Financial Management	X
Auditing	Auditing	X
[none]	Education, Training, and Career Development	

Source: DoD Instruction 5000.58 (Defense Acquisition Workforce), 14 Jan 1992, sec. 6.1, 10.

in the Defense Logistics Agency). Of the total acquisition positions, the services and other components reserved 18,042 (14 percent) for the uniformed military. Of the services, the Air Force had the highest number and percentage of military positions (11,581, or 31 percent), well above the figures for the Army (2,235, 7 percent) and the Navy (3,372, 10 percent). The remaining 854 acquisition positions filled by military personnel were in other DoD components. The Air Force established the most well-defined career path for uniformed military officers. Unlike in the other services, newly commissioned Air Force officers could be assigned to acquisition and remain in the field for most of their careers. Each service assigned program management positions disproportionately to the uniformed military. Of the 111 program managers of ACAT I programs, all but 10 were uniformed officers—a rate of almost 91 percent. The services tried to balance this with civilian deputies; of the 108 deputies, 83 (77 percent) were civilians.[15]

Of the 127,534 total acquisition positions, 17,642 were "critical," meaning only members of a service acquisition corps could fill them. The Army had organized its corps first, having started when the Defense Management Report was released in summer 1989. It originally comprised only military officers but soon included civilians in accordance with DAWIA. In December 1992, it had 3,831 members; half were military and half were civilian. As of February 1995, the Air Force corps comprised 4,499 members (2,030 military, 2,469 civilian); the Navy, 3,709 (986 military, 2,723 civilian); and the Marine Corps, 285 (189 military, 96 civilian). The acquisition corps for OSD and the defense agencies consisted of 2,969 members, all civilian.[16]

The services complied with DAWIA in a broad sense, but they did not achieve the uniformity and common standards Congress deemed essential for efficient management. Five years after the law passed, inconsistencies still existed between acquisition organizations in areas such as membership criteria for the acquisition corps, position rotation requirements for civilians, centralized systems for announcing job openings and career opportunities, and selection and promotion procedures for senior system program officials.[17]

The Defense Department established the qualifications and standards for the acquisition career fields and developed appropriate training and education programs. The department assigned each position category and career field to one of three career levels according to position requirements and worker capabilities. Level I (basic or entry level) standards focused on the fundamental qualifications and expertise of the career field. Level II (intermediate or journeyman level) standards initially emphasized specialization and then went on to broaden the worker's understanding of and general expertise in the field. Level III (advanced or senior level) standards sought to ensure the worker was prepared for the most challenging assignments in the career field. Once hired, the employee had to meet the certification standards for the position or obtain a waiver within 18 months.[18]

The 15 organizations DAWIA brought together as part of the new Defense Acquisition University (DAU) provided workforce education and training. University planners chose a consortium structure for the new institution, in which the Defense Systems Management College and the other organizations would sign memoranda of agreement with the university and act as if

Career Fields, 1995

- Acquisition Logistics
- Auditing
- Business, Cost Estimating, and Financial Management
- Communications-Computer Systems
- Contracting
- Industrial Contract Property Management
- Manufacturing, Production, and Quality Assurance
- Program Management
- Purchasing
- Systems Planning, Research, Development, and Engineering
- Test and Evaluation

Thomas M. Crean, president of Defense Acquisition University, 1994–2000. *(DAU)*

they were separate, specialized campuses of an academic university. Each would remain administratively a part of its parent service or agency and stay in its current location. DAU established its headquarters in leased office space in Alexandria, Virginia, and began operations in July 1992. After a long search, in November 1994 Paul Kaminski, Yockey's successor, named Thomas M. Crean DAU's first full-time president. A retired Army colonel, Crean had served as commandant of the Army Judge Advocate General's School and as presiding judge of the Army Court of Criminal Appeals. He possessed some experience in acquisition. While chief legal officer for U.S. Army Europe and other Army commands, he had been involved in contracting issues.[19]

Although the consortium structure was the quickest and least expensive way to set up the university, it had a major management weakness: The president had little authority over the members, who still reported through separate chains of command. The relationship between the university and the Defense Systems Management College illustrated what could happen without a clear command line. Both the DAU president and the DSMC commandant reported directly to the under secretary for acquisition (beginning in 1993 to the deputy under secretary for acquisition reform). According to Evelyn Layton, the historian of DAU's early years, the parallel reporting arrangement produced "confusion in roles and tension between the two organizations." The discord lasted until 1997 when Under Secretary Kaminski realigned the command relationships to have the commandant report to the president.[20]

One of the most important tasks Defense Acquisition University faced was developing a curriculum and common academic standards for educating and training acquisition professionals. Each member of the consortium taught its own courses and used its own instructional methods, but the university, with the help of experts (known as functional advisors) in various acquisition fields, oversaw curriculum development and certified the pedagogical soundness of each course. These advisors formed functional boards that determined the appropriate standards for each career field, which the schools then used to develop curricula and courses. The boards assigned subject-matter experts to assist the schools in developing curriculum. However, for each course, one school, known as the sponsor, maintained university-wide responsibility for managing that course. DAU employed an instructional approach called competency-based training that expected students to master clearly defined knowledge, skills, and abilities. This approach required a faculty of skilled practitioners who used case studies, simulations, and experiential exercises rather than traditional lectures. The curriculum proceeded through three levels of difficulty reflected in the certification levels. In 1991, its first year of operation, DAU offered 38 courses covering

Defense Acquisition University headquarters staff and faculty, Fort Belvoir, Virginia, 2000. *(DAU)*

seven career fields. By 1995 the number of career fields was up to 11 and the number of individual courses had more than doubled to 78. There were three different types of courses: certification courses, assignment-specific courses, and the Senior Acquisition Course. The certification courses had been designated as mandatory or desirable for the respective career fields. Two were core courses: the two-week Fundamentals of Systems Acquisition Management for Level I, and the four-week Intermediate Systems Acquisition for Level II. These provided a general introduction to acquisition; in 7 of the 11 career fields, students at Levels I or II took one of these courses first. After completing certification courses, they could take the more specialized courses in their career field. Not every career field offered Level I, or even Level II courses. In program management, for example, the two core courses were considered entry and journeyman-level. Students at Level III took the 14-week Advanced Program Management Course.[21]

Assignment-specific courses concentrated on a particular acquisition function. Workers who had moved into a new position might take one of them to learn the skills needed for that job; others might be directed to take courses in a career field other than their own. In 1997 there were 22 such courses. Workers at Level II who were involved in international acquisition could take the Multinational Program Management Course and the International Security and Technology Transfer/Control Course; and those at Level III, the Advanced International Management Workshop. All new program executive officers and managers and deputy managers for ACAT I and II programs attended the intensive, four-week Level III Executive Program Managers Course. New ACAT III program managers and deputies completed the two-week Program Managers Survival Course, also at Level III.[22]

The Senior Acquisition Course capped the university's educational program. As mandated by the Defense Acquisition Workforce Improvement Act, the course was "a substitute for, and equivalent to, existing senior-level professional military educational school courses specifically designed for personnel serving in critical acquisition positions." It was taught at the Industrial College of the Armed Forces (ICAF), which joined the DAU consortium while remaining a part of National Defense University. At the time DAWIA was enacted, ICAF was already offering a senior-level program emphasizing defense resources management, especially materiel acquisition and logistics. DAU's Senior Acquisition Course included the entire 10-month ICAF program as the "core curriculum," with the addition of two mandatory acquisition policy advanced studies courses, a selection from among 20 advanced studies electives, and an optional major research project. Senior Acquisition Course members were part of the ICAF student body and, after receiving the Master of Science degree in National Resource Strategy awarded by ICAF, were graduates of both the course and the college.[23]

Frank J. Anderson Jr., president of Defense Acquisition University, 2000–2010; commandant of Defense Systems Management College; and vice president of Defense Acquisition University, 1999–2000. *(DAU)*

By 1997, the Defense Acquisition University consortium members were offering almost 1,300 classes from among 81 courses to approximately 35,000 students. The classes ranged from three days to 44 weeks (for the Senior Acquisition Course), with most from one to four weeks long. Four schools—the Defense Systems Management College (271), the Army Logistics Management College (285), the Air Force Institute of Technology (242), and the Naval Center for Advanced Training (184)—taught more than three-quarters of the classes.[24]

In the late 1990s the Defense Acquisition University underwent a fundamental organizational transformation from a consortium to a unified structure. The change resulted from Defense Secretary William Cohen's Defense Reform Initiative of November 1997, which focused on streamlining the department's organizations (see chapter X), and from an earlier process action team report that highlighted the ineffectiveness of the consortium setup. In November 1999 Deputy Defense Secretary John Hamre directed DAU to adopt a unified structure that separated the consortium organizations and personnel from their parent services and required them to report only to the university's president. Four campuses replaced the widely scattered locations of the consortium schools: Fort Belvoir, Virginia; Fort Lee, Virginia; Norfolk Naval Base, Virginia; and Wright-Patterson Air Force Base, Ohio.[25]

The process action team's report had recommended that a senior acquisition official head Defense Acquisition University. In October 2000 retired Brig. Gen. Frank J. Anderson Jr., who spent most of his 27-year Air Force career in acquisition, succeeded Crean as president. Since 1999, Anderson had been dual-hatted as DAU's vice president and as commandant of the Defense Systems Management College. His other acquisition credentials included positions as deputy assistant secretary of the Air Force for contracting, director of contracting at the Aeronautical Systems Center, and systems program director for the AGM–130 and GBU–15 guided munitions. The month before his appointment, DAU headquarters relocated from Alexandria to the university's Fort Belvoir campus. During his nearly 10-year presidency, Anderson increased the university's responsiveness to its stakeholders, refined its curriculum, and expanded the use of technology throughout the university system.[26]

THE WORKFORCE AND ACQUISITION REFORM

It has already been noted that the Clinton-era reformers paid close attention to workforce issues, especially education and training (see chapter X). This was partly due to the need to keep the workforce up to date on the many acquisition reforms being implemented. Such rapid transformation in an organization as large as the Defense Department normally causes uncertainty, confusion, and hesitation. The reformers wanted to win the support of the workforce and implement the new policies and procedures as quickly as possible. They believed previous efforts had failed because the department had been unable or unwilling to change the culture of its acquisition organizations. Workers who were uncertain about the direction and future of change would be inclined to "wait it out" rather than commit to a potentially ephemeral reform program. Gaining the support of the workforce was especially important in the 1990s because the reformers sought not just incremental improvements but a complete reengineering of how the department conducted acquisition. "We had to change the way people thought and dealt with the acquisition process," Deputy Under Secretary for Acquisition Reform Colleen Preston would later say, "and the only way we were going to do that was to institutionalize a cultural change."[27]

A 1989 paper by Bernard Hebl, a former contract services administration officer, described the difficulty in changing defense acquisition culture. Hebl's observations about the culture in contracting could be applied to many acquisition organizations. According to Hebl, workers performed specialized contract administration functions without a clear understanding of their relation to the organization's mission. Once a method of performing a function was in use, no one questioned whether it was the best way of doing the job or sought to make improvements. Each succeeding generation of contract administrators would be trained in that method by people they assumed to be experts and would use it without question. Such preferred methods, when repeated often enough over time, in effect became mandatory even though there were no regulations or rules requiring them—because they had become part of the organization's culture. Once that happened, change was difficult because the workers, comfortable with the existing system, were understandably reluctant to "make waves" by challenging it. Hebl concluded, "This environment has developed over the past twenty plus years and now any real, meaningful change is almost impossible. Most people in upper and middle level management have come up through this system and in general do not possess the knowledge, outside experience or courage to risk their careers to make a change."[28]

Reformers therefore had to explain the new ways of doing things and persuade workers to adopt them. New regulations accompanied by incentives to encourage compliance could help bring workers on board. Beyond that, however, reformers hoped to change mindsets—to get workers thinking about their jobs in other ways, to experiment with different approaches, and not to assume they were restricted to traditional methods. Changing attitudes and behavior could be a difficult task, as some workers would likely be averse to taking risks that might jeopardize their careers.

Defense leaders set out to raise awareness of the acquisition reform program and explain the new policies using several methods. Under Secretary Kaminski and Preston, his deputy for acquisition reform, gave speeches and interviews at every opportunity and held town hall meetings where officials encouraged workers to ask questions and air concerns. Reformers intended worker participation to bolster confidence that their ideas mattered and to promote a feeling of ownership in the program. Similar motives lay behind Preston's use of process action teams composed of workers themselves. The department published a bimonthly newsletter, *Acquisition Reform Today*, and a professional journal, *Acquisition Review Quarterly*, which featured detailed discussions about reform and other acquisition issues.[29]

Raising awareness of acquisition reform was only a first step. Workers needed training in the new procedures and ways of approaching their jobs. The reformers were conscious of this problem early on. When Preston became deputy under secretary in 1993 she concluded the department's approach to career development was insufficient. Once certified as having met the education, training, and experience standards for their positions, workers had no further obligation to seek additional training or to keep current in their fields. To rectify this, Preston issued an interim policy in August 1996 to "test the feasibility of adding a new dimension of continuing acquisition education and training to existing education and training standards." The policy stated that workers who had completed the training for their positions should be given the opportunity to receive 40 hours of training per year for two years. As with certification training, the Defense Acquisition University was to pay the costs for students attending one of its consortium schools, while the components would pay the expenses for attending a non-consortium institution. Meanwhile, she directed the functional boards to analyze the types of courses to include in the continuing education program for each career field and the director of acquisition education, training, and career development to come up with a final, comprehensive continuing education policy by 1997.[30]

Preston and the other reformers recognized they could not wait for the new concepts and procedures to filter through the school system. A pressing need existed for "just-in-time" training, partly due to statutory deadlines. The Federal Acquisition Streamlining Act of 1994 stated that its provisions and the resulting revisions of the Federal Acquisition Regulation would become effective in October 1995. Furthermore, much of the training had to be done locally, preferably at the worksite, to reduce costs and minimize disruption. One way to reach workers in person was through roadshows, a concept borrowed from Army Materiel Command. In 1992 AMC began sending officials to its major subordinate commands annually to provide on-site training and "to carry a philosophy of streamlining acquisition management to the acquisition workforce." The Air Force and Navy followed with their own roadshows. (For more on roadshows and other service efforts to gain the support of their workforces for acquisition reform, see chapters XI, XII, and XIII.)[31]

The acquisition under secretary's office stepped up the outreach campaign by holding Acquisition Reform Acceleration Day on 31 May 1996. Kaminski and other officials gave speeches at the Pentagon, while around the country the entire acquisition workforce stood down for the day to attend local workshops, training sessions, and discussions. The event was so popular that the following March the department expanded it to a week, with the theme Sustaining the Momentum. The services added their own, similar activities. In 1999 Under Secretary for Acquisition, Technology, and Logistics Jacques Gansler broadened the event to include the logistics community under the name Acquisition and Logistics Reform Week.[32]

Chartered by the under secretary in May 1995, the Acquisition Reform Communications Center (ARCC) organized, coordinated, and executed much of the outreach effort. Organizationally part of Defense Acquisition University, the center relied heavily on multimedia technologies, especially the distribution of live broadcasts or prerecorded videotapes of training sessions, lectures, and panel discussions. In June it broadcast the first of a series of training sessions on the Federal Acquisition Streamlining Act. The four-hour session, broadcast live from the Army Logistics Management College at Fort Lee, Virginia, reached 15,000 people at 77 sites around the country. In keeping with the focus on increasing workforce participation in acquisition reform, the program included a one-and-a-half-hour question and answer period. Five more broadcasts on reform topics and initiatives followed in the fall. Eleven such broadcasts were made during 1996, including some of the events from the Acquisition Reform Acceleration Day.[33]

Even more than satellite broadcasts, the proliferation of networked desktop computers gave reformers a direct communication channel to the acquisition workforce. Electronic educational materials would not only provide foundational knowledge but also help bring about the cultural changes reformers sought. The ARCC digitized training and other reference materials, placing them initially on floppy disks or CD-ROM; by 1996 they were available online.[34]

The capstone application of the new technology was the Defense Acquisition Deskbook, an automated system intended to give users ready access to acquisition information. In 1996 the ARCC released the Deskbook on CD-ROM, sent it to more than 4,000 sites, and subsequently made it available through the Internet. Within a year, the Deskbook boasted a community of approximately 500,000. Contents included policy changes, lessons learned, and a reference library containing the FAR, the Defense FAR Supplement, the DoD 5000 series documents, and other acquisition-related statutes and regulations. It also housed an "information structure" of discretionary guidance such as best practices and how-to guides. Other components of the Deskbook's website were a bulletin board for user comments and an Ask a Professor feature for users to pose questions to Defense Systems Management College faculty members.[35]

The Deskbook attempted to diffuse the philosophy of the acquisition reform program to the workforce at large. By including discretionary guidance along with reference materials, it encouraged workers to use professional judgment on the job and to take prudent risks in trying new concepts and approaches. This is exactly what Kaminski was looking for. "By being an impetus for a reexamination of the current regulations, by allowing insight across the acquisition community, and by providing direct, unfiltered information to the entire workforce at the same time, the

Deskbook fosters cultural change," he told Congress in 1997. "It does this by giving each member of the acquisition workforce the knowledge to do his or her job better and the freedom to ask questions and challenge assumptions."[36]

Along with providing workers access to information and the means to express their views, the acquisition reformers offered incentives for workers to change their behavior. One was to recognize individuals and groups that advanced the adoption of acquisition reform ideas or that had successfully applied the concepts in an innovative way. This program included three new awards: the Defense Certificate of Recognition for Acquisition Innovation, the Defense Acquisition Executive Certificate of Achievement for integrated product teams, and the most prestigious, the David Packard Excellence in Acquisition Award for individuals and teams "who have demonstrated exemplary innovation and best acquisition practices reflecting goals and objectives furthering life cycle cost reduction and/or acquisition excellence in DoD."[37]

DEFINING AND DOWNSIZING THE ACQUISITION WORKFORCE

Determining the makeup and size of the acquisition workforce was essential to implementing the Defense Acquisition Workforce Improvement Act. To establish policies and procedures regarding the accession, education, training, and career development of the workforce, the secretary of defense needed to know who would be classified as an acquisition worker and how many there were. The process of classifying and counting workers helped define the boundaries of a professional acquisition workforce. And, as the post–Cold War personnel drawdown continued throughout the 1990s, such information would be crucial to ensuring the department could maintain the skills and experience necessary for acquiring superior weapon systems.

Two methods were used to define and count the number of acquisition workers when DAWIA became law in late 1990. One method identified acquisition organizations and then counted everyone who belonged to them. Known as the Acquisition Organization Count, it was quickly accomplished, but lacked accuracy. In 1990, just before DAWIA's passage, the number of personnel in acquisition organizations totaled 460,516, but this count included many, like clerical workers, who did not perform typical acquisition functions. It also excluded those workers performing acquisition tasks in organizations not formally classified as acquisition organizations.[38]

The second method counted the workers according to their military or civil service occupational specialties. Without a standard definition of an acquisition occupation, it was difficult to count the acquisition workforce using military or civilian occupational codes. The law required the secretary of defense to designate "acquisition related positions" in several functional areas in order to more accurately estimate the size of the workforce. The first calculation (1992) of these positions totaled 115,668 workers. This so-called DAWIA number was much smaller than the organizational count and excluded large groups such as clerical personnel and blue-collar workers. The broad functional areas used in this count, however, still did not distinguish between acquisition and non-acquisition workers. For example, not everyone who worked in logistics, financial management, education, training, and career development performed acquisition tasks.[39]

DAWIA Functional Areas

- Program management
- Systems planning, research, development, engineering, and testing
- Procurement, including contracting
- Industrial property management
- Logistics
- Quality control and assurance
- Manufacturing and production
- Business, cost estimating, financial management, and auditing
- Education, training, and career development
- Construction
- Joint development and production with other government agencies and foreign countries[I]

The term "acquisition workforce" continued in use for the next five years without an agreed upon definition. By late 1997 there were at least four different workforce definitions, each one producing a different count. As of 1 October 1997, the acquisition organization count, which included all civilian and military personnel belonging to organizations listed in DoD Instruction 5000.58 (Defense Acquisition Workforce), totaled 355,299. The FY 1996 National Defense Authorization Act had included all civilian and military personnel in acquisition organizations except blue-collar employees at repair depots, for a total of 320,641. The FY 1998 authorization act also counted all civilian and military personnel in acquisition organizations but exempted all civilian repair depot workers, yielding a figure of 269,603. Finally, the DAWIA count for FY 1997, which included only those personnel covered under the act, was 105,544.[40]

To reduce the potential for confusion, Congress, in the FY 1998 National Defense Authorization Act, directed the Defense Department to provide a definition of the term "defense acquisition workforce" that would be applied uniformly throughout the department. Even before the authorization act became law in November 1997, DoD was already at work on a definition. In the spring the department contracted with the consulting firm Jefferson Solutions to study ways of defining and counting the workforce more accurately. In its September 1997 report, Jefferson Solutions recommended using a combination of both organizational and occupational data, an approach the Packard Commission had used to count the workforce. The company also followed the Packard model in assigning acquisition personnel to one of two separate classes: Category I, those whose occupations were considered to be acquisition related no matter where they worked in DoD, such as contracting officers; and Category II, those whose occupations were considered to be acquisition related only if they worked in an acquisition organization, such as budget analysts. Secretary Cohen forwarded the Jefferson Solutions report to Congress in December 1997 and recommended the department adopt the firm's updated Packard approach as the basis for the acquisition workforce count.[41]

Congress did not object to Cohen's recommendation and the department began to refine the Jefferson Solutions methodology, employing a working group comprising personnel from OSD, DoD components, and the consulting firm. To determine which workers belonged in Categories I and II, the working group developed a list of acquisition functions in a weapon system's life cycle and then matched occupational specialties to those functions.[42]

Deciding who at the front and back ends of the life cycle should be counted as part of the acquisition workforce was complicated. At the front end were personnel from the DoD science and technology community—scientists and engineers involved in pre-Milestone 0 (Concept Studies Approval) activities such as basic research. The

Acquisition Organizations

- Army Materiel Command
- Army Information Systems Command
- Army Strategic Defense Command
- Army Acquisition Executive
- Office of the Assistant Secretary of the Navy (Research, Development, and Acquisition)
- Naval Sea Systems Command
- Naval Air Systems Command
- Naval Supply Systems Command
- Naval Facilities Engineering Command
- Office of the Chief of Naval Research
- Space and Naval Warfare Systems Command
- Navy Strategic Systems Program Office
- Navy Program Executive Officer/Direct Reporting Program Manager Organization
- Marine Corps Research, Development and Acquisition Command
- Office of the Assistant Secretary of the Air Force (Acquisition)
- Air Force Systems Command
- Air Force Logistics Command
- Air Force Program Executive Organization
- Defense Logistics Agency
- Strategic Defense Initiative Organization
- Special Operations Command[II]

working group included these personnel in the count and created Category IIB, both for the S&T community and for others not usually acknowledged as carrying out acquisition activities. At the back end of a system's life cycle was the logistics community. It engaged in both acquisition-related activities, such as procurement of spare parts, and support operations, such as maintenance, which might not have anything to do with acquisition. The working group sorted out most of these workers without too much difficulty. When it came to logistics managers, the group counted only those who spent more than half of their time in acquisition work.[43]

Other decisions addressed the appropriate classification for several other sets of workers. Nonprofessional clerical and other staff supporting acquisition workers and organizations had been included in the original Packard Commission count, always in the acquisition organization counts, and among the total of 189,158 acquisition workers reported by Jefferson Solutions in September 1997. The working group, however, eliminated clerical and other nonprofessional administrative personnel from the count, but included professionals providing acquisition support. Finally, the working group created Category III for personnel who did not fit any other category—those who clearly performed acquisition work but did not fit in a Category I occupation or who did not belong to an acquisition-related organization.[44]

The Refined Packard method, as the approach was officially named, was not perfect. For example, it counted people, not positions, and used data intended for managing career development, not manpower planning. Also, an occupational series did not always indicate a worker's actual function—many engineers were performing management functions, for example. And although all the personnel included in the count performed acquisition work, they might also carry out non-acquisition tasks. For these and other reasons, the Defense Department did not consider data from the Refined Packard method to be appropriate for planning workforce reductions.[45]

Despite its flaws, Refined Packard was far more informative and accurate than any other method available. A count based on the data from 30 September 1998 produced the official FY 1998 total of 146,071 for the acquisition workforce, including 129,618 civilians and 16,453 uniformed personnel. The official count for FY 2000 was 135,014. By comparison, the acquisition organization count for that fiscal year was 292,661; and the DAWIA count, 91,322 (see figure 15-1).[46]

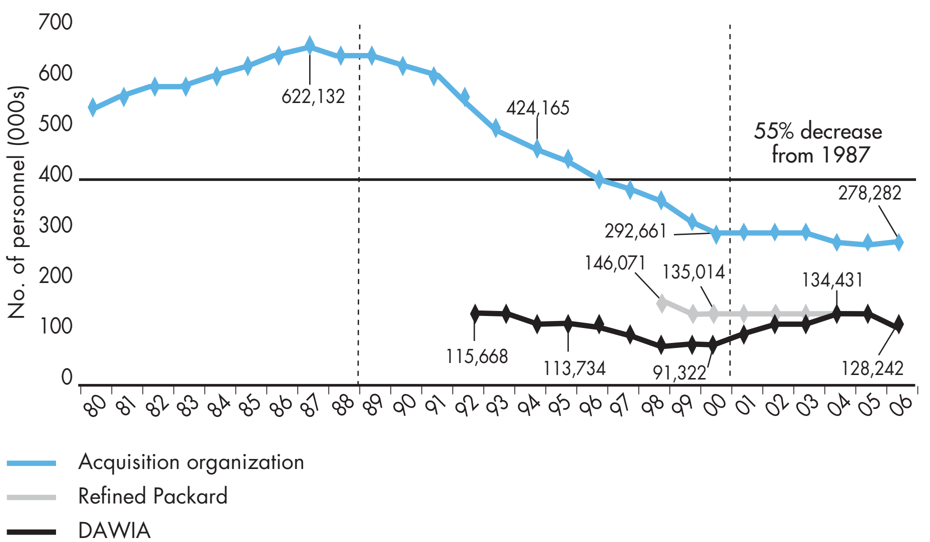
Whatever the definition of the acquisition workforce, the number of acquisition workers dropped steadily from the late 1980s through the 1990s. The Defense Department reported that by the end of FY 1996 the total employment in acquisition organizations, 356,813, was down 218,224 from the end of FY 1989, a drop of 38 percent. The DAWIA count was down too during the same period, from 143,432 to 108,007—a decline of 25 percent. Although there was widespread agreement over the need to downsize the acquisition workforce after the Cold War, DoD's plan to come under the target for total civilian employment set by the National Performance Review in 1993 was not enough for Republican legislators who had won control of Congress in 1994. Representative Floyd D. Spence (R-SC), chairman of the House

National Security Committee (renamed from the House Armed Services Committee in 1995), and Representative Duncan Hunter (R-CA), chairman of its procurement subcommittee, were particularly vocal in their belief DoD had not reduced its acquisition workforce sufficiently. Complaining the department was overloaded with "shoppers and buyers," Hunter was the driving force behind personnel reduction measures that would last almost to the end of the Clinton administration in 2001. While House Republicans were early champions of downsizing the acquisition workforce, the National Security Committee ultimately supported the campaign on a bipartisan basis.[47]

In June 1995 the House National Security Committee released its version of the National Defense Authorization Act for FY 1996, which contained a provision cutting the number of military and civilian acquisition personnel by 25 percent, including a "down payment" of 30,000 by October 1996. The bill also required the secretary of defense to submit a report with a plan for restructuring the department's acquisition organizations to accommodate the cuts and to streamline their operations. In its report on the bill, the committee declared it intended to spur the acquisition reform process and wring further efficiencies out of the Pentagon by directing "an accelerated downsizing of the bloated civilian bureaucracy."[48]

Although the Defense Department accepted that cuts were necessary, it complained the House reductions were draconian and would remove from the workforce skilled personnel needed to implement acquisition reform properly. The Senate, which had not asked for specific reductions, supported DoD. The ensuing House-Senate conference agreed to a reduction of 15,000 in FY 1996 and directed the secretary of defense to submit a report on reducing the acquisition workforce

Figure 15-1: Acquisition Workforce Trends, 1980–2006



Source: Adapted from Figure 3-1 (Workforce Trends), in Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review,* 3-8.

by 25 percent over four years. Given that it was already planning a larger cut, the department decided not to fight the conference number and in fact cut almost 24,000 from the acquisition workforce in 1996. The House sought further reductions in 1997—and for four years after that. For 1997 it wanted 25,000, but in conference the Senate lowered that figure to 15,000. Again, the burden was not onerous because DoD had programmed cuts of over 36,000 personnel for FY 1997, for a two-year total of 59,974 workers, or 15.8 percent.[49]

In January 1997 the Defense Department delivered the report Congress had requested in the FY 1996 authorization act. It was a defiant rejection of the House National Security Committee's insistence on reducing the workforce to arbitrary levels. The report laid out a five-year plan for downsizing the workforce, noting DoD was on track to meet a 25 percent reduction by the end of 2000. However, it offered only vague ideas for restructuring acquisition organizations and suggested the department was on an "excellent path of managed reductions" and had the process well in hand, so "a separate plan is not required." Finally, the report warned against imposing workforce reductions beyond what DoD was already planning. The department had programmed for the minimum number of workers based on its workload, and Congress, it said, should not impose any arbitrary reductions or personnel levels.[50]

The House National Security Committee firmly rejected these conclusions. The report "demonstrated no real effort to consider the various organizational and management options identified by the law," and did not propose any significant alterations in the current acquisition structure. The committee warned that "the Department's continued refusal to restructure and streamline acquisition infrastructure will result in the continued squandering of limited resources." In the Defense Reform Act of 1997 and later in its markup of the FY 1998 authorization act, the committee demanded a further reduction of 124,000 workers over four years: 40,000 each in 1998 and 1999, and 22,000 each in 2000 and 2001, a 42 percent cut in four years. Furthermore, the committee called for DoD to submit another report explaining how it would achieve the reductions. Finally, it wanted to turn over reorganization of the acquisition system to a Commission on Defense Organization and Streamlining proposed elsewhere in the bill, "in order to obtain independent analysis of these issues and develop specific alternative organizational options." The armed services committees would appoint the commission's nine members.[51]

The debate in Congress over an amendment to the authorization act transferring workforce reduction and other provisions of the defense reform bill reveals the bipartisan nature of the effort to decrease the size of the acquisition workforce. In Congress, acquisition reform was one of the few issues on which both parties agreed. Ron Dellums (D-CA) and Jane Harman (D-CA) enthusiastically joined Republicans Spence and Hunter in advocating the measure, which indeed was known as the "Spence-Dellums Amendment." It passed easily, 405-14.[52]

The Defense Department also supported workforce reductions but not on the scale Congress proposed. The department appealed the cuts in July 1997, arguing they should "not be legislated" but determined on the basis of workload. Again, the

Senate in conference on the FY 1998 authorization act worked a compromise that softened the provisions for large, multiyear cuts wanted by the House. The workforce reduction would be for FY 1998 only, and for only 25,000 to as few as 10,000 should the secretary of defense object to the higher number.[53]

Although the House continued the pressure to downsize in FY 1999 and FY 2000, opposition to further arbitrary reductions was solidifying. Even the House Armed Services Committee (the name to which the House National Security Committee had reverted in 1999) admitted the reductions had surpassed what Congress had required. From 1990 through 1999, the Defense Department shed some 289,000 civilian acquisition workers, or 49 percent of its civilian acquisition workforce. Reorganizations, business process reengineering, enhanced technology, and outsourcing shrank the number of acquisition positions. Buyouts, hiring freezes, and attrition were the primary tools for reducing the number of personnel. During the same period, the department's acquisition workload gradually increased. For example, the number of procurement actions rose from 13.2 million to 14.8 million. Of these, the number of contracting actions over $100,000 had climbed from 97,948 to 125,692—an increase of 28 percent.[54]

Concerned that the cuts already made had weakened the department's ability to do its job, senior defense officials were having second thoughts about further downsizing. "After 11 consecutive years of downsizing," warned Under Secretary Gansler and Dr. Bernard D. Rostker, the under secretary for personnel and readiness, in October 2000, "we face serious imbalances in the skills and experience of our highly talented and specialized civilian workforce." Along with the imbalances Gansler and Rostker cited, a study by the DoD inspector general stated the cuts had also caused staff shortages and work slowdowns. The 14 acquisition organizations visited by the inspector general's office reported that further reductions would lead to serious problems, including increased costs, longer lead times, a reduction in oversight, and limits on recruiting and retaining a qualified workforce.[55]

Saving money had been one of downsizing's key goals, but some questioned whether that had happened. There were indications to the contrary. The department often transferred workers whose jobs had been cut to other positions. In one case, an entire acquisition organization, the Army Information Systems Command, was disestablished and the workers transferred. Of the roughly 40,000 civilian acquisition personnel reductions in 1996 and 1997, 9,000 workers (22 percent) continued to be employed by DoD. Furthermore, contractors took on many of the functions that had been cut, adding to the workload of contracting offices. It was widely recognized that contracting would offset the result of downsizing to some degree; for some in the Defense Department and Congress, the outsourcing and privatization of noncritical activities was a significant goal of workforce reductions and acquisition reform. DoD officials were coming to realize that contractors were just as essential to operations as civilian employees and uniformed personnel, and that reducing the latter was to manage only part of the workforce.[56]

Even those organizations reporting that downsizing had not impaired their operations suffered from low employee morale. A 1994 study of acquisition culture cited a flag officer who noted, "The acquisition workforce is now in a free fall. No one is managing it. No one is in charge of it. Considering the large size of the personnel reductions, the workforce is scared." In 1998 the Defense Acquisition University Board of Visitors warned about the impact of the most recent cuts ordered by Congress ("a long, laborious, slow death," one member called them), especially the effect they would have on workforce recruitment, and urged Gansler to accomplish them quickly.[57]

In 2000 the House Armed Services Committee proposed another reduction in acquisition personnel, but only for 13,000. The Senate, meanwhile, dug in its heels. Citing the 2000 DoD inspector general report, it proposed a three-year moratorium on further cuts unless the secretary of defense wanted them. The conference report noted that neither the 13,000 personnel reduction nor the three-year moratorium had been adopted. The downsizing of the defense acquisition workforce was over.[58]

* * * * *

During the 1990s the acquisition workforce began to acquire a distinct professional identity. The Defense Acquisition Workforce Improvement Act created the framework for that identity by providing for a corps of acquisition specialists in each service, with its own education and training system run by the Defense Acquisition University. The law also established clear-cut career development paths that could lead to top acquisition positions in the Defense Department for both civilians and uniformed officers. It was a solid foundation that defined the different components of the acquisition workforce so that it could be managed as a cohesive whole. The continued development of a professional ethos in the acquisition workforce, along with the functional skills needed to sustain successful weapon programs in the future, would demand careful and continuous attention.

Endnotes

1. Packard Commission, *Quest for Excellence*, 66.

2. Evelyn Layton, *The Defense Acquisition University: Training Professionals for the Acquisition Workforce, 1992–2003* (Fort Belvoir, VA: Defense Acquisition University Press, Jan 2007), 4–5, www.dau.mil/AckerLibrary/AckerLibraryDocs/History%20Book.pdf, accessed 15 Jan 2015. The other three panels and years of their reports were the Fitzhugh Commission (1970), the Commission on Government Procurement (1972), and the Grace Commission (1984).

3. Cheney, *Defense Management*, 14–15 (quote, 14), B-1–B-2.

4. HCAS, Subcommittee on Investigations, *A Review of Defense Acquisition in France and Great Britain: Report*, 101st Cong., 1st sess., 16 Aug 1989, HASC No. 5, 11; HCAS, Subcommittee on Investigations, *The Quality and Professionalism of the Acquisition Workforce: Report*, 101st Cong., 2d sess., 8 May 1990, HASC No. 10, 29–30, 51–52; HCAS, Subcommittee on Investigations, *Life Is Too Short: A Review of the Brief Periods Managers of Major Defense Acquisition Programs Stay on the Job: Report*, 101st Cong., 2d sess., 4 Jul 1990, HASC No. 12, 1–10 (quotes, 1, 10).

5. James H. Edgar, "The Origins and Impact of the Defense Acquisition Workforce Improvement Act (DAWIA)," in *Providing the Means of War*, 267–271; HCAS, Subcommittee on Investigations, *Acquisition Workforce: Hearings*, 101st Cong., 2d sess., 28 Mar 1990, HASC No. 101-71, 52 (quote); ltr, USDA(A) Betti to Reps. Nicholas Mavroules and Larry Hopkins, 7 Aug 1990, file 7 Aug 90, box 8, Acc 330-94-0006, OSD Records, WNRC; *National Defense Authorization Act for Fiscal Year 1991*, P.L. 101-510 (5 Nov 1990), Title XII. The other three acquisition corps bills were H.R. 4950, by Rep. Dennis M. Hertel (D-MI); H.R. 965, by Rep. Barbara L. Boxer (D-CA); and S. 1202, by Sen. William V. Roth Jr. (R-DE). See also John F. Morton, "Acquisition Corps Proposals," *National Journal*, 19 Nov 1990, 18.

6. *Defense Acquisition Workforce Improvement Act* [hereafter *DAWIA*], Title XII in *National Defense Authorization Act for Fiscal Year 1991*, sec. 1202, subchapter I (quote).

7. *DAWIA*, sec. 1202, subchapter II; David C. Morrison, "Acquisition Amateurs," *National Journal*, 21 Jul 1990, 1.

8. *DAWIA*, sec. 1202, subchapter III.

9. Ibid.

10. Ibid.

11. Ibid., sec. 1202, subchapters IV–V.

12. Office of Assistant Secretary of Defense for Acquisition, "Dr. James S. McMichael," www.acq.osd.mil/asda/docs/biography/bio-drmcmichael.pdf, accessed 2 Feb 2015; GAO, *Acquisition Management: Implementation of the Defense Acquisition Workforce Improvement Act*, GAO/NSIAD-93-129 (Apr 1993), 8–9. For the OSD implementing regulations, see DoD Directive 5000.57 (Defense Acquisition University), 22 Oct 1991; DoD Directive 5000.52 (Defense Acquisition Education, Training, and Career Development Program), 25 Oct 1991; DoD Instruction 5000.55 (Reporting Management Information on DoD Military and Civilian Acquisition Personnel and Positions), 1 Nov 1991; DoD Instruction 5000.58 (Defense Acquisition Workforce), 14 Jan 1992.

13. Arthur Santo-Donato, *The Defense Acquisition Workforce Improvement Act: What Is It and Where Is It Today?* (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, Jan 1992), 15.

14. DoD Instruction 5000.58, sec. 6.1, 9–10.

15. GAO, *Implementation of the Defense Acquisition Workforce Improvement Act*, 23–24.

16. Ibid., 12; Dick Cheney, *Annual Report to the President and the Congress*, Jan 1993, 174; Perry, *Annual Report to the President and the Congress*, Feb 1995, F-10–F-12.

17. Andrea Garcia et al., "The Defense Acquisition Workforce Improvement Act: Five Years Later," *Acquisition Review Quarterly* 4, no. 3 (Summer 1997): 295–308.

18. GAO, *Implementation of the Defense Acquisition Workforce Improvement Act*, 14–15.

19. Memo, USD(A) Don Yockey for Service Secretaries et al., 1 Jul 1991, subj: Decision Memorandum for the Defense Acquisition University and Senior Course, copy in author files, OSD/HO; *Department of Defense Implementation Plan for the Defense Acquisition University, Prepared for the Committees on Armed Services, United States Congress, Oct 1991*; DoD Directive 5000.57, 22 Oct 1991; Layton, *Defense Acquisition University*, 20–22, 27–28; "Secretary Kaminski Appoints Thomas M. Crean New DAU President," *Program Manager* 23, no. 6 (Nov-Dec 1994): 18. Under Secretary Yockey had appointed James McMichael, DoD's director of acquisition education, training, and career development, as DAU's first president, but only as an additional duty. See Layton, *Defense Acquisition University*, 22.

20. Layton, *Defense Acquisition University*, 29–30, 32–33 (quote, 33), 35. Chartered in 1994, the Board of Visitors oversaw DAU's academic program, organizational management, and facilities; the Defense Acquisition University Program Review Board, chartered in 1997, reviewed its plans, operations, budgets, and program initiatives. Jacques Gansler, who would become under secretary for acquisition and technology in 1997, was the first chairman of the Board of Visitors.

21. DoD Directive 5000.52-M (Acquisition Career Development Program), Nov 1995, viii (listing of career fields 1995); Edward A. Molnar, Kathleen L. Newbold, and Albert H. Schroetel, *Defense Acquisition University Core Requirements and Faculty Structure* (McLean, VA: Logistics Management Institute, Sep 1998), 3-8–3-9, 3-15–3-16. The seven career fields that required Level I and Level II students to take one of the core courses were Acquisition Logistics; Business, Cost

Estimating, and Financial Management; Communication-Computer Systems; Manufacturing, Production, and Quality Assurance; Program Management; Systems Planning, Research, Development, and Engineering; and Test and Evaluation.

22. DoD Directive 5000.52-M, xi; Under Secretary of Defense (Acquisition and Technology), "Assignment-Specific Training: Programs and Policies: Final Draft," 1 May 1997, www.library.dau.mil/DAU_AssignSpecTrng_May97.pdf, accessed 4 Feb 2015; USD(A&T), *Defense Acquisition University Fiscal Year 1997 Course Catalog* (Fort Belvoir, VA: Defense Acquisition University, 1996), 10, H-3-9; *Defense Systems Management College 1997 Catalog*, 9, 33, 49–50, 57–58.

23. *DAWIA*, sec. 1205(a)4 (quote); Yockey memo, Decision Memorandum for the Defense Acquisition University and Senior Course; *Defense Acquisition University Fiscal Year 1997 Course Catalog*, 2–-23.

24. Layton, *Defense Acquisition University*, 83; Molnar, Newbold, and Schroetel, *Defense Acquisition University*, 3-15–3-16.

25. Layton, *Defense Acquisition University*, 83, 88–90.

26. Ibid., 90–91; U.S. Air Force, "Biography: Brigadier General Frank J. Anderson Jr." (Nov 1999), www.af.mil/About-Us/Biographies/Display/Article/107838/brigadier-general-frank-j-anderson-jr/, accessed 31 May 2018; Defense Acquisition University, Past Leadership, "The Anderson Years (October 2000–July 2010)," https://www.dau.mil/about/p/Past-Leadership, accessed 31 May 2018.

27. "Colleen Preston on Acquisition Reform," *Program Manager* 26, no. 1 (Jan–Feb 1997): 26 (quote).

28. Undated typescript attached to ltr, Bernard Hebl to SecDef Dick Cheney, "Improving Contract Administration Operations," 12 Jul 1989 (quote), file 400.1 (Jul-), box 74, Acc 330-91-0095, OSD Records, WNRC.

29. Kimberly A. Harokopus, "Transforming the Department of Defense: Creating the New Defense Procurement System," in *Transforming Organizations*, eds. Mark Abramson and Paul R. Lawrence (Lanham, MD: Rowman & Littlefield, 2001), 11–55.

30. Memo, USD(A) John Deutch for Director, Administration and Management, 14 May 1993, subj: Establish Deputy Under Secretary of Defense for Acquisition Reform, Acker Library, DAU; memo, DUSD(AR) Colleen Preston for Director, Acquisition Education, Training and Career Development et al., 7 Aug 1996, subj: Attached Interim Policy on Continuing Acquisition Education and Training, Acker Library, DAU; Preston, memo for distribution, 7 Aug 1996, subj: Continuing Acquisition Education and Training for Acquisition Workforce Members—Interim Policy (quote), Acker Library, DAU: copies of all in author files.

31. *Federal Acquisition Streamlining Act*, P.L. 103-355 (13 Oct 1994), sec. 10002; Brown, "U.S. Army on the Road Again for AR," 6 (quote).

32. DoD News Release 319-96, "DoD Observes Acquisition Reform Day," 31 May 1996; Defense Acquisition University, *Acquisition Reform Acceleration Day Summary Report*, 23 Jul 1996, http://web.archive.org/web/19970626172739/http://www.acq.osd.mil/dau/arcc/accelday/adsumm.pdf, accessed 5 Feb 2015; Paul G. Kaminski, "Acquisition Reform Day Feedback," transcript of videotaped remarks, 10 Oct 1996, 6, http://web.archive.org/web/19990209021601/http://www.acq.osd.mil/ar/doc/ardayrmk.pdf, accessed 5 Feb 2015; "Acquisition Reform Week 17–21 March 1997," http://web.archive.org/web/19970612014708/http://www.safaq.hq.af.mil/acq_ref/ar2week.html, accessed 5 Feb 2015; memo, Gansler for Secretaries of Military Departments et al., 24 Jan 2000, subj: Acquisition and Logistics Reform Week – May 22–26, 2000, "Embracing Change for the 21st Century Warfighter," www.dau.mil/pubscats/PubsCats/PM/articles00/gansma01.pdf, accessed 5 Feb 2015.

33. "Acquisition Reform Communications Center (ARCC) History," 5 Jun 1997, http://web.archive.org/web/19970605205423/http://www.acq.osd.mil/dau/arcc/arcc3.html, accessed 5 Feb 2015; memo, Kaminski for ASD (Economic Security), 4 May 1995, subj: Acquisition Reform Communications Center; memo, DUSD(AR) for SecDef, 10 May 1995, subj: Proposed Appearance in a Motivational Video for Use in Acquisition Reform Training: copies of both in author files; Mary Ackerman et al., "Acquisition Reform Communications Center (ARCC) Broadcasts First Program via Satellite," *Program Manager* 25, no. 1 (Jan–Feb 1996): 18–21; "ARCC Satellite Broadcasts, 'FASA: Making it Work,'" 21 Apr 1997, http://web.archive.org/web/19970605205605/http://www.acq.osd.mil/dau/arcc/arbrold.html, accessed 5 Feb 2015; Alex Dean, "Broadcast News: Beaming

Down FASA," *Acquisition Reform Today* 1, no. 1 (Feb 1996): 5; Kaminski memo, Acquisition Reform Communications Center; William S. Cohen, *Annual Report to the President and the Congress*, Apr 1997, 106; Layton, *Defense Acquisition University*, 73–74.

34. "Acquisition Reform Training Module (ARTM) Information," archived webpage dated 21 Apr 1997.

35. Frances M. Valore, "AAI PAT Introduces the Acquisition Deskbook," *Program Manager* 24, no. 4 (Jul-Aug 1995): 27–32; Jay Bishop, "Deskbook: New Info Source Looms as AR 'Best Seller,'" *Acquisition Reform Today* 1 (Aug-Sep 1996): 1; Kaminski, Statement on Defense Acquisition Reform before the House Committee on National Security, 26 Feb 1997, 23, copy in author files; Doreen Harwood, "Defense Acquisition Deskbook—An Acquisition Reform Unqualified Success," *Program Manager* Special Issue 26, no. 1 (Jan-Feb 1997): 41–42.

36. Valore, "AAI PAT," 27–32; Harwood, "Defense Acquisition Deskbook," 40–42; Kaminski statement, 23 (quote).

37. Paul Kaminski, memo for distribution, 9 Jun 1996, subj: Recognizing and Rewarding Acquisition Personnel—Policy Memorandum, copy in author files. Gansler reissued this policy in November 1997 and October 2000; see Gansler, memo for distribution, 13 Oct 2000, subj: Recognition and Awards for Acquisition Personnel – David Packard Excellence in Acquisition Award Nominations, http://www.acq.osd.mil/dpap/Docs/awardpolicy.pdf, accessed 9 Feb 2015.

38. DoD IG, *DoD Acquisition Workforce Reduction Trends and Impacts*, Audit Report D-2000-088 (Washington, DC: DoD, 29 Feb 2000), 5–6; Allan V. Burman, "Who's Who in Acquisition?" *Government Executive* 30, no. 12 (1 Dec 1998): 1–3.

39. *DAWIA*, sec. 1202, subchapter II; Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review,* 3-8.

40. OUSD(A&T), *Right-Sizing the Department of Defense Acquisition Workforce*, 28 Jan 1997, 3, 9; GAO, *Defense Acquisition Organizations: Status of Workforce Reductions*, GAO/NSIAD-98-161 (Jun 1998), 8; William S. Cohen, *Annual Report to the President and the Congress*, 1998, F-1.

41. H.R. 1119, *National Defense Authorization Act for Fiscal Year 1998*, P.L. 105-85, 18 Nov 1997, sec. 912; Allan V. Burman, Nathaniel M. Cavallini, and Kisha N. Harris, *Identification of the Department of Defense Key Acquisition and Technology Workforce* (Washington, DC: Jefferson Solutions, Apr 1999), 11–12. In determining its count of 165,000 military and civilian personnel in the acquisition workforce, the Packard Commission included 8 occupational series, but workers in 39 other series only if they were in a designated acquisition organization. See Packard Commission, *Quest for Excellence*, 43.

42. Minutes of the Acquisition Reform Senior Steering Group meeting, 23 Sep 1997, http://web.archive.org/web/20020615101246/http://www.acq.osd.mil/ar/arssg.htm, accessed 18 Feb 2015; Burman, Cavallini, and Harris, *Identification*, 12–14.

43. Burman, Cavallini, and Harris, *Identification*, 14–15, 19–20.

44. Ibid., 12, 14–15, 18–19, 20–22.

45. PDUSD(A&T) David Oliver, memo for distribution, 13 May 1999, subj: Refined Packard Key Acquisition and Technology Workforce Identification Policy for the Fiscal Year 1999 (FY99), www.acq.osd.mil/dpap/Docs/workforc.pdf, accessed 28 Feb 2015; Burman, Cavallini, and Harris, *Identification*, 26–27; DoD IG, *DoD Acquisition Workforce Reduction Trends and Impacts*, 52.

46. DoD IG, *DoD Acquisition Workforce Reduction Trends and Impacts*, 8–9; Defense Acquisition University, *Defense Acquisition Structures and Capabilities Review,* 3-8.

47. Cohen, *Annual Report,* 1998, F-1; GAO, *Status of Workforce Reductions*, 4; William Perry, "Department of Defense," in National Performance Review, *The Best Kept Secrets in Government*, 1996 Annual Report, 81; Burman, "Who's Who in Acquisition?"1–3.

48. House of Representatives, H.R. 1530 RH [Reported in House], 104th Cong., 1st sess., 31 May 1995, H. Rep. 104-131, 336–339; House Committee on National Security, *National Defense Authorization Act for Fiscal Year 1996: Report . . . on H.R. 1530*, 104th Cong., 1st sess., 1 Jun 1995, H. Rep. 104-131, 11–12, 244–245 (quote, 11).

49. Jeff Erlich, "DoD Will Cut 15,000 in 1996," *Defense News*, 13 Nov 1995, 13; House of Representatives, *National Defense Authorization Act for Fiscal Year 1996: Conference Report to Accompany H.R. 1530*, 104th Cong., 2d sess., 22 Jan 1996, H. Rep. 104-406, 221–222. (The Defense Authorization Act for FY 1996 was vetoed by President Clinton, but the workforce provisions were essentially the same in the bill, S. 1124, that was eventually signed into law, P.L. 104-106, sec. 906.); HCNS, *National Defense Authorization Act for Fiscal Year 1997: Report . . . on H.R. 3230*, 104th Cong., 2d sess., 7 May 1996, H. Rep. 104-563, 316–317; House of Representatives, *National Defense Authorization Act for Fiscal Year 1997: Conference Report to Accompany H.R. 3230*, 104th Cong., 2d sess., 1 Aug 1996, H. Rep. 104-724, 196.

50. OUSD(A&T), *Right-Sizing the Department of Defense Acquisition Workforce*, 28 Jan 1997, 2–5, 13 ("separate plan"), 19 ("excellent path").

51. HCNS, *The Defense Reform Act of 1997: Report . . . on H.R. 1778*, 105th Cong., 1st sess., 17 Jun 1997, H. Rep. 105-133, pt. 1:29–30 (quotes, 30); H.R. 1778, *The Defense Reform Act of 1997*, 4 Jun 1997, secs. 102, 501–509: 8–10, 80, 81–82, 83–89; HCNS, *National Defense Authorization Act for Fiscal Year 1998: Report . . . on H.R. 1119*, 105th Cong, 1st sess., 16 Jun 1997, H. Rep. 105-132, 392–393. The commission was dropped from the authorization bill because it would have duplicated Cohen's Defense Reform Task Force. See Colin Clarke and David Ruppe, "At Least 10,000 Acquisition Jobs On Block," *Defense Week*, 3 Nov 1997, 2.

52. *Congressional Record* 143 (19 Jun 1997), pt. 8:11580–11583.

53. Quote in Clarke and Ruppe, "Acquisition Jobs on the Block," 2; H.R. 1119, *National Defense Authorization Act for Fiscal Year 1998*, P.L. 105-85 (18 Nov 1997), sec. 912.

54. DoD IG, *DoD Acquisition Workforce Reduction Trends and Impacts*, 4–10, 15.

55. Memo, Bernard Rostker and Jacques Gansler for Secretaries of Military Departments et al., 11 Oct 2000, subj: Shaping the Civilian Acquisition Workforce of the Future—Action Memorandum, with attached Acquisition 2005 Task Force, *Shaping the Civilian Acquisition Workforce of the Future: Final Report* (DoD, Oct 2000), http://history.defense.gov/Portals/70/Documents/acq_documents/report_acq_2005.pdf, accessed 18 Feb 2015; DoD IG, *DoD Acquisition Workforce Reduction Trends and Impacts*, 30. The DoD inspector general's office acknowledged, however, that the acquisition organizations did not provide data to support their assertions, nor were they required to. For additional evidence of the impact of acquisition workforce reductions, see GAO, *Acquisition Management: Workforce Reductions and Contractor Oversight*, GAO/NSIAD-98-127 (Jul 1998), 7, 8; SCAS, *Department of Defense Authorization for Appropriations for Fiscal Year 1999 and the Future Years Defense Program: Hearings . . . on S. 2057*, 105th Cong., 2d sess., 18 Mar 1998, S. Hrg. 105-605, pt. 5:163, 166, 167.

56. GAO, *Quadrennial Defense Review: Status of Efforts to Implement Personnel Reductions in the Army Materiel Command*, GAO/NSIAD-99-123 (Mar 1999), 9. (In 1998 the GAO admitted that it could not correlate budget reductions to workforce reductions. See GAO, *Status of Workforce Reductions*, Jun 1998, 5.) GAO, *Defense Acquisition Organizations: Reductions in Civilian and Military Workforce*, GAO/NSIAD-98-36R (23 Oct 1997), 1–5; Acquisition Reform Senior Steering Group Minutes, 1997–2001, 16 Dec 1997, http://web.archive.org/web/20020615101426/http://www.acq.osd.mil/ar/arssg97.htm, accessed 23 Feb 2015.

57. J. Ronald Fox et al., *Critical Issues in the Defense Acquisition Culture: Government and Industry Views from the Trenches* (Fort Belvoir, VA: DSMC Executive Institute, 1994), 64 (quote); minutes of the DAU Board of Visitors Executive Session, 26 Feb 1998, 1 (quote), copy in author files. The flag officer quoted is Lt. Gen. Thomas R. Ferguson Jr. (USAF, Ret.), the former head of the Aeronautical Systems Center at Air Force Materiel Command. See Defense Acquisition University, "DAU Board of Visitors," http;//web.archive.org/web/20010409234702/www.dau.mil/about-dau/bov/daubov.htm, accessed 23 Feb 2015.

58. HCAS, *Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001: Report . . . on H.R. 4205*, 106th Cong., 2d sess., 12 May 2000, H. Rep. 106-616, 399–400; SCAS, *National Defense Authorization Act for Fiscal Year 2001: Report [to accompany S. 2549]*, 106th Cong., 2d sess., 12 May 2000,

S. Rep. 106-292, 327–328; House of Representatives, *Enactment of Provisions of H.R. 5408, the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001: Conference Report to Accompany H.R. 4205*, 106th Cong., 2d sess., 6 Oct 2000, H. Rep. 106-945, 840–841.

I. *Defense Acquisition Workforce Improvement Act*, sec. 1202, subchapter II. Acquisition positions were also to include "acquisition-related" positions in management headquarters.

II. DoD Instruction 5000.58 (Defense Acquisition Workforce), 14 Jan 1992, 30–31.

CHAPTER XVI

Conclusion

Reform and experimentation characterized defense acquisition in the 1990s. The results were changes to policy, organization, and process coming from different quarters—the White House, the Office of the Secretary of Defense, the services, and Congress. Although they often had differing emphases, objectives, and outcomes, the reforms and experiments aimed at ensuring the nation would have the military systems it needed, when it needed them, and at a cost it was willing to pay. The reform spirit reflected a willingness to depart from established organizational structures and practices to develop and implement new approaches to the acquisition of major weapon systems.

Acquisition reform took place in the context of a dramatically altered international order. The Soviet Union's collapse brought an end to the Cold War geopolitical framework that had determined U.S. security policy since the late 1940s. A decade would pass before a well-defined international security environment would take shape. Although Russia, the Soviet Union's successor state, retained a formidable nuclear arsenal, policymakers believed the most likely danger to the United States would come from aggression by a regional power prepared to conduct large-scale military operations with heavy conventional forces. The Gulf War's example lent weight to this prospect. In response, the George H. W. Bush and Clinton administrations adopted nearly identical national security strategies. The key elements of the two were to maintain strong strategic deterrent forces; continue to deploy conventional forces overseas to support diplomatic and military objectives; prepare U.S. forces for a major regional conflict and for operations other than war, especially international peacekeeping missions; and ensure the national industrial base would remain capable of reconstituting Cold War–size forces, equipped with the latest technology, should major new threats arise.

This post–Cold War strategic posture influenced weapons acquisition in a variety of ways throughout the 1990s. The most immediate was the bipartisan demand for a peace dividend of savings from reducing the defense establishment's size. From FY 1990 through FY 1998 the Defense budget declined steadily, with the procurement account suffering the heaviest reductions. In this context, force structure shrank and many weapon system programs were terminated, stretched out, or had their planned production quantities cut back. Inventories remained full of relatively new systems. Without the Soviet Union to serve as a pacing competitor, there was less incentive to start major new programs. To preserve the defense industrial base, the Bush and Clinton administrations invested heavily in R&D to upgrade existing weapon systems with new technologies. Both administrations also sought to reform the acquisition system to cut costs and thereby compensate for smaller budgets. Defense establishment contraction further encouraged the armed forces to adapt to the revolution in military affairs that some policymakers, analysts, and uniformed military leaders believed was underway. Underpinned by advances in information technology that had demonstrated their value in the Gulf War, the revolution in military affairs had the potential to transform the U.S. military into the smaller, lighter, and more agile force considered essential for meeting national security strategy requirements in the context of reduced defense spending.

NEW APPROACHES TO DEVELOPING INNOVATIVE TECHNOLOGY

The Bush and Clinton administrations, like their predecessors, relied on technologically advanced weapon systems to give U.S. forces an advantage over their opponents. In the late 1940s and 1950s, national leaders expected advanced weapon systems to overcome superior numbers—such as Soviet long-range bomber fleets and tank armies and masses of Chinese infantry. By the 1970s, development of cutting edge technologies aimed less at countering greater numbers than at producing systems capable of offsetting Soviet advances in ballistic missile, air defense, and undersea warfare systems. Even with the end of the Cold War, the United States continued to develop and deploy advanced systems such as the B–2, the F–35, and *Virginia*-class submarines to maintain superiority over any foreseeable adversary. At the same time, the armed forces adopted new technologies, especially information technology, to coordinate and execute military operations more effectively.

Throughout the Cold War, the Defense Department had employed concurrency as an acquisition approach to deploy weapon systems rapidly. Starting production, even low-rate production, before development was complete, however, often resulted in cost growth, schedule delays, and performance shortfalls. Thus OSD in the 1970s and Congress in the 1980s tried to limit concurrency. Despite the risks, the military services continued to employ it in the 1990s—for example, in the Joint Direct Attack Munition and C–17 programs discussed in this study.[1]

After the Gulf War, the acquisition community devised new approaches to developing and validating advanced technologies that promised not only to cut the time from a technology's conception to its addition to the weapons inventory but also to reduce the risks frequently associated with concurrency. During the Gulf War, the military services had deployed weapon systems that were not yet fully developed, essentially prototypes, such as the Joint Surveillance Target Attack Radar System and the NAVSTAR Global Positioning System. They performed successfully and were modified in real time during combat operations. With the exception of the Air Force's Rapid Response Process, the services abandoned the wartime organizational structures and procedures they had created to field new technologies quickly. But the idea of developing new technologies in operational settings survived by way of the advanced technology demonstration and the advanced concept technology demonstration. Both programs validated new technologies, depended heavily on user feedback, and resided outside the established acquisition system. The advanced technology demonstration focused on exploring the technology rather than fielding a prototype; in contrast, the advanced concept technology demonstration emphasized a prototype's military utility. If successful, an ACTD entered the established acquisition process. UAVs, particularly the Predator, became the model for that program. By 2004, 154 advanced concept technology demonstrations had been initiated and 80 completed, of which 25 had been converted to full-fledged acquisition programs and 36 had provided useful capabilities.

Once completed, advanced concept technology demonstrations did not immediately enter the formal acquisition system. They had to secure funding and satisfy the bureaucratic requirements imposed on every acquisition program, which might take up to two years. To keep the demonstration technology viable during this so-called valley of death, the Army established the Warfighting Rapid Acquisition Program and the Air Force, a similarly named Warfighter Rapid Acquisition Program. Not limited to advanced concept technology demonstrations, these service programs identified and streamlined the development of other new technologies, such as the Army's brigade and below battlefield command, control, and communications system, called FBCB2.

Initiated to identify and mature technologies for a low-cost, multiservice tactical fighter, the Joint Advanced Strike Technology program was another Defense Department effort to maintain a technological edge and also reduce costs. Although it did not originate as an advanced concept technology demonstration, JAST had much in common with that program in terms of its approach to technological development. Like advanced concept technology demonstrations, it prioritized the use of commercial off-the-shelf products, prototyping, and affordability, and it employed cost as an independent variable to establish cost and performance objectives. Additionally, JAST did not proceed with the intent to produce a completed aircraft designed for production. Instead, the program had been structured to turn out a series of demonstrators in order to mature technologies. Once the program was finished, the resulting technologies could be integrated into the engineering and manufacturing development phase of a formal acquisition program, but with much less risk and cost. To keep costs down, JAST also explored commonality through the use of a single airframe that shared subsystems, components, and parts. But just over two years after the Joint Advanced Strike Technology program began, OSD, influenced by the established practice of competitive prototyping and under pressure from Congress and industry to make the demonstrators fully functioning aircraft, turned it into a standard acquisition program, the F–35 Joint Strike Fighter. That program soon exhibited the performance shortfalls, schedule delays, and cost growth its predecessor was designed to avoid.

REFORMING ACQUISITION MANAGEMENT

Experimentation and reform at the program level proceeded in line with a long-term trend toward centralizing acquisition oversight and management in OSD. Until Robert McNamara became secretary of defense in 1961, the services had enjoyed virtual autonomy in acquisition. Assisted by civilian analysts in his office, McNamara asserted direct and personal control over service weapon programs. David Packard, deputy secretary of defense in the early 1970s, backed away from McNamara's heavy-handed approach toward the services. Nonetheless, Packard institutionalized OSD's role in acquisition oversight by establishing the Defense Systems Acquisition Review Council to assess the progress of major weapon system programs at key points and by issuing department-wide acquisition policy guidance, Department of Defense Directive 5000.1. Adoption of the Packard Commission recommendations in the late 1980s continued the centralizing trend by establishing the position of under secretary of defense for acquisition, the USD(A), and by creating a direct reporting chain from the program manager to the program executive officer to the civilian service acquisition executive and then to the under secretary for acquisition. This management reorganization enhanced civilian control of acquisition at the expense of the service field commands and headquarters staffs that were led and dominated by uniformed officers.

When the Bush administration entered office in 1989, the Packard acquisition reforms had not been fully implemented. Secretary Cheney's Defense Management Report sought to finish the process. It directed the services to complete organizational changes ensuring civilian control of acquisition; gave the USD(A) authority over acquisition in the services; strengthened the role of the Defense Acquisition Board, the DSARC's successor, in determining whether individual programs should pass from one milestone to another; authorized the JCS Joint Requirements Oversight Council to validate requirements for joint and service-unique programs; and consolidated department contract administration in the newly established Defense Contract Management Command. In early 1991 the OSD revision of the 5000 series directives and instructions standardized acquisition policy guidance throughout the Defense Department and prohibited the services from interpreting it differently with their own regulations. (Three years later the Section 800 Panel report and the Federal Acquisition Streamlining Act addressed rationalization of acquisition statutes.) In 1992 OSD established the Defense Information Infrastructure under the control of the Defense Information Systems Agency to enforce interoperability among command, control, communications, and intelligence systems. During the Clinton administration, the Defense Department furthered this objective by working on a common architectural framework to govern the development of all new C3I systems.

The Clinton administration also expanded the acquisition under secretary's authority and responsibilities, clearly illustrated by changes in the position title: from under secretary for acquisition to under secretary for acquisition and technology (1993) to under secretary for acquisition, technology, and logistics (1999). The expanded title and portfolio signaled that acquiring major systems involved activities beyond R&D, testing, and production. They reflected the growing recognition that acquisition extended from science and technology activities and weapon requirements all the way to product upgrades, system maintenance, and other logistics support. Jacques Gansler, acquisition under secretary from 1997 to 2001, obtained agreement from the Joint Chiefs to make requirements formulation, historically the preserve of the uniformed military, a formal part of the acquisition process. Gansler also took steps to integrate the Defense Department's acquisition and logistics functions and their communities. The broader view of acquisition's scope also appeared at the service field command level when Air Force Systems Command and Air Force Logistics Command merged into Air Force Materiel Command in 1992.

Congress supported OSD's preference for centralization and initiated similar measures of its own. In 1993 it backed OSD's decision to move UAV programs out of the services and consolidate their management in the Defense Airborne Reconnaissance Office. The 1996 Clinger-Cohen Act required every federal executive department and agency to appoint a chief information officer to oversee information technology acquisition. Later, Congress gave the chief information officers authority to review information system budget requests and to ensure compatibility and interoperability among those systems. Centralized management, however, did not produce the anticipated results. Except for the Predator, the Defense Airborne Reconnaissance Office did not develop any other unmanned aerial vehicles. Influenced by manned reconnaissance system supporters, Congress withdrew DARO's budget and management authority. Also, despite the Clinger-Cohen Act, by the decade's end the Defense Department had made only limited progress toward achieving compatibility and interoperability among its information technology systems.

The Bush and Clinton administrations took sharply different approaches to improving management of the acquisition system. Secretary Cheney and other top officials in OSD viewed the system as basically sound. Its deficiencies could be dealt with through firm and effective oversight to ensure clear policy guidance and adherence to established procedures under the appropriate organizational structure. The Defense Management Report and the 5000 series document revision prioritized these objectives. In contrast, the Clinton-era reformers operated with a broader mandate to "reinvent" government and make it work more efficiently. They sought fundamental change in the culture of acquisition by defining roles for participants and using incentives to give them a greater stake in their jobs and to inspire higher performance.

The president's reinventing government initiative notwithstanding, acquisition reform was already a top priority for the new Defense Department leaders, Secretary Les Aspin, Deputy Secretary William Perry, and Under Secretary for Acquisition John Deutch. To carry out their ambitious plans, they established the Office of the Deputy Under Secretary of Defense for Acquisition Reform headed by Colleen Preston who formulated specific reform initiatives, drew up plans to execute them, and oversaw their implementation. Both she and Deutch's successor, Paul Kaminski, actively promoted the reform agenda to the acquisition community, including industry. The services embraced OSD's effort. They established their own reform organizations and outreach efforts and applied OSD reforms to their weapon programs. They also came up with service-specific reform initiatives—Air Force "Lightning Bolts," Army "Thrust Areas," and Navy "Cardinal Points."

INNOVATION IN ORGANIZING SYSTEM DEVELOPMENT AND MANAGING PROGRAM COSTS

Changes to the acquisition process in the 1990s were long-lasting and touched nearly every corner of the acquisition community. By established practice, major weapon systems typically moved through the acquisition process as a grand design in a largely sequential pipeline fashion (except when concurrency was applied), from a fixed set of requirements, often well beyond the state of the art. Each stage of the sequence, such as design or manufacturing, was the domain of specialists. These experts, along with others in fields such as contracting and budgeting, advised the program manager, but the extent of interactions among them often varied widely from program to program. Users typically got involved only at the beginning and the end of the process. In the early 1990s the services experimented with and modified this long-standing practice. They integrated every aspect of a system's acquisition from the program's start; stressed the use of collaborative teams of functional specialists and other stakeholders, especially users; and employed incremental, iterative development approaches. These modifications attempted to avoid costly design changes late in the development process and allow systems to enter the inventory more rapidly and to work better in the field.

Integrated product and process development grew out of the concurrent engineering concept, a total quality management principle that industry started to employ in the 1980s. IPPD involved the simultaneous and coordinated design of products and their related processes such as manufacturing and after-market service. As applied to defense acquisition, it meant that when a program began and as it proceeded, program participants considered all aspects of a system's life cycle from concept formulation through its disposal, including user requirements, performance, cost, schedule, and logistics support. Before IPPD, for example, post-deployment sustainment requirements did not factor into system design and cost estimates. Integrated product and process development became the basis of Air Force Materiel Command's integrated weapon system management approach, in which a single manager exercised responsibility for a system's life cycle. Initially applied to 16 programs in 1991, a single manager and IPPD became mandatory for all command programs by the end of 1993. Army Materiel Command began to explore IPPD in late 1990 and two years later requested that all Army major system programs adopt it.

The integrated product and process development concept depended on integrated product teams that operated out of a system program office and managed the entire program. Integrated product teams included supervisory personnel; functional specialists in system design, engineering, test and evaluation, manufacturing, contracting, finance, training, and logistics support; the system's users; and often contractor representatives. Smaller teams sometimes formed to handle particular problems during system development, such as difficulties in software integration. Above the program office, a hierarchy of similarly constituted IPTs oversaw the program. Team members had the authority to make decisions affecting system development without referring to their parent organizations. The Defense Department also employed teams in other acquisition activities. OSD, for example, used process action teams to prepare reform initiatives and plans to implement them.

In May 1995 Secretary Perry directed the use of both integrated product and process development and integrated product teams throughout the acquisition process. Nearly all of the programs discussed in this volume employed them: the Global Command and Control System and the F–35 Joint Strike Fighter; the Air Force's C–17 transport and F–22 fighter (in use in that program since the mid-1980s); the Army's UH–60 Black Hawk, RAH–66 Comanche, and AH–64 Apache Longbow helicopters, the Crusader self-propelled howitzer, and the FBCB2 digitized brigade and below information sharing system; the Navy's F/A–18E/F fighter, *San Antonio*-class amphibious ship, *Virginia*-class attack submarine; and the Marine Corps' Advanced Amphibious Assault Vehicle/Expeditionary Fighting Vehicle. In addition to their potential to improve coordination and efficiency in the acquisition process, integrated product and process development and integrated product teams constituted a cultural change. Under the team concept, workers viewed system development as a whole rather than from narrow functional perspectives. Empowered with substantial decision-making authority, even at junior levels, workers had a larger stake in a program's successful outcome.

Integrated product and process development and integrated product teams guided the planning of acquisition programs and how their participants related to each other and to the systems they developed. In the 1990s the acquisition community also devised alternatives to the grand design approach for how acquisition programs began and proceeded through the acquisition process. Two new initiatives, evolutionary acquisition and spiral development, that originated in the 1970s and 1980s in software development methodologies attempted to accommodate uncertain or changing requirements, especially prevalent in heavily software-dependent command and control systems where they were first successfully applied. In evolutionary acquisition, system development occurred in increments that began with a limited capability version and, based on testing and user feedback, added new capabilities in subsequent increments that ended in the final version, the complete system. In spiral development, users participated in initial system tests and, based on the results, modified the system again for more user testing, an iterative process called "build a little, test a little." The Army applied the concept to develop and field the FBCB2 system. At the Central Technical Support Facility at Fort Hood, Texas, and in field exercises, system users worked closely with contractors to effect improvements with each increment. The services also employed a third alternative to the grand design—preplanned product improvement. In this approach, the capacity for system upgrades, either improvements to existing capabilities or the addition of new ones, were part of the design at the outset.

In July 1999 Gansler directed that evolutionary acquisition be the preferred, although not the exclusive, approach used in Defense Department programs. It and spiral development promised to reduce the risk inherent in developing advanced technology systems and could, consequently, cut costs and shorten cycle times. They could also take advantage of new technologies that appeared as systems were being developed and permit adaptations to changing requirements.

Both the Bush and Clinton administrations, operating within the context of declining Defense budgets, sought to reduce acquisition costs. Integrated product and process development in weapons acquisition enabled the Defense Department to incorporate cost analysis and control more thoroughly and effectively than previous cost control initiatives. In the late 1990s Gansler initiated an effort, planned and overseen by the Defense Systems Affordability Council, to reduce weapon system total ownership costs throughout a system's life cycle. Using cost as an independent variable, each program office set and managed cost targets for system development and made performance and cost trade-offs to achieve the optimal system configuration at an affordable price. With respect to system production, sustainment, modification, and disposal, costing focused on reducing average unit procurement and operations and support costs. In 1998 the Defense Systems Affordability Council directed each service to designate 10 pilot programs (for a total of 30) as test beds for the Reduction in Total Ownership Cost initiative. The services progressed slowly in designating their programs and identified cost reduction targets well below what Gansler had in mind. By the end of the 1990s, however, life-cycle cost analysis and trade-offs had become integral parts of the acquisition process.

RESHAPING THE RELATIONSHIP BETWEEN GOVERNMENT AND THE DEFENSE INDUSTRIAL BASE

To field the most technologically advanced weapon systems, the government relied on a healthy defense technological and industrial base. By the late 1980s and early 1990s, many observers believed industry exhibited weaknesses that threatened this capability, including a decline in the number of defense-oriented prime contractors and subcontractors and a growing dependence on foreign sources for critical technologies, components, and raw materials. Defense contracting had also become less appealing to industry, especially to firms selling their products in large private-sector markets. Declining Defense budgets, along with scandals and accusations of waste, fraud, and abuse, had led to the tightening of contracting regulations and policies, including a reduction in progress payments, more fixed-price contracts for R&D, and more restrictive ethics requirements. The Bush administration minimized these problems and maintained industry could meet defense requirements. The Clinton administration disagreed and called instead for aggressive government intervention to strengthen the industrial base and improve government-industry cooperation.

To strengthen the technological and industrial base, the Clinton administration sought to integrate the economy's defense and civilian market-oriented sectors in a two-pronged effort. On the one hand, the government acted to attract nondefense firms to sell commercially available systems and components to the Defense

Department, particularly those items not requiring further development. On the other, it encouraged defense companies to develop and sell products for the commercial market. The Clinton administration received support for these initiatives from Congress in the Federal Acquisition Streamlining Act.

Numerous obstacles stood in the way of attracting commercial firms to the defense market: government-specific regulatory and contracting regimes, the requirement to conform to strict military specifications and standards in end-items, differing accounting systems, and the government's assertion that it owned cost and technical data derived from work performed under contract. The Clinton administration made limited progress in breaking down these barriers. It successfully broke the logjam on MILSPECs and contracting but failed to reverse rules on government claims to proprietary data.

Most analysts believed military specifications added to acquisition costs by discouraging the use of commercial off-the-shelf products and stifling industry innovations in development and manufacturing. Secretary Perry began radically reducing their number by replacing them with commercial standards and performance-based specifications. In June 1994 he prohibited MILSPEC use, unless authorized by a waiver. By February 1997 the Defense Department had eliminated over 5,000 of the 30,000 total military specifications. There were dramatic reductions in specific programs. For example, the number of MILSPECs for the Navy's Mark 48 torpedo fell from 103 to 5; and the Army's AH–64D, from 47 to 1. Authority to use open systems—commercially available subsystems and components installed with little or no modification—accompanied MILSPEC reduction. Five months after Perry's order banning military specifications, Under Secretary for Acquisition and Technology Kaminski directed the department to apply the open systems approach to the acquisition of weapon system electronics.

The Defense Department, in line with the Clinton administration's push for more government-industry cooperation, enlisted contractors as participants in acquisition reform. In the Light Airborne Multi-Purpose System Mark III antisubmarine program, in an approach called alpha contracting—essentially applying integrated product and process development to the award of a sole-source contract—Naval Air Systems Command assembled contractor representatives, Navy officials, and personnel from the Defense Contract Audit Agency. They prepared the proposal and awarded the contract in just over three months rather than the usual 12 months. In the C–17 program, initially characterized by tense, even hostile, government-contractor relations, the Air Force significantly improved the atmosphere by including representatives from McDonnell Douglas, the prime contractor, on integrated product teams in the system program office. The Non-Developmental Airlift Aircraft program office, working on alternatives to the C–17, applied numerous reforms industry desired in its contract with Boeing for a modified 747–400F to potentially supplement the McDonnell Douglas aircraft. Among the reforms were price-based rather than cost-based acquisition, mutually agreed contract changes, performance requirements instead of MILSPECs, and reliance on commercial quality assurance standards and certifications in lieu of government inspection.

Encouraging defense contractors to produce for the commercial market was the other prong of the Clinton administration effort to integrate the civilian and defense-oriented economies. To advance this objective, the Defense Department supported developing dual-use technologies to meet both military and civilian needs. The concept test case—active-matrix liquid crystal flat panel displays, or LCDs—failed. None of the small number of companies manufacturing displays established itself commercially or achieved volume production. Additionally, adapting the displays to military systems proved to be more difficult than expected. By 2000 the last domestic display provider prepared to withdraw from the military market, which forced the government to turn to foreign sources or find a substitute for active-matrix LCD technology.

Separate from the Clinton administration's program to integrate defense and commercially oriented industry, the defense sector continued the restructuring of the 1980s, with mergers and acquisitions accelerating in the mid-1990s. Without enough business to go around, the Defense Department supported mergers that maintained critical defense capabilities at the expense of reducing the number of prime contractors capable of building major weapon systems. By the end of the decade, those capabilities remained but competition had diminished. Only a few major prime contractors were left and of those, ironically, nearly all were even more focused on the defense market, an orientation the Clinton administration had tried to change.

INCREASING THE QUALITY OF THE ACQUISITION WORKFORCE

The success of nearly every acquisition reform depended on people—the acquisition workforce. Since the 1950s, study after study had emphasized the relationship between workforce quality and successful acquisition outcomes, but measures to enhance its quality had not matched the rhetoric. Secretary Cheney's Defense Management Report began to close the gap; it directed each service to establish a corps of acquisition specialists to receive specialized education and training and required the under secretary for acquisition to oversee career development for the workforce.

These measures did not go far enough for Congress. The Defense Acquisition Workforce Improvement Act of 1990 mandated sweeping changes intended to create a highly qualified professional workforce with enhanced training and additional experience. It directed the secretary of defense to identify the department's acquisition positions and to designate those that were critical, such as program executive officer or program manager of a major system acquisition. OSD and each service (including the Marine Corps) were to establish an acquisition corps in which only its members could occupy the critical positions. To break the near-monopoly by uniformed officers of senior acquisition posts, especially at the program manager level, the law directed that civilians in the acquisition corps be permitted to hold high-level posts as well. DAWIA also required anyone occupying a critical position to meet rigorous experience and professional education requirements. Paying special attention to program and deputy program manager qualifications, it specified longer tenures for those officials. To increase workforce quality as a whole, the act instructed the Defense Department to set up a centrally managed career program for acquisition personnel to govern their accession, training, education, and career development. A defense acquisition university provided for in the legislation would educate and train the workforce department-wide. As implemented by OSD and the services, the Defense Acquisition Workforce Improvement Act provided the means for significantly improving the quality and enhancing the professionalism of the acquisition workforce.

Since much of the reform agenda required changes in the prevailing culture of the acquisition workforce, especially behavior patterns, Clinton-era reformers encouraged worker support for their programs through a variety of methods. They raised worker awareness through speeches, interviews, roundtable discussions, town hall meetings, reform newsletters, and a professional journal, *Acquisition Review Quarterly*; they conducted on-site training with traveling roadshows and department or service-wide stand-down days; and they reached workers at a distance with satellite broadcasts and digital technologies, especially the Defense Acquisition Deskbook that users accessed online. In providing workers with information about the reforms and, more importantly, by encouraging them to ask questions and challenge assumptions, these tools promoted cultural change and professionalization. So did awards programs recognizing individuals and groups that applied reforms in innovative ways. Of all the methods for soliciting worker support and effecting cultural change, none was more consequential than the integrated product team. This reform initiative forced different functional specialists to work together and empowered them with greater authority to influence program outcomes.

ASSESSING ACQUISITION IN THE 1990s: SUCCESSES AND SHORTFALLS

It is difficult to make generalized statements about the net impact of acquisition reforms on weapon system programs in the 1990s. The Defense Department identified some programs as reform test beds—the Defense Acquisition Pilot Program and the R-TOC pilot programs mentioned earlier—and devised metrics to track them, but measures of success proved hard to develop. The reforms were applied in varying degrees to systems differing widely with respect to function, degree of technological risk, level and stability of funding, and projected cycle time.

What is clear is that numerous successful programs employed acquisition reforms from the start. These included the F/A–18E/F Super Hornet, with cost as an independent variable and integrated contractor and Navy test teams; FBCB2, with spiral development and commercial off-the-shelf purchases; the Joint Direct Attack Munition, with the government taking a hands-off approach to specifications and design; the Predator UAV, with the streamlined management characteristic of advanced concept technology demonstration programs; and the *Virginia*-class attack submarine, with a modified preplanned product improvement approach, computer-aided design and manufacturing techniques, modular design and construction, and commercial off-the-shelf computer systems. Other programs applied acquisition reforms after they began. For example, the Navy introduced cost-cutting reforms well into the production run of the *Arleigh Burke*-class guided missile destroyer. Similarly, the Air Force adopted acquisition reforms, notably integrated product and process development and integrated product teams, in its troubled C–17 transport program. Thereafter the program turned around. Although observers credited the acquisition reforms with having a significant impact, it is not possible to distinguish their relative importance from other factors that put the program back on track: assertive leadership in OSD, at Air Force headquarters, and in the Air Force and the McDonnell Douglas program offices; an infusion of capital by the company; the threat of competition from the Non-Developmental Airlift Aircraft program; and the prospect of the C–17's cancellation.

Acquisition reform was not a panacea. It failed to head off problems in several high-profile programs. Two of these—the *San Antonio*-class amphibious ship and the Advanced Amphibious Assault Vehicle/Expeditionary Fighting Vehicle—were initially heralded as model acquisition programs; indeed, they won awards in the 1990s for their application of reform principles. Later, however, both programs experienced extensive technical difficulties and system breakdowns, yearslong schedule delays, and multibillion dollar cost growth. *San Antonio* and other ships in the class eventually went to sea, but the secretary of defense terminated the Marines' amphibious vehicle program in 2011. Some follow-on acquisition programs did not successfully incorporate the reforms employed in the original program. For example, the Joint Air-to-Surface Standoff Missile, a technologically advanced successor to the Joint Direct Attack Munition, encountered major schedule slips and cost growth even though the same official headed both programs.

In some cases, the application of acquisition reforms had little relation to program outcomes. Reform could not create supporting constituencies for programs that lacked a sustained commitment from service leadership and Congress. The Arsenal Ship employed much of the reformers' toolkit but did not make it into production. Unlike the V–22 Osprey, which withstood Secretary Cheney's repeated cancellation attempts because a strong constituency in the Marine Corps and in Congress supported the tiltrotor aircraft, the Arsenal Ship had powerful opponents in the Navy, in the other services, and in Congress. The Crusader self-propelled howitzer program, which claimed substantial cost savings through computer-aided design and manufacturing techniques and the purchase of commercial components, also went by the wayside. Despite efforts to reduce its weight and increase mobility, Crusader never found a role in the service's and OSD's emerging vision of lighter and more rapidly deployable forces. In the end, however, acquisition reform could not resolve debates over national security strategy, defense priorities, or roles and missions taking place within the Defense Department, at the White House, and on Capitol Hill that would determine which weapon systems the nation should acquire.

Despite the difficulty of determining their impact on particular programs, the reforms introduced during the 1990s reshaped weapons acquisition to meet uncertain national security requirements and new missions that followed the end of the Cold War. Reforms solidified civilian control and gave the JCS chairman the power to mitigate service parochialism in determining requirements for weapon systems. They provided policymakers with new approaches that made greater use of prototypes to introduce new technologies quickly into weapons and place them in the hands of warfighters. The innovations included the advanced technology demonstration and advanced concept technology demonstration programs as well as alternatives to the grand design pipeline model for developing and fielding weapon systems such as evolutionary acquisition, spiral development, and preplanned product improvement. The reforms took into account all aspects of a system's life cycle, especially relative costs, during concept formulation, design, development, and production. The changes that brought about the increased use of commercial products reflected the Defense Department's recognition that it was no longer the pacesetter for many technologies, especially in computing, and could find better solutions in the private sector. That acknowledgment, in turn, resulted in efforts to improve government-contractor relations. For the long term, however, the most significant acquisition reforms were likely those instituted to professionalize the workforce.

Ultimately, as Norman Augustine points out, acquisition outcomes depend on producing "competent, dedicated, experienced people" operating in a system that "delegates authority, rewards success, and penalizes failure." Despite drastic personnel cuts, reforms implemented across the Defense Department during the 1990s increased acquisition training requirements, provided incentives for improved performance, and offered clear opportunities for advancement to ensure that the workforce would have the tools necessary to procure the equipment and weapons needed to defend the nation.[2]

After the 11 September attacks, the demands of the global war on terrorism replaced the strategic uncertainty of the 1990s. Defeating asymmetric terrorist threats and waging counterinsurgency campaigns in Afghanistan and Iraq required a fundamental reshaping of the U.S. military. The Iraq War especially demonstrated the continuing need for strong and substantial conventional forces, albeit reconfigured to deploy rapidly. All the while, Russia and China strengthened their military capabilities and grew into formidable strategic competitors. While the reforms of the 1990s could not prepare the Defense Department for every challenge, taken together, they made the acquisition system better able to adopt innovations and best practices from outside the government, more responsive to the users of weapon systems, and more capable of adapting policies, organizations, and procedures to address the security threats of the new century.

Endnotes

1. Edmund Dews et al., *Acquisition Policy Effectiveness: Department of Defense Experience in the 1970s* (Santa Monica, CA: RAND, Oct 1970), 2; Donald Birchler, Gary Christle, and Eric Groo, "Investigating Concurrency in Weapons Programs," *Defense AT&L* 38, no. 5 (Sep-Oct 2010): 18–21.

2. Testimony of Norman R. Augustine on Defense Acquisition Reform before the Armed Services Committee of the United States Senate, 1 Dec 2015, 1–4 (quotes, 3), https://www. armed-services.senate.gov/imo/media/doc/Augistine_12-01-15.pdf, accessed 19 Oct 2015.

Appendix I

U.S. Forces

FY 1989–FY 2001

FY	89	90	91	92	93	94	95
LAND FORCES (Active/Reserve)[1]							
Army Divisions	18/10	18/10	18/10	14/10	14/8	12/8	12/8
Marine Corps Divisions	3/1	3/1	3/1	3/1	3/1	3/1	3/1
Army Separate Brigades	8/20	8/27	8/27	7/27	7/24	7/24	3/24
Army Special Forces Groups	4/4	5/4	5/4	5/4	5/4	5/2	5/2
TACTICAL AIR FORCES (Active/Reserve Squadrons)[2]							
Air Force[3]	79/42	76/43	71/43	57/43	56/42	53/40	53/38
Navy	65/10	57/9	59/10	61/10	56/10	50/7	44/3
Marine Corps	25/8	24/8	26/8	24/6	23/6	23/5	23/4
NAVAL FORCES							
Ballistic Missile Submarines	42	39	40	34	24	19	16
Battle Forces	434	410	393	357	342	315	300
(Aircraft Carriers)[4]	(16)	(16)	(16)	(15)	(14)	(13)	(12)
Support Forces Ships	64	66	62	57	51	41	37
Reserve Forces Ships	26	31	32	19	18	16	19
Total	**566**	**546**	**527**	**467**	**435**	**391**	**372**
STRATEGIC FORCES							
Land-based ICBMs	1,000	1,000	1,000	930	787	675	585
Heavy Bombers[5]	263	277	240	213	168	151	140
Submarine-launched Ballistic Missiles	576	584	616	464	408	384	360
PERSONNEL (in thousands)							
Active Military	2,130.2	2,069.4	2,002.6	1,808.1	1,705.1	1,610.5	1,518.2
Reserve Military[6]	1,170.6	1,130.8	1,137.8	1,114.9	1,057.7	971.3	945.8
Civilian	1,107.4	1,102.4	1,048.7	1,038.4	984.1	916.5	865.2

[1, 2, 6] Reserve includes National Guard.

[3] Includes conventional bombers (61 B–52s, FY 89; 33 B–52s, FYs 90–93;19 B–52s, FY 94; 54 B–1s, FYs 98–99; 52 B–1s, FYs 00–01).

[4] Part of Battle Forces total and includes one training carrier.

[5] Includes B–1s, B–2s (beginning FY 94), B–52s.

U.S. Forces *(continued)*

FY 1989–FY 2001

FY	96	97	98	99	00	01
LAND FORCES (Active/Reserve)[1]						
Army Divisions	10/8	10/8	10/8	10/8	10/8	10/8
Marine Corps Divisions	3/1	3/1	3/1	3/1	3/1	3/1
Army Separate Brigades	3/22	3/18	3/18	3/18	3/18	3/18
Army Special Forces Groups	5/2	5/2	5/2	5/2	5/2	5/2
TACTICAL AIR FORCES (Active/Reserve Squadrons)[2]						
Air Force[3]	52/40	52/40	52/40	49/38	47/38	45/38
Navy	37/3	36/3	36/3	36/3	36/3	36/3
Marine Corps	21/4	21/4	21/4	21/4	21/4	21/4
NAVAL FORCES						
Ballistic Missile Submarines	17	18	18	18	18	18
Battle Forces	294	292	271	256	259	259
(Aircraft Carriers)[4]	(12)	(12)	(12)	(12)	(12)	(12)
Support Forces Ships	26	26	26	25	25	25
Reserve Forces Ships	18	18	18	18	16	15
Total	**355**	**354**	**333**	**317**	**318**	**317**
STRATEGIC FORCES						
Land-based ICBMs	580	580	550	550	550	550
Heavy Bombers[5]	125	126	138	143	152	154
Submarine-launched Ballistic Missiles	384	408	432	432	432	432
PERSONNEL (in thousands)						
Active Military	1,471.7	1,438.6	1,406.8	1,385.7	1,384.4	1,385
Reserve Military[6]	920.4	902.2	881.5	869.1	864.6	869
Civilian	818.7	798.8	747.8	724.4	698.3	650

[1, 2, 6] Reserve includes National Guard.

[3] Includes conventional bombers (61 B–52s, FY 89; 33 B–52s, FYs 90–93;19 B–52s, FY 94; 54 B–1s, FYs 98–99; 52 B–1s, FYs 00–01).

[4] Part of Battle Forces total and includes one training carrier.

[5] Includes B–1s, B–2s (beginning FY 94), B–52s.

Sources: Secretary of Defense, *Annual Reports to the President and the Congress*, FY 1989–FY 2001; Table 7 (Department of Defense Personnel Levels, Selected Years), and Table 9 (U.S. Military Force Structure, FY 1980–FY 2003), in Stephen Daggett and Amy Belasco, *Defense Budget for FY 2003: Data Summary*, CRS Report RL31349 (Washington, DC: Congressional Research Service, 29 Mar 2002).

Appendix II

KEY ACQUISITION OFFICIALS, 1989–2001

Secretaries of Defense

Richard B. "Dick" Cheney	March 1989–January 1993
Leslie "Les" Aspin	January 1993–February 1994
William J. Perry	February 1994–January 1997
William S. Cohen	January 1997–January 2001

Deputy Secretaries of Defense

William H. Taft IV	February 1984–April 1989
Donald J. Atwood Jr.	April 1989–January 1993
William J. Perry	March 1993–February 1994
John M. Deutch	March 1994–May 1995
John P. White	June 1995–July 1997
John J. Hamre	July 1997–March 2000
Rudy deLeon	March 2000–March 2001

Under Secretaries of Defense (Acquisition)

Robert B. Costello	December 1987–May 1989
John A. Betti	August 1989–December 1990
Donald J. Yockey (Acting)	January 1991–June 1991
Donald J. Yockey	June 1991–January 1993
John M. Deutch	April 1993–November 1993

Under Secretaries of Defense (Acquisition and Technology)*

John M. Deutch	November 1993–March 1994
R. Noel Longuemare Jr. (Acting)	March 1994–October 1994
Paul G. Kaminski	October 1994–May 1997
R. Noel Longuemare Jr. (Acting)	May 1997–November 1997
Jacques S. Gansler	November 1997–October 1999

**In November 1993 the position title Under Secretary of Defense (Acquisition) changed to Under Secretary of Defense (Acquisition and Technology).*

Under Secretaries of Defense (Acquisition, Technology, and Logistics)*

Jacques S. Gansler	October 1999–January 2001
Edward C. Aldridge Jr.	May 2001–May 2003

**In October 1999 the position title Under Secretary of Defense (Acquisition and Technology) changed to Under Secretary of Defense (Acquisition, Technology, and Logistics).*

Principal Deputy/Deputy Under Secretaries of Defense (A, A&T, AT&L)*

Milton Lohr	October 1988–May 1989
Donald J. Yockey	March 1990–December 1990
Donald C. Fraser	December 1991–January 1993
R. Noel Longuemare Jr.	November 1993–November 1997
David R. Oliver Jr.	June 1998–July 2001

**During 1989–2001 the next-ranking official to the Under Secretary of Defense was known either as the Principal Deputy Under Secretary of Defense or the Deputy Under Secretary of Defense.*

Deputy Under Secretary of Defense (Logistics and Materiel Readiness)

Roger W. Kallock	September 2000–January 2001

Directors of Defense Research and Engineering

Robert C. Duncan	December 1987–November 1989
Charles M. Herzfeld	March 1990–May 1991
Victor H. Reis	December 1991–May 1993
Anita Jones	June 1993–May 1997
Hans M. Mark	July 1998–May 2001

Directors of Operational Test and Evaluation

John E. Krings	April 1985–June 1989
Robert C. Duncan	November 1989–January 1993
Lee Frame (Acting)	January 1993–September 1994
Philip E. Coyle III	October 1994–January 2001

Assistant Secretaries of Defense (Command, Control, Communications, and Intelligence)

Gordon A. Smith	May 1988–May 1989
Thomas P. Quinn (Acting)	May 1989–November 1989
Duane P. Andrews	November 1989–January 1993
Emmett Paige Jr.	June 1993–May 1997
Arthur L. Money (Senior Civilian Official)	February 1998–October 1999
Arthur L. Money	October 1999–April 2001

Assistant Secretary of Defense (Economic Security)

Joshua Gotbaum	May 1994–December 1995

Assistant Secretaries of Defense (Production and Logistics)

Jack Katzen	March 1988–January 1990
Colin McMillan	March 1990–December 1992

Assistant Secretary of Defense (Program Analysis and Evaluation)

David S. C. Chu	July 1988–January 1993

Directors of Program Analysis and Evaluation

William J. Lynn	June 1993–November 1997
Robert R. Soule	July 1998–April 2001

Chairmen of the Joint Chiefs of Staff

Admiral William J. Crowe Jr., USN	October 1985–September 1989
General Colin L. Powell, USA	October 1989–September 1993
Admiral David E. Jeremiah, USN (Acting)	October 1993
General John M. D. Shalikashvili, USA	October 1993–September 1997
General Henry H. Shelton, USA	October 1997–September 2001

Vice Chairmen of the Joint Chiefs of Staff

General Robert T. Herres, USAF	February 1987–February 1990
Admiral David E. Jeremiah, USN	March 1990–February 1994
Admiral William A. Owens, USN	March 1994–February 1996
General Joseph W. Ralston, USAF	March 1996–March 2000
General Richard B. Myers, USAF	March 2000–October 2001

Directors, Advanced Research Projects Agency/ Defense Advanced Research Projects Agency

Ray S. Colladay	January 1988–May 1989
Craig I. Fields	June 1989–April 1990
Victor H. Reis	November 1990–November 1991
Gary L. Denman	December 1991–March 1995
Verne L. "Larry" Lynn	July 1995–April 1998
Fernando L. "Frank" Fernandez	May 1998–January 2001

Commanders, Defense Contract Management Command

Maj. Gen. Charles R. Henry, USA	February 1990–December 1992
Rear Adm. Leonard Vincent, USN	December 1992–July 1995
Maj. Gen. Robert W. Drewes, USAF	July 1995–September 1997
Maj. Gen. Timothy P. Malishenko, USAF	September 1997–March 2000

Directors, Defense Contract Management Agency

Maj. Gen. Timothy P. Malishenko, USAF	March 2000–February 2001
Brig. Gen. Edward M. Harrington, USA	February 2001–December 2003

Secretaries of the Army

John O. Marsh Jr.	January 1981–August 1989
Michael P. W. Stone	August 1989–January 1993
John W. Shannon (Acting)	January 1993–August 1993
Gordon R. Sullivan (Acting)	August 1993–November 1993
Togo D. West Jr.	November 1993–May 1997
Robert M. Walker (Acting)	January 1998–July 1998
Louis Caldera	July 1998–January 2001

Under Secretary of the Army*

Michael P. W. Stone	May 1988–August 1989

**The Under Secretary of the Army served as the Service Acquisition Executive until May 1989 when the Assistant Secretary of the Army (Research, Development, and Acquisition) assumed that responsibility.*

Assistant Secretaries of the Army (Research, Development, and Acquisition)

Jay R. Sculley	October 1981–August 1989
George E. Dausman (Acting)	August 1989–March 1990
Stephen K. Conver	March 1990–January/February 1993
George E. Dausman (Acting)	March 1993–April 1994
Gilbert F. Decker	April 1994–May 1997
Paul J. Hoeper	May 1998–February 1999

Assistant Secretary of the Army (Acquisition, Logistics, and Technology)*

Paul J. Hoeper	February 1999–January 2001

**In February 1999 the positon title Assistant Secretary of the Army (Research, Development, and Acquisition) changed to Assistant Secretary of the Army (Acquisition, Logistics, and Technology).*

Chiefs of Staff of the Army

General Carl E. Vuono	June 1987–June 1991
General Gordon R. Sullivan	June 1991–June 1995
General Dennis R. Reimer	June 1995–June 1999
General Eric K. Shinseki	June 1999–June 2003

Vice Chiefs of Staff of the Army

General Arthur E. Brown Jr.	June 1987–January 1989
General Robert W. RisCassi	January 1989–June 1990
General Gordon R. Sullivan	June 1990–June 1991
General Dennis J. Reimer	June 1991–March 1993
General J. H. Binford Peay III	March 1993–July 1994
General John H. Tilelli Jr.	July 1994–June 1995
General Ronald H. Griffith	June 1995–November 1997
General William W. Crouch	November 1997–November 1998
General Eric K. Shinseki	November 1998–June 1999
General John M. Keane	June 1999–October 2003

Commanding Generals, Army Materiel Command

General Louis C. Wagner Jr.	April 1987–September 1989
General William G. T. Tuttle Jr.	September 1989–January 1992
General Jimmy D. Ross	February 1992–February 1994
General Leon E. Salomon	February 1994–March 1996
General Johnnie E. Wilson	March 1996–April 1999
General John G. Coburn	May 1999–October 2001

Commanding Generals, Army Training and Doctrine Command

General Maxwell R. Thurman	June 1987–August 1989
General John W. Foss	August 1989–August 1991
General Frederick M. Franks Jr.	August 1991–October 1994
General William W. Hartzog	October 1994–September 1998
General John N. Abrams	September 1998–November 2002

Secretaries of the Navy

William L. Ball III	March 1988–May 1989
H. Lawrence Garrett III	May 1989–June 1992
Sean O'Keefe (Acting)	July 1992–December 1992
Sean O'Keefe	December 1992–January 1993
John H. Dalton	July 1993–November 1998
Richard Danzig	November 1998–January 2001

Under Secretaries of the Navy*

H. Lawrence Garrett III	August 1987–May 1989
J. Daniel Howard	August 1989–January 1993

**The Under Secretary of the Navy served as the Service Acquisition Executive until March 1990 when the Assistant Secretary of the Navy (Research, Development, and Acquisition) assumed that responsibility.*

Assistant Secretaries of the Navy (Research, Development, and Acquisition)*

Gerald A. Cann	March 1990–January 1993
Nora Slatkin	October 1993–May 1995
John W. Douglass	November 1995–August 1998
H. Lee Buchanan III	November 1998–January 2001

**In March 1990 the Office of the Assistant Secretary of the Navy (Research, Engineering, and Systems) merged with the Office of the Assistant Secretary of the Navy (Shipbuilding and Logistics) to create the Office of the Assistant Secretary of the Navy (Research, Development, and Acquisition).*

Chiefs of Naval Operations

Admiral Carlisle A. H. Trost	July 1986–June 1990
Admiral Frank B. Kelso II	July 1990–April 1994
Admiral Jeremy M. Boorda	April 1994–May 1996
Admiral Jay L. Johnson (Acting)	May 1996–August 1996
Admiral Jay L. Johnson	August 1996–July 2000
Admiral Vernon E. Clark	July 2000–July 2005

Vice Chiefs of Naval Operations

Admiral Leon A. Edney	August 1988–May 1990
Admiral Jerome L. Johnson	May 1990–July 1992
Admiral Stanley R. Arthur	July 1992–May 1995
Admiral Joseph W. Prueher	May 1995–March 1996
Admiral Jay L. Johnson	March 1996–May 1996
Admiral Harold W. Gehman Jr.	September 1996–October 1997
Admiral Donald L. Pilling	October 1997–October 2000
Admiral William J. Fallon	October 2000–August 2003

Chiefs of Naval Research

Rear Adm. John R. Wilson Jr.	September 1987–June 1990
Rear Adm. William C. Miller	June 1990–June 1993

Rear Adm. Marc Y. E. Pelaez	June 1993–July 1996
Rear Adm. Paul G. Gaffney II	July 1996–June 2000
Rear Adm. Jay M. Cohen	June 2000–January 2006

Commanders, Naval Air Systems Command

Vice Adm. Joseph B. Wilkinson	August 1985–September 1989
Vice Adm. Richard C. Gentz	September 1989–January 1991
Vice Adm. William C. Bowes	March 1991–March 1995
Vice Adm. John A. Lockard	March 1995–June 2000
Vice Adm. Joseph W. Dyer	June 2000–June 2003

Commanders, Naval Sea Systems Command

Vice Adm. Peter M. Hekman Jr.	August 1988–June 1991
Vice Adm. Kenneth C. Malley	June 1991–April 1994
Vice Adm. George R. Sterner	April 1994–May 1998
Vice Adm. George P. "Pete" Nanos Jr.	May 1998–June 2002

Commanders, Space and Naval Warfare Systems Command

Rear Adm. Glenwood Clark	July 1985–June 1988
Rear Adm. John C. Weaver	June 1988–August 1990
Rear Adm. Robert H. Ailes	August 1990–August 1992
Rear Adm. Walter H. Cantrell	August 1992–April 1995
Rear Adm. George F. A. Wagner	April 1995–March 1998
Rear Adm. John A. Gauss	March 1998–May 2001

Directors, Office of Strategic Systems Programs

Rear Adm. Kenneth C. Malley	June 1985–April 1991
Rear Adm. John T. Mitchell Jr.	April 1991–June 1994
Rear Adm. George P. "Pete" Nanos Jr.	June 1994–May 1998
Rear Adm. John F. "Dugan" Shipway	May 1998–April 2000
Rear Adm. Dennis M. "Denny" Dwyer	April 2000–July 2002

Commandants of the Marine Corps

General Alfred M. Gray Jr.	July 1987–July 1991
General Carl E. Mundy Jr.	July 1991–June 1995
General C. C. Krulak	July 1995–June 1999
General James L. Jones Jr.	July 1999–January 2003

Commanding Generals, Marine Corps Research, Development and Acquisition Command

Maj. Gen. Ray M. Franklin	November 1987–October 1989
Lt. Gen. John R. Dailey	October 1989–July 1990
Maj. Gen. Jeremiah W. Pearson III	July 1990–June 1991
Maj. Gen Robert A. Tiebout	June 1991–December 1991

Commanders, Marine Corps Systems Command

Maj. Gen. Robert A. Tiebout	January 1992–June 1992
Maj. Gen. James A. Brabham Jr.	June 1992–May 1994

Maj. Gen. Carol A. Mutter	June 1994–July 1996
Maj. Gen. Michael J. Williams	July 1996–July 1998
Brig. Gen. James M. Feigley	August 1998–July 2002

Secretaries of the Air Force

Donald B. Rice	May 1989–January 1993
Sheila E. Widnall	August 1993–October 1997
F. Whitten Peters (Acting)	November 1997–August 1999
F. Whitten Peters	August 1999–January 2001

Assistant Secretaries of the Air Force (Acquisition)

John J. Welch Jr.	October 1987–April 1992
G. Kim Wincup	May 1992–December 1992
Darlene A. Druyun (Acting)	January 1993–May 1994
Clark G. Fiester	May 1994–April 1995
Darlene A. Druyun (Acting)	April 1995–January 1996
Arthur L. Money	January 1996–February 1998
Lawrence J. Delaney	April 1999–January 2001

Chiefs of Staff of the Air Force

General Larry D. Welch	July 1986–June 1990
General Michael J. Dugan	July 1990–September 1990
General John M. Loh (Acting)	September 1990–October 1990
General Merrill A. McPeak	October 1990–October 1994
General Ronald R. Fogleman	October 1994–October 1997
General Michael E. Ryan	October 1997–September 2001

Vice Chiefs of Staff of the Air Force

General Monroe W. Hatch Jr.	February 1987–May 1990
General John M. Loh	June 1990–March 1991
General Michael P. C. Carns	May 1991–June 1994
General Thomas S. Moorman Jr.	July 1994–July 1997
General Ralph E. Eberhart	July 1997–June 1999
General Lester L. Lyles	June 1999–April 2000
General John W. Handy	July 2000–November 2001

Commanders, Air Force Logistics Command

General Alfred G. Hansen	July 1987–October 1989
General Charles C. McDonald	October 1989–July 1992

Commanders, Air Force Systems Command

General Bernard P. Randolph	July 1987–April 1990
General Ronald W. Yates	April 1990–July 1992

Commanders, Air Force Materiel Command

General Ronald W. Yates	July 1992–June 1995
General Henry Viccellio Jr.	June 1995–May 1997
Lt. Gen. Kenneth E. Eickmann (Acting)	May 1997

General George T. Babbitt	May 1997–April 2000
General Lester L. Lyles	April 2000–August 2003

Sources: Historical Office, Office of the Secretary of Defense, *Department of Defense Key Officials, September 1947–December 2020*; DARPA Directors, 1958–Present, www.darpa.mil/attachments/DARPA_Directors_Sheet–web.pdf, accessed 26 Jun 2017; Robert M. Walker, "From the Army Acquisition Executive," *Army AL&T* (Jul–Aug 1997); "Fifty Years of Army Acquisition, 1960–2010," Army AL&T (Oct–Dec 2010); Historical Office, U.S. Army Materiel Command, *A Brief History of AMC and Biographies of Commanding Generals* (Alexandria, VA: Historical Office, U.S. Army Materiel Command, Dec 2000), 9; TRADOC Command History, Frequently Asked Questions, Who Have Been TRADOC's Commanders? www.tradoc.army.mil/HISTORIAN/faqs.htm, accessed 25 Jun 2017; Assistant Secretary of the Navy (Research, Development, and Acquisition) and Vice Chiefs of Naval Operations, Lists of Senior Officers and Civilian Officials of the U.S. Navy, Naval History and Heritage Command website, https://www.history.navy.mil, accessed 27 Jun 2017; Mark L. Evans and Roy A. Grossnick, *United States Naval Aviation, 1910–2010*, vol. II: *Statistics* (Washington, DC: Naval History and Heritage Command, 2015), 298; Marine Corps Systems Command, "Silver Anniversary: 25 Years of Acquisition Excellence," www.marcorsyscom.marines.mil/Portals/105/FRO/Silver_Anniversary, accessed 24 Jun 2017; App. (Key Acquisition Organizations and Leaders), in Lawrence R. Benson, *Acquisition Management in the United States Air Force and Its Predecessors* (Washington, DC: Air Force History and Museums Program, United States Air Force, 1997), 53, 55; Air Force Biographies, Department of the Air Force website, www.af.mil/About–Us/Biographies; Organizational Charts: Headquarters USAF, 1947–1990 and 1991–2015, Air Force Historical Support Division website, www.afhistory.mil; Air Force Materiel Command, Air Force Historical Research Agency website, www.afhra.af.mil/.../Article/432442/air–force–materiel–command–usaf, accessed 26 Jun 2017; DoD, *General/Flag Officer Worldwide Roster* (Washington, DC: Washington Headquarters Services, 1988–1998); *Army RD&A Bulletin*, 1988–1996; House Committee on Armed Services, Research and Development Subcommittee, *Hearings on Research, Development, Test, and Evaluation*, HASC No. 101–48 (1990), 225, https://catalog.hathitrust.org/Record/007602790, accessed 13 Feb 2020; Senate Committee on Armed Services, *Hearings on Nominations of Douglas A. Brook (Feb. 21); Stephen K. Conver (Feb. 21); William J. Haynes, II (Feb. 21); Enrique Mendez, Jr. (Feb. 21); Collin R. McMillian (Feb. 21) . . . Gen. Merrill A. McPeak (Oct. 24)* (1991), 66, https://catalog.hathitrust.org/Record/007602531, accessed 10 January 2020.

List of Abbreviations

AAAM	Advanced Air-to-Air Missile
AAAV	Advanced Amphibious Assault Vehicle
AAE	Army Acquisition Executive
ACAT	acquisition category
ACTD	advanced concept technology demonstration
AEGIS	Advanced Electronic Guidance and Instrumentation System
AFAE	Air Force Acquisition Executive
AFAR	*(News from) Air Force Acquisition Reform*
AFAS	Advanced Field Artillery System
AFB	Air Force Base
AFCC	Air Force Communications Command
AFLC	Air Force Logistics Command
AFMC	Air Force Materiel Command
AFSC	Air Force Systems Command
A/F-X	Advanced Fighter Experimental
AGM	air-to-ground missile
AIS	automated information system
AIWS	Advanced Interdiction Weapon System
AMC	Army Materiel Command
AMST	Advanced Medium STOL Transport
AP&PI	Acquisition Policy and Program Integration
ARCC	Acquisition Reform Communications Center
ARIAT	Acquisition Reform Implementation Assessment Team
ARO	Acquisition Reform Office
ARPA	Advanced Research Projects Agency
ARSSG	Acquisition Reform Senior Steering Group
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASARC	Army Systems Acquisition Review Council
ASA(RDA)	Assistant Secretary of the Army for Research, Development, and Acquisition
ASD	Assistant Secretary of Defense

ASD(PA)	Assistant Secretary of Defense for Public Affairs
ASTOVL	advanced short takeoff/vertical landing
ASW	antisubmarine warfare
ATD	advanced technology demonstration
ATF	Advanced Tactical Fighter
AUSA	Association of the United States Army
AWACS	Airborne Warning and Control System
AWE	advanced warfighting experiment
BLU	bomb live unit
BRAC	Base Realignment and Closure
BUR	Bottom-Up Review
C3I	command, control, communications, and intelligence
C3IS	command, control, communcations, intelligence, and space
C4I	command, control, communications, computers, and intelligence
CAA	Concepts Analysis Agency (U.S. Army)
CAD/CAM	computer-aided design and computer-aided manufacturing
CAIG	Cost Analysis Improvement Group
CAIV	cost as an independent variable
CBO	Congressional Budget Office
CD-ROM	compact disc read-only memory
CENTAF	Central Command Air Forces (U.S.)
CENTCOM	Central Command (U.S.)
CEO	Chief Executive Officer
CFE	contractor furnished equipment
CG	Commanding General
CG(X)	guided missile cruiser (program)
CIA	Central Intelligence Agency
CITV	Commander's Independent Thermal Viewer
CJCS	Chairman of the Joint Chiefs of Staff
CNO	Chief of Naval Operations
COEA	cost and operational effectiveness analysis
COTS	commercial off-the-shelf
CPU	central processing unit
CQ	*Congressional Quarterly*
CRT	cathode-ray tube
CSIS	Center for Strategic and International Studies
CVN	aircraft carrier (nuclear powered)
D	Democrat
DA	Department of the Army
DAB	Defense Acquisition Board
DAC	Designated Acquisition Commander
DAE	Defense Acquisition Executive
DAES	Defense Acquisition Executive Summary
DARO	Defense Airborne Reconnaissance Office
DARPA	Defense Advanced Research Projects Agency
DASD	Deputy Assistant Secretary of Defense

DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DCMA	Defense Contract Management Agency
DCMC	Defense Contract Management Command
DCS	Deputy Chief of Staff
DD(X)	destroyer (program)
DDG	guided missile destroyer
DDR&E	Director of Defense Research and Engineering
DFARS	Defense FAR Supplement
DIMOC	Defense Imaging Management Operations Center
DMR	Defense Management Report
DoD	Department of Defense
DoN	Department of the Navy
DOT&E	Director of Operational Test and Evaluation
DSAC	Defense Systems Affordability Council
DSARC	Defense Systems Acquisition Review Council
DSB	Defense Science Board
DSMC	Defense Systems Management College
DTLOMS	doctrine, training, leader development, organizations, materiel, and soldiers
DUSD(A)	Deputy Under Secretary of Defense for Acquisition
DUSD(A&T)	Deputy Under Secretary of Defense for Acquisition and Technology
DUSD(AT&L)	Deputy Under Secretary of Defense for Acquisition, Technology, and Logistics
EA	evolutionary acquisition
EFV	expeditionary fighting vehicle
EFX	expeditionary force experiment
EMD	engineering and manufacturing development
ENIAC	Electronic Numerical Integrator and Computer
ESC	Electronic Systems Center (U.S. Air Force)
ESL	Electromagnetic Systems Laboratory/ESL Incorporated
FAR	Federal Acquisition Regulation
FARA	Federal Acquisition Reform Act
FASA	Federal Acquisition Streamlining Act
FBCB2	Force XXI Battlefield Command, Brigade and Below
FBI	Federal Bureau of Investigation
FCS	Future Combat System
FLIR	Forward-Looking Infrared Radar
FORSCOM	Forces Command (U.S. Army)
FY	fiscal year
FYDP	Future Years Defense Program
GAO	General Accounting Office
GBU	guided bomb unit
GD	General Dynamics Corporation
GFE	government furnished equipment
GM	General Motors Corporation

GPO	Government Printing Office/ Government Publishing Office (as of 12/2014)
GPS	Global Positioning System
HARM	High-speed Anti-Radiation Missile
HASC	House Armed Services Committee
HCA	House Appropriations Committee
HCAS	House Committee on Armed Services
HCGRO	House Committee on Government Reform and Oversight
HCNS	House Committee on National Security
HMMWV	High Mobility Multipurpose Wheeled Vehicle (Humvee)
HTI	horizontal technology integration
IBM	International Business Machines Corporation
ICAF	Industrial College of the Armed Forces
ICBM	intercontinental ballistic missile
IDA	Institute for Defense Analyses
IED	improvised explosive device
IG	Inspector General
IOC	initial operational capability
IPD	integrated product development
IPPD	integrated product and process development
IPPM	integrated product and process management
IPT	integrated product team
IVIS	Intervehicular Information System
IWSM	integrated weapon system management
JAF	Joint Attack Fighter
JASSM	Joint Air-to-Surface Standoff Missile
JAST	Joint Advanced Strike Technology
JCS	Joint Chiefs of Staff
JDAM	Joint Direct Attack Munition
JLC	Joint Logistics Commanders
JROC	Joint Requirements Oversight Council
JSF	Joint Strike Fighter
JSTARS	Joint Surveillance Target Attack Radar System
LAM	Louisiana Maneuvers
LAMPS	Light Airborne Multi-Purpose System
LANTIRN	Low Altitude Navigation and Targeting Infrared for Night
LCD	liquid crystal display
LCS	littoral combat ship
LHX	Light Helicopter Experimental
LPD	landing platform dock
M&S	modeling and simulation
MAD	Mission Area Director
MAIS	major automated information system
MAISRC	Major Automated Information System Review Council
MAP	Management Action Plan
MCM	mine countermeasures

MCRDAC	Marine Corps Research, Development and Acquisition Command
MDAP	Major Defense Acquisition Program
MilAsst	Military Assistant
MilDep	Military Deputy
MIL STD	military standard
MILSPECs	military specifications
MILSTAR	Military Strategic and Tactical Relay
MIT	Massachusetts Institute of Technology
MLRS	Multiple-Launch Rocket System
MRC	major regional conflict
MRF	Multi-Role Fighter
NARA	National Archives and Records Administration
NARSOC	Navy Acquisition Reform Senior Oversight Council
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NCAT	National Center for Advanced Technologies
NDAA	Non-Developmental Airlift Aircraft
NDU	National Defense University
NGO	nongovernmental organization
NPR	National Performance Review
NRO	National Reconnaissance Office
NSDD	National Security Decision Directive
NSR	National Security Review
NTC	National Training Center
O&M	operation and maintenance (congressional appropriations account)
O&M	operations and maintenance (military activity)
OIS	Optical Imaging Systems Inc.
OMB	Office of Management and Budget
OMFTS	Operational Maneuver from the Sea
OPNAV	Office of the Chief of Naval Operations
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OSD(PA&E)	Office of the Secretary of Defense for Program Analysis and Evaluation
OTA	Office of Technology Assessment
OUSD(A)	Office of the Under Secretary of Defense for Acquisition
OUSD(A&T)	Office of the Under Secretary of Defense for Acquisition and Technology
OUSD(AT&L)	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
P3I	preplanned product improvement
PAT	process action team

PDUSD(A)	Principal Deputy Under Secretary of Defense for Acquisition
PDUSD(A&T)	Principal Deputy Under Secretary of Defense for Acquisition and Technology
PEO	Program Executive Officer
PIT	Process Integration Team
PM	Program Manager
POM	Program Objective Memorandum
PPBS	Planning, Programming, and Budgeting System
PSOC	Preliminary System Operational Concept
QDR	Quadrennial Defense Review
R	Republican
R&D	research and development
RDT&E	research, development, and test and evaluation
RFP	request for proposal
RIT	Rapid Improvement Team
RMA	revolution in military affairs
RPG	rocket-propelled grenade
RRP	Rapid Response Process
R-TOC	Reduction in Total Ownership Cost
SAE	Service Acquisition Executive
SAF/AQ	Assistant Secretary of the Air Force for Acquisition
SAMP	Single Acquisition Management Plan
SCA	Senate Committee on Appropriations
SCAS	Senate Committee on Armed Services
SDI	Strategic Defense Initiative
SEMATECH	Semiconductor Manufacturing Technology
SIE	Standards Improvement Executive
SMART	Simulation and Modeling in Acquisition Requirements and Training
SPAWAR	Space and Naval Warfare Systems Command
SPO	system program office
SSN	attack submarine (nuclear powered)
S&T	science and technology
STOL	short takeoff and landing
STOM	Ship-To-Objective Maneuver
STOVL	short takeoff/vertical landing
SYSCOM	systems command
TAC	Tactical Air Command
TASC	The Analytic Sciences Corporation
TEMP	Test and Evaluation Master Plan
THAAD	Theater High Altitude Area Defense
TOW	Tube-launched, Optically tracked, Wire-guided (missile)
TQM	total quality management
TRADOC	Training and Doctrine Command (U.S. Army)
TRL	technology readiness level
TRP	Technology Reinvestment Project

UAV	unmanned aerial vehicle
UN	United Nations
UNOSOM	United Nations Operation in Somalia
USAWC	U.S. Army War College
USD	Under Secretary of Defense
USD(A)	Under Secretary of Defense for Acquisition
USD(A&T)	Under Secretary of Defense for Acquisition and Technology
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USSR	Union of Soviet Socialist Republics
VTOL	vertical takeoff and landing
V/STOL	vertical short takeoff and landing
WMD	weapons of mass destruction
WNRC	Washington National Records Center
WRAP	Warfighter Rapid Acquisition Program (U.S. Air Force)
WRAP	Warfighting Rapid Acquisition Program (U.S. Army)

Bibliography

The authors of this book benefited from a wide variety and large volume of sources, including documents housed in archives, oral history interviews, published studies and reports, materials available on the Internet, trade publications, and an extensive secondary literature of books and of articles from academic and professional journals. Dr. Shiman was especially adept at exploiting the increasing quantity of government documents posted online at a time when the Internet was growing in popularity as a tool for sharing information. His persistence in locating these sources and his skill in composing narratives from them prevented the traditional obstacles facing scholars conducting research on near-contemporaneous topics from becoming barriers to writing an accurate and informed history.

This study relied most heavily on Record Group 330, the official records of the Office of the Secretary of Defense, deposited at the National Archives and Records Administration, Washington National Records Center, in Suitland, Maryland. Among these, the most important were the records of the secretary and deputy secretary of defense and the under secretary of defense for acquisition. Also vital were copies of records located in the Historical Office, Office of the Secretary of Defense: biographical and subject files, 5000 series document revision files, and the secretary of defense's annual reports and compilations of public statements. Oral history interviews were another valuable source, especially since the great majority of participants in the events under study were still alive as the authors conducted their research. The interviews enriched this book with the perspective of numerous acquisition officials and provide context for interpreting the documentary record.

Given the importance of major weapon systems to national security and the responsibility of government officials to acquire the most advanced systems at the lowest possible cost, the published literature on defense acquisition from the legislative and executive branches, as well from think tanks and universities, is substantial. The hearings and reports of the armed services, government affairs, and appropriations committees of the U.S. Senate and House of Representatives were essential to this study, as were the reports of congressional agencies, such as the Congressional Budget Office, the Government Accountability Office, the Congressional Research Service, and the Office of Technology Assessment. Key executive branch materials came from the Defense Science Board, the Department of Defense Inspector General, various presidential commissions, and the offices of senior acquisition officials in OSD and the military services. The authors also consulted studies from think tanks and federally funded research and development centers, as well as theses and reports from Department of Defense professional educational programs, including the Air Command and Staff College, Air Force Institute of Technology, Defense Acquisition University, Defense Systems Management College, Naval Postgraduate School, and U.S. Army War College.

PRIMARY SOURCES

ARCHIVAL REPOSITORIES

Naval History and Heritage Command, Washington Navy Yard, Washington, DC.

Office of the Secretary of Defense, Historical Office (OSD/HO), Washington, DC.

5000 Series 1991 Revision Files
Biographical Files
Online Documents: https://history.defense.gov
Oral History Collection
Public Statements of the Secretaries of Defense
Subject Files

U.S. National Archives and Records Administration (NARA), College Park, MD. Record Group 330. Combined Military Service Digital Photographic Files, 1982–2007. https://catalog.archives.gov/id/6274097.

U.S. National Archives and Records Administration, Washington National Records Center (WNRC), Suitland, MD. Record Group 330.

Accession 330-91-0095, Official Records (Secret and Below) of the Secretary and Deputy Secretary of Defense, 1989
Accession 330-92-0097, Official Records (Secret and Below) of the Secretary and Deputy Secretary of Defense, 1990
Accession 330-93-0004, Official Records (Secret and Below) of the Secretary and Deputy Secretary of Defense, 1991
Accession 330-95-0014, Official Records (Secret and Below) of the Secretary and Deputy Secretary of Defense, 1992
Accession 330-93-0002, Signer's Files for the Deputy Secretary of Defense, 1991
Accession 330-96-0008, Chron Files for OUSD(A&T) Acquisition Program Integration, 1990
Accession 330-93-0047, Official Records (Secret and Below) of the Secretary and Deputy Secretary of Defense Transition Files
Accession 330-92-0136, USD(A) Chron Files, 1989
Accession 330-94-0006, USD(A) Chron Files, 1990
Accession 330-94-0007, USD(A) Chron Files, 1991
Accession 330-95-0057, USD(A) Chron Files, 1992

Accession 330-97-0030, USD(A) Chron Files, 1993
Accession 330-94-0009, USD(A) Congressional Relations Files, 1989–1990

U.S. CONGRESS: HOUSE HEARINGS

Committee on Appropriations. Subcommittee. *Department of Defense Appropriations for 1990: Hearings.* Pt. 6. 101st Cong., 1st sess., 1989.

———. *Department of Defense Appropriations for 1991: Hearings.* Pt. 1. 101st Cong., 2d sess., 1990.

———. *Department of Defense Appropriations for 1991: Hearings.* Pt. 2. 101st Cong., 2d sess., 1990.

———. *Department of Defense Appropriations for 1992: Hearings.* Pt. 1. 102d Cong., 1st sess., 1991.

———. *Department of Defense Appropriations for 1992: Hearings.* Pt. 8. 102d Cong., 1st sess., 1991.

———. *Department of Defense Appropriations for 1993: Hearings.* Pt. 1. 102d Cong., 2d sess., 1992.

Committee on Armed Services. *Hearings on National Defense Authorization Act for Fiscal Year 1990—H.R. 2461 and Oversight of Previously Authorized Programs.* 101st Cong., 1st sess., 1989.

———. *Hearings on National Defense Authorization Act for Fiscal Year 1991—H.R. 4739 and Oversight of Previously Authorized Programs.* 101st Cong., 2d sess., 1990.

———. *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100 and Oversight of Previously Authorized Programs.* 102d Cong., 1st sess., 1991.

———. *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006 and Oversight of Previously Authorized Programs.* 102d Cong., 2d sess., 1992.

———. Defense Policy Panel. *Building a Defense That Works for the Post–Cold War World: Hearings.* 101st Cong., 2d sess., 1990.

———. Investigations Subcommittee. *Acquisition Workforce: Hearings.* 101st Cong., 2d sess., 1990.

———. Investigations Subcommittee. *Department of Defense Implementation of the Packard Commission Report of 1986: Hearings.* 101st Cong., 1st sess., 1989.

———. Investigations Subcommittee. *DoD Military Specifications and Standards: Hearing.* 102d Cong., 2d sess., 1992.

———. Military Acquisition Subcommittee. *Acquisition Reform: Fact or Fiction? Hearing.* 103d Cong., 1st sess., 1993.

———. Military Acquisition Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 1995—S. 2182 (H.R. 4301) . . . Hearings on Title I—Procurement.* 103d Cong., 2d sess., 1994.

———. Military Acquisition Subcommittee and the Oversight and Investigations Subcommittee. *C–17 Aircraft Program Review: Joint Hearings.* 103d Cong., 1st sess., 1993.

———. Military Procurement Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 2000—H.R. 1401 . . . Title I—Procurement.* 106th Cong., 1st sess., 1999.

———. Procurement and Military Nuclear Systems Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Years 1992 and 1993—H.R. 2100 and Oversight of Previously*

Authorized Programs . . . on Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement. 102d Cong., 1st sess., 1991.

———. Procurement and Military Nuclear Systems Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006 and Oversight of Previously Authorized Programs . . . on Procurement of Aircraft, Missiles, Weapons and Tracked Combat Vehicles, Ammunition, and Other Procurement*. 102d Cong., 2d sess., 1992.

———. Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee. *The Status of the V–22 Tiltrotor Aircraft Program: Hearing.* 102d Cong., 2d sess., 1992.

———. Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee and the Investigations Subcommittee. *The Navy's A–12 Aircraft Program: Joint Hearing.* 101st Cong., 2d sess., 1990.

———. Research and Development Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 1993–H.R. 5006 . . . on Research, Development, Test, and Evaluation.* 102d Cong., 2d sess., 1992.

———. Seapower and Strategic and Critical Materials Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 1993—H.R. 5006 . . . on Seapower*. 102d Cong., 2d sess., 1992.

Committee on Banking, Finance, and Urban Affairs. Subcommittee on Economic Stabilization. *Defense Production Act: Hearings*. 102d Cong., 1st sess., 1991.

Committee on Energy and Commerce. Subcommittee on Oversight and Investigations. *Northrop Corp. Investigation: Hearings.* 101st Cong., 2d sess., 1990.

Committee on Government Operations. Legislation and National Security Subcommittee. *Management of the Department of Defense Automated Information Systems: Hearing.* 101st Cong., 1st sess., 1989.

Committee on Government Reform. Subcommittee on National Security, Veterans Affairs, and International Relations. *F–22 Cost Controls: Will Product Cost Savings Materialize? Hearings*. 106th Cong., 2d sess., 2000.

Committee on Government Reform and Oversight. *Oversight of Implementation of Federal Acquisition Streamlining Act of 1994: Hearing.* 104th Cong., 1st sess., 1995.

Committee on National Security. Military Procurement Subcommittee and the Military Research and Development Subcommittee. *Department of Defense Modernization Plans: Joint Hearing.* 105th Cong., 2d sess., 1998.

———. Military Research and Development Subcommittee. *Hearings on National Defense Authorization Act for Fiscal Year 1998—H.R. 1119 . . . Title II–Research, Development, Test, and Evaluation*. 105th Cong., 1st sess., 1997.

U.S. CONGRESS: HOUSE DOCUMENTS AND REPORTS

Committee on Appropriations. *Department of Defense Appropriations Bill, 1996: Report of the Act*. 104th Cong., 1st sess., 1995. H. Rep. 104-208.

———. *Department of Defense Appropriations Bill, 1996: Report of the Committee on Appropriations together with Dissenting Views [to accompany H.R. 2126]*, 104th Cong., 1st sess., 1995. H. Rep. 104-150.

Committee on Armed Services. *Department of Defense Appropriations Bill, 1998: Report . . . [to accompany H.R. 2266].* 105th Cong., 1st sess., 1997. H. Rep. 105-206.

———. *Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001: Report . . . on H.R. 4205*. 106th Cong., 2d sess., 2000. H. Rep. 106-616.

———. *Future of the Defense Industrial Base: Report of the Structure of U.S. Defense Industrial Base Panel*. 102d Cong., 2d sess., 1992. Committee Print.

———. *National Defense Authorization Act for Fiscal Years 1990–1991: Report . . . on H.R. 2461.* 101st Cong., 1st sess., 1989. H. Rep. 101-121.

———. *National Defense Authorization Act for Fiscal Years 1992 and 1993: Conference Report to Accompany H.R. 2100.* 102d Cong., 1st sess., 1991. H. Rep. 102-311.

———. *National Defense Authorization Act for Fiscal Years 1992 and 1993: Report . . . on H.R. 2100.* 102d Cong., 1st sess., 1991. H. Rep. 102-60.

———. *National Defense Authorization Act for Fiscal Year 1993: Report . . . on H.R. 5006*. 102d Cong., 2d sess., 1992. H. Rep. 102-527.

———. *National Defense Authorization Act for Fiscal Year 2000: Report . . . on H.R. 1401*. 106th Cong., 1st sess., 1999. H. Rep. 106-162.

———. Subcommittee on Investigations. *Life Is Too Short: A Review of the Brief Periods Managers of Major Defense Acquisition Programs Stay on the Job: Report*. 101st Cong., 2d sess., 1990. Committee Print.

———. *The Quality and Professionalism of the Acquisition Workforce: Report*. 101st Cong., 2d sess., 1990. Committee Print.

———. *A Review of Defense Acquisition in France and Great Britain: Report*. 101st Cong., 1st sess., 1989. Committee Print.

Committee on Government Operations. *DoD Automated Information Systems Experience Runaway Costs and Years of Schedule Delays While Providing Little Capability: Sixth Report.* 101st Cong., 1st sess., 1989. H. Rep. 101-382.

Committee on National Security. *The Defense Reform Act of 1997: Report . . . on H.R. 1778 together with Dissenting Views*. Pt. 1. 105th Cong., 1st sess., 1997. H. Rep. 105-133.

———. *National Defense Authorization Act for Fiscal Year 1996: Report . . . on H.R. 1530 together with Additional, Supplemental, and Dissenting Views.* 104th Cong., 1st sess., 1995. H. Rep. 104-131.

———. *National Defense Authorization Act for Fiscal Year 1997: Report . . . on H.R. 3230 together with Additional, Supplemental, and Dissenting Views.* 104th Cong., 2d sess., 1998. H. Rep. 104-563.

———. *National Defense Authorization Act for Fiscal Year 1998: Report . . . on H.R. 1119 together with Additional and Dissenting Views*. 105th Cong., 1st sess., 1997. H. Rep. 105-132.

Committee on Oversight and Government Reform. Majority Staff. *The Expeditionary Fighting Vehicle: Over Budget, Behind Schedule, and Unreliable*. 110th Cong., 2d sess., 2008. Committee Print.

Committee on Science, Space, and Technology. Subcommittee on Investigations and Oversight. *Bugs in the Program: Problems in Federal Government Computer Software Development and Regulation*. Staff Study. 101st Cong., 1st sess., 1989. Committee Print.

Department of Defense. Office of the Inspector General. *Government Actions Concerning McDonnell Douglas Corporation Financial Condition during 1990, Report of the Department of Defense Office of Inspector General to the Committee on Government Operations, House of Representatives*. 103d Cong., 1st sess., 1993. Committee Print.

House Permanent Select Subcommittee on Intelligence. *Intelligence Authorization Act for Fiscal Year 1998*. 105th Cong., 1st sess., 1997. H. Rep. 105-135.

House of Representatives. *Authorizing Appropriations for Fiscal Year 1990 for Military Activities of the Department of Defense . . . and for Other Purposes: Conference Report to Accompany H.R. 2461*. 101st Cong., 1st sess., 1989. H. Rep. 101-331.

———. *Dire Emergency Supplemental Appropriations for Disaster Assistance, Food Stamps, Unemployment Compensation Administration, and Other Urgent Needs, and Transfers, and Reducing Funds Budgeted for Military Spending for the Fiscal Year Ending September 30, 1990, and Other Purposes.* 101st Cong., 2d sess., 1990. H. Rep. 101-493.

———. *Enactment of Provisions of H.R. 5408, the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001: Conference Report to Accompany H.R. 4205.* 106th Cong., 2d sess., 2000. H. Rep. 106-945.

———. *Making Appropriations for the Department of Defense for Fiscal Year 1981, and for Other Purposes: Conference Report [to accompany H.R. 8105].* 96th Cong., 2d sess., 1980. H. Rep. 96-1528.

———. *Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 1990, and for Other Purposes: Conference Report [to accompany H.R. 3072]*. 101st Cong., 1st sess., 1989. H. Rep. 101-345.

———. *National Defense Authorization Act for Fiscal Year 1994: Conference Report to Accompany H.R. 2401.* 103d Cong., 1st sess., 1993. H. Rep. 103-357.

———. *National Defense Authorization Act for Fiscal Year 1996: Conference Report to Accompany H.R. 1530*. 104th Cong., 1st sess., 1995. H. Rep. 104-406.

———. *National Defense Authorization Act for Fiscal Year 1997: Conference Report to Accompany H.R. 3230*. 104th Cong., 2d sess., 1996. H. Rep. 104-724.

———. *National Defense Authorization Act for Fiscal Year 1998: Conference Report to Accompany H.R. 1119*. 105th Cong., 1st sess., 1997. H. Rep. 105-340.

———. *National Defense Authorization Act for Fiscal Year 2000: Conference Report to Accompany S. 1059.* 106th Cong., 1st sess., 1999. H. Rep. 106-301.

———. *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999: Conference Report to Accompany H.R. 3616*. 105th Cong., 2d sess., 1998. H. Rep. 105-736.

U.S. CONGRESS: SENATE HEARINGS

Committee on Appropriations. Subcommittee. *Department of Defense Appropriations for Fiscal Year 1983: Hearings*. Pt. 3. 97th Cong., 2d sess., 1982.

———. *Department of Defense Appropriations for Fiscal Year 1990: Hearings . . . on H.R. 3072*. Pt. 6. 101st Cong., 1st sess., 1989.

———. *Department of Defense Appropriations for Fiscal Year 1991: Hearings . . . on H.R. 5803/S. 3189*. Pt. 1. 101st Cong., 2d sess., 1990.

———. *Department of Defense Appropriations for Fiscal Year 1992: Hearings . . . on H.R. 2521*. Pt. 5. 102d Cong., 1st sess., 1991.

———. *Department of Defense Appropriations for Fiscal Year 1993: Hearings*. Pt. 1. 102d Cong., 2d sess., 1992.

Committee on Armed Services. *Acquisition Reform: Next Steps: Hearings.* 114th Cong., 1st sess., 2016.

———. *Defense Acquisition Process: Hearings*. 100th Cong., 2d sess., 1989.

———. *Department of Defense Authorization for Appropriations for Fiscal Years 1990 and 1991: Hearings . . . on S. 1085*. Pt. 1. 101st Cong., 1st sess., 1989.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1991: Hearings . . . on S. 2884*. Pt. 1. 101st Cong., 2d sess., 1990.

———. *Department of Defense Authorization for Appropriations for Fiscal Years 1992 and 1993: Hearings . . . on S. 1507*. Pt. 1. 102d Cong., 1st sess., 1991.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearings . . . on S. 3114.* Pt. 1. 102d Cong., 2d sess., 1992.

———. Department of Defense *Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program . . . on S. 3114.* Pt. 4. 102d Cong., 2d sess., 1992.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1993 and the Future Years Defense Program: Hearings . . . on S. 3114.* Pt. 5. 102d Cong., 2d sess., 1992.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1994 and the Future Years Defense Program: Hearings . . . on S. 1298*. Pt. 5. 103d Cong., 1st sess., 1993.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1995 and the Future Years Defense Program: Hearings . . . on S. 2182*. Pt 5. 103d Cong., 2d sess., 1994.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1996 and the Future Years Defense Program: Hearings . . . on S. 1026*. Pt. 5. 104th Cong., 1st sess., 1995.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 1999 and the Future Years Defense Program: Hearings . . . on S. 2057.* Pt. 5. 105th Cong., 2d sess., 1998.

———. *Department of Defense Authorization for Appropriations for Fiscal Year 2000 and the Future Years Defense Program: Hearings . . . on S. 1059*. Pt. 3. 106th Cong., 1st sess., 1999.

———. *Nominations Before the Senate Armed Services Committee, First Session, 100th Congress: Hearings*. 1987.

———. *Nominations Before the Senate Armed Services Committee, First Session, 101st Congress: Hearings*. 1989.

———. *Nominations Before the Senate Armed Services Committee, Second Session, 101st Congress: Hearings*. 1990.

———. *Nominations Before the Senate Armed Services Committee, First Session, 103d Congress: Hearings*. 1993.

———. *Nominations Before the Senate Armed Services Committee, Second Session, 103d Congress: Hearings*. 1994.

———. *Nominations Before the Senate Armed Services Committee, First Session, 104th Congress: Hearings*. 1995.

———. *Nominations Before the Senate Armed Services Committee, First Session, 105th Congress: Hearings*. 1997.

Committee on the Budget. *Concurrent Resolution on the Budget for Fiscal Year 1993: Hearings . . . The 1993 Budget: Defense and Domestic Spending in the Post–Cold War Era*. V. 2. 102d Cong., 2d sess., 1992.

Committee on Governmental Affairs. *Management of the Department of Defense: Hearing.* Pt. 1. 98th Cong., 1st sess., 1983.

Committee on Governmental Affairs and Committee on Armed Services. *S. 1587, Federal Acquisition Streamlining Act of 1993: Joint Hearings.* 103d Cong., 2d sess., 1994.

U.S. CONGRESS: SENATE DOCUMENTS AND REPORTS

Committee on Appropriations. *Department of Defense Appropriations Bill, 1990: Report [to accompany H.R. 3072]*. 101st Cong., 1st sess., 1989. S. Rep. 101-132.

———. *Department of Defense Appropriations Bill, 1996: Report [to accompany S. 1087].* 104th Cong., 1st sess., 1995. S. Rep. 104-124.

Committee on Armed Services. *Department of Defense Authorization Act for Fiscal Year 1999: Report to Accompany S. 2060.* 105th Cong., 2d sess., 1998. S. Rep. 105-189.

———. *National Defense Authorization Act for Fiscal Year 1991: Report [to accompany S. 2884]*. 101st Cong., 2d sess., 1990. S. Rep. 101-384.

———. *National Defense Authorization Act for Fiscal Years 1992 and 1993: Report [to accompany S. 1507].* 102d Cong., 1st sess., 1991. S. Rep. 102-113.

———. *National Defense Authorization Act for Fiscal Year 1997: Report [to accompany S. 1745].* 104th Cong., 2d sess., 1996. S. Rep. 104-267.

———. *National Defense Authorization Act for Fiscal Year 2001: Report [to accompany S. 2549]*. 106th Cong., 2d sess., 2000. S. Rep. 106-292.

Committee on Governmental Affairs. *Government Performance and Results Act of 1993: Report to Accompany S. 20*. 103d Cong., 1st sess., 1993. S. Rep. 103-58.

Committee on Homeland Security and Governmental Affairs. Permanent Subcommittee on Investigations. *Defense Acquisition Reform: Where Do We Go From Here? A Compendium of Views by Leading Experts*. Staff Report. 113th Cong., 2d sess., 2014.

CONGRESSIONAL AGENCY REPORTS

Congressional Budget Office. Washington, DC. CBO Reports. http://www.cbo.gov.

Government Accountability Office. Washington, DC. GAO Reports. http://www.gao.gov.

Library of Congress. Congressional Research Service. Washington, DC. CRS Reports. https://crsreports.congress.gov.

Office of Technology Assessment. OTA Legacy. Princeton University, Princeton, NJ. OTA Reports. https://www.princeton.edu/~ota.

EXECUTIVE BRANCH: DOCUMENTS AND REPORTS

Acquisition Reform Process Action Team. *Reengineering the Acquisition Oversight and Review Process: Final Report to the Secretary of Defense.* Washington, DC: Department of Defense, 1994.

Aspin, Les. *Annual Report to the President and the Congress*. Washington, DC: Office of the Secretary of Defense, 1994.

———. *Report on the Bottom-Up Review*. Washington, DC: Department of Defense, 1993.

Assistant Secretary of Defense (Production and Logistics). *Report to Congress on the Defense Industrial Base: Critical Industries Planning*. Washington, DC: Department of Defense, 1990.

Boorda, Admiral Jeremy M. *Mine Countermeasures–An Integral Part of Our Strategy and Our Forces*. White Paper. Washington, DC: Office of the Chief of Naval Operations, 1995.

Bowers, Rod. *U.S. Marine Corps Tactical Systems Acquisition: An Overview of the Process and Participants*. Washington, DC: Marine Corps Research, Development and Acquisition Command, 1989.

Brown, Linda. *DoD Software Reuse Initiative: Vision and Strategy*. Arlington, VA: Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, Director of Defense Information, 1992.

Bush, George [H. W]. *Public Papers of the Presidents of the United States: George Bush, 1989–1993.* 8 books. Washington, DC: Office of the Federal Register, National Archives and Records Administration, 1990–1993.

Cheney, Dick. *Annual Report to the President and the Congress*. 1990.

———. *Annual Report to the President and the Congress*. 1992.

———. *Annual Report to the President and the Congress*. 1993.

———. *Defense Management: Report to the President*. Washington, DC: Department of Defense, 1989.

———. *Defense Strategy for the 1990s: The Regional Defense Strategy*. Washington, DC: Department of Defense, 1993.

———. *White Paper on the Department of Defense and the Congress: Report to the President by the Secretary of Defense*. 1990.

Clinton, William J. *Public Papers of the Presidents of the United States: William J. Clinton, 1993*. 2 books. Washington, DC: Office of the Federal Register, National Archives and Records Administration, 1994.

Cohen, William S. *Actions to Accelerate the Movement to the New Workforce Vision: Report to Congress*. Washington, DC: Department of Defense, 1998.

———. *Annual Report to the President and the Congress*, 1997.

———. *Annual Report to the President and the Congress*, 1998.

———. *Annual Report to the President and the Congress*, 2001.

———. *Defense Reform Initiative Report*. Washington, DC: Department of Defense, 1997.

———. *The Report of the Quadrennial Defense Review*. Washington, DC: Department of Defense, 1997.

Defense Acquisition University. *Defense Acquisition Structures and Capabilities Review: Report*. 2007.

Defense Airborne Reconnaissance Office. *Unmanned Aerial Vehicles (UAV) Master Plan*. Washington, DC: Deputy Under Secretary of Defense (Advanced Technology), 1994.

Defense Science Board. Summer Study and Task Force Reports. 1978–2001. http://www.dsb.cto.mil/reports.

Department of the Air Force. *The Air Force and US National Security: Global Reach–Global Power*. Washington, DC, 1990.

———. Air Force Materiel Command. AFMC Pamphlet 800-60, *Integrated Weapon System Management (IWSM)*, 1993.

Department of the Army. Army Materiel Command. AMC Pamphlet, *Guidance for Product and Process Management*. 3 vols. 1995.

———. Office of the Chief of Staff, Army. Director, Louisiana Maneuvers Task Force. *America's Army of the 21st Century: Force XXI, Meeting the 21st Century Challenge*. 1995.

Department of Commerce. Office of Industrial Resource Administration. Strategic Analysis Division. *National Security Assessment of the Domestic and Foreign Subcontractor Base: A Study of Three U.S. Navy Weapon Systems*. Washington, DC, 1992.

Department of Defense. *Conduct of the Persian Gulf War: Final Report to Congress.* Washington, DC, 1992.

———. *Industrial Capabilities for Defense*. Washington, DC, 1994.

———. *Overcoming Barriers to the Use of Commercial Integrated Circuit Technology in Defense Systems*. Washington, DC, 1996.

Department of Defense. Office of Inspector General. Audit Reports. http://www.dogig.mil/reports.

Department of the Navy. . . . *From the Sea: Preparing the Naval Service for the 21st Century*. Washington, DC, 1992.

———. *Forward . . . From the Sea*. Washington, DC, 1997.

———. *Implementation of Acquisition Reform*. Washington, DC, 1997 and 1998.

Director, Defense Research and Engineering. *Defense Science and Technology Strategy.* Washington, DC: Department of Defense, 1992, 1994.

Gansler, Jacques S. *Into the 21st Century: A Strategy for Affordability*. [Department of Defense] 1999.

Gore, Al. *From Red Tape to Results: Creating a Government That Works Better and Costs Less: Report of the National Performance Review*. Washington, DC: GPO, 1993.

Johnson, Admiral Jay L. *Forward . . . From the Sea: The Navy Operational Concept*. Washington, DC: Office of the Chief of Naval Operations, 1997.

Joint Staff. J–6, C4 Architecture & Integration Division. *C4I for the Warrior*. Washington, DC: Joint Chiefs of Staff, 1992.

Marine Corps Combat Development Command. *Operational Maneuver From the Sea*. Marine Corps Capabilities Plan (MCCP) 1. Washington, DC: Department of the Navy, Headquarters U.S. Marine Corps, 1996.

McPeak, Merrill A. *Selected Works, 1990–1994*. Maxwell AFB, AL: Air University Press, 1995.

National Military Strategy of the United States. [Washington, DC:] Joint Chiefs of Staff, 1992.

Naval Sea Systems Command and LPD 17 Team 17. "Smart Ship Impact on LPD 17 Design: Final Systems Engineering Report." 30 November 1997.

Office of the Assistant Secretary of Defense for Economic Security. *Dual Use Technology: A Defense Strategy for Affordable, Leading-Edge Technology*. Washington, DC: Department of Defense, 1995.

Office of the Department of Defense Comptroller. *National Defense Budget Estimates – FY 1991*. Washington, DC: Department of Defense, 1990.

Office of Management and Budget. *Budget of the United States Government, Fiscal Year 1990*. 1989.

———. *Budget of the United States Government, Fiscal Year 1991*. 1990.

———. *Budget of the United States Government, Fiscal Year 1992*. 1991.

Office of the Secretary of Defense. *Public Statements of Caspar W. Weinberger, Secretary of Defense, 1984*. 4 vols. Washington, DC: OSD Historical Office, n.d.

———. *Public Statements of Les Aspin, Secretary of Defense, 1993–1994*. 3 vols. Washington, DC: OSD Historical Office, n.d.

———. *Public Statements of Richard B. Cheney, Secretary of Defense, 1990*. 4 vols; *1992–1993*. 3 vols. Washington, DC: OSD Historical Office, n.d.

———. *Public Statements of William J. Perry, Secretary of Defense, 1994*. 4 vols. Washington, DC: OSD Historical Office, n.d.

Office of the Under Secretary of Defense (Comptroller). *National Defense Budget Estimates for FY 2001*. Washington, DC: Department of Defense, 2000.

———. *National Defense Budget Estimates for FY 2014*. Washington, DC: Department of Defense, 2013.

Office of the Under Secretary of Defense for Acquisition and Technology. *MilSpec Reform: Results of the First Two Years*. Washington, DC: Department of Defense, 1996.

Perry, William J. *Acquisition Reform: A Mandate for Change*. Washington, DC: Department of Defense, 1994.

———. *Annual Report to the President and the Congress*. 1995.

———. *Annual Report to the President and the Congress*. 1996.

President's Blue Ribbon Commission on Defense Management. *A Formula for Action: A Report to the President on Defense Acquisition*. Washington, DC: The Commission, 1986.

———. *An Interim Report to the President*. Washington, DC: The Commission, 1986.

———. *A Quest for Excellence: Final Report to the President*. Washington, DC: The Commission, 1986.

Process Action Team on Military Specifications and Standards. *Blueprint for Change: Report of the Process Action Team on Military Specifications and Standards*. Washington, DC: Office of the Under Secretary of Defense (Acquisition and Technology), 1994.

Procurement Process Reform Process Action Team. *Final Report of the Procurement Process Reform Process Action Team to the Under Secretary of Defense for Acquisition and Technology*. Washington, DC: Department of Defense, 1995.

Reagan, Ronald. *Public Papers of the Presidents of the United States: Ronald Reagan, 1986*. 2 books. Washington, DC: Office of the Federal Register, National Archives and Records Administration, 1988–1989.

Shalikashvili, John M. *Joint Vision 2010*. Washington, DC: Office of the Chairman of the Joint Chiefs of Staff, n.d.

Shiman, Philip. *Forging the Sword: Defense Production during the Cold War*. USACERL Special Report, 97/77. N.p.: U.S. Air Force Air Combat Command and the DoD Legacy Program, Cold War Project, 1997.

Sullivan, Gordon R. *The Collected Works of the Thirty-Second Chief of Staff, United States Army: June 1991–June 1995*. [Washington, DC]: Department of the Army, [1996].

Webb, William Joe, et al. *Department of the Army Historical Summary, Fiscal Years 1990 and 1991*. Washington, DC: U.S. Army Center of Military History, 1997.

Winner, Robert I. *Integrated Product/Process Development in the New Attack Submarine Program: A Case Study*. 2d ed. Washington, DC: Under Secretary of Defense (Acquisition, Technology, and Logistics), 2000.

Under Secretary of Defense (Acquisition) and Assistant Secretary of Defense (Production and Logistics). *Report to Congress on the Defense Industrial Base*. Washington, DC: Department of Defense, 1991.

United States. *National Security Strategy of the United States*. Washington, DC: The White House. 1991.

INTERVIEWS

Adams, Dale G. Interview by Robert G. Darius and Michael Bellafaire. Alexandria, VA, 6 February 1998. Alexandria, VA: AMC Historical Office, September 1999.

Beauchamp, Maj. Gen. Roy E. Interview by Michael Bellafaire and Jeffrey Hosmer. AMC Headquarters, Alexandria, VA, 20 June 1997. AMC Historical Office.

Boorda, Adm. J. M. Eric Schmitt, "Transcript of an Interview with Admiral J. M. Boorda, Chief of Naval Operations," 24 August 1995. http://www.fas.org/man/dod-101/ sys/ship/docs/boor0824.htm.

Christle, Gary. Interview by members of Defense Acquisition History Project. U.S. Army Center of Military History, Fort Lesley J. McNair, DC, 21 May 2008. OSD/HO.

Douglass, John. Gibson LeBoeuf, "John Douglass, Assistant Secretary of the Navy for Research, Development, & Acquisition Speaks to *Program Manager*." *Program Manager* 25, no. 6 (November-December 1996): 2–11.

Dyer, Vice Adm. Joe, USN (Ret.). Interview by J. Ronald Fox, David Allen, and Philip Shiman. Harvard Business School, Boston, MA, 17 September 2008. OSD/HO.

Fields, Craig I. DARPA interview of Craig I. Fields. 15 March 2007. DARPA Case No. 13-01968.000225–250. www.esd.whs.mil/Portals/54/Documents/FOID/Reading Room/DARPA/15-F-0751_DARPA_Director_Craig_Fields.pdf.

Gotbaum, Joshua. Gibson LeBoeuf, "*Program Manager* Interviews Joshua Gotbaum, Assistant Secretary of Defense for Economic Security." *Program Manager* 24, no. 6 (November-December 1995): 30–34.

Hamre, John J. Interview by Alfred Goldberg and Richard Hunt. Washington, DC, 18 May 2001. OSD/HO.

———. Interview by Alfred Goldberg and Rebecca Cameron. Washington, DC, 29 June 2001. OSD/HO.

———. Interview by Alfred Goldberg and Rebecca Cameron. Washington, DC, 15 August 2001. OSD/HO.

Kaminski, Paul G. Interview by Alfred Goldberg and Richard Hunt. Fairfax Station, VA, 14 June 2000. OSD/HO.

———. Interview by Stuart Rochester and Richard Hunt. Fairfax Station, VA, 24 January 2001. OSD/HO.

———. Interview by Philip Shiman. Fairfax Station, VA, 8 September 2004. OSD/HO.

Paige, Emmett, Jr. Interview by Alfred Goldberg and Richard Hunt. Washington, DC, 4 October 2000. OSD/HO.

———. Interview by Craig B. Hanford. *Executive Summary: Senior Officer Oral History Program Interview of Lieutenant General (Retired) Emmett Paige Jr.* Carlisle Barracks, PA: U.S. Army War College, 25 April 1997.

Perry, William J. Interview by Alfred Goldberg and Roger Trask. Arlington, VA, 6 October 1998. OSD/HO.

———. Interview by Alfred Goldberg and Roger Trask. Arlington, VA, 22 October 1998. OSD/HO.

Pigaty, Lt. Gen. Leo J. Interview by Robert G. Darius and Herbert A. Leventhal. Alexandria, VA, 2 May 1994. Alexandria, VA: AMC Historical Office, January 1996.

Preston, Colleen A. Interview by J. Ronald Fox et al. U.S. Army Center of Military History, Fort Lesley J. McNair, DC, 26 March 2008. OSD/HO.

Sambur, Marvin. "Interview with Marvin Sambur, Assistant Secretary of the Air Force (Acquisition): Pathfinder Program Testing the Potential of Spiral Arms Development." *Program Manager* 32, no. 4 (July-August 2003): 2–9.

Taylor, Col. William E. Glen W. Goodman Jr., "Interview: Col. William E. Taylor, USMC, Program Executive Officer for Land Systems." *Program Executive Officer Land Systems, Marine Corps*, 2008/2009 ed., 12–14.

Tuttle, General William G. T. Interview by Robert G. Darius and Herbert A. Leventhal. AMC Headquarters, Alexandria, VA, 14 February 1992. AMC Historical Office.

PUBLISHED MEMOIRS

Bush, George, and Brent Scowcroft. *A World Transformed*. New York: Knopf, 1998.

Clark, Wesley K. *Waging Modern War: Bosnia, Kosovo, and the Future of Combat*. New York: Public Affairs, 2001.

Franks, Tommy. *American Soldier*. With Malcolm McConnell. New York: Regan Books, 2004.

Powell, Colin L. *My American Journey*. With Joseph E. Persico. New York: Random House, 1995.

Rumsfeld, Donald. *Known and Unknown: A Memoir*. New York: Sentinel, 2011.

Stone, Bob. *Confessions of a Civil Servant: Lessons in Changing America's Government and Militar*y. New York: Rowman & Littlefield, 2003.

SECONDARY SOURCES

BOOKS

Allard, Kenneth. *Command, Control, and the Common Defense*. Rev. ed. Washington, DC: National Defense University, Institute for Strategic Studies, 1996.

———. *Somalia Operations: Lessons Learned*. Washington, DC: National Defense University Press, 1995.

Atkinson, Rick. *Crusade: The Untold Story of the Persian Gulf War*. Boston, MA: Houghton Mifflin, 1993.

Bailey, J.B.A. *Field Artillery and Firepower*. Oxford: The Military Press, 1989.

Battershell, A. Lee. *The DOD C–17 versus the Boeing 777: A Comparison of Acquisition and Development*. Washington, DC: National Defense University Press, 1999.

Benson, Lawrence R. *Acquisition Management in the United States Air Force and Its Predecessors*. Washington, DC: Air Force History and Museums Program, 1997.

Beschloss, Michael R., and Strobe Talbott. *At the Highest Levels: The Inside Story of the End of the Cold War*. Boston: Little, Brown, 1993.

Bourque, Stephen A. *Jayhawk! The VII Corps in the Persian Gulf War*. Washington, DC: Department of the Army, 2002.

Branch, Taylor. *The Clinton Tapes: Wrestling History with the Preside*nt. New York: Simon & Schuster, 2009.

Brands, Hal. *From Berlin to Baghdad: America's Search for Purpose in the Post–Cold War World*. Lexington: University Press of Kentucky, 2008.

Brown, John Sloan. *Kevlar Legions: The Transformation of the U.S. Army, 1989–2005*. Washington, DC: U.S. Army Center of Military History, 2011.

Brown, Ronald J. *U.S. Marines in the Persian Gulf, 1990–1991: With Marine Forces Afloat in Desert Shield and Desert Storm*. Washington, DC: History and Museums Division, Headquarters, U.S. Marine Corps, 1998.

Brown, Shannon A., ed. *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*. Washington, DC: U.S. Army Center of Military History and Industrial College of the Armed Forces, 2005.

Burton, James G. *The Pentagon Wars: Reformers Challenge the Old Guard*. Annapolis, MD: Naval Institute Press, 1993.

Carter, Ashton B., and William J. Perry. *Preventive Defense: A New Security Strategy for Americ*a. Washington, DC: Brookings Institution Press, 1999.

Chiarelli, Peter W., and Raymond C. Gagnon Jr. *The Politics of Military Reform*. Newport, RI: Center for Naval Warfare Studies, 1985.

Chollet, Derek, and James Goldgeier. *America Between the Wars: From 11/9 to 9/11: The Misunderstood Years Between the Fall of the Berlin Wall and the Start of the War on Terror*. New York: Public Affairs, 2008.

Clancy, Tom. *Into the Storm: A Study in Command*. With General Fred Franks Jr. New York: Putnam, 1997.

Clark, Asa A., IV, Peter W. Chiarelli, Jeffrey S. McKitrick, and James W. Reed, eds. *The Defense Reform Debate: Issues and Analysis*. Baltimore: Johns Hopkins University Press, 1984.

Congressional Quarterly Almanacs, 1989–2000. Washington, DC: Congressional Quarterly Inc., 1989–2000.

Converse, Elliott V., III. *Rearming for the Cold War, 1945–1960*. Vol. 1 of *History of Acquisition in the Department of Defense*. Washington, DC: Office of the Secretary of Defense Historical Office, 2012.

Coram, Robert. *Boyd: The Fighter Pilot Who Changed the Art of War*. Boston: Little, Brown, 2002.

Coulam, Robert. *Illusions of Choice: The F–111 and the Problem of Weapons Acquisition Reform*. Princeton, NJ: Princeton University Press, 1977.

Creech, Bill. *The Five Pillars of TQM: How to Make Total Quality Management Work for You*. New York: Truman Talley Books/Dutton, 1994.

Dastrup, Boyd L. *Modernizing the King of Battle, 1973–1991*. Fort Sill, OK: Office of the Command Historian, U.S. Army Field Artillery Center and School, 2003.

Defense Systems Management College. *Mission Critical Computer Resources Management Guide: Technical Management*. Fort Belvoir, VA: Defense Systems Management College, 1988.

———. *Systems Engineering Fundamentals*. Fort Belvoir, VA: Defense Acquisition University Press, 2001.

Dunnigan, James F., and Austin Bay. *From Shield to Storm: High-Tech Weapons, Military Strategy, and Coalition Warfare in the Persian Gulf*. New York: William Morrow, 1992.

Fallows, James M. *National Defense*. New York: Random House, 1981.

Ferens, Daniel V. *Defense System Software Project Management*. Wright-Patterson AFB, OH: Air Force Institute of Technology, 1990.

Fitzgerald, A. Ernest. *The Pentagonists: An Insider's View of Waste, Mismanagement, and Fraud in Defense Spending*. Boston: Houghton Mifflin, 1989.

Flamm, Kenneth. *Creating the Computer: Government, Industry, and High Technology*. Washington, DC: Brookings Institution, 1988.

Fontenot, Gregory, E. J. Degen, and David Tohn. *On Point: The United States Army in Operation Iraqi Freedom*. Washington, DC: Office of the Chief of Staff, United States Army, 2004.

Fox, J. Ronald. *Arming America: How the U.S. Buys Weapons*. Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1974.

———. *Critical Issues in the Defense Acquisition Culture: Government and Industry Views from the Trenches*. Fort Belvoir, VA: Defense Systems Management College, 1994.

———. *Defense Acquisition Reform, 1960–2009: An Elusive Goal*. With contributions by David G. Allen, Thomas C. Lassman, Walton S. Moody, and Philip L. Shiman. Washington, DC: U.S. Army Center of Military History, 2011.

Friedberg, Aaron. *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy*. Princeton, NJ: Princeton University Press, 2000.

Friedman, Norman. *Naval Institute Guide to World Naval Weapon Systems*. 5th ed. Annapolis MD: Naval Institute Press, 2006.

———. *U.S. Destroyers: An Illustrated Design History*. Rev. ed. Annapolis MD: Naval Institute Press, 2004.

Gaddis, John Lewis. *The Cold War: A New History*. New York: Penguin Books, 2007.

Gansler, Jacques S. *Affording Defense*. Cambridge, MA: MIT Press, 1989.

———. *Defense Conversion: Transforming the Arsenal of Democracy*. Cambridge, MA: MIT Press, 1995.

———. *The Defense Industry*. Cambridge, MA: MIT Press, 1980.

Hafner, Katie, and Matthew Lyon. *Where Wizards Stay Up Late: The Origins of the Internet*. New York: Simon & Schuster, 1996.

Hallion, Richard P. *Storm Over Iraq: Air Power and the Gulf War*. Smithsonian History of Aviation Series. Washington, DC: Smithsonian Institution Press, 1992.

Hammer, Michael, and James Champy. *Reengineering the Corporation: A Manifesto for Business Revolution*. New York: Harper Business, 1993.

Hart, Jeffrey A. *Technology, Television, and Competition: The Politics of Digital TV*. New York: Cambridge University Press, 2004.

Hodgson, Quentin E. *Deciding to Buy: Civil-Military Relations and Major Weapons Programs*. Carlisle Barracks, PA: U.S. Army War College, 2010.

Jaffe, Lorna S. *The Development of the Base Force, 1989–1992*. Washington, DC: Joint History Office, Office of the Chairman of the Joint Chiefs of Staff, 1993.

Jones, Wilbur D., Jr. *Introduction to Defense Acquisition Management.* Fort Belvoir, VA: Defense Systems Management College, 1989.

Kennedy, Betty Raab. *Globemaster III: Acquiring the C–17*. Scott AFB, IL: Office of History, Air Mobility Command, 2004.

King, Benjamin. *Victory Starts Here: A Short 40-Year History of the US Army Training and Doctrine Command*. Fort Leavenworth, KS: Combat Studies Institute Press, U.S. Army Combined Arms Center, 2013.

Kross, Walter. *Military Reform: The High-Tech Debate in Tactical Air Forces*. Washington, DC: National Defense University Press, 1985.

Layton, Evelyn. *The Defense Acquisition University: Training Professionals for the Acquisition Workforce, 1992–2003*. Fort Belvoir, VA: Defense Acquisition University Press, 2007.

Leventhal, Herbert A. *Project Management in the Army Materiel Command, 1962–1987*. Alexandria, VA: Historical Office, U.S. Army Materiel Command, 1992.

Mait, Joseph N., ed. *Making IT Happen: Transforming Military Information Technology*. Washington, DC: Center for Technology and National Security Policy, National Defense University, 2005.

Marolda, Edward J., and Robert J. Schneller Jr. *Shield and Sword: The United States Navy and the Persian Gulf War*. Washington, DC: Naval Historical Center, 1998.

McCormick, David. *The Downsized Warrior: America's Army in Transition*. New York: New York University Press, 1998.

McKenney, Janice E. *The Organizational History of Field Artillery*. Washington, DC: U.S. Army Center of Military History, 2007.

Melia, Tamara Moser. *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777–1991*. Washington, DC: Naval Historical Center, 1991.

Norberg, Arthur L., and Judy E. O'Neill. *Transforming Computer Technology: Information Processing for the Pentagon, 1962–1986*. Baltimore, MD: Johns Hopkins University Press, 1996.

Osborne, David, and Ted Gaebler. *Reinventing Government: How the Entrepreneurial Spirit Is Transforming the Public Sector*. Reading, MA: Addison-Wesley, 1992.

Owens, William A. *High Seas: The Naval Passage to an Uncharted World*. Annapolis, MD: Naval Institute Press, 1995.

———. *Lifting the Fog of War*. With Ed Offley. New York: Farrar, Straus and Giroux, 2000.

Pearson, David E. *The World Wide Military Command and Control System: Evolution and Effectiveness*. Maxwell AFB, AL: Air University Press, 2000.

Polmar, Norman. *Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet*. 18th ed. Annapolis, MD: Naval Institute Press, 2005.

Poole, Walter S. *Adapting to Flexible Response, 1960–1968*. Vol. 2 of *History of Acquisition in the Department of Defense*. Washington, DC: Office of the Secretary of Defense Historical Office, 2013.

Przemieniecki, J. S., ed. *Acquisition of Defense Systems*. AIAA Education Series. Washington, DC: American Institute of Aeronautics and Astronautics, 1993.

Raines, Rebecca Robbins. *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*. Washington, DC: U.S. Army Center of Military History, 1996.

Roland, Alex. *Strategic Computing: DARPA and the Quest for Machine Intelligence, 1983–1993*. With Philip Shiman. Cambridge, MA: MIT Press, 2002.

Sarotte, Mary E. *1989: The Struggle to Create Post–Cold War Europe*. Princeton Studies in International History and Politics. Princeton, NJ: Princeton University Press, 2009.

Schein, Edgar H., and Paul Kampas. *DEC Is Dead, Long Live DEC: The Lasting Legacy of Digital Equipment Corporation*. San Francisco, CA: Barrett-Koehler Publishers, 2003.

Schmoll, Joseph H. *Introduction to Defense Acquisition Management*. 2d ed. Fort Belvoir, VA: Defense Systems Management College Press, 1993.

———. *Introduction to Defense Acquisition Management*. 3d ed. Fort Belvoir, VA: Defense Systems Management College Press, 1996.

Schmoll, Joseph H., and Chuck B. Cochrane. *Introduction to Defense Acquisition Management*. 4th ed. Fort Belvoir, VA: Defense Systems Management College Press, 1999.

Service, Robert. *The End of the Cold War, 1985–1991*. New York: Public Affairs, 2015.

Slife, James C. *Creech Blue: Gen Bill Creech and the Reformation of the Tactical Air Forces, 1978–1984*. Maxwell AFB, AL: Air University Press, 2004.

Spinney, Franklin C. *Defense Facts of Life: The Plans/Reality Mismatch*. Boulder, CO: Westview Press, 1985.

———. *Defense Power Games*. Washington, DC: Fund for Constitutional Government, 1990.

Stevenson, James P. *The $5 Billion Misunderstanding: The Collapse of the Navy's A–12 Stealth Bomber Program*. Annapolis, MD: Naval Institute Press, 2001.

Stewart, Richard W. *The United States Army in Somalia, 1992–1994*. Washington, DC: U.S. Army Center of Military History, 2002.

U.S. News and World Report. *Triumph Without Victory: The Unreported History of the Persian Gulf War*. New York, Random House, 1992.

Van Nostrand, A.D. *Fundable Knowledge: The Marketing of Defense Technology*. Rhetoric, Knowledge, and Society Series. Mahwah, NJ: Lawrence Erlbaum Associates, 1997.

Vickers, Michael G., and Robert C. Martinage. *The Revolution in War*. Washington, DC: Center for Strategic and Budgetary Assessments, 2004.

Werrell, Kenneth P. *Chasing the Silver Bullet: U.S. Air Force Weapons Development from Vietnam to Desert Storm*. Washington, DC: Smithsonian Books, 2003.

Wheeler, Winslow T., and Lawrence J. Korb. *Military Reform: A Reference Handbook*. Contemporary Military, Strategic, and Security Issues. Westport, CT: Praeger Security International, 2007.

Whittle, Richard. *The Dream Machine: The Untold History of the Notorious V–22 Osprey*. New York: Simon & Schuster, 2010.

Wilson, George C. *This War Really Matters: Inside the Fight for Defense Dollars*. Washington, DC: CQ Press, 2000.

Wilson, Mark R. *Destructive Creation: American Business and the Winning of World War II*. Philadelphia: University of Pennsylvania Press, 2016.

Woodward, Bob. *The Commanders*. New York: Simon & Schuster, 1991.

Yarrison, James L. *The Modern Louisiana Maneuvers*. Washington, DC: U.S. Army Center of Military History, 1999.

ARTICLES

Ackerman, Mary, et al. "Acquisition Reform Communications Center (ARCC) Broadcasts First Program via Satellite." *Program Manager* 25, no. 1 (January-February 1996): 18–21.

Alford, L. D. "Software Surprise: Three Invisible Problems of Weapon System Software Development." *Program Manager* 28, no. 2 (March-April 1999): 65.

Arkin, William A. "Spiraling Ahead." *Armed Forces Journal International* 143 (February 2006): 39.

Augustine, Norman R. "The Last Supper, Revisited: Meeting Ignited Inevitable Consolidation." *Defense News*, 26 June 2006, n.p.

———. "P3I: An Idea Whose Time Has Come . . . Again." *National Defense* 65, no. 364 (January 1981): 27–31, 62.

———. "Reshaping an Industry: Lockheed Martin's Survival Story." *Harvard Business Review* 75, no. 3 (May-June 1997): 83–94.

Bachkosky, John M. "The Contribution of ACTDs to Acquisition Reform." *Program Manager* 26 (January-February 1997): 54–56.

Barfield, Claude. "Flat Panel Displays: A Second Look." *Issues in Science and Technology* 11, no. 2 (Winter 1994): 21–25.

Barrick, Alan E., and Henry C. Alberts. "Acquisition of State-of-the-Art Logistics Combat Support Systems: The Joint Logistics Advanced Concept Technology Demonstration Program." *Acquisition Review Quarterly* 4, no. 2 (Summer 1997): 349–359.

Betti, John A. "Acquisition Improvement Update." *Program Manager* 19, no. 5 (September-October 1990): 1.

Biery, Frederick P. "Are Other Acquisition Strategies Superior to the P3I Approach?" *Defense Management Journal* 19, no. 1 (First Quarter 1983): 13–14.

Bishop, Jay. "Deskbook: New Info Source Looms as AR 'Best Seller.'" *Acquisition Reform Today* 1 (August-September 1996): 1.

Blaker, James R. "The Owens Legacy." *Armed Forces Journal International* 133 (July 1996): 20–22.

Boeder, Thomas L., and Gary J. Dorman. "The Boeing/McDonnell Douglas Merger: The Economics, Antitrust Law and Politics of the Aerospace Industry." *Antitrust Bulletin* 45 (Spring 2000): 1–7, 12–24.

Boehm, Barry. "Anchoring the Software Process." *IEEE Software* 13, no. 4 (July 1996): 73–82.

———. "A Spiral Model of Software Development and Enhancement." *IEEE Computer* 21, no. 5 (May 1988): 61–72.

Bond, David F. "Transfer of DARPA Chief Draws Criticism in Congress." *Aviation Week & Space and Technology* 132, no. 18 (30 April 1990): 26.

Boutelle, Steven, and Alfred Grasso. "A Case Study: The Central Technical Support Facility." *Army RD&A* 39, no. 2 (April 1998): 30–32.

Bowers, Pamela. "Judy Stokley and Terry Little Lead Acquisition Reform." *CrossTalk: The Journal of Defense Software Engineering* 13, no. 11 (November 2000): 4–7.

Bryan, Trish. "Open Systems—Fielding Superior Combat Capability Quicker." *Program Manager* 27, no. 1 (January-February 1998): 50–51.

Burman, Allan V. "Who's Who in Acquisition." *Government Executive* 30, no. 12 (1 December 1998): 1–3.

Burns, Richard F. "NSSN C3I Systems—Integration by Lockheed Martin." *Sea Technology* 37, no. 7 (July 1996): 64–65.

Butrica, Andrew J. "An Overview of Acquisition, 1981–1990." In *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*, edited by Shannon A. Brown, 216–217. Washington, DC: U.S. Army Center of Military History and Industrial College of the Armed Forces, 2005.

Cahlink, George. "Fallen Star: The Cautionary Tale of a Celebrated Federal Executive's Corporate Flameout." *Government Executive* 36, no. 2 (February 2004): 21–22.

Cameron, Robert S. "Pushing the Envelope of Battlefield Superiority: American Tank Development from the 1970s to the Present." *Armor* (November-December 1998): 10–12.

Cebrowski, Arthur K., and John J. Garstka. "Network Centric Warfare: Its Origins and Future." U.S. Naval Institute *Proceedings* 124, no. 1 (January 1998): 28–35.

Charette, Robert N. "Why Software Fails." *IEEE Spectrum* 42, no. 9 (September 2005): 42–49.

Chinnock, Chris. "Defense Integrators Take Another Look at Asian Flat-Panel Suppliers." *Military & Aerospace Electronics* 8, no. 5 (1 May 1997): 3–4.

———. “North American Flat-Panel Industry Loses a Player.” *Military & Aerospace Electronics* 9, no. 1 (1 January 1998): 3.

———. “OIS Turns Corner: Wins Apache Longbow Contract.” *Military & Aerospace Electronics* 9, no. 7 (1 July 1998): 4.

Cook, David A. “Computers and M&S—Modeling and Simulation 101.” *CrossTalk: The Journal of Defense Software Engineering* 14, no. 1 (January 2001): 8–10.

Cothran, Julian. “Battle Labs: Tools and Scope.” *Acquisition Review Quarterly* 3, no. 1 (Winter 1996): 51–62.

Cottengim, David. “Irreducible Truths of Software-Intensive Program Management.” *Defense Acquisition Review Journal* 12, no. 3 (December 2005-March 2006): 393–400.

Coutinho, Al. “Integrated Weapon System Management: A New Management Philosophy for the Air Force Materiel Command.” *Air Force Journal of Logistics* 17, no. 3 (Summer 1993): 15–17.

Davenport, Thomas H., and James E. Short. “The New Industrial Engineering: Information Technology and Business Process Redesign.” *Sloan Management Review* 31, no. 4 (Summer 1990): 11–27.

Davis, Joshua. “If We Run Out of Batteries, This War Is Screwed.” *Wired News* 11, no. 6 (January 2003). http://www.wired.com/wired/archive/11.06/battlefield_pr.html.

Davis, Paul K. “Planning Under Uncertainty Then and Now: Paradigms Lost and Paradigms Emerging.” In *New Challenges for Defense Planning: Rethinking How Much Is Enough*, edited by Paul K. Davis, 15–57. Santa Monica, CA: RAND, 1994.

Davis, Randy, Bill Phillips, and Bud Vazquez. “The Phoenix Rises.” *Acquisition Review Quarterly* 4, no. 4 (Fall 1997): 411–433.

Davis, Stanley M., and Paul R. Lawrence. “Problems of Matrix Organizations.” *Harvard Business Review* 56, no. 3 (June 1978): 131–142.

Delano, Capt. Kenneth. “HSC Conducts USAF’s First Acquisition Reform Roadshow.” *News from AFAR* 1, no. 5 (September 1995): 11.

Doe, Dennis D. “Current Practice.” In *Aerospace Software Engineering*, edited by Christine Anderson and Merlin Dorfman, 17–29. Washington, DC: American Institute of Aeronautics and Astronautics, 1991.

Drewes, Robert W. “SPI—Progress Made and Lessons Learned.” *Program Manager* 26, no. 1 (January-February 1997): 37–39.

Dubois, Matt, and Scott Dalrymple. “SBIRS SPO Used Innovation to Streamline DAB and RFP Cycles.” *News from AFAR* 1, no. 2 (May 1995): 5–6.

Edgar, James H. “The Origins and Impact of the Defense Acquisition Workforce Improvement Act (DAWIA).” In *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*, edited by Shannon A. Brown, 261–280. Washington, DC: U.S. Army Center of Military History and Industrial College of the Armed Forces, 2005.

Elkins, Marlene M. “P3I—Help in Reducing Weapon Systems Costs.” *Concepts* 5, no. 2 (Spring 1982): 108–109.

Emison, Col. Steven A. "Post Task Force XXI Advanced Warfighting Experiment." *Army RD&A* 70, no. 5 (October 1997): 3–4.

Engel, Richard, "Overarching Integrated Product Team—Working Integrated Product Team Process." *Program Manager* 26, no. 1 (January-February 1997): 48–50.

Erwin, Sandra I. "Navy Faulted for Slow-Going in Fielding Anti-Mine Systems." *National Defense*, 1 January 1999. http://www.nationaldefensemagazine.org/archive/1999/January/Pages/Navy_Faulted4430.aspx.

Fallows, James. "Uncle Sam Buys an Airplane." *The Atlantic Monthly* 289, no. 6 (June 2002). https://www.theatlantic.com/magazine/archive/2002/06/uncle-sam-buys-an-airplane/302509/.

Ferrara, Joe, and Collie Johnson. "Institutionalizing Integrated Product Teams: DoD's Commitment to Change." *Program Manager* 24, no. 6 (November-December 1995): 2–5.

Flamm, Kenneth S. "Flat Panel Displays: Catalyzing a U.S. Industry." *Issues in Science and Technology* 11, no. 1 (Fall 1994): 27–32.

Fong, Glenn R. "The Potential for Industrial Policy: Lessons from the Very High Speed Integrated Circuit Program." *Journal of Policy Analysis and Management* 5, no. 2 (Winter 1986): 264–291.

Forman, Brenda. "Wanted: A Constituency for Acquisition Reform." *Acquisition Review Quarterly* 1, no. 2 (Spring 1994): 90–99.

Furey, Tim R., Jennifer L. Garlitz, and Michael L. Kelleher. "Applying Information Technology to Reengineering." *Planning Review* 21, no. 6 (1 June 1993): 22–55. https://doi.org/10.1108/eb054446.

Gansler, Jacques. "The Revolution in Business Affairs: The Need to Act Now." *Program Manager* 27, no. 5 (September-October 1998): 30–33.

Garcia, Andrea, Hugo Keyner, Thomas B. Robillard, and Mary VanMullekom. "The Defense Acquisition Workforce Improvement Act: Five Years Later." *Acquisition Review Quarterly* 4, no. 3 (Summer 1997): 295–308.

Gazis, Denos C. "Brief Time, Long March: The Forward Drive of Computer Technology." In *Technology 2001: The Future of Computing and Communications*, edited by Derek Leebaert, 41–46. Cambridge, MA: MIT Press, 1991.

Gillis, Matt. "Open Systems Joint Task Force Gets the Word Out." *Program Manager* 28, no. 4 (July-August 1999): 44–47.

Glasgow, Wes, Christopher Cardine, and David Latson. "The M1A2: Current and Future Program Plans." *Armor* (June 1996): 11–15.

Golden, Frederick. "DARPA Buys into Tiny Computer Chips Firm." *The Scientist* 4, no. 11 (13 May 1990): 8.

Goodman, Glenn W., Jr. "Reengineering the Fleet: U.S. Navy Rewrites the Book in Developing Its New Surface Warships." *Armed Forces Journal International* 134 (March 1997). https://web.archive.org/web/19970418020723/http://sc21.crane.navy.mil/afji.htm.

Gorod, Alex, Brian Sauser, and John Boardman. "System-of-Systems Engineering Management: A Review of Modern History and a Path Forward." *IEEE Systems Journal* 2, no. 4 (December 2008): 484–499.

Guha, Subashish, William J. Kettinger, and James T. C. Teng. "Business Process Reengineering: Building a Comprehensive Methodology." *Information Systems Management* 10, no. 3 (Summer 1993): 13–22.

Gunzinger, Mark. "Beyond the Bottom-Up Review." In *Essays on Strategy XIV*, edited by Mary A. Somerville, 95–147. Washington DC: National Defense University Press, Institute for National Strategic Studies, 1997.

Gutleber, Marc W. "Spiral Development: New Opportunities and Challenges." *Army RD&A* 40, no. 4 (August 1999): 44–45.

Haines, Linda. "Technology Refreshment Within DoD." *Program Manager* 30, no. 2 (March-April 2001): 22–27.

Hammer, Michael. "Reengineering Work: Don't Automate, Obliterate." *Harvard Business Review* 68, no. 4 (July-August 1990): 104–112.

Hamscher, Walter. "AI in Business-Process Reengineering." *AI Magazine* 15, no. 4 (Winter 1994): 71–72. https://doi.org/10.1609/aimag.v15i4.1113.

Hanratty, Michael, Robert H. Lightsey, and Arvid G. Larson. "Open Systems and the Systems Engineering Process." *Acquisition Review Quarterly* 7, no. 5 (Winter 1999): 47–58.

Harokopus, Kimberly A. "Transforming the Department of Defense: Creating the New Defense Procurement System." In *Transforming Organizations*, edited by Mark Abramson and Paul R. Lawrence, 11–55. Lanham, MD: Rowman & Littlefield, 2011.

Harwood, Doreen. "Defense Acquisition Deskbook—An Acquisition Reform Unqualified Success." *Program Manager* 26, no. 1 (January-February 1997): 40–42.

Henderson, Breck W. "DARPA Invests $4 Million as Venture Capital in High-Technology Companies." *Aviation Week & Space Technology* 132, no. 18 (30 April 1990): 25–26.

Heygate, Richard. "Immoderate Redesign." *The McKinsey Quarterly* (1 January 1993): 73–87.

Hocevar, Susan P., and Walter E. Owen. "Team-Based Redesign as a Large-Scale Change: Applying Theory to the Implementation of Integrated Product Teams." *Acquisition Review Quarterly* 5, no. 2 (Spring 1998): 147–166. https://apps.dtic.mil/docs/citations/ADA487695.

Homa, Peter. "Business Process Re-engineering." *Business Process Re-Engineering & Management Journal* 1, no. 3 (December 1, 1995): 10–30.

Hurd, Kim. "Lightning Bolts Star at Acquisition Renaissance Workshop." *News from AFAR* 1, no. 4 (July 1995): 5, 9.

Johnson, Collie J. "AAAV—At the Brink of Prototype." *Program Manager* 27, no. 6 (November-December 1998): 3–7, 10–16.

Kenne, Leslie F. "Inside the Spiral." *Aerospace Acquisition 2000* 2, no. 3 (December 1999): 7.

Kutner, Joshua A. "Failed Flat-Panel Display Firm Leaves Partners High and Dry." *National Defense* 83, no. 545 (February 1999): 30.

Larman, Craig, and Victor R. Basili. "Iterative and Incremental Development: A Brief History." *IEEE Computer* 36, no. 6 (June 2003): 47–56.

LeSueur, Stephen C. "New Documents Outline Plans for Massive Changes in Navy Acquisition Processes." *Inside the Navy*, 7 August 1989, 1.

Leveson, Nancy G. "The Role of Software in Spacecraft Accidents." *AIAA Journal of Spacecraft and Rockets* 41, no. 4 (July 2004): 4–22.

Linden, Russ. "Business Process Reengineering: Newest Fad, or Revolution in Government?" *Public Management* 75, no. 11 (November 1993): 9–12.

Liss, Steven, Cathy Lambert, Alan Li, and Shailesh Parmar, "From Approved J&A to Contract Award in 16 Weeks." *Defense AT&L* 34, no. 1 (February 2005): 18–21.

Luebke, William H. "Leading the Way in Ship Design: The San Antonio-Class LPD 17." *Sea Power* 42, no. 11 (November 1999): 36–40.

Lyon, Hylan B. "Pre-Planned Product Improvement." *National Defense* 65, no. 364 (January 1981): 20–25.

MacCormack, Alan. "Product Development Practices That Work: How Internet Companies Build Software." *MIT Sloan Management Review* 42, no. 2 (Winter 2001): 7–84.

Malishenko, Maj. Gen. Timothy. "C-17 Program—From the Brink of Cancellation to Baldridge National Quality Award Winner." *Program Manager* 28, no. 3 (May-June 1999): 34–38.

Manganelli, Raymond L. "It's Not a Silver Bullet." *Journal of Business Strategy* 14, no. 6 (December 1993): 45.

Mathews, Randy T. "Total Ownership Cost Reduction—A Secretary of Defense Imperative." *Army Logistician* 31, no. 1 (February 1999): 138–139.

McNutt, Ross T. "Reducing Acquisition Cycle Time: Creating a Fast and Responsive Acquisition System." In *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*, edited by Shannon A. Brown, 317–338. Washington, DC: U.S. Army Center of Military History and Industrial College of the Armed Forces, 2005.

Morrocco, John D. "JAST to Be Single Seat/Engine Design." *Aviation Week & Space Technology* 142 no. 6 (6 February 1995): 22–23.

———. "Reports Cast Doubts on Joint Attack Fighter." *Aviation Week & Space Technology* 138, no. 20 (17 May 1993): 63.

Morrocco, John D., and David A. Fulghum. "Saving Industrial Base Key in Bottom-Up Review." *Aviation Week & Space Technology* 139, no. 10 (6 September 1993): 24–25.

Morrow, Garcia E., and Jules J. Bellaschi. "A Cultural Change: Pre-Planned Product Improvement." *Concepts* 5, no. 3 (Summer 1982): 20–21.

Myers, Dominique. "Acquisition Reform: Inside the Silver Bullet—A Comparative Analysis—JDAM Versus F–22." *Acquisition Review Quarterly* 9, no. 4 (Fall 2002): 313–321.

Myers, Dominique B., and D. Colleen Griffith. "A Pilot Program's Legacy: Lessons Learned in Applying Commercial-like Practices to a Large, Sophisticated Program." *Program Manager* 25, no. 3 (May-June 1996): 18–25, 32.

Nelson, Philip B., and Robert D. Stoner. "Defense Industry Rationalization: Lockheed Martin (1995)." In *The Antitrust Revolution: Economics, Competition, and Policy*, edited by John E. Kwoka Jr. and Lawrence J. White, 430–451. 3d ed. New York: Oxford University Press, 1999.

Newberry, George A. "Changes from DoD-STD-2167A to MIL-STD-498." *CrossTalk: The Journal of Defense Software Engineering* 8, no. 4 (April 1995): 4–7.

Norton, William J. "Foreign Military Resource Dependence: Inevitable International Dependency Undermines Tactical and Strategic Sustainment." *Program Manager* 24, no. 5 (September-October 1995): 35–40.

O'Berry, Carl G. "An Air Force Perspective on Software Development." *CrossTalk: The Journal of Defense Software Engineering* 8, no. 7 (July 1995): 1–3.

O'Donohue, Bob, and Dayton Silver. "DSMC Hosts Fifth Semiannual PEO/SysCom Commanders/PM Conference." *Program Manager* 27, no. 4 (July-August 1997): 88–90.

Oden, Michael. "Cashing In, Cashing Out, and Converting: Restructuring of the Defense Industrial Base in the 1990s." In *Arming the Future: A Defense Industry for the 21st Century*, edited by Ann R. Markusen and Sean S. Costigan, 74–105. New York, NY: Council on Foreign Relations Press, 1999.

Openshaw, Col. Shane. "The AH-64 Apache Helicopter: Evolution—Certainly Revolution—Absolutely." *Army AL&T* (December 2010): 39–42.

Owens, William A. "The Emerging U.S. System-of-Systems." National Defense University, Institute for National Strategic Studies, *Strategic Forum,* no. 63 (February 1996): 1–6.

Paige, Emmett, Jr. "Re-Engineering DoD's C31 Operations." *Defense 93*, No. 6. (1993): 15–22.

Parker, Leon A., III. "PMs Begin Transfer to the Army Materiel Command." *Army RD&A* 70, no. 2 (April 1997): 2–5.

Parnas, David Lorge. "Software Aspects of Strategic Defense Systems." *Communications of the ACM* 28, no. 12 (December 1985): 1326–1335.

Parnas, David Lorge, and Paul C. Clements. "A Rational Design Process: How and Why to Fake It." *IEEE Transactions on Software Engineering* SE-12, no. 2 (February 1986): 251–257.

Paulk, Mark C. "A History of the Capability Maturity Model for Software." *ASQ Software Quality Professional* 12, no. 1 (December 2009): 5–19.

Pendley, William T. "Mortgaging the Future to the Present in Defense Policy: A Commentary on the Bottom-Up Review." *Strategic Review* 22, no. 2 (Spring 1994): 36–39.

Perry, William J. "Defense in an Age of Hope." *Foreign Affairs* 75, no. 6 (November-December 1996): 64–79.

———. "Desert Storm and Deterrence." *Foreign Affairs* 70, no. 4 (Fall 1991): 66–82.

———. "Military Action: When to Use It and How to Ensure Its Effectiveness." In *Global Engagement: Cooperation and Security in the 21st Century*, edited by Janne E. Nolan, 235–242. Washington, DC: Brookings Institution, 1994.

Perry, William J., and Cynthia A. Roberts. "Winning Through Sophistication: How to Meet the Soviet Military Challenge." *Technology Review* 85, no. 5 (July 1982): 27–35.

Pinker, Aron, Charles G. Smith, and Jack W. Booher. "Selecting Effective Prosecution Metrics." *Acquisition Review Quarterly* 4, no. 2 (Spring 1997): 189–208.

Pinney, Charles W. "The USAF PEO/DAC/MAD Structure: Successful Pattern for Future Weapon System Acquisition?" *Acquisition Review Quarterly* 6, no. 1 (Winter 1999): 21–46.

Polmar, Norman. "The U.S. Navy: 'More Bang for the Buck.'" U.S Naval Institute *Proceedings* 122, no. 1 (January 1996): 30–31.

Powell, Colin. "U.S. Forces: Challenges Ahead." *Foreign Affairs* 71, no. 5 (Winter 1992): 32–45.

Rasmus, Dan. '"Reengineering,' or Evolution Through Violent Overthrow." *Manufacturing Systems* 10, no. 9 (September 1992): 52–58.

Ratcliff, Ronald E. "CNO and OPNAV Reorganization." In *Case Studies in Policy Making & Implementation*, edited by David A. Williams, 326–335. 6th ed. Newport, RI: Naval War College, 2002.

Reifer, Donald J. "Quantifying the Debate: Ada vs. C++." *CrossTalk: The Journal of Defense Software Engineering* 9, no. 7 (July 1996): n.p.

Revenaugh, D. Lance. "Business Process Re-engineering: The Unavoidable Challenge." *Management Decision* 32, no. 7 (1 October 1994): 16–27.

Roth, R. Theodore. "The Impact of Decreased Defense Spending on Employment in the United States." *Armed Forces and Society* 18, no. 3 (Spring 1992): 383–405.

Schaller, Robert R. "Moore's Law: Past, Present and Future." *IEEE Spectrum* 34, no. 6 (June 1997): 52–59.

Shebalin, Paul V. "Software Development Standards and the DoD Program Manager." *Acquisition Review Quarterly* 1, no. 3 (Summer 1994): 202–218.

Singleton, Christopher J. "Industry Employment and the 1990–91 Recession." *Monthly Labor Review* 166, no. 7 (July 1993): 15–25.

Skantze, Lawrence A. "USAF Acquisition Process Headed in Wrong Direction." *National Defense* 82, no. 532 (November 1997): 36–37.

Slabodkin, Gregory. "DoD Revamps Process for Overseeing IT Buys." *Government Computer News* 17, no. 25 (10 August 1998): 3.

Sorensen, Reed. "A Comparison of Software Development Methodologies." *CrossTalk: The Journal of Defense Software Engineering* 8, no. 1 (January 1995). https://web.archive.org/web/19991010020706/http://www.stsc.hill.af.mil/CrossTalk/1995/jan/Comparis.asp.

———. "Software Standards: Their Evolution and Current State." *CrossTalk: The Journal of Defense Software Engineering* 12, no. 12 (December 1999): 21–25.

Starr, Stuart, and Stuart Johnson. "The Challenge of Achieving Interoperability of Information Technology Systems." In *Making IT Happen: Transforming Military Information Technology*, edited by Joseph N. Mait, 39–58. Washington, DC: National Defense University Center for Technology and National Security Policy, 2005.

Stewart, Thomas A., and Joyce E. Davis. "Reengineering: The Hot New Managing Tool." *Fortune* 128, no. 4 (23 August 1993): 41–48.

Stimson, Richard A., and Frank Doherty. "Acquisition Streamlining: Striving to Increase Cost-Effectiveness of DoD Acquisition Requirements." *Program Manager* 14 (January-February 1985): 15–18.

Stowsky, Jay. "The Dual-Use Dilemma." *Issues in Science and Technology Online* 13, no. 2 (Winter 1996): 56–64.

Strassmann, Paul. "CIM: Consider It Mañana?" *Defense Issues* 7, no. 55 (22 September 1992): 1–8.

Sumpter, LeAntha. "Gansler Endorses Single Process Initiative Throughout DoD-Industry." *Program Manager* 27, no. 5 (September-October 1998): 2–7.

Tibbitts, B., and R.G. Keane Jr. "Acquisition Reform: It All Starts with Design." *Naval Engineers Journal* 111, no. 1 (January 1999): 39–53.

Truver, Scott C. "Floating Arsenal to Be 21st Century Battleship." *Jane's International Defence Review* 29, no. 7 (July 1996): 44–47.

Valore, Frances M. "AAI PAT Introduces the Acquisition Deskbook." *Program Manager* 24, no. 4 (July-August 1995): 26–33.

Van Atta, Richard H., et al. "Unmanned Aerial Vehicles." Chapter 6 in Richard H. Van Atta, et al. *Transformation and Transition: DARPA's Role in Fostering an Emerging Revolution in Military Affairs*, Vol. 2: *Detailed Assessments*. IDA Paper P-3698. Alexandria, VA: Institute for Defense Analyses, 2003.

Vance, Marlu W. "FY98 Streamlining of the Program Executive Officer Structure." *Army RD&A* (January-February 1997): 7–9.

Vitiello, Jill. "Reengineering: It's Totally Radical." *Journal of Business Strategy* 14, no. 6 (December 1993): 44–47.

Voss, Bristol, J. Vitiello, C. Johnson, and C. D. Winslow. "Setting a Course for Radical Change." *Journal of Business Strategy* 14, no. 6 (December 1993): 52–59.

Walsh, Edward J. "Submarine Designers Rely on COTS To Broaden Undersea Warfare Missions." *Military & Aerospace Electronics*, 1 March 2000. http://www.militaryaerospace.com/articles/print/volume-11/issue-3/features/special-report/submarine-designers-rely-on-cots-to-broaden-undersea-warfare-missions.html.

Whitney, Myrna-Lynne. "Propelling Acquisition into the 21st Century." *News from AFAR* 1, no. 4 (July 1995): 1–2.

Whittle, Richard. "The Drone Started Here." *Air & Space* 28, no. 1 (April/May 2013): 28–33.

Will, Edward L. "Paving the Way for Price-Based Acquisition." *Acquisition Review Quarterly* 6, no. 4 (Fall 1999): 369–381.

Wilson, John R. "Battle Labs: What Are They, Where Are They Going?" *Acquisition Review Quarterly* 3, no. 1 (Winter 1996): 63–74.

Wyman, Bruce D. "A New Acquisition Reform Culture for the Air Force." *Program Manager* 28, no. 1 (January-February 1999): 62–65.

Yilmaz, Muzaffer Ercan. "UN Peacekeeping in the Post–Cold War Era." *International Journal on World Peace* 22, no. 2 (Jun 2005): 13–28.

STUDIES AND REPORTS

Aronstein, David C., and Albert C. Piccirillo. *Comments and Observations on Flight Demonstrator Programs*. Arlington, VA: Analytic Services, 1994.

Beck, Charles L., Jr., Nina Lyn Brokaw, and Brian A. Kelmar. *A Model for Leading Change: Making Acquisition Reform Work*. Report of the 1996–1997 DSMC Military Research Fellows. Fort Belvoir, VA: Defense Systems Management College Press, 1997.

Biery, Frederick, and Mark Lorell. "Preplanned Product Improvement and Other Modification Strategies: Lessons from Past Aircraft Modification Programs." RAND Note. Santa Monica, CA: RAND, 1981.

Birkler, John, et al. *The U.S. Submarine Production Base: An Analysis of Cost, Schedule, and Risk for Selected Force Structures*. Santa Monica, CA: RAND, 1994.

Burman, Allan V., Nathaniel M. Cavallini, and Kisha N. Harris. *Identification of the Department of Defense Key Acquisition and Technology Workforce*. Washington, DC: Jefferson Solutions, 1999.

Carter, Ashton B., and William J. Perry. *New Thinking and American Defense Technology*. A Report of the Carnegie Commission on Science, Technology, and Government, Task Force on National Security. New York: Carnegie Commission on Science, Technology, and Government, 1990.

Center for Strategic and International Studies. *Deterrence in Decay: The Future of the U.S. Defense Industrial Base: The Final Report of the CSIS Defense Industrial Base Project*. Washington, DC: Center for Strategic & International Studies, 1989.

———. *Integrating Commercial and Military Technologies for National Strength: An Agenda for Change: Report of the CSIS Steering Committee on Security and Technology*. Washington, DC: Center for Strategic & International Studies, 1991.

———. *Road Map for Milspec Reform: Integrating Commercial and Military Manufacturing*. Washington, DC: Center for Strategic & International Studies, 1993.

DiTrapani, Anthony R., and Jonathan D. Geithner. *Getting the Most Out of Integrated Product Teams (IPTs)*. Alexandria, VA: Center for Naval Analyses, 1996.

Donley, Michael B., et al. *The Office of the Secretary of Defense: Creating a New Organization for a New Era*. McLean, VA: Hicks & Associates, 1997.

Drezner, Jeffrey A., and Robert S. Leonard. *Innovative Development: Global Hawk and DarkStar: Transitions Within and Out of the HAE UAV ACTD Program*. Santa Monica, CA: RAND, 2002.

Drezner, Jeffrey A., Geoffrey Sommer, and Robert S. Leonard. *Innovative Management in the DARPA High Altitude Endurance Unmanned Aerial Vehicle Program: Phase II Experience*. Santa Monica, CA: RAND National Defense Research Institute, 1999.

Ehrhard, Thomas P. *Air Force UAVs: The Secret History*. N.p.: Mitchell Institute Press, July 2010.

Evans, Thomas R., Kathleen M. Lyman, and Michael S. Ennis. *Modernization in Lean Times: Modifications and Upgrades*. Report of the 1994–1995 DSMC Military Research Fellows. Fort Belvoir, VA: Defense Systems Management College Press, 1995.

Faughn, Anthony W. *Interoperability: Is It Achievable?* Cambridge, MA: Harvard Center for Information Policy Research, Program on Information Resources Policy, 2002.

Ferguson, Jack R., and Michael E. DeRiso. "Software Acquisition: A Comparison of DoD and Commercial Practices." Special Report. Pittsburgh, PA: Carnegie Melon University, Software Engineering Institute, October 1994.

Garcia, Albert B., Robert P. Gocke Jr., and Nelson P. Johnson Jr. *Virtual Prototyping: Concept to Production*. Report of the 1992–1993 DSMC Military Research Fellows. Fort Belvoir, VA: Defense Systems Management College Press, 1994.

Gouré, Daniel, and Jeffrey M. Ranney. *Averting the Defense Train Wreck in the New Millennium*. Significant Issues Series. Washington, DC: Center for Strategic and International Studies Press, 1999.

Graham, David R., et al. *Defense Acquisition: Observations Two Years after the Packard Commission*. Vol. 1: *Main Report*. Alexandria, VA: Institute for Defense Analyses, 1988.

Griffin, Larry, and Robert I. Winner. *Integrated Product/Process Development in Upgrade and Mod Programs*. Hopkinton, MA: R. Winner & Associates, 2003.

Hanna, Mark. "Task Force XXI: The Army's Digital Experiment." Strategic Forum No.119. National Defense University, Institute for National Strategic Studies, 1997.

Hansen, W. J., et al. *Spiral Development: Building the Culture: A Report on the CSE-SEI Workshop, February 2000*. Pittsburgh, PA: Carnegie Mellon University, Software Engineering Institute, 2000.

Hillegas, Anne, et al. *The Use of Modeling & Simulation (M&S) Tools in Acquisition Program Offices: Results of a Survey*. McLean, VA: Hicks & Associates, 2001.

Ingols, Cynthia, and Lisa Brem. *Implementing Acquisition Reform: A Case Study on Joint Direct Attack Munitions*. Fort Belvoir, VA: Defense Systems Management College, 1998.

Isenberg, David. "The Pentagon's Fraudulent Bottom-Up Review." CATO Institute Policy Analysis No. 206, 21 April 1994. https://www.cato.org/policy-analysis/pentagons-fraudulent-bottom-review.

Johnson, Michael V. R., Mark F. McKeon, and Terence R. Szanto. *Simulation Based Acquisition: A New Approach*. Report of the 1997–1998 DSMC Military Research Fellows. Fort Belvoir, VA: Defense Systems Management College Press, 1998.

Kanter, Herschel, and Richard H. Van Atta. *Integrating Defense into the Civilian Technology and Industrial Base*. IDA Paper P-2801. Alexandria, VA: Institute for Defense Analyses, 1993.

Kaufmann, William W. *Assessing the Base Force: How Much Is Too Much?* Studies in Defense Policy. Washington, DC: Brookings Institution, 1992.

Kelman, Steven. "Implementing Federal Procurement Reform." Occasional Paper 1-97. Innovations in American Government Program. Cambridge, MA: John F. Kennedy School of Government, Harvard University, Spring 1998.

———. *Unleashing Change: A Study of Organizational Renewal in Government*. Brookings Institution Press, 2005.

Kugler, Richard L. *U.S. Military Strategy and Force Posture for the 21st Century: Capabilities & Requirements*. Santa Monica, CA: RAND, 1994.

Larson, Eric V., David T. Orletsky, and Kristin Leuschner. *Defense Planning in a Decade of Change: Lessons from the Base Force, Bottom-up Review, and Quadrennial Defense Review*. Santa Monica, CA: RAND, 2001.

Leonard, Robert S., Jeffrey A. Drezner, and Geoffrey Sommer. *The Arsenal Ship Acquisition Process Experience: Contrasting and Common Impressions from the Contractor Teams and Joint Program Office*. Santa Monica, CA: RAND, 1999.

Lorell, Mark A., John C. Graser, and Cynthia R. Cook. *Priced-Based Acquisition: Issues and Challenges for Defense Department Procurement of Weapon Systems*. Santa Monica, CA: RAND, 2005.

Lorell, Mark A., Julia F. Lowell, Michael Kennedy, and Hugh P. Levaux. *Cheaper, Faster, Better? Commercial Approaches to Weapons Acquisition.* RAND Report MR-1147-AF. Santa Monica, CA: RAND, 2000.

Lyons, H. Dwight, Jr. "The Mine Threat: Show Stoppers or Speed Bumps?" Center for Naval Analyses Occasional Paper. Alexandria, VA: Center for Naval Analyses, July 1993.

Mazarr, Michael J., Jeffrey Shaffer, and Benjamin Ederington. *Military Technical Revolution: A Structural Framework: Final Report of the CSIS Study Group on the MTR*. CSIS Panel Report. Washington, DC: Center for Strategic and International Studies, 1993.

National Center for Advanced Technologies. *Proposed Acquisition Teamwork and Cycle Time Improvements: Evolutionary Defense Acquisition*. Washington, DC: National Center for Advanced Technologies, 1996.

National Research Council (U.S.). Commission on Engineering and Technical Systems. National Materials Advisory Board. Committee on Aging of U.S. Air Force Aircraft. *Aging of U.S. Air Force Aircraft: Final Report*. Washington, DC: National Academy Press, 1997.

———. Commission on Physical Sciences, Mathematics, and Applications. Computer Science and Telecommunications Board. Committee to Review DoD C4I Plans and Programs. *Realizing the Potential of C4I: Fundamental Challenges*. Washington, DC: National Academy Press, 1999.

———. Commission on Physical Sciences, Mathematics, and Applications. Naval Studies Board. Committee on Technology for Future Naval Forces. *Technology for the United States Navy and Marine Corps, 2000–2035: Becoming a 21st-Century Force*. Vol. 2: *Technology*. Washington, DC: National Academy Press, 1997.

———. Committee on Naval Analytical Capabilities and Improving Capabilities-Based Planning. *Naval Analytical Capabilities: Improving Capabilities-Based Planning*. Washington, DC: National Academies Press, 2005.

———. Division on Engineering and Physical Sciences. Air Force Science and Technology Board. Committee on Aging Avionics in Military Aircraft. *Aging Avionics in Military Aircraft*. Washington, DC: National Academies Press, 2001.

———. Division on Engineering and Physical Sciences. Naval Studies Board. Committee for Mine Warfare Assessment. *Naval Mine Warfare: Operational and Technical Challenges for Naval Forces*. Washington, DC: National Academy Press, 2001.

Pernin, Christopher G., et al. *Lessons from the Army's Future Combat Systems Program*. Santa Monica, CA: RAND, 2012.

Piplani, Lalit K., Joseph G. Mercer, and Richard O. Roop. *Systems Acquisition Manager's Guide for the Use of Models and Simulations*. Report of the 1993–1994 DSMC Military Research Fellows. Fort Belvoir, VA: Defense Systems Management College Press, 1994.

Sanders, Greg. *Road Map for Milspec Reform: Integrating Commercial and Military Manufacturing: The Report of the Working Group on Military Specifications and Standards*. Washington, DC: Center for Strategic and International Studies, 1993.

Santo-Donato, Arthur. *The Defense Acquisition Workforce Improvement Act: What Is It and Where Is It Today?* Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, 1992.

Schank, John F., et al. *Learning from Experience.* Vol. 2: *Lessons from the U.S. Navy's Ohio, Seawolf, and Virginia Submarine Programs*. Santa Monica, CA: RAND, 2011.

Schmidt, Conrad Peter. *Changing Bureaucratic Behavior: Acquisition Reform in the United States Army*. Santa Monica, CA: RAND, 2000.

Science Applications International Corporation. *Acquisition, Streamlining and Lessons Learned Report for Crusader Self-Propelled Howitzer (SPH) and Resupply Vehicle (RSV)*. Falls Church, VA: U.S. Army Cost and Economic Analysis Center, 1995.

Sheehan, L., and M. Wilson. *Joint Command, Control, Communications, and Computers Systems Descriptions*. Vol. II, sec. II. McLean, VA: Science Applications International Corporation, 1995.

Swartz, Peter M. *Organizing OPNAV (1970–2009).* With Michael C. Markowitz. Alexandria, VA: Center for Naval Analyses, 2010.

Thirtle, Michael R., Robert V. Johnson, and John L. Birkler. *The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process*. RAND Report MR-899-OSD. Santa Monica, CA: RAND, 1997.

Thompson, Frederick D., and Christopher A. Trenholm. "OPNAV Functional Reorganization Study: Final Report." CRM 90-16. Alexandria, VA: Center for Naval Analyses, 1990.

Thompson, Roger. *Brown Shoes, Black Shoes and Felt Slippers: Parochialism and the Evolution of the Post-War U.S. Navy*. Research Report 5-95. Occasional Papers of the Center for Naval Warfare Studies. Newport, RI: Strategic Research Department, Naval War College, 1995.

Troxell, John F. *Force Planning in an Era of Uncertainty: Two-MRCs as a Force Sizing Framework*. Carlisle Barracks, PA: U.S. Army War College, Strategic Studies Institute, 1997.

Tyson, Karen W., et al. *The Effects of Management Initiatives on the Costs and Schedules of Defense Acquisition Programs*. Vol. 1: *Main Report*. Alexandria, VA: Institute for Defense Analyses, 1992.

Tyson, Karen W., David E. Hunter, and Daria C. Rendon. *Acquisition Initiatives in the New Environment: Multi-year Procurement Update.* IDA Paper P-2185. Alexandria, VA, IDA, 1999.

Van Atta, Richard H., et al. *Transformation and Transition: DARPA's Role in Fostering an Emerging Revolution in Military Affairs*. Vol. 2: *Detailed Assessments*. IDA Paper P-3698. Alexandria, VA: Institute for Defense Analyses, 2003.

Watts, Barry D. *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects*. Washington, DC: Center for Strategic and Budgetary Assessments, 2007.

———. *The US Defense Industrial Base: Past, Present and Future*. Strategy for the Long Haul Series. Washington, DC: Center for Strategic and Budgetary Assessments, 2008.

Whittle, Richard. *Predator's Big Safari*. Mitchell Paper No. 7. N.p.: Mitchell Institute Press, 2011.

Younossi, Obaid, David E. Stem, Mark A. Lorell, and Frances M. Lussier. *Lessons Learned from the F/A–22 and F/A–18E/F Development Programs*. Santa Monica, CA: RAND/Project Air Force, 2005.

DISSERTATIONS, THESES, AND RESEARCH REPORTS

Adams, Scott R. "A Case Study of the Advanced Amphibious Assault Vehicle (AAAV) Program from a Program Management Perspective." Master's thesis, Naval Postgraduate School, 1999.

Andersen, William H. "Future U.S. Army Finance Corps' Structure at the Department of the Army Level." Strategy Research Project, U.S. Army War College, 1996.

Bannick, Kathy A. "Breakdown of Software Expenditures in the Department of Defense, United States and in the World." Master's thesis, Naval Postgraduate School, 1991.

Barefield, James L., II. "The Heavy Bomber Industrial Base: A Study of Present and Future Capabilities." Research paper, Air Command and Staff College, Air University, 1997.

Bearden, James Bryan. "Command and Control Enabling the Expeditionary Aerospace Force." Research report, Air Command and Staff College, Air University, April 2000.

Bell, Hugh M., III. "What Are Battle Labs—Do We Still Need Them?" Strategy Research Project, U.S. Army War College, 2003.

Boelke, Ross Dennis. "A Historical Summary of the Armored Systems Modernization Program and the Lessons Learned from Its Interaction with the Acquisition Environment." Master's thesis, Naval Postgraduate School, 1992.

Branstetter, Jeffrey. "The Darleen Druyun Debacle: Procurement, Power, and Corruption." Thesis, George Washington University Law School, 2005.

Carlson, Barak J. "Past UAV Program Failures and Implications for Current UAV Programs." Research report, Air Command and Staff College, Air University, 2001.

Cate, Devin L. "Where Have All the Prototypes Gone? The Failure of the Prototyping Initiatives of the 1990s." Research paper, Air Command and Staff College, Air University, 1997.

Clements, Andrew F. "A Study of the Alpha Contracting Process and Its Effects on Integrated Product and Process Development (IPPD) Within Selected Army Acquisition Programs." Master's thesis, Naval Postgraduate School, 2002.

Cornish, Gregory J. "U.S. Naval Mine Warfare Strategy: Analysis of the Way Ahead." Strategy Research Project, U.S. Army War College, 2003.

Coronado, Betty J., and Jane M. Kwiecinski. "An Analysis of the Impact of Integrated Weapon System Management (IWSM) Upon the Support Equipment Acquisition Process (Covering the Period from Submittal of SERD Through the Preparation of the Statement of Work)." Master's thesis, Air Force Institute of Technology, 1994.

Dalrymple, Scott A., and Lester F. Pietraszuk. "An Investigation of Integrated Weapon System Management Implementation Issues." Master's thesis, Air Force Institute of Technology, Air University, 1992.

Eidson, Edward H. "Introduction to Command, Control, and Communications: A Primer." Thesis, Naval Postgraduate School, 1995.

Flynn, Karl Scott. "Analysis of the Army's Horizontal Technology Integration Policy: A Case Study of the Second-Generation Forward-Looking Infrared Program." Master's thesis, Naval Postgraduate School, 1995.

Goodwin, Connie M. "Acquisition Reform Through Alpha Contracting." Master's thesis, Naval Postgraduate School, 2002.

Hayden, Mark K. "The Basis for Interoperability." Individual study project, U.S. Army War College, 1991.

Hopkins, Jay R., and Curtis R. De Keyrel. "An Analysis of the Root Causes of Delays and Deficiencies in the Development of Embedded Software for Air Force Weapons Systems." Master's thesis, Air Force Institute of Technology, 1994.

Jones, Walter. "Case Analysis of the U.S. Army Warfighting Rapid Acquisition Program: Bradley Stinger Fighting Vehicle—Enhanced Weapon System." Master's thesis, Naval Postgraduate School, 1996.

King, John G. "Acquisition Streamlining and Reform: An Analysis of Alpha Acquisition at the Naval Air Systems Command." Master's thesis, Naval Postgraduate School, 1994.

Knox, Bernard D. "Ten Years' Worth of Procurement Reforms with Specific Attention to Selected DON Programs." Thesis, Naval Postgraduate School, 2002.

Lance, Darell G. "Army Participation in the Defense Airborne Reconnaissance Program." Strategy Research Project, U.S. Army War College, 1996.

McNutt Ross T. "Reducing DoD Product Development Time: The Role of the Schedule Development Process." PhD diss., Massachusetts Institute of Technology, 1998.

Mol, Mark H. "Advanced Concept Technology Demonstrations (ACTD): Are They Relevant in Today's Acquisition Environment?" Master's thesis, Air Command and Staff College, Air University, 1998.

Munechika, Curtis K. "Acquisition Reform: This Too, Shall Pass . . . ?" Research paper, Air Command and Staff College, Air University, 1997.

O'Brien, Mark A. "The V–22 Osprey: A Case Analysis." Master's thesis, Naval Postgraduate School, 1992.

Ostrowski, Paul Adam. "Matrix Organizational Structure and Its Effect on Army Acquisition Program Management Offices." Master's thesis, Naval Postgraduate School, 1996.

Pope, Joseph Kevin. "Measuring the Effect of the Defense Acquisition Workforce Improvement Act." Thesis, Naval Postgraduate School, 1997.

Radice, Mark Robert. "The Defense Enterprise Program: A Managerial Assessment." Master's thesis, Naval Postgraduate School, 1992.

Robotham, Rojan J. "Predator Acquisition Program Transition from Rapid to Standard Processes." Masters of Military Art and Science thesis, U.S. Army Command and General Staff College, 2012.

Samborowski, Leonard J. "The Joint Surveillance Target Attack Radar System: Can Procedures Be Developed to Support the Requirements of the Land and Air Component Commanders?" Master of Military Art and Science thesis, U.S. Army Command and General Staff College, 1992.

Sickels, Stephen W. "Pre-Planned Product Improvement (P3I)." Master's thesis, Air Force Institute of Technology, 1981.

Smith, Danny Roy. "The Influence of Contract Type in Program Execution/V–22 Osprey: A Case Study." Master's thesis, Naval Postgraduate School, 1989.

South, Matthew T. "Transitioning Advanced Concept Technology Demonstrations to Acquisition Programs." Master's thesis, Naval Postgraduate School, 2003.

Stinson, Benjamin P. "Understanding How Program Managers Successfully Manage Innovation in Major Defense Acquisition Programs (MDAPs): An Exploratory Study." Master's thesis, Naval Postgraduate School, 2001.

Sutton, Travis L. "Investigation of IPPD: A Case Study of the Marine Corps AAAV." Master's thesis, Naval Postgraduate School, 1998.

Szczublewski, Kenneth J. "The V–22: A Turning Point in Congressional Behavior?" Master's thesis, Naval Postgraduate School, 1992.

Varnado, Frank. "The Effects on Weapon Systems' Producibility of Suspending System Development After Advanced Technology Demonstration." Master's thesis, Naval Postgraduate School, 1993.

Index

Page numbers in *italics* indicate photographs. Italicized *f*, *sb*, and *t* indicate figures, sidebars, and tables.

5000 series acquisition policy documents: 1971 initial issuance of, 71; 1991 revision of, 40–41, 45, 189, 199–200, 554, 555; 1996 revision of, 189–190, 199–200; 2000–2001 revision of, 332–335, 334*f*; advanced concept technology demonstrations and, 215, 222; Defense Acquisition Deskbook and, 537; evolutionary acquisition and, 319, 322, 326, 332–333, 334*f*; Global Command and Control System and, 278; information technology acquisition and, 256, 260, 271; integrated product and process development and, 190; Navy and Marine Corps acquisition process and, 469–470; preplanned product improvement and, 322–323, 326; prototypes in acquisition process and, 135, 213; R&D emphasis over production and, 138; Section 800 Panel and, 169; spiral development and, 323, 326; V–22 Osprey and, 112; Yockey and, 74, 77. *See also specific DoD 5000 directives and instructions*

A

A–6 Intruder attack aircraft, 60, 94, 233
A–10 Thunderbolt II (Warthog) close air support aircraft, 233, 242
A–12 Avenger II stealth attack aircraft, 53–77; acquisition reform stimulated by, xv–xvi, 451–453; Beach Report and, 63–64, 70–71, 451–452; Betti and, 53–59; cost estimation and, 61–62, 67–68; Defense budget decline, impact on, 90, 91, 92, 93; design for, 60–61, *61*, 80n22; lack of discipline in, 69; lessons of, 66–71; Major Aircraft Review, 62; oversight failures, 69–70; prototypes lacking for, 135; stealth technology and, 234; termination of, reasons for, 65–66
Abrams tank. *See* M1 Abrams tank
ACATs. *See* acquisition categories
ACAT I, 40; Air Force acquisition process and, 365; Army acquisition process and, 403, 405, 434n49; criteria, 42*t*; Navy and Marine Corps acquisition process and, 447
ACAT IC: criteria, 42*t*; Navy and Marine Corps acquisition process and, 460, 484n50
ACAT ID: Army acquisition process and, 393, 421; criteria, 42*t*; Navy and Marine Corps acquisition process and, 460, 484n50
ACAT II: Air Force acquisition process and, 365; Army acquisition process and, 403, 404–405, 409, 421, 431n13, 434n49; criteria, 42*t*

ACAT III: Army acquisition process and, 395, 402, 420, 431n13; criteria, 42*t*; Defense Acquisition University and, 533
ACAT IV: Army acquisition process and, 395, 402, 419; criteria, 42*t*
acquisition, definition of, xiii, xvi–xvii (note 2), 554–555
Acquisition and Logistics Reform Week, 312, 537
acquisition categories (ACATs), 40, 42*t*. *See also main headings starting with* ACAT
Acquisition Center of Excellence (Navy), 458
acquisition corps, 35–36, 37, 44–45, 447, 526–527, 528, 529, 531, 560–561
Acquisition Cycle Time Reduction Task Force, 308, 319, 328, 330
Acquisition Improvement Program (Carlucci Initiatives, 1981), 25, 322
Acquisition Leadership Conference (1990), 57
Acquisition Organization Count method of defining acquisition workforce, 538–539
Acquisition Professional Development Council (Air Force), 529
acquisition program milestones and phases: 31, 41*f*, 61, 189*f*, 333*f*, 334*f*; A–12 Avenger II, 60–61, 67–68, 69, 74; acquisition reforms and, 31; acquisition workforce and, 540–541; Advanced Amphibious Assault Vehicle, 467, 476, 477; advanced concept technology demonstrations and, 216, 217*f*; Air Force acquisition process and, 354; Army acquisition process and, 404, 411; C–17 Globemaster III, 371, 377; Crusader, 423, 426; decision authority and, 27, 42*t*; Defense Acquisition Board, role in, 26, 27; Defense Management Review and Report and, 35, 40–41, 41*f*, 45; evolutionary acquisition and, 332–333, 334*f*; FBCB2, 421, 437n84; Forward-Looking Infrared Radar (FLIR), 409; Global Command and Control System, 278–279, 279–280*f*; integrated product and process development and, 189–190, 189*f*; technology transition and, 214
acquisition program reporting structure, xv, 26, 27–29, 31, 35, 45, 346, 349, 350, 393, 394*f*, 444, 445–447, 446*f*. *See also subheading* acquisition organization and management *under main headings for* Air Force, U.S.; Army, U.S.; Marine Corps, U.S.; and Navy, U.S.
Acquisition Reform Acceleration Stand-Down Day (1996), 434n43, 536–537
Acquisition Reform Benchmarking Group, 195
Acquisition Reform Communications Center (ARCC), 537
Acquisition Reform Core Team (Air Force), 366
Acquisition Reform Directorate (Army), 399, 401
Acquisition Reform Implementation Assessment Team (ARIAT) (Army), 402
Acquisition Reform Implementation Plan (Army), 432n22
Acquisition Reform Improvement Plan (Army), 399, 432n22
Acquisition Reform Leadership Council (Air Force), 366
Acquisition Reform Process Action Team, 186, 188
acquisition reforms. *See* 5000 series acquisition policy document revisions; advanced concept technology demonstrations; advanced technology demonstrations; alpha contracting; Clinger-Cohen Act; commercial off-the-shelf (COTS); concurrent engineering; cost as an independent variable; dual-use technologies; evolutionary acquisition; Federal Acquisition Reform Act; Federal Acquisition Regulation; Federal Acquisition Streamlining Act; integrated product and process development; integrated product and process management (Army); integrated product development (Air Force); integrated product teams; integrated weapon system management (Air Force); modeling and simulation; multiyear contracting/procurement; open systems approach; non-developmental items; performance specifications; preplanned product improvement; Section 800 Panel; spiral development. *See also* acquisition reforms, application of

acquisition reforms, application of. *See* A–12 Avenger II; Advanced Amphibious Assault Vehicle/Expeditionary Fighting Vehicle; AH–64 Apache; *Arleigh Burke*-class destroyers; Arsenal Ship; AV–8B Harrier; *Blue Ridge*-class amphibious command ship; C–17 Globemaster III; Crusader; E–8 JSTARS; F–15E Strike Eagle; F–16 Fighting Falcon; F–22 Raptor; F–35 Joint Strike Fighter; F/A–18E/F Super Hornet; FBCB2; Global Command and Control System; Intelligence and Electronic Warfare Common Sensor; Joint Advanced Strike Technology; Joint Direct Attack Munition; M2 Bradley Fighting Vehicle; Mark 48 torpedo; MIM–104 Patriot; Navy Area Theater Ballistic Missile Defense; Non-Developmental Airlift Aircraft; RAH–66 Comanche; *San Antonio*-class amphibious ships; Theater High Altitude Area Defense; UGM–133 Trident II; UH–60 Black Hawk; *Virginia*-class submarines. *See also* unmanned aerial vehicles, *subheading* RQ–1 Predator

Acquisition Reform Senior Steering Group, 183, 203n8, 306, 308, 457

Acquisition Reform Steering Group (Navy), 457

Acquisition Reform Strategy Implementation Network (Army), 399

Acquisition Reform Team Working Group (Navy), 458, 459

Acquisition Reform Working Group (industry), 304

acquisition system, criticism of, xiii, 23, 25, 32, 63–64, 71–72, 131–134, 141–147, 451–452. *See also* Beach Report; Burton, James G.; Christie, John D.; General Accounting Office; Logistics Management Institute; Spinney, Franklin C. "Chuck"

acquisition workforce, 525–545; acquisition reforms and, xv, 200–201, 535–538; Air Force, 528, 529–531, 536, 560–561; Army, 430n5, 434n43, 528, 529, 531, 560–561; career development, 529–530, 530*t*, 546n21; cultural change in acquisition and, xv, 535, 537–538, 561; culture of, 142–143, 188; Defense Acquisition Deskbook and, 200; Defense Acquisition Workforce Improvement Act and, 525–534, 560–561; Defense Management Review and Report and, 35–36; defining, 538–541; downsizing, 541–545, 542*f*, 549n55; integrated product teams and, 188; Marine Corps, 528, 531, 560–561; Navy, 447, 459, 528, 529, 531, 536, 560–561; qualification and standards, 531; Section 912 studies and, 315–316; training of, 306, 316, 400–401, 459, 531–533, 560–561

Acquisition Workforce Oversight Council (Navy), 529

Adams, Dale G., 400

Addington, David S., 103–104

Admiral Gooding Center (Navy), 458

Advanced Amphibious Assault Vehicle (AAAV)/Expeditionary Fighting Vehicle (EFV), *467*; acquisition reforms and, xvi, 200, 467–468, 475–477, 480, 562; cost as an independent variable and, 467; cost, schedule, and performance difficulties, 476; IEDs as threat to, 476; integrated product and process development and, 467, 557; integrated product teams and, 467, 557; mines as threat to, 477–478; modeling and simulation and, 467; open systems approach and, 200; requirements definition, 476–477

advanced concept technology demonstrations (ACTDs), 215–223; acquisition reforms and, 132; acquisition system and, 215–216, 217*f*, 222, 553; DARPA and, 215; difficulties with, 219–220, 222; distinguished from ATDs, 216, 553; as fieldable protoypes, 132–133; funding for, 219, 221; selection process for, 216–217; technology transition and, 211, 214, 222; UAVs as, 223–233, 227–228*f*, 230*t*; users role in, 216. *See* unmanned aerial vehicles *and specific ACTDs*

Advanced Field Artillery System (AFAS). *See* Crusader howitzer

Advanced Fighter–Experimental (A/F–X) program, 234, 235, 237, 238

Advanced Interdiction Weapon System, 49n34

Advanced Joint Planning ACTD, 218
Advanced Medium Range Air-to-Air Missile, 367
Advanced Medium STOL Transport (AMST) program, 368
Advanced Research Projects Agency (ARPA), 506, 507
Advanced Short Takeoff/Vertical Landing (ASTOVL) program, 234–235, 237, 238
Advanced Tactical Fighter. *See* F–22 Raptor
Advanced Technology Breakfast Club, 217, 245n13
advanced technology demonstrations (ATDs), 137–138, 553, 563
advanced technology weapons: advanced concept technology demonstrations and, 219; advantage over opponents, xiv, 14–15, 345, 552; Army modernization and, 408; business process reengineering and, 180; command and control system interoperability, 281–283; command and control system requirements, 274–280, 279–280*f*; DARPA and, 162; as force multiplier, 16, 415; information technology central to, 17, 251–252; life-cycle mismatch, integrated circuits vs. weapon systems, 265, 265*f*; modeling and simulation and, 284, 286; new approaches to developing innovative technology, 552–553; Office of the Secretary of Defense and computer acquisition, 252–262; technology transition into, 212–214, 214*f*. *See also* information technology and warfare
advanced warfighting experiment (AWE) (Army), 418–419, 421
Advisory Panel on Streamlining and Codifying Acquisition Laws. *See* Section 800 Panel
Aegis Combat System, 253, 254*f*, *466*, 466–467
Aegis Program Quality Management Board (Navy), 467
Aerospace Industries Association, 496
Afghanistan: advanced concept technology demonstration program products used in, 222; C–17 Globemaster III used in, 381, *382*; combat operations in, 7; counterinsurgency operations in, 563; FBCB2 used in, 422; information technology systems used in, 287; precision-guided munitions used in, 252
AGM–86C air-launched cruise missile, 125, *126*, 272
AGM–114 Hellfire air-to-ground missile, 233, *233*, 404
AH–64 Apache attack helicopter: acquisition reforms and, 200, 404, 405, 557, 559; Defense budget decline, impact on, 88, 90, 92; flat panel displays for, 509, 510; integrated product and process management and, 405; integrated product teams and, 404, 405, 557; MILSPECs reduction and, 200, 559; upgrade of (AH–64D Apache Longbow), 200, 404, 405, 429
Aidid, Mohamed, 6
AIM–54 Phoenix air-to-air missile, 88
Airborne Warning and Control System (AWACS), 127
Air Force, U.S., 345–382; acquisition organization and management, 345–358, 347*f*, 349*sb*, 351*f*, 356*f*, 383n8, 384n19; acquisition process, roll in, xiv; acquisition reforms, 358–367, 562; acquisition workforce, 528, 529–531, 536, 560–561; advanced concept technology demonstrations and, 221; C–17 Globemaster III and, 367–382; Civil Engineering Support Agency, 129; command and control systems and, 276–277; cost reductions achieved through acquisition reforms, 201, 365, 367; DARO and, 226; Defense Acquisition Pilot Program and, 194, 196–199, 208n50, 362, 379; Defense Acquisition Workforce Improvement Act and, 529; Defense Enterprise Programs and, 31, 49n34; Defense Management Review and Report and, 27, 35, 37; evolutionary acquisition and, 329–331, 333; Have Blue project and, 241; information technology acquisition and, 268, 273, 552–553; Instruction 63-101 (Acquisition System), 383n8; integrated product development and, 188, 356, 357, 358, 378, 556; JAST and, 235, 239; JDAM and, 196, 198; Joint Primary Aircraft Training System and, 199; Logistics Command, 35, 37, 123, 346, 348,

350, 352–355; Materiel Command, 350, 353–354, 357; modeling and simulation and, 284; Operation Desert Storm and, 122–127, 130; PEOs in, 28, 348, 349*sb*, 352, 361; Policy Directive 63-1 (Acquisition System), 383n8; post–Cold War force structure, 8, 11, 12, 13*t*, 565–566 (App. I); preplanned product improvement and, 322; process action teams and, 185; Reduction of Total Ownership Cost initiative and, 312, 313, 314*t*; reinventing government initiatives and, 166; Special Operations Test & Evaluation Division, 268; spiral development and, 324–327, 326*f*; Systems Command, 35, 37, 123, 346, 348, 350, 352–355, 357; UAVs and, 223, 231, 232. *See also other specific weapon systems and programs and* Druyun, Darleen
Air Force Acquisition and Sustainment Reinvention Process, 365–366
Air Force Communications Command (AFCC), 346, 348, 353
Air Force Flight Test Center, 346
Air Force Institute of Technology, 534
Air Force Logistics Command (AFLC), 35, 37, 123, 346, 348, 352–355, 357, 369; 383n2, 555
Air Force Materiel Command (AFMC): acquisition reforms and, 350, 364, 365, 555; creation of, 353–354, 555; integrated product development and, 356–358, 556; integrated weapon system management and, 354–356, 556
Air Force Office of Scientific Research, 387n54
Air Force Operational Test and Evaluation Center, 346
Air Force Research Laboratory, 387n54
Air Force Scientific Advisory Board, 326–327
Air Force Systems Acquisition Review Council, 348, 365, 367
Air Force Systems Command (AFSC): acquisition organization and management, 346, 348, 352–355, 357, 382–383n2; acquisition reforms and, 123, 128, 555; Defense Management Review and Report and, 35, 37
Air Research and Development Command (Air Force), 354
Aldridge, Edward C. "Pete," 335
Alliant Techsystems Inc., 229
AlliedSignal Inc., 509, 510
Allison Gas Turbine Division of General Motors, 96, 117n47
alpha contracting. *See* contracts/contracting
American Defense Preparedness Association, 162
Analytic Sciences Corporation, 162, 190
Anderson, Frank J., Jr., 534, *534*
Andrews, Duane P., 257–258, *258*, 258*sb*
Anti-Deficiency Act, 69, 81n46
Anti-Fratricide Identification Device, 129
Anti-Satellite system, 49n34
Apache helicopter. *See* AH–64 Apache attack helicopter
Arleigh Burke-class (DDG 51) destroyers, 466, *466* (*Oscar Austin*), 472, 508, 562; acquisition reform and, 466–467, 480. *See also* DDG 51 Class Affordability Program
Armament Research, Development and Engineering Center (Army), 425
Armed Forces Communications and Electronics Association, 275–276
Armored Systems Integration program management office (Army), 409
armored systems modernization (Army), 411–413, 412*f*
Armored Systems Modernization program (Army). *See* armored systems modernization
Army, U.S., 391–430; acquisition organization and management, 391–399, 392*f*, 394*f*, 430nn3–5; acquisition process, roll in, xiv; acquisition reform organization and training, xiv, 396–

402, 432n23; acquisition workforce, 528, 529, 531, 560–561; advanced concept technology demonstrations and, 218, 221; armored systems modernization, 411–413, 412*f*; concurrent engineering and, 403; "continuous modernization," 406–413, 434n9; cost reductions achieved through acquisition reforms, 201; Crusader, 422–429; DARO and, 226; Defense Acquisition Workforce Improvement Act and, 529; Defense Enterprise Programs and, 31, 49n34; Defense Management Review and Report and, 27, 37; digitization of the battlefield, 408, 415, 416, 420; FBCB2, 420–422; Helicopter Improvement Program, 94; horizontal technology integration, 408–409; information technology and, 252, 553; integrated product and process development and, 403–404, 556; integrated product and process management and, 402, 403–405, 429; Materiel Command, 28, 35, 37; matrix management and, 396–399; MILSPECs reduction and, 400, 402–404, 409; modeling and simulation and, 284; modernization through spares, 409–410; Operation Desert Storm and, 124, 130; PEOs in, 28, 393, 396, 397, 398–399, 430n9, 431n13; post–Cold War force structure, 8, 11, 12, 13*t*, 565–566 (App. I); preplanned product improvement and, 557; process action teams and, 185; R&D emphasis over production and, 139; Reduction of Total Ownership Cost initiative and, 314*t*; revolution in military affairs and, 16; spiral development and, 323–324, 325*f*, 326, 557; teaming and, 403–405; UAVs and, 227, 246n37. *See also other specific weapon systems and programs and* Sullivan, Gordon R.
Army Acquisition Executive Support Agency, 396, 398
Army Acquisition Policy Memorandum #91-4, 398
Army After Next, 426
Army Departmental Standardization Program Office, 403
Army Digitization Office, 420
Army Information Systems Command, 544
Army Logistics Management College, 534, 537
Army Materiel Command (AMC): acquisition organization and management, 353, 392–396; acquisition reforms and, 400, 401–402, 430n8, 431n13; acquisition workforce and, 536; concurrent engineering and, 403; integrated product and process development and, 403–404, 556; integrated product and process management and, 404, 403–405, 429; matrix management and, 397–398; MILSPECs reduction and, 402–403; PEOs and, 395–396, 398–399; teaming and, 404–405
Army Science Board, 434n49
Army Streamlined Acquisition Program, 399
Army Systems Acquisition Review Council, 393, 404, 409, 419
Arnold Engineering and Development Center (Air Force), 346
Arsenal Ship, *469*; acquisition reforms and, 470, 562; DARPA and, 469–470, 471; termination of, 471–472; underfunding of, 472
artificial intelligence, 265
Aspen Strategy Group, 159
Aspin, Leslie "Les," *10*; acquisition reform and, xv, 555; advanced concept technology demonstrations and, 215; advanced technology weapons and, 211; Aspen Strategy Group and, 159; B–2 Spirit and, 91; Base Force and, 9–10; Bottom-Up Review and, 11; C–17 Globemaster III and, 374, 375; comprehensive resource strategy and, 140, 155; defense industry restructuring and, 510, 511; Defense Management Improvement Act of 1990 and, 43; Defense Management Review and Report and, 26, 46n8; defense posture review, 6; JAST and, 240, 242; R&D as strategic asset and, 131, 133; resignation of and Somalia, 6; R&D emphasis over production and, 140; Rollover-Plus approach, 133, 134, 140; as secretary of

defense, 10, 155; targeted procurement, 140; threat-based force planning and, 10; V–22 Osprey and, 89, 102, 107, 108
assistant secretary of defense for economic security, 181, 207, 503–504, 521n33
assistant secretary of the Air Force for acquisition (SAF/AQ), 346–352, *347f*, *351f*
assistant secretary of the Air Force for research, development, and logistics, 345–346
assistant secretary of the Army for research, development, and acquisition, 47n11, 391, 430n5
assistant secretary of the Navy for research, development, and acquisition, 447, 529
ASTOVL (Advanced Short Takeoff/Vertical Landing) program, 234, 237, 238
ATDs. *See* advanced technology demonstrations
Atwood, Donald J., Jr., *38*; A–12 Avenger II and, 62, 65, 74; Air Force acquisition process and, 353; Army acquisition process and, 395; biographical background, 38*sb*; command and control systems and, 282–283; Defense Management Review and Report and, 33, 35, 42, 53–54; DoD Directive 5000.1 and, 74; information technology acquisition and, 257; modeling and simulation and, 286; Operation Desert Storm and, 122, 130; R&D emphasis over production and, 135, 136, 137; total quality management and, 56; V–22 Osprey and, 101; Yockey and, 72–73
AuCoin, Walter Leslie "Les," 106
Augustine, Norman R., 500, 511–512, *514*, 514*sb*, 515, 517, 524nIV, 563
Automatic Data Processing Act of 1965 (Brooks Act), 253, 255, 260
AV–8B Harrier aircraft, 233; open systems approach and, 200
Avenger II aircraft. *See* A–12 Avenger II stealth attack aircraft
Avondale Alliance, 462–463
Avtex Fiber Inc., 495–496, 520n14
AWACS. *See* E–3 Sentry Airborne Warning and Control System

B

B–1 Lancer bomber aircraft, 60
B–2 Spirit stealth bomber aircraft, *91*; Defense budget decline, impact on, 92; JDAM use of by, 198; Major Aircraft Review, 62; mismanagement of, 59; political engineering and, 145; post–Cold War force structure and, 9, 87, 90, 94, 552; program funding/rescheduling, 89, 91, 92, 94, 136, 511
B–52 Stratofortress bomber aircraft, 125, *126*, 127–128
Baker, James A., 2
Balanced Budget Act of 1997, 300
Balanced Budget and Emergency Deficit Control Act of 1985 (Gramm-Rudman-Hollings Act), 7, 18n17, 90
Barry, Edward P., 374
Base Force, 8–9, 11, 19n21, 137, 499
Base Realignment and Closure (BRAC) process, 461
Basic Acquisition Reform Training (Army), 401
Battle Labs, 418–419, 436nn73–74
battlespace, 16, 21n36
Beach, Chester Paul, Jr., 63–66, 71, 142, 451
Beach Report, 63–64, 70–71, 142, 451–452
Bechtel Corporation, 397
Bell Helicopter Textron Inc., 95–98, 104–105, 112, 136; XV–3 convertiplane, 95, *95*; XV–15 tiltrotor aircraft, *95*, 95–96, 98

Bell Labs, 275
Benenson, Bob, 91
Betti, John A., *55*; A–12 Avenger II and, 62, 64–65, 66, 72, 77, 82n52; acquisition workforce and, 527; biographical background, 55*sb*; Defense Management Review and Report and, 38–39, 45, 53–59; on Northrop Corporation, 59; total quality management and, 56–57, 164; as USD(A), 77–78n3
biennial budgeting, 31, 521n30
Big Five systems (Army). *See* AH–64 Apache attack helicopter; M1 Abrams tank; M2 Bradley Fighting Vehicle; MIM–104 Patriot missile; UH–60 Black Hawk helicopter
Big Safari (Air Force), 231
Black Hawk helicopter. *See* UH–60 Black Hawk helicopter
Blaz, Ben G., 97
Block Change Initiative, 191–192
Blot, Harold W. "Harry," 99
BLU–109 hardened penetration bomb, 128
Blue Ridge (LCC 19), USS, 200
Blue Ridge-class amphibious command ship modifications: open systems approach and, 200
Boehm, Barry W., 269
Boeing Company: A–12 Avenger II and, 70, 82n53; C–17 Globemaster III and, 370; defense industry restructuring and, 492, 516; information technology acquisition and, 272; JAST and, 241–242; modeling and simulation and, 285; V–22 Osprey and, 96, 97, 98, 104–105, 112, 136
Boorda, Jeremy M., 469, 471
Boskin, Michael J., 500
Bosnia and Herzegovina: combat operations in, 7; command and control communications problems in, 283; peacekeeping operations in, 5, 6; UAVs used in, 229–230
Bottom-Up Review (BUR), 11–12, 161, 236, 237, 511
Boxer, Barbara L., 33, 546n5
BRAC. *See* Base Realignment and Closure process
Bradley Fighting Vehicle. *See* M2 Bradley Fighting Vehicle
brassboard configuration. *See* prototypes
Brooks, Jack, 253
Brooks Act (Automatic Data Processing Act of 1965), 253, 255, 260
Brown, Harold, 33, 369
Bryant, John Wiley, 59
Budget, Department of Defense, xiii; decline in, 1, 12, 45, 85, 90, 112, 136, 299, 302, 441, 494–495, 551; FY 1990, 86–89, 86*t*; FY 1991, 7–8, 86*t*, 90–93; FY 1992, 86*t*, 93–94; FY 1994, 10–11; FY 1997, 300; FY 1998, 300; Army acquisition process and, 406; command and control systems and, 280; Department of Defense Appropriations Act, 1992, 111; Department of Defense Authorization Act, 1982, 253; Department of Defense Authorization Act, 1987, 29; defense industry restructuring and, 494–495, 519n10; dual-use technologies and, 504; impact on weapon system programs, 10–11, 85–94, 101, 299–303; increase in, 12, 300–303; National Defense Authorization Act for FY 1990, 502; National Defense Authorization Act for FY 1991, 43, 44, 168, 502, 527; National Defense Authorization Act for FY 1993, 235; National Defense Authorization Act for FY 1996, 173, 539, 542, 549n49; National Defense Authorization Act for FY 1998, 315, 539,

543; National Defense Authorization Act for FY 1999, 313, 558; peace dividend and, 90, 551; trends in, 12, 85–86, 301*f*, 301*t*, 391
Budget Enforcement Act of 1990, 7, 90, 299
Budget Enforcement Act of 1997, 300
Bumpers, Dale L., 100
"Bunker Buster" (GBU–28) bomb. *See* GBU–28 "Bunker Buster" bomb
Burton, James G., 145, *145*
Bush, George H. W., *3*; acquisition reform and, xiii, xv, xvi, 141; defense industry and, 491; Defense Management Review and Report and, 23, 32–33, 45; Gulf War (1991) and, 3; post–Cold War strategy and, 1, 2–5; service secretary selection delegated to secretary of defense, 54; United Nations and, 4; V–22 Osprey and, 106
Bush, George W., 427–428
business process reengineering, 179–181, 203n6
Butchko, Michael J., Jr., 374

C

C3I. *See* command, control, communications, and intelligence
C–5A/B/D Galaxy transport aircraft, 368–369, *368*, 370, 379, 381
C–17 Globemaster III transport aircraft, 367–382, *373, 381–382*; acquisition reforms and, xvi, 31, 141, 345, 562, 382; Air Force acquisition process and, 365; audits of program, 387n57; Commercial Derivative Engine and, 199; contracting scandal, 59, 358, 373–374; cost reductions achieved through acquisition reforms, 201; defense industrial base policy and, 559; dual-use technologies and, 508; front-loading for, 145; information technology acquisition and, 267; integrated product and process development and, 557; integrated product development and, 378, 382; integrated product teams and, 378, 382; Major Aircraft Review, 62; Non-Developmental Airlift Aircraft and, 379, 380–381; software development difficulties and, 267–268, 371
C–130 Hercules transport aircraft, 368
C–141A/B Starlifter transport aircraft, 368–369, *368*, 370
CAD/CAM. *See* computer-aided design and computer-aided manufacturing. *See also* modeling and simulation
Calvert, John F., 63
Canadian Light Armored Vehicle III, 427
Cann, Gerald A., 452
capabilities-based force planning, 9–10
Capability Maturity Model Integration, 272
Caporali, Renso L., 512
Carlucci, Frank C., 56, 96, 322, 370
Carl Vinson (CVN 70), USS, *231*, 455
Carnegie Commission on Science, Technology, and Government, 131–132, 503
Carnegie Mellon University, 268, 272
Carter, Jimmy, 503
Cate, Devin L., 220
cathode-ray tube (CRT) displays, 505
Cebrowski, Arthur K., 15
Center for Naval Analyses, 450

Center for Strategic and International Studies (CSIS), 162, 163, 170, 492
Central Intelligence Agency (CIA), 223, 229
centralized self-diagnostics, 239, 248n61
Central Technical Support Facility (Army), 421
C4I Architectural Framework, 283
C4I for the Warrior concept, 281, 282–283, 447
CH–46 Sea Knight helicopter, 95, 102
CH–53E Super Stallion helicopter, 97
Chaker, Lucien "Lou," 338n30
Champy, James, 180
Charles, Keith, 396
Cheney, Richard B. "Dick," *3*; A–12 Avenger II and, 62, 63, 65, 70; acquisition reform and, xv, 144, 193, 555; advanced technology demonstrations and, 216; advanced technology weapons and, 213; Air Force acquisition process and, 350; appointment as secretary of defense, 33; Army acquisition process and, 395; Betti chosen as USD(A) by, 53–54; C–17 Globemaster III and, 372; command and control systems and, 282; Defense budget and, 85–94; defense industry and, 491, 511, 518; Defense Management Review and Report and, 23, 33–37, 41–45, 77, 157; industrial base policy and, 499–500, 501; information technology acquisition and, 256, 257; JROC and, 35; Major Aircraft Review and, 62; Navy and Marine Corps acquisition process and, 452; post–Cold War force structure and, 7; post–Cold War strategy and, 2, 3; R&D emphasis over production and, 134, 136, 138; V–22 Osprey and, 85, 88, 94–95, 97, 99–113
Cheyenne Mountain Upgrade project, 277
chief information officers, 260–261, 261*f*
chief of naval operations (CNO), 442–443, 449, 463
Childress, James S., 377–378
Christie, John D., 71, 82n57
Christle, Gaylord E. "Gary," 62, 69–70, 142, 154n53
Chu, David S. C., 87, 97, 99, 110
civilian control of acquisition, strengthening of, xv, 25, 35, 345–349, 350, 391–393, 444–447, 563
Clark, Vernon E., 451
Clinger, William, 173
Clinger-Cohen Act (Information Technology Management Reform Act of 1996), 173, 199, 260–262, 290n17, 401, 555
Clinton, William J. "Bill," *10, 165*; acquisition reform and, xiii, xv; business process reengineering and, 180; defense industry and, 491; Federal Acquisition Streamlining Act and, 171; increased defense spending and, 301, 303; National Defense Authorization Act for FY 1996 vetoed by, 549n49; post–Cold War strategy and, 5–7, 10–11; reinventing government initiatives and, 164–168; V–22 Osprey and, 109
Cohen, William S., *309*; acquisition reform and, 173, 303–304, 306; acquisition workforce and, 540; Defense Acquisition University and, 534; evolutionary acquisition and, 276; federal acquisition of information systems and, 260; increased defense spending and, 300, 301, 302; Navy and Marine Corps acquisition process and, 450; Section 912 studies and, 316; UAVs and, 232. *See also* Clinger-Cohen Act
Cold War, end of, impact on: acquisition, xiv, 1, 16–17, 551–552; international order, 1, 3–5, 16; national security strategy, 2. *See also* Budget, Department of Defense, *subheading* impact on weapon system programs

Comanche helicopter. *See* RAH–66 Comanche reconnaissance and attack helicopter
command, control, communications, and intelligence (C3I), 15, 257, 443
command and control systems: evolutionary acquisition and, 275–280, 279–280*f*, 288, 319; interoperability of, 281–283; requirements for, 274–280, 279–280*f*. *See also* Global Command and Control System
Commercial Business Environment study group, 318
Commercial Derivative Engine, 194, 199, 208n50, 362
commercial off-the-shelf (COTS) products, 559; *Arleigh Burke*-class destroyers and, 466–467; Arsenal Ship and, 470; Defense Acquisition Pilot Program and, 194; evolutionary acquisition and, 334*f*; Federal Acquisition Streamlining Act and, 171; FBCB2 and, 421, 430; Granite Sentry project and, 276; industrial base policy and, xv, 498, 500; information technology acquisition and, 252, 260, 264, 265; JAST and, 553; Navy and Marine Corps acquisition process and, 460; Operation Desert Storm and, 129–130; *Virginia*-class submarines and, 465, 466, 562
Commercial Operations and Support Savings Initiative, 508, 509
Commission on Defense Organization and Streamlining (proposed), 543
Commission on Government Procurement (1972), 44, 545n2
Competency Aligned Organization (Navy), 461, 485n52
Competition in Contracting Act of 1984. *See* contracts/contracting
computer-aided design and computer-aided manufacturing (CAD/CAM), 284–285; in C–17 Globemaster III, 376, 405; in Crusader, 425, 426, 562; in F–22 Raptor, 285; in LPD 17 *San Antonio*, 462, 478; in RAH–66 Comanche, 285. *See also* modeling and simulation
Computer-Aided Three Dimensional Interactive Applications (IBM), 284
Computer Program Development Plan (Air Force), 268
computer revolution, 251–288; command and control systems interoperability, 281–283; command and control systems requirements, 274–280, 279–280*f*; embedded computer systems, 253–257, 254*f*, 282–283, 288n6, 371; hardware and software development challenges, 262–274, 266*f*, 267*t*; impact on military weapon systems, 251–252, 265, 267*t*; life-cycle mismatch, integrated circuits vs. weapon systems, 265, 265*f*; mission-critical computer systems, 252–253, 255*sb*; modeling and simulation and, 284–287, 285*sb*; Office of the Secretary of Defense and computer acquisition, 252–262; terminology, 263*sb*
Concepts-Based Requirements System (Army), 416
concurrency, 123, 136, 138, 144, 188, 356–357, 384n25, 552, 556; C–17 Globemaster III and, 369, 552; JDAM and, 197, 552
concurrent engineering, 188–189, 356–357, 384n25, 556; Air Force and, 357; Army and, 403. *See also* integrated product and process development; integrated product and process management integrated product development
Congress: acquisition process, role in, xiv; acquisition reform, role in, 23, 25, 33, 143–144, 168–173, 555; acquisition workforce and, 542–544; Air Force acquisition process and, 352; Army acquisition process and, 435n56; C–17 Globemaster III and, 369–370, 372–373, 374, 380, 381; Defense Acquisition Pilot Program, 193–194; Defense budget and, 86, 89, 90, 91, 93–94, 299–303; Defense Enterprise Programs and, 193; Desert Storm appropriations and, 130; F/A–18E/F Super Hornet and, 454; industrial base policy and, 497, 501, 502, 521n27; information technology acquisition and, 289n12; JAST and, 237–238, 242, 247n48; JSTARS and, 149n11; Navy and Marine Corps acquisition process and, 477; Section 800 Panel and, 168–171; UAVs and, 224; V–22 Osprey and, 94–95, 97–103, 106–107, 109–111
Congressional Budget Office (CBO), 236, 303, 501
Connecticut (SSN 22), USS, 510

contingency operations, 499
contract administration consolidation. *See* Defense Contract Management Command
contracts/contracting: alpha contracting, 461–462, 470, 485n53, 559; Competition in Contracting Act, 23, 172; cost-plus development contracts, 66, 420; cost-reimbursement contracts, 136; fixed-price development contracts, 58, 61, 66, 75, 81n36, 104–105, 117n47, 136, 375, 421, 494, 558; fixed-price-incentive-fee contracts, 104–105; multiyear contracting/procurement, 25, 31–32, 33, 41, 43, 220; sole-source (noncompetitive) contracting, 43, 423, 424
Contract Services Association of America, 304
Convair, 512
Conver, Stephen K., 139, 398, 431–432n17
Conyers, John, Jr., 171, 373
Cooperative Engagement Capability (Navy), 469
Coors, Joseph, Jr., 110
Corona Conferences (Air Force), 330–331
Corporate Information Management, 258–259
Cost Analysis Improvement Group (CAIG), 67–69, 70. *See also* cost estimation
Cost Analysis Requirements Document, 68. *See also* cost estimation
cost and operational effectiveness analysis (COEA), 69, 102. *See also* cost estimation
cost as an independent variable (CAIV), 233, 242, 311, 454, 467, 558
Costello, Robert B., *29*; A–12 Avenger II and, 61, 69; acquisition reform and, 27; biographical background, 29*sb*; C–17 Globemaster III and, 371; concurrent engineering and, 357; Defense Management Review and Report and, 33, 54, 56; industrial base policy and, 502; total quality management and, 56, 164, 188, 357
cost estimation, 67–69, 70, 81n42, 102, 256, 452, 488n78. *See also* Cost Analysis Improvement Group; Cost Analysis Requirements Document; cost and operational effectiveness analysis
cost-plus development contracts. *See* contracts/contracting
cost-reimbursement contracts. *See* contracts/contracting
Coyle, Philip E., III, 453, 456, 475
Crawford, Susan J., 65, 68
Crean, Thomas M., 532, *532*
Creech, William L., 166
Crosby, Philip B., 78n4
cruise missiles, 7, 125, *126*, 272. *See also specific missile systems*
Crusader howitzer (Advanced Field Artillery System), 422–429, *428*; acquisition reforms and, 200, 562; armored systems modernization program and, 411–413, 412*f*, 423; advanced technology, use of, 425, 426; Army acquisition and, 407, 422–423; commercial off-the-shelf products and, 425, 562; computer-aided design and computer-aided manufacturing, 426, 426, 562; development of, 423–426, 428–429; integrated product development and, 424, 427, 557; integrated product teams and, 424; joint government-industry team and, 426; open systems approach and, 200; software development difficulties and, 426, 428–429; termination of, reasons for, 426, 428, 429, 562
cultural change, acquisition reform and, 32, 63–64, 80n32, 142–143, 144, 146, 148, 154n56, 155, 173, 179, 180, 200, 201; acquisition workforce and, xv, 200, 458, 535, 537–538, 561; integrated product teams and, 188, 363, 378, 404, 461, 557
Cycle Time Reduction Tiger Team (Air Force), 329, 330
cycle times, for weapon systems, 329*f*; Acquisition Cycle Time Reduction Task Force, 308; acquisition reforms to reduce, 25, 141–142, 308, 319, 332, 366; cost reductions achieved

through acquisition reforms, 208n50; cost reductions not realized, 252; cycle times not reduced, 252; evolutionary acquisition and, 319, 328–329; preplanned product improvement and, 322–323; total ownership cost reduction and, 310

D

Dalton, John H., 459
D'Angelo, Debbie, 61–62
DarkStar. *See* unmanned aerial vehicles
Darman, Richard G., 500
DARO. *See* Defense Airborne Reconnaissance Office
DARPA. *See* Defense Advanced Research Projects Agency
data-rights policies, 170
David Packard Excellence in Acquisition Award, 465, 468, 475, 478, 538
David Taylor Model Basin (Navy), 444
Davis, Randy, 389n83
Davis-Bacon Act of 1931, 172
DAWIA. *See* Defense Acquisition Workforce Improvement Act
Dawson, Kenneth R., *422*
DD 21 Twenty-First Century Destroyer program, 468–469, 471, 472–473
DDG 51 Class Affordability Program, 466
DD(X) destroyer program, 335, 473
decentralization: acquisition reforms and, 12, 41; FBCB2 and, 422; National Performance Review and, 167, 173; Packard Commission recommendations for, 41, 348; of post–Cold War force structure, 12; reinventing government initiatives and, 165–166, 167, 173
Decker, Gilbert F. "Gil," 403, 404, 424, 433n36
Defense Acquisition Board (DAB): A–12 Avenger II and, 62, 67, 69, 71, 72, 74; acquisition reforms and, 26, 27, 144, 554; Air Force acquisition process and, 362; Army acquisition process and, 393, 404; Army modernization and, 411; Betti and, 57; C–17 Globemaster III and, 375, 380, 381; Conventional Systems Committee, 62; Defense Management Review and Report and, 34, 40, 45; discipline in acquisition process and, 76; fixed-price development contracts and, 75; information technology acquisition and, 256, 257; integrated product teams and, 187; Navy and Marine Corps acquisition process and, 453; technology transition and, 213–214, 214*f*; V–22 Osprey and, 112
Defense Acquisition Deskbook, 200, 322, 537, 561
defense acquisition executive (DAE), 26
Defense Acquisition Executive Certificate of Achievement, 538
Defense Acquisition Executive Summary (DAES), 452
Defense Acquisition Improvement Act of 1986, 46n5
Defense Acquisition Improvement Team, 57
Defense Acquisition Pilot Program, 41, 43, 197, 561; Commercial Derivative Engine, 194, 199, 208n50, 362; commercial off-the-shelf products and, 194; Defense Acquisition Pilot Program Consulting Group, 195, 207n38; implementation of, 193–194, 561; JDAM, 194, 196–199, 208n50, 362; Joint Primary Aircraft Training System, 194, 199, 208n50, 362; metrics for acquisition reforms and, 194–196; Non-Developmental Airlift Aircraft, 194, 199, 362, 379; OMB and, 194; program managers and, 194
Defense Acquisition Pilot Program Consulting Group, 195, 207n38
Defense Acquisition Policy Steering Group, 332, 334

Defense Acquisition University (DAU): Acquisition Reform Communications Center and, 537; acquisition reforms and, 318, 536; acquisition workforce and, 526, 531–534, *533*; acquisition workforce downsizing and, 545; Army acquisition process and, 401; DAWIA and, 528–529; Program Review Board, 546n20

Defense Acquisition Workforce Improvement Act (DAWIA), 44–45, 560–561; acquisition reform and, 141, 525; Army acquisition process and, 402; Defense Acquisition University and, 528–529; implementation of, 529–531, 538–541; Mavroules, Nicholas J. and, 526–527; origins and passage of, 526–527; provisions of, 527–529

Defense Advanced Research Projects Agency (DARPA): acquisition reforms and, 135; advanced concept technology demonstrations and, 215; advanced technology weapons and, 162; Arsenal Ship and, 469, 472; dual-use technologies and, 504; Have Blue project and, 241; industrial base policy and, 501–503; JAST and, 234; JSTARS and, 126; Operation Desert Storm and, 129; other transaction authority and, 215, 469, 502, 503; prototyping and, 122; UAVs and, 229

Defense Airborne Reconnaissance Office (DARO), 211, 225–229, 228*f*, 232–233, 243, 555

Defense Certificate of Recognition for Acquisition Innovation, 538

Defense Communications Agency, 257

Defense Contract Administration Services, 39

Defense Contract Audit Agency: A–12 Avenger II and, 59, 70, 451; alpha contracting and, 559; Defense Acquisition Pilot Program Consulting Group and, 207n38; Navy and Marine Corps acquisition process and, 461; V–22 Osprey and, 105

Defense Contract Management Agency (DCMA), 36, 39, 49n35

Defense Contract Management Command (DCMC): A–12 Avenger II and, 81n50, 451; acquisition reform and, 554; Advanced Amphibious Assault Vehicle and, 468; Air Force acquisition process and, 378; contract administration consolidation in, 36, 554; Defense Acquisition Pilot Program Consulting Group and, 207n38; Defense Management Review and Report and, 36, 39, 45, 49n35; integrated product and process development and, 187

Defense Contractor Performance Review System, 57–58

Defense Conversion, Reinvestment, and Transition Assistance Act of 1992, 507

Defense Criminal Investigative Service, 70

Defense Enterprise Programs, 31, 39, 49n34, 193

Defense FAR Supplement (DFARS), 31, 40, 141, 169, 193, 537

Defense Finance and Accounting Service (DFAS), 40

Defense Industrial Base Oversight Council, 503

defense industry, 491–518; assistant secretary of defense for economic security and, 181; decline and contraction, 492, 494, 518, 558; DoD critical technologies and, 497, 498*sb*; dual-use technologies and, 503–510, 518; front-loading and, 144–145; Government-Industry Coordinating Group, 308; government relationship with, xv, 558–560; horizontal integration in, 517; industrial base policy, 497–503, 518, 558; integration with commercial market industry (civil-military integration), 157, 161–164, 559, 560; lean manufacturing and, 239, 249n63; political engineering and, 144–145, 146–147*f*; response to R&D emphasis over production, 137; restructuring of, 495–496, 510–518, 513*f*; 560; role in acquisition system, xiv, 491–492; vertical integration in, 517; vulnerabilities of, 495–496, 558

Defense Information Infrastructure, 282, 554

Defense Information Systems Agency (DISA), 257, 260, 274, 278, 282–283, 554

Defense Integration Support Tool Database, 283

Defense Logistics Agency, 36, 39, 49n35, 207n39, 265, 530

Defense Management Improvement Act (proposed 1990), 41, 43
Defense Management Report (DMR), 34–45; acquisition program milestones and phases and, 40–41; acquisition reforms and, 555; acquisition workforce and, 525–526, 527, 531; Air Force acquisition process and, 350, 353; Army acquisition process and, 395, 396; Betti's support for goals of, 57, 80n32; Defense Management Improvement Act and, 41–43; guiding principles, 34; implementation of, 37–45, 77, 141, 554; National Performance Review and, 167; Navy and Marine Corps acquisition process and, 446–447; Perry and, 157; prototypes in acquisition process and, 135; resistance to by services, 37; revision of 5000 series acquisition policy documents and, 40–41, 45; Section 800 Panel and, 168; Yockey and, 72. *See also* Defense Management Review
Defense Management Report Implementation Coordination Office, 38–39
Defense Management Review, 23–34; acquisition objectives of, 47n18; conducting the review, 32–34; Directive 918, 282; quest for acquisition reform, 23–32. *See also* Defense Management Report
Defense Manufacturing Council, 185–186, 306–307. *See also* Defense Systems Affordability Council (DSAC)
Defense Microelectronics Activity, 265
Defense Planning and Resources Board, 34, 76
Defense Production Act, 506
Defense Reform Act of 1997, 543
Defense Reform Initiative, 306, 308, 316, 337n18, 534
Defense Resources Board, 26, 34
Defense Science Board (DSB): A–12 Avenger II and, 70; acquisition reforms and, 57, 132–133, 160; Acquisition Streamlining Task Force, 142, 154n51; advanced concept technology demonstrations and, 215; Air Force acquisition process and, 361; C–17 Globemaster III and, 375, 376, 380; command and control systems and, 275; concurrent engineering and, 357; on defense industry restructuring, 512, 515, 517; information technology acquisition and, 272, 273; integrated product and process development and, 188, 189; JAST and, 235–236, 238; Operation Desert Storm and, 122
Defense Standards Improvement Council, 195, 205n23, 207n39, 403
Defense Systems Acquisition Review Council (DSARC), 26, 71, 370, 554
Defense Systems Affordability Council (DSAC): acquisition reforms and, 306–309, 307*f*, 312, 558; evolutionary acquisition and, 328, 330, 331, 333; Reduction of Total Ownership Cost initiative and, 310, 312–315, 314*f*
Defense Systems Management College (DSMC): A–12 Avenger II and, 452; acquisition reforms and, 168, 184, 195, 319; acquisition workforce and, 526, 528, 532, 534; Defense Management Review and Report and, 44; evolutionary acquisition and, 319, 321, 322; integrated product and process development and, 188; metrics for acquisition reforms and, 195; technology acquisition and, 251, 265, 274, 276
Defense Technology Board, 137
Defense Technology Conversion Council, 507
Delaney, Lawrence J., 361, 366
DeLauer, Richard D., 96, 370
deLeon, Rudy, 360, 377, 380
Dellums, Ronald V., 89, 91, 171, 543
Deming, W. Edwards, 54–55, 164, 275
Department of Commerce, 496, 507
Department of Defense, organization of, 24*f*

Department of Defense Appropriations Act, 1990, 89
Department of Defense Appropriations Act, 1992, 111
Department of Defense Appropriations Act, 1999, 303
Department of Defense Authorization Act, 1982, 253, 487n78
Department of Defense Authorization Act, 1984, 23
Department of Defense Authorization Act, 1987, 31
Department of Defense Directive 5000.1: 1971 (Acquisition of Major Systems), 71, 81n36, 554; 1987 (Major and Non-Major Defense Acquisition Programs), xiii, 40, 71; 1991 (Defense Acquisition), 40, 74; 1996 (Defense Acquisition), 333; 2000 (The Defense Acquisition System), 333–334
Department of Defense Directive 5000.62 (Review of Mergers, Acquisitions, Joint Ventures, Investments, and Strategic Alliances of Major Defense Suppliers on National Security and Public Interest), 515
Department of Defense Directive 7920.1 (Life-Cycle Management of Automated Information Systems [AISs]), 256
Department of Defense Instruction 5000.2: 1980 (Major System Acquisition Procedures), 275; 1987 (Defense Acquisition Program Procedures), 40, 71; 1991 (Defense Acquisition Management Policies and Procedures), 40, 71, 257, 322; 2000 (Operation of the Defense Acquisition System), 333–334; 2002 (Operation of the Defense Acquisition System), 335
Department of Defense Instruction 5000.58 (Defense Acquisition Workforce), 539
Department of Defense Instruction 7920.2 (Major Automated Information System Approval Process), 256
Department of Defense Manual 5000.2-M (Defense Acquisition Management Documentation and Reports), 40
Department of Defense Modeling and Simulation Information Analysis Center, 286
Department of Defense Regulation 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs [MDAPs] and Major Automated Information System [MAIS] Acquisition Programs): 1996, 278, 332, 333–334; 2001, 335
Department of Defense Revolution in Military Affairs Initiative, 15
Department of Energy, 507
Department of Justice, 515, 518
Department of Labor, 194
Department of Transportation, 507
Department of Veterans Affairs, 194
designated acquisition commanders (DACs), 350, 352
Deutch, John M., *158*; acquisition reform and, 157–161, 179, 181, 555; Air Force acquisition process and, 358; Aspen Strategy Group and, 159; biographical background, 158*sb*; business process reengineering and, 203n6; C–17 Globemaster III and, 375, 379; post–Cold War force structure and, 11; technology acquisition and, 15
DFARS. *See* Defense FAR Supplement
Digital Equipment Corporation, 397
Diminishing Manufacturing Sources and Material Shortages Teaming Group, 265
Dingell, John D., Jr., 63, 373
director of defense research and engineering (DDR&E): A–12 Avenger II and, 65, 74; Executive Council for Models and Simulations and, 286; Operation Desert Storm and, 122; organizational structure, 149n9
Distributed Explosive Technology system, 477
DoD M&S Information Analysis Center, 286
DoD-STD-2167, 293n39

DoD-STD-2167A, 271, 272, 293n39
DoD-STD-7935A, 293n39
Douglas Aircraft Company, 370, 372
Douglass, John W., 457, 457, 459, 469, 472
dpiX (company), 510
drones. *See* unmanned aerial vehicles
Drucker, Peter F., 164, 180
Druyun, Darleen A., 345, 358–367, *359*, 359*sb*, 374
Dual Use Applications Program, 508
dual-use technologies: acquisition reform and, 137; defense industry and, 503–510, 518, 560; industrial base policy and, 163, 500, 501
Dugan, Michael J., 54
Dukakis, Michael S., 89
Dunleavy, Richard M., 63

E

E–3 Sentry Airborne Warning and Control System (AWACS), 127
E–8 JSTARS electronic surveillance aircraft, 125, 127
EA–18G Growler electronic warfare aircraft, 82n53
Earth Penetrating Weapon, 49n34
Ehrhard, Thomas P., 232–233
Elberfeld, Lawrence G., 61–62, 63, *64*, 64*sb*, 69, 71
Electric Boat. *See* General Dynamics Corporation
Electronic Systems Center (ESC) (Air Force), 324–325, 330, 342n59
embedded computer systems, 253–257, 254*f*, 282–283, 288n6, 371. *See also* Office of the Secretary of Defense, computer acquisition
empowerment of government employees, 32, 166–167, 173, 188–189
engineering and manufacturing development (EMD), 40, 41*f*, 111–112, 216, 221, 241
Enhanced Air Force Corporate Structure, 364
Enhanced Fiber Optic Guided Missiles for the Rapid Force Projection Initiative ACTD, 219
EO–5C Airborne Reconnaissance Low-Multifunction aircraft, 226
evolutionary acquisition: command and control systems, 275–280, 279–280*f*, 288, 319; development of, 319–328, 320*f*, 342n59; phases, 278–279, 279*f*; as policy, 328–335, 333*f*, 334*f*, 557, 563
Evolutionary Acquisition Reinvention Team (Air Force), 330
Evolutionary Phase Implementation Plan, 278–279, 279*f*
Evolved Expendable Launch Vehicle, 362, 367, 385n37
Executive Council for Models and Simulations, 286
Expeditionary Fighting Vehicle (EFV). *See* Advanced Amphibious Assault Vehicle
expeditionary force experiment (EFX) (Air Force), 325, 326*f*
Expeditionary Warfare Training Group (Navy), 463

F

F–4 Phantom II fighter aircraft, 265, 267*t*
F–14A Tomcat fighter aircraft, 88, 89, 234, 449, 452, 456
F–14D Super Tomcat fighter aircraft, 88, 89, *89*, 90, 93, 98

F–15E Strike Eagle fighter aircraft, 88, 92, 106, 123, *123, 129*, 200, 234; open systems approach and, 200
F–16 Fighting Falcon fighter aircraft: computer software in, 265, 267*t*, 272; development of, 247–248n49; evolutionary acquisition and, 335; operational lifespan of, 233; political atlas of, 145, 146–147*f*; preplanned product improvement used in, 322; Rollover-Plus approach and, 140
F–22 Raptor (Advanced Tactical Fighter) stealth aircraft: avionics system in, 239, 455; computer software in, 265, 267*t*; concurrent engineering and, 357; development of, 58; information technology acquisition and, 234, 239, 264; integrated product and process development and, 200, 364, 557; Major Aircraft Review, 62; prime contractors and subcontractors for, 492, 493*sb*; underfunding of, 76, 90, 93; virtual prototyping for, 285
F–35 Joint Strike Fighter aircraft, 233, *242*; acquisition reforms and, xvi, 200, 233; deployment of, 552; dual-use technologies and, 508; integrated product and process development and, 200, 557; open systems approach and, 200; technology innovation and, 211–212, 233–243, 553. *See also* Joint Advanced Strike Technology (JAST) aircraft program
F–111 Aardvark fighter-bomber aircraft, 128, 235
F–117 Nighthawk stealth fighter aircraft, 60, 94, 140, 241, 365
F/A–18C/D Hornet fighter aircraft, *198*, 234, 452, 454
F/A–18E/F Super Hornet fighter aircraft, 234, *455*; acquisition reforms and, xvi, 451–456, 561; cost as an independent variable and, 454; cost reductions achieved through acquisition reforms, 201; integrated product and process development and, 200, 557; Navy and Marine Corps acquisition process and, 449; underfunding of, 76
FAR. *See* Federal Acquisition Regulation
FBCB2. *See* Force XXI Battlefield Command, Brigade and Below
Federal Acquisition Network, 172
Federal Acquisition Reform Act of 1995 (FARA), 173, 199
Federal Acquisition Regulation (FAR): acquisition reforms and, 31, 193; Defense Acquisition Deskbook and, 537; Defense Management Review and Report and, 39; dual-use technologies and, 507; Section 800 Panel and, 169; source selection and contract negotiation, 199
Federal Acquisition Streamlining Act of 1994 (FASA): acquisition workforce and, 536, 537; Air Force acquisition process and, 362, 379; Army acquisition process and, 401; Defense Acquisition Pilot Program and, 194; defense industry and, 559; implementation of, 171–173, 199, 554; passage of, 168, 171
Federal Aviation Administration (FAA), 101, 379
Federal Bureau of Investigation (FBI), 32, 59
Federal Quality Institute, 56
Federal Trade Commission (FTC), 515, 516, 517
Fedorochko, William, Jr., 40
Feigenbaum, A. V., 78n4
Feigley, James M., 468
Ferguson, Thomas R., Jr., 128, 549n57
fieldable brassboards. *See* prototypes
fieldable prototypes. *See* prototypes
Field Integration Program (Navy), 459
Fields, Craig I., *502*, 502–503, 502*sb*
Fiester, Clark G., *360*, 360–361, 362
Fighting Falcon aircraft. *See* F–16 Fighting Falcon fighter aircraft
Fitzhugh Commission (1970), 545n2

fixed-price development contracts. *See* contracts/contracting
fixed-price-incentive-fee contracts. *See* contracts/contracting
flat panel displays, *422*, 505–507, 509, 560
FMC Corporation, 433n42
Fogleman, Ronald R., 364
Foley, Thomas S., 109
Forces Command (FORSCOM). *See* U.S. Army Forces Command
force structure: Air Force, 8, 11, 12, 13*t*; Army, 8, 11, 12, 13*t*; capabilities-based vs. threat-based, 9–10; decentralization of, 12; Marine Corps, 8, 11, 13*t*; Navy, 8, 11, 12, 13*t*; Operation Desert Storm as test for, 3, 92; post–Cold War strategy, 7–12, 13*t*. *See also* Appendix I, U.S. Forces, FY 1989–FY 2001
Force XXI, 420, 437n77; spiral development and, 323–324
Force XXI Battlefield Command, Brigade and Below (FBCB2) information technology system, 420–422; 437–438n84; acquisition reforms and, xvi, 561–562; commercial off-the-shelf products and, 421; deployment of, 422; integrated product and process development and, 557; integrated product teams and, 557; spiral development and, 420–421
Ford Motor Company, 40, 495
Forward-Looking Infrared Radar (FLIR), 409, 410*f*
forward presence (National Security Strategy, 1991), 2
France, acquisition system in, 526
Franklin, Ray M., 99
Franks, Frederick M., Jr., 16, 126, 414, *417*, 417–419
Franks, Tommy, 417
friendly fire, prevention of, 129–130
Fuqua, Don, 496
Future Combat System (FCS), 427, 429
Future Years Defense Program (FYDP): A–12 Avenger II and, 75–76; acquisition reforms and, 26; advanced concept technology demonstrations and, 221; budget authority, 86–89, 86*t*, 90; R&D emphasis over production and, 136; Reduction of Total Ownership Cost initiative and, 315

G

Gaebler, Ted, 164, 165, 166
Galaxy aircraft. *See* C–5A/B/D Galaxy transport aircraft
Galvin, John R., 126, 127
Gansler, Jacques S., *305*; acquisition reform and, 205n29, 299, 302, 304, 308–309, 335, 555; acquisition workforce and, 306, 537, 544; biographical background, 305*sb*; civil-military integration concept and, 162; Defense Acquisition University and, 546n20; Defense Systems Affordability Council and, 308; dual-use technologies and, 509; evolutionary acquisition and, 319, 328–329, 331–334, 557; Reduction of Total Ownership Cost initiative and, 310, 312–315, 558; Section 912 studies and, 315, 316
Garrett, H. Lawrence, III, 63, 64, 65, 67, 447
Gazelle Microcircuits, 502–503
GBU–28 “Bunker Buster” bomb, 128–129, *129*, 130
General Accounting Office (GAO): on acquisition system, 141–142, 143, 154n56, 167; on Advanced Field Artillery System, 423; on Air Force acquisition process, 346, 348, 350; on C–17 Globemaster III, 379–380; command and control systems and, 276, 283; on cost

reductions achieved through acquisition reforms, 201; on Crusader, 428–429; Defense Department audits, 36; on embedded computer systems, 288n6; evolutionary acquisition and, 332; on F/A–18E/F Super Hornet, 456; on FBCB2 low-rate production, 421; industrial base policy and, 500; information technology acquisition and, 257, 267; on Navy and Marine Corps acquisition process, 444–445, 452, 474; underfunded programs identified by, 76, 114n5; on V–22 Osprey, 106, 110, 119n67
General Atomics Aeronautical Systems Inc., 229
General Dynamics Corporation: A–12 Avenger II and, 61, 63, 65, 67, 70, 82n53, 105; Advanced Amphibious Assault Vehicle and, 468, 476; Advanced Field Artillery System and, 424; Arsenal Ship and, 487n71; Crusader and, 426; defense industry restructuring and, 495; Electric Boat Division, 139, 285, 464, 474, 510–511; F–16 production by, 145, 146–147*f*; Navy and Marine Corps acquisition process and, 478; software development by, 272
General Electric Company, 397, 454, 495
General Motors Corporation, 96, 117n47, 140
General Services Administration (GSA), 253, 260
General Services Board of Contract Appeals, 173
Gentz, Richard C., 63
Glenn, John H., 100
Global Combat Support System, 259
Global Command and Control System (GCCS): deployment of, 279–280, 287; development of, xvi, 277–278, 279–280*f*, 287; evolutionary acquisition and, 277–278; integrated product and process development and, 557
Global Hawk. *See* unmanned aerial vehicles
Global Positioning System (GPS) (NAVSTAR), 124–125, 552; Air Force acquisition process and, 365, 367; development and deployment of, 124–125, 129, 149n8; FBCB2 and, 420; as fieldable prototype, 132, 552; JDAM and, 196, 197; in Operation Desert Storm, 414, 552; UAVs and, 225
Globemaster III aircraft. *See* C–17 Globemaster III transport aircraft
Gnat–750. *See* unmanned aerial vehicles
Godwin, Richard P., 27, *28*; biographical background, 28*sb*
Gold, Theodore S., 131–132, 134
Goldwater-Nichols Department of Defense Reorganization Act of 1986, xiv–xv, 9, 23, 345, 346, 391, 393, 441, 445
Gooding, Robert C., 458
Gorbachev, Mikhail S., 2, 4, 87
Gore, Albert A., Jr., 164–168, *165*, 180
Gotbaum, Joshua, 503, *504*
Government Competition Coalition (industry), 304
government furnished equipment (GFE), 425, 492
Government-Industry Coordinating Group, 308, 337n21
Government Performance and Results Act of 1993, 194–195
GPS. *See* Global Positioning System
Grace Commission (1984), 545n2
Graham, David R., 46n8
Gramm-Rudman-Hollings Act. *See* Balanced Budget and Emergency Deficit Control Act of 1985
grand design approach, 269, 271, 320*f*, 321, 327–328, 335, 556–557, 563
Granite Sentry project, 276–277

Gray, Alfred M., Jr., 97, 99, *100*, 101, 444
Greene, James B., Jr., 57
Gribbin, David J., III, 33, 43
Ground Theater Air Control System, 362, 385n37
Growler aircraft. *See* EA–18G Growler electronic warfare aircraft
Grumman Aerospace Corporation: A–12 Avenger II and, 61; defense industry restructuring and, 494, 512; JSTARS and, 126; Operation Desert Storm and, 127
Guardian Industries, 509
Guenther, Otto J., 324
Gulf War (1990–1991), 121–130; acquisition and, 16–17, 551; advanced technology weapons in, 211; command and control communications problems in, 283; command and control systems in, 281; information technology in, 268, 552; international order and, 3; national security strategy and, 11, 16; Navy mine countermeasures in, 449. *See also* Operation Desert Shield; Operation Desert Storm

H

Hafer, Tom, 61–62
Haiti, peacekeeping operations in, 6
Hamilton, Charles S., II, 470, 473
Hammer, Michael, 180
Hamre, John J., 260, 303, 315, 534
Hansen, Alfred G., 353
Harman, Jane, 543
Harrier aircraft. *See* AV–8B Harrier aircraft
Harry S. Truman (CVN 75), USS, *198*
Harsco Corporation, 433n42
Have Blue project, 241
Heavy Force Modernization program (Army). *See* armored systems modernization
Hebl, Bernard, 535
Hekman, Peter M., Jr., 37
Helicopter Improvement Program (Army), 94
Hellfire missile. *See* AGM–114 Hellfire air-to-ground missile
Henry, Charles R., 39–40
Henry, William, 424
Hercules aircraft. *See* C–130 Hercules transport aircraft
Hertel, Dennis M., 33, 546n5
Herzfeld, Charles M., 70
High Altitude Endurance ACTD. *See* unmanned aerial vehicles
High Mobility Artillery Rocket System. *See* M142 High Mobility Artillery Rocket System
High Mobility Multipurpose Wheeled Vehicle (HMMWV, Humvee), 410, 462
High-speed Anti-Radiation Missile (HARM), 123, 124, 492
Hixenbaugh, A. Allen, 374
Hochbrueckner, George J., 99–100, 101
Honeywell Corporation, 426
Hoover Commission report (1955), 525
horizontal integration (industry), 517
horizontal technology integration (HTI) (Army), 408–409, 434n51

Horner, Charles A., 127
Hornet aircraft. *See* F/A–18C/D Hornet fighter aircraft
Howard, J. Daniel, 44
Hughes Aircraft Company, 409, 454, 487n71, 495, 512
humanitarian assistance missions, 5–6
Hunter, Duncan, 542, 543
Hunter. *See* unmanned aerial vehicles

I

IBM, 275, 284, 285
IEDs. *See* improvised explosive devices
Illinois (SSN 786), USS, 475, *475*
Ill Wind operation, 32, 526
Impoundment Control Act of 1974, 106, 108
Improved Recovery Vehicle. *See* M88 Improved Recovery Vehicle
improvised explosive devices (IEDs), 476
Industrial Base Executive Committee, 503
Industrial College of the Armed Forces (ICAF), 533
Industry Affordability Task Force, 337n21
Industry Depot Coalition (industry), 304
information technology and warfare, 251–288; advanced concept technology demonstrations and, 219; as advantage over opponents, xiv, 345, 552; Army modernization and, 408; business process reengineering and, 180; command and control systems interoperability, 281–283; command and control systems requirements, 274–280, 279–280*f*; embedded computer systems, 253–257, 254*f*, 282–283, 288n6, 371; as force multiplier, 14, 17, 415; hardware and software development challenges, 262–274, 266*f*, 267*t*; life-cycle mismatch, integrated circuits vs. weapon systems, 265, 265*f*; mission-critical computer systems, 252–253, 255*sb*; modeling and simulation and, 284–287, 285*sb*; new approaches to developing innovative technology, 552–553; Office of the Secretary of Defense and computer acquisition, 252–262; terminology, 263*sb*
Information Technology Management Reform Act of 1996. *See* Clinger-Cohen Act
Information Technology Overarching Integrated Product Team, 290n16, 409
Inouye, Daniel K., 140
Institute for Defense Analyses (IDA): on acquisition reforms, 26, 132; on C–17 Globemaster III, 375, 380; on concurrent engineering, 357, 384n25; on Defense Management Review and Report, 32; on Global Command and Control System, 279; on integrated product and process development, 188; on Navy and Marine Corps acquisition process, 450
Integrated Management System (Air Force), 357
integrated product and process development (IPPD): Army acquisition process and, 403–404, 424; Crusader and, 427; F/A–18E/F Super Hornet and, 453; implementation of, 188–190, 556–557, 558; Navy and Marine Corps acquisition process and, 453, 464, 467. *See also* concurrent engineering; integrated product and process management; integrated product development
integrated product and process management (IPPM) (Army), 402, 403–404. *See also* concurrent engineering; integrated product and process development

integrated product development (IPD) (Air Force), 188, 356, 357, 358; C–17 Globemaster III and, 378, 382; Crusader and, 424, 427. *See also* concurrent engineering; integrated product and process development
integrated product teams (IPTs): acquisition reform and, 200; Air Force acquisition process and, 358, 363–364; Army acquisition process and, 403–404; Advanced Amphibious Assault Vehicle and, 467, 557; AH–64 Apache and, 404, 405, 557; C–17 Globemaster III and, 378, 382; Crusader and, 424; F/A–18E/F Super Hornet and, 453; FBCB2 and, 557; implementation of, 186–190, 556–557; JDAM and, 197; Navy and, 460; *Virginia*-class submarines and, 463–464, 557
Integrated Warfare Architectures, 450
integrated weapon system management (IWSM) (Air Force), 188, 312, 354–358, 356*f*, 556
Integration Planning Team (Air Force), 355
Intelligence and Electronic Warfare Common Sensor, 201; open systems approach and, 200
Intervehicular Information System (IVIS), 413, 419, 435n60
Into the 21st Century: A Strategy for Affordability (Gansler), 309
Intruder aircraft. *See* A–6 Intruder attack aircraft
Iowa-class battleships, 468
Iraq: advanced concept technology demonstration program products used in, 222; C–17 Globemaster III used in, 381; counterinsurgency operations in, 563; FBCB2 used in, 422; information technology acquisition and, 287; Kuwait invasion by, 3; mine warfare conducted by, 449; precision-guided munitions used in, 252. *See also* Gulf War; Operation Desert Shield; Operation Desert Storm
Ireland, Andrew, 65, 68
Ishikawa, Kaoru, 78n4
ISO (International Organization for Standardization) 9000, 192; ISO 12207, 272
Israel: advanced concept technology demonstration contributions from, 216; UAV development in, 223
Israel, Kenneth R., 226

J

JAST. *See* Joint Advanced Strike Technology aircraft program
JDAM. *See* Joint Direct Attack Munition
Jefferson Solutions (consulting firm), 539–540, 541
Jimmy Carter (SSN 23), USS, 511, 523n54
Johnson, Jay L., 450, 471
Joint Advanced Strike Technology (JAST) aircraft program, xvi, 211, 233–243, 553; acquisition reforms and, 211, 233, 242–243, 553. *See also* F–35 Joint Strike Fighter aircraft
Joint Air-to-Surface Standoff Missile (JASSM), 198, 367, 562
Joint Attack Fighter (JAF) aircraft program, 235–236
Joint Chiefs of Staff (JCS): advanced concept technology demonstrations and, 217; command and control systems and, 282, 283; Defense Systems Affordability Council and, 308; Defense Technology Board and, 137; evolutionary acquisition and, 319, 328–329, 335; Executive Council for Models and Simulations and, 286; Operation Desert Storm and, 122; role in determining requirements for weapon systems, 35, 45, 278, 554, 555, 563; UAVs and, 225
Joint Concept Technology Demonstrations, 232
Joint Countermine ACTD, 218

Joint Direct Attack Munition (JDAM), *198*; acquisition reforms and, 179, 194, 561; Air Force acquisition process and, 362, 365, *367*; cost reductions achieved through acquisition reforms, 201, 208n50; as Defense Acquisition Pilot Program, 196–199; evolutionary acquisition and, 335
Joint Dual Use Program Office, 509
joint-industry teams, 405
Joint Interoperability Test Command, 283
Joint Logistics ACTD, 215, 277
Joint Logistics Commanders, 271, 276, 319, 321, 322
Joint Mission Areas Assessment Process (Navy), 450
Joint Operational Architecture, 283
Joint Operation Planning and Execution System, 280
Joint Primary Aircraft Training System, 194, 199, 201, 362
Joint Requirements Oversight Council (JROC): acquisition process, role in, 15, 36*f*, 217, 472, 554; advanced concept technology demonstrations and, 217; Arsenal Ship and, 472; command and control systems and, 282; Defense Management Review and Report and, 35, 37; FBCB2 and, 438n84; Navy and Marine Corps acquisition process and, 450; V–22 Osprey and, 112
Joint Services Aircraft Program, 96
joint-service technology assessment group, 96, 115n27
Joint Strike Fighter (JSF). *See* F–35 Joint Strike Fighter aircraft
Joint Surveillance Target Attack Radar System (JSTARS), 121, *127*; Army acquisition process and, 404; command and control systems and, 274; development and deployment of, 121, 125–128, 149n11; as fieldable prototype, 132–133, 552; open systems approach and, 200
Joint Systems Architecture, 283
Joint Technical Architecture, 283
Joint Vision 2010 (Shalikashvili), 16
Jones, David C., 166
JROC. *See* Joint Requirements Oversight Council
JSTARS. *See* Joint Surveillance Target Attack Radar System
Juran, J. M., 78n4

K

Kadish, Ronald T., 324–325, 326, 342n59, 376, *376*, 376*sb*, 378
Kait, Thomas C., Jr., 480
Kaminski, Paul G., *159*; acquisition reform and, 160, 179, 184, 199, 202, 304, 312, 555; acquisition workforce and, 532, 536, 537–538; advanced concept technology demonstrations and, 215–216, 220; biographical background, 159*sb*; Block Change Initiative and, 192; Crusader and, 425; dual-use technologies and, 508, 509; evolutionary acquisition and, 322; information technology acquisition and, 260; integrated product teams and, 184, 186–187; JAST and, 236, 240, 242; metrics for acquisition reforms and, 196; MILSPECs reduction and, 192, 559; process action teams and, 185; Reduction of Total Ownership Cost initiative and, 312; technology transition and, 213
Kappmeier, Jay, 378
Kasich, John R., 89, 91, 92
KC–135 Stratotanker aircraft, 201
Kelley, Paul X. "P.X.," 96
Kelman, Steven, 172, 180–181

Kelso, Frank B., II, 447, 449, 450, 482n18
Kiowa helicopter. *See* OH–58 Kiowa reconnaissance helicopter
Kluter, Eugene E., 378
Kosovo: advanced concept technology demonstration program products used in, 222; combat operations in, 7; command and control communications problems in, 283; funding for, 302–303; precision-guided munitions used in, 252
Kozlowski, Donald R., *377*, 377*sb*
Kresa, Kent, 512, 518
Krings, John E., 132

L

Laird, Melvin R., 33
LAM Task Force (Army), 416–417, 418, 419, 420, 437n77
Lancaster, H. Martin, 102
Larson, Charles R., *10*
Layton, Evelyn, 532
Lean Aircraft Initiative, 330
lean manufacturing, 239, 248–249n63
Lehman, John F., Jr., 27, 96, 104
Levin, Carl, 139
LGM–118A Peacekeeper ICBM, 90
Libby, I. Lewis "Scooter," 149n5
Lieberman, Joe, 511
life-cycle management of systems, 310, 310*f*, 312–315. *See also* integrated weapon system management (IWSM) (Air Force)
Light Airborne Multipurpose System (LAMPS) Mark III, 269, 275, 461, 559
Light Helicopter Experimental (LHX) program, 49n34, 88, 90. *See also* RAH–66 Comanche reconnaissance and attack helicopter
liquid crystal displays (LCDs), 505, 506, 509–510, 560
Little, Terry, 196, 197, 198
Litton Data Systems, 421–422
Littoral Combat Ship (LCS), 335, 473–474
Lockheed Corporation: Advanced Tactical Fighter and, 75; C–17 Globemaster III and, 369, 370; defense industry restructuring and, 514–515, 517; Have Blue project and, 241; Operation Desert Storm and, 128
Lockheed Martin Corporation: Advanced Field Artillery System and, 424; Arsenal Ship and, 487n71; defense industry restructuring and, 492, 515, 517–518; JAST and, 241–242; JDAM and, 197, 198
logistics, relationship to acquisition, xiii, 308, 321, 554–555, 556; integration of acquisition and logistics communities, 299, 312, 537, 541, 555
Logistics Management Institute, 142, 154n51, 519n3
Logistics Reform Senior Steering Group, 308
Loh, John M., 353
Longuemare, R. Noel, Jr., 424
Los Angeles-class submarines, 88, 92, 447, 463–464, 521n27
Low Altitude Navigation and Targeting Infrared for Night (LANTIRN), 88, 123–124, 517
Low Life-Cycle Cost, Medium Lift Helicopter ACTD, 215

LTV Aircraft Division, 495
Lyles, Lester L., 331
Lynn, Verne L. "Larry," 214

M

M1 Abrams tank, 49n34; advanced concept technology demonstrations and, 218; Force XXI and, 419; information technology and, 252; modernization of, 391, 406, 410*f*, 411–413, 435n59; post–Cold War force structure and, 9, 89, 90, 92, 94
M2 Bradley Fighting Vehicle, *124*; alpha contracting used for, 462; Army acquisition process and, 391, 405; development and deployment of, 124, 129, 130; dual-use technologies and, 508; modernization of, 411; post–Cold War force structure and, 93
M8 Buford Armored Gun System, 407, 410
M88 Improved Recovery Vehicle, 88
M109A6 Paladin artillery system, 410, 423
M142 High Mobility Artillery Rocket System, 429
Mahan (DDG 72), USS, 466
Major Aircraft Review, 62, 65, 67–68, 92
Major Automated Information System Review Council (MAISRC), 256, 257, 278, 290n16
major automated information systems, 256, 260; Global Command and Control System as, 278
Major Defense Acquisition Programs, defined, xiv
major regional conflict (MRC), 11, 19n25
Management Action Plan (MAP) (Navy), 458
manufacturing technology (Mantech) program, 498
Marine Corps, U.S., 441–480; Advanced Amphibious Assault Vehicle/Expeditionary Fighting Vehicle and, 467–468, 475–478; acquisition organization and management, 441–451, 442–443*f*, 446*f*, 448*f*; acquisition process, role in, xiv; acquisition reform organization and initiatives, 456–459; acquisition reform results, 472–480; acquisition workforce, 528, 531, 560–561; advanced concept technology demonstrations and, 218; budgets for acquisition, 441–442, 442*f*; DARO and, 226; information technology and, 252; JAST and, 234, 235, 239; network-centric warfare and, 16; post–Cold War force structure, 8, 11, 13*t*, 565–566 (App. I); revolution in military affairs and, 16; tiltrotor aircraft and, 96; UAVs and, 224; V–22 Osprey, 94–113
Marine Corps Combat Development Command, 444
Marine Corps Research, Development and Acquisition Command (MCRDAC), 444, 445
Marine Corps Systems Command, 444
Mark, Hans, 95
Mark 48 torpedo, 492; MILSPECs reduction and, 200, 559
Marshall, George C., 416
Martin Marietta Corporation: Advanced Field Artillery System and, 424; defense industry restructuring and, 495, 511, 512, 514–515, 517; JDAM and, 196
Material Professional Program (Navy), 447
matrix management: Army use of, 396–399; Navy use of, 447, 461
Mavroules, Nicholas J., 26, 46n8, *526*, 526–527
MC–130 Combat Talon II special operations aircraft, 268
McDonald, Charles C., 353
McDonnell, John F., 374, 375, 376, 379

McDonnell Douglas Corporation: A–12 Avenger II and, 61, 63, 64, 65, 67, 70, 105; C–17 Globemaster III development and production by, 199, 358, 367–381, 388n66, 388n72, 559, 562; defense industry restructuring and, 516; F/A–18E/F Super Hornet and, 453, 454; JDAM and, 196, 197; Longbow Apache and, 405; software development by, 267–268
McMichael, James, 529, 546n19
McNamara, Robert S., 235, 554
McNicol, David L., 68
McNutt, Ross T., 330, *331*
McPeak, Merrill A., 354, 358
metrics for acquisition reforms, 194–196, 201–202, 206–207n37, 401–402
Metro Machine Corporation, 487n71
MGM–134A Midgetman ICBM, 87, 136
MH–53 Pave Low combat search and rescue helicopter, 125
Michitsch, John F., 426, 427
Midgetman ICBM. *See* MGM–134A Midgetman ICBM
milestone decision authority, 42*t*, 278, 332, 484n50
milestones. *See* acquisition program milestones and phases
Military Airlift Command, 127, 369, 371
Military Retirement Reform Act of 1986, 46n5
Military Sealift Command, 218
MILSPECs (military specifications and standards), 163, 175n13; acquisition reform to reduce use of, 190–192, 200, 201, 559, 563; Air Force acquisition process and, 363; Army acquisition process and, 409; defense industry and, 163; FBCB2 and, 421
MILSTAR satellite communications system, 201, 365
MIL-STD (military standard)-498, 271–272
MIM–104 Patriot missile, *125*; Army acquisition process and, 391; development and deployment of, 124, 149n6; information technology acquisition and, 268; integrated product and process development and, 200; joint government-industry teams for, 405; modernization of, 406; R&D emphasis over production and, 139
mine warfare, 449, 477–478
Minney, Elton D., 400
mission area directors (MADs), 350, 352
mission-critical computer systems, 252–253, 255*sb*, 256, 265. *See also* Office of the Secretary of Defense, *subheading* computer acquisition and
Mission Need Statement, 35, 36*f*, 69, 452, 470
Mississippi (SSN 782), USS, 475
modeling and simulation (M&S), 284–287, 285*sb*, 418–419
Modeling and Simulation Executive Agent, 286
Modeling and Simulation Management Plan, 286
Model Installation Program, 166
modernization through spares (Army), 409–410
Money, Arthur L., 260, 329, 361, 385n33
Moore's Law, 262, 290n20
Mounted Battlespace Battle Lab, 419
Mounts, William E., 195, 318
Muellner, George K., 361

Multiple-Launch Rocket System (MLRS), 423
Multi-Role Fighter (MRF), 234, 235, 237, 238
multiyear contracting/procurement. *See* contracts/contracting
Mundy, Carl E., Jr., 108–109
Murtha, John P. "Jack," 99, 109, 301

N

Nader, Ralph, 516
National Advanced Research Projects Agency (proposed), 503
National Advisory Committee for Aeronautics, 95
National Aeronautics and Space Administration (NASA), 194, 333, 507
National Center for Advanced Technologies (NCAT), 321–322, 340n47
National Defense Authorization Act for FYs 1990 and 1991, 502
National Defense Authorization Act for FY 1991, 43, 44, 168, 527
National Defense Authorization Act for FY 1993, 236
National Defense Authorization Act for FY 1994, 237, 379
National Defense Authorization Act for FY 1996, 173, 539, 542, 549n49
National Defense Authorization Act for FY 1998, 315, 539, 543. *See also* Section 912 studies and report
National Defense Authorization Act for FY 1999, 313
National Defense Commerce Act, 496
National Defense Panel, 426
National Defense University (NDU), 533
National Economic Council, 505
National Flat Panel Display Initiative, 505–507, 509
National Military Strategy of the United States (1992), 9
National Performance Review (NPR), 164–168, 173, 180, 276, 308, 541–542
National Reconnaissance Office (NRO), 223, 225
National Research Council, 422, 478
National Science Foundation, 507
National Security Decision Directive (NSDD) 219 (1986), 25
National Security Review 11 (1989), 33, 34. *See also* Defense Management Review
National Security Review 12 (1989), 2
National Security Strategy of the United States (1991), 2, 4
Nauseef, John M., 374
Naval Air Systems Command (NAVAIR): A–12 Avenger II and, 61, 63, 451; acquisition organization and management, 443, 445, 458–459; acquisition reforms and, 458–459, 460, 460*f*, 461; alpha contracting and, 485n53, 559; Defense Management Review and Report and, 35, 37; Marine Corps acquisition coordinated through, 444; V–22 Osprey and, 96, 97, 104
Naval Acquisition Reform Senior Oversight Council (NARSOC), 457, 459
Naval Center for Advanced Training, 534
Naval Criminal Investigative Service (NCIS), 70
Naval Sea Systems Command (NAVSEA): acquisition organization and management, 443, 444, 445; acquisition reforms and, 458–459, 462–463; Defense Management Review and Report and, 35, 37; Marine Corps acquisition coordinated through, 444
Naval Supply Systems Command, 458–459
Naval Surface Warfare Center, 444
Naval Undersea Warfare Center, 444

NAVSTAR Global Positioning System. *See* Global Positioning System (GPS) (NAVSTAR)
Navy, U.S., 441–480; A–12 Avenger II, 53–77; acquisition organization and management, 441–451, 442–443*f*, 446*f*, 448*f*, 460*f*, 481n17; acquisition process, role in, xiv; Acquisition Reform Office (ARO), 458–459; acquisition reform organization and initiatives, 456–459, 562; acquisition reform results, 472–480; acquisition workforce, 528, 529, 531, 536, 560–561; advanced concept technology demonstrations and, 218; *Arleigh Burke*-class destroyers, 466–467; Arsenal Ship, 468–472; budgets for acquisition, 441–442, 442*f*; command and control systems and, 277; cost reductions achieved through acquisition reforms, 201; DARO and, 226; Defense Acquisition Workforce Improvement Act and, 529; Defense Enterprise Programs and, 31, 49n34; Defense Management Review and Report and, 27, 37; F/A–18E/F Super Hornet, 452–456; information technology acquisition and, 256, 269; JAST and, 235, 239; JDAM and, 196, 198; Joint Primary Aircraft Training System and, 199; modeling and simulation and, 284; network-centric warfare and, 16; PEOs in, 28; post–Cold War force structure, 8, 11, 12, 13*t*, 565–566 (App. I); process action teams and, 185; R&D emphasis over production and, 139; Reduction of Total Ownership Cost initiative and, 313, 314*t*; revolution in military affairs and, 16; *San Antonio*-class amphibious ships, 462–463, 478–480; spiral development and, 323; stealth technologies and, 234; UAVs and, 223–224, 229; V–22 Osprey, 85–113; *Virginia*-class submarines, 463–466, 474–475. *See also other specific weapon systems and programs*
Navy Area Theater Ballistic Missile Defense: open systems approach and, 200
Navy Command and Control System, 277
network-centric warfare, 14, 16
New Attack Submarine program, 200, 462, 463. *See also Virginia*-class submarines
Newport News Shipbuilding, 464, 510–511
New York (LPD 21), USS, 479
Non-Developmental Airlift Aircraft (NDAA): acquisition reforms and, 194, 199, 559–560, 562; Air Force acquisition process and, 362, 379, 380–381, 382; C–17 Globemaster III and, 194, 199, 379, 380, 382
non-developmental items, 57, 123, 123, 194, 218, 430n8. *See also* commercial off-the-shelf (COTS) products
North American Aerospace Defense Command Center, 276
North Atlantic Treaty Organization (NATO), 1, 198, 216
North Dakota (SSN 784), USS, 474
Northrop Corporation, 59, 61, 65, 454, 495, 512
Northrop Grumman Corporation, 479, 487n71, 512, 517–518
nuclear deterrence (National Security Strategy, 1991), 2
Nunn, Samuel A. "Sam," Jr., 91, 102, 133, 172
Nunn-McCurdy Act of 1982, 474, 476, 487n78

O

Office of Federal Procurement Policy, 180, 182
Office of Management and Budget (OMB): business process reengineering and, 180; Defense Acquisition Pilot Program and, 194; role in budget process, 93
Office of Strategic Systems Programs (Navy), 443, 445
Office of Technology Assessment (OTA), 133
Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence, 261, 261*f*, 283, 289n12, 306, 319, 337n18

Office of the Assistant Secretary of Defense for Production and Logistics, 181
Office of the Assistant Secretary of the Air Force for Acquisition (SAF/AQ), 346, 348, 352, 382, 383n9
Office of the Assistant Secretary of the Army for Research, Development, and Acquisition, 399–400
Office of the Chief of Naval Operations (OPNAV): Navy and Marine Corps acquisition process and, 444–445; organization of, 442–444, 481n17, 482n18; reorganization of, 447–451
Office of the Deputy Under Secretary of Defense for Acquisition Reform, 160, 181–183, 555
Office of the Deputy Under Secretary of Defense for Advanced Technology, 225
Office of the Secretary of Defense (OSD): A–12 Avenger II and, 70, 72, 452; acquisition process, role in, xiv, xv, 554; acquisition reform, role in, xv, 25, 134, 141–144, 160, 551, 554–555; acquisition workforce and, 531, 560; advanced concept technology demonstrations and, 221; advanced technology weapons and, 211; Air Force acquisition process and, 358, 363, 364; Army acquisition process and, 401, 403; Army modernization and, 409, 411; C–17 Globemaster III and, 367–368, 370, 374; centralization of acquisition authority in, xiv, 34, 40, 45, 142, 154n53; command and control systems and, 278, 282, 283; computer acquisition and, 252–262; concurrent engineering and, 552; cost estimation and, 67; Crusader and, 428; Defense Acquisition Pilot Program Consulting Group and, 207n38; Defense Acquisition Workforce Improvement Act and, 529; defense industry and, 491; Defense Management Review and Report and, 23–45; Defense Systems Affordability Council and, 308; dual-use technologies and, 504, 509; evolutionary acquisition and, 319, 322, 328–335, 342n59; Executive Council for Models and Simulations and, 286; Future Years Defense Program and, 76; industrial base policy and, 497, 503, 521n26; information technology acquisition and, 265, 290n17; integrated product and process development and, 188–189, 190, 357, 557; integrated product teams and, 186, 187, 188, 189, 190, 200, 557; JAST and, 236, 238, 241; Major Aircraft Review, 62, 65, 67–68, 92; metrics for acquisition reforms and, 195; modeling and simulation and, 286; Navy and Marine Corps acquisition process and, 446–447, 457, 459–460, 474, 475; Open Systems Joint Task Force and, 192; Operation Desert Storm and, 122, 130; organization for acquisition reform, 181–184, 182*f*, 200; preplanned product improvement and, 322–323, 326; process action teams and, 184–185, 557; R&D emphasis over production and, 135, 136–137, 138; Reduction of Total Ownership Cost initiative and, 310–315; reinventing government initiatives and, 166; Section 912 studies and, 315–318, 317*sb*; spiral development and, 324, 326, 327, 342n59; technology transition and, 214; UAVs and, 224, 225, 229; V–22 Osprey and, 102, 103–104, 110. *See also individual defense secretaries, deputy secretaries, under secretaries, assistant secretaries, and directors*; 5000 series acquisition policy documents; Budget, Department of Defense; Defense Acquisition Board
OH–58 Kiowa reconnaissance helicopter, 88, 89
Ohio-class submarines, 93, 269
O'Keefe, Sean, 62, 76, 99, 101, 108–111, *111*, 118n62, 449
Oliver, David R., Jr., 304, 313, 315
Oliver Hazard Perry-class frigates, 468
open systems approach, 192, 200, 201, 409, 559
Open Systems Joint Task Force, 192
Operation Allied Force, 7, 198, 426
Operational Maneuver From the Sea (OMFTS), 477, 478, 488n85
Operational Requirements Document (ORD), 222, 363, 409, 423, 427, 437–438n84, 454, 470, 472, 477
operation and maintenance (O&M, congressional appropriations account), 89, 114n9, 118n62, 278, 458
operations and maintenance (O&M, military activity), 101, 145, 234, 302, 463
Operation Desert Hammer (1994), 419

Operation Desert Shield (1990–1991), 3, 92, 121–122, 283, 406
Operation Desert Storm (1991), 121–130; Army performance in, 406, 414; command and control communications problems in, 283; importance of stealth and missile technologies, demonstrated in, 94, 234; information technology acquisition and, 287; post–Cold War strategy tested by, 3, 92; precision-guided munitions in, 234, 252
Operation Enduring Freedom, 198
Operation Iraqi Freedom, 429
Operation Nomad Vigil, 229
Operation Support System (Navy), 277
OPNAV. *See* Office of the Chief of Naval Operations
Optical Imaging Systems Inc., 505, 506, 509–510
Osborne, David, 164, 165, 166
Oscar Austin (DDG 79), USS, 466, *466*
OSD. *See* Office of the Secretary of Defense
Osprey aircraft. *See* V–22 Osprey tiltrotor aircraft
other transaction authority, 215, 469, 473, 502, 503, 507, 509
Outrider. *See* unmanned aerial vehicles
Owens, William A., 8, 15–16, *15*, 160, 415, 450

P

Packard, David, xiv, 29, 37, 71, 157, 166, 212–213, 554
Packard Commission (President's Blue Ribbon Commission on Defense Management): acquisition reforms not fully implemented, xv, 17, 23, 26–27, 46n8, 554; acquisition workforce and, 525–526, 539–540, 548n41; advanced concept technology demonstrations and, 215; Air Force acquisition process and, 345, 346, 348; Army acquisition process and, 391, 393, 396, 399; Betti's support for goals of, 57; Defense Management Review and Report and, 34–35; implementation of recommendations, 141; Navy and Marine Corps acquisition process and, 441, 445; prototyping and, 135, 212; recommendations of, xiii, xiv–xv, 29–32, 157; Section 800 Panel and, 168
Paige, Emmett, Jr., 259–260, *259*, 259*sb*
Pallas, Spiros, 308, 313, 315, 338n30
Parametric Corporation, 284
Paravant Computer Systems, 421–422
Patriot missile. *See* MIM–104 Patriot missile
Pave Low. *See* MH–53 Pave Low combat search and rescue helicopter, 125
peace dividend, xiv, 7, 86–94; Clinton and, 10; defense industry restructuring and, 495; demanded by Congress, 7, 9, 551. *See also* budget, Department of Defense, impact on weapon system programs
Peacekeeper ICBM. *See* LGM–118A Peacekeeper ICBM
peacekeeping missions, 4–5
PEO/SYSCOM Commanders' Conferences, 186, 308, 311, 312, 333
PEOs. *See* program executive officers
Performance-Based Services Acquisition RIT, 318
performance specifications, 73, 190–192, 205n23, 402–403, 411, 454. *See also* MILSPECs
Perry, William J. "Bill," *14, 156*; acquisition reform and, xv, 131, 133, 155–161, 179, 304, 306, 319, 555; advanced concept technology demonstrations and, 222; advanced technology weapons and, 211, 212–213; Air Force acquisition process and, 363; Aspen Strategy Group and, 159; biographical background, 156*sb*; command and control systems and, 275; Defense

Acquisition Pilot Program and, 193–194; defense industry restructuring and, 510, 511–512, 515; Defense Standards Improvement Council and, 207n39; evolutionary acquisition and, 275; information technology acquisition and, 15, 259, 272; integrated product and process development and, 189, 190, 557; integrated product teams and, 189, 190, 557; JAST and, 240; MILSPECs and, 190–191, 192, 559; modeling and simulation and, 286; Navy and Marine Corps acquisition process and, 456; reinventing government initiatives and, 168
Perry Panel, 131–132, 134
Persian Gulf War. *See* Gulf War; Operation Desert Shield; Operation Desert Storm
Peters, F. Whitten, 361
Peters, Thomas J. "Tom," 164, 166
phases. *See* acquisition program milestones and phases
Phillips, Bill, 389n83
Phoenix missile. *See* AIM-54 Phoenix air-to-air missile
Pigaty, Leo J., 400, 401
pilot programs. *See* Defense Acquisition Pilot Program; integrated weapon system management (IWSM) (Air Force); modernization through spares (Army); Reduction of Total Ownership Cost (R-TOC) initiative. *See also* Defense Enterprise Programs
Pioneer. *See* unmanned aerial vehicles
Planar Systems Inc., 510
Planning, Programming, and Budgeting System (PPBS), 26, 76
Porter, Dan E., 457–458
post–Cold War strategy: force structure, 7–12, 13*t*, 565–566 (App. I); search for, 2–7; technology and new methods of warfare, 14–16
Potomac Institute for Policy Studies, 508
Powell, Colin L., 2, 3, 4, 8, *8*, 93, 237, 281
precision engagement, 14
Predator. *See* unmanned aerial vehicles
Preliminary System Operational Concept (PSOC) (Air Force), 369
preplanned product improvement (P3I), 322–323, 326, 327, 331, 465, 557, 563
President's Blue Ribbon Commission on Defense Management. *See* Packard Commission
Preston, Colleen A., 183; acquisition reforms and, 160, 172, 179, 181–184, 304, 555; acquisition workforce and, 535, 536; biographical background, 183*sb*; business process reengineering and, 203n6; Defense Acquisition Pilot Program and, 194; metrics for acquisition reforms and, 195; MILSPECs and, 190; process action teams and, 185
Price-Based Acquisition Study Group, 318
prime contractors, 491–492, 493*sb*, 519n3
process action teams (PATs), 184–186, 355–356, 536, 557
Process Integration Team (PIT) (Air Force), 355–356
Pro/Engineer (Parametric), 284
program advocacy, 39, 49n33
Program Assist Visits (Navy), 459
Program Budget Decisions, 62
program executive officers (PEOs): acquisition reforms and, 26, 29, 31; Air Force, 28, 348, 349*sb*, 352, 361; Army, 28, 393, 396, 397, 398–399, 430n9, 431n13; Defense Management Review and Report and, 35, 37, 45; Defense Systems Affordability Council and, 308; evolutionary acquisition and, 333; Marine Corps, 447; Navy, 445, 447, 466, 467, 473; process action teams and, 186; Reduction of Total Ownership Cost initiative and, 311; UAVs and, 229; USD(A) and, 74–75

Program Management Directive (Air Force), 350
Program Management Responsibility Transfer (Air Force), 354–355
program managers (PMs): acquisition reforms and, 26, 28, 29, 30*f*; acquisition workforce and, 528, 561; Air Force (also called system program directors), 346, 347*f*, 353, 354–355, 365; Army, 396, 398–399, 407, 430–431n9; Betti and, 58; C–17 Globemaster III and, 376, 376*sb*, 377*sb*; Defense Acquisition Pilot Program and, 194; Defense Acquisition University and, 533; Marine Corps, 468; Navy, 447, 456; tenure of, 526, 528, 561; USD(A) and, 74–75
Program Objective Memorandum (POM), 76, 83n70, 221
prototypes: in acquisition process, 121, 132–134, 135–136, 137–138, 148; A–12 Avenger II, lack of, 135; Advanced Amphibious Assault Vehicle, 467–468, 476; advanced concept technology demonstrations and, 211, 212–213; advanced technology demonstrations and, 137–138; competitive prototyping, 170, 240, 241, 553; Crusader, 426; Federal Acquisition Streamlining Act and, 172; fieldable brassboards, 132–133, 151n27; fieldable prototypes, 132–133; GAO on, 144; modeling and simulation and, 284–285; Packard Commission and, 212; Section 800 Panel and, 170; technology transition and, 212; UAVs, 229; V–22 Osprey, 96, 104, 107, 108, 109, 110, 111. *See also* advanced concept technology demonstrations; advanced technology demonstrations

Q

Quadrennial Defense Review (QDR), 16, 300, 304, 425
Quayle, Dan, 112

R

RAH–66 Comanche reconnaissance and attack helicopter, 75, *94*; acquisition reforms and, 136; alpha contracting used for, 462; Army acquisition process and, 434n47; integrated product and process development and, 200, 557; joint-industry teams for, 405; modernization of, 406–407; post–Cold War force structure and, 88, 90, 94. *See also* Light Helicopter Experimental (LHX) program
Ralston, Joseph W., 319
RAND Corporation, 471, 474
Randolph, Bernard P., 266, 353
Rapid Acquisition Tiger Team (Army), 419, 436n76
rapid improvement teams (RITs), 318
Rapid Response Process (RRP) (Air Force), 122, 123, 130, 330–331, 553
Raptor (Advanced Tactical Fighter). *See* F–22 Raptor (Advanced Tactical Fighter) stealth aircraft
Raytheon Corporation, 192
RC–12 Guardrail Common Sensor reconnaissance aircraft, 226
RC–135 Rivet Joint reconnaissance aircraft, 125
Reagan, Timothy, 127
reconnaissance-strike complex, 14
Reduction of Total Ownership Cost (R-TOC) initiative, 310–315, 310*f*, 314*t*, 401, 558, 561
Reduction of Total Ownership Cost Working Group, 308
Reengineering the Corporation (Hammer & Champy), 180
Reich, Robert B., 164
Reimer, Dennis J., 437n77
Reinventing Government (Osborne & Gaebler), 164–168, 179
Reinvention Labs, 166

Reis, Victor H., 134–135, 137
remotely piloted vehicles. *See* unmanned aerial vehicles
requests for proposal (RFPs), 75, 77, 96, 111, 196, 365, 367, 379, 380, 381, 401, 402, 409, 420, 424, 459, 470
requirements for weapon systems, determination of: acquisition process and, 36*f*, 40, 274–275, 278, 319–323, 320*f*, 327–328, 332, 335, 476–477; GAO and, 144; Gulf War and, 122, 129–130; Joint Chiefs of Staff and, 45, 555, 563; JROC and, 15, 35, 36*f*, 69, 112, 217, 472, 554; military services and, xiv, 223, 416, 442, 444; MILSPECs and, 191; Mission Need Statement and, 35, 36*f*; modeling and simulation and, 284; Operational Requirements Document and, 222, 363, 472; software development and, 266, 269; technology push and, 213. *See also specific systems*
research and development (R&D): advanced concept technology demonstrations and, 219; Air Force acquisition process and, 354; Army acquisition process and, 424; civilian industrial base and, 163; defense industry restructuring and, 494; dual-use technologies and, 504, 505–506; emphasis over production, 134–141, 552; fixed-price development contracts for, 558; industrial base policy and, 497, 499, 501; Navy and Marine Corps acquisition process and, 441, 443; as strategic asset, 131–134; technology transition and, 212–214, 214*f*. *See also* research, development, and test and evaluation; science and technology research; *and specific systems*
research, development, and test and evaluation (RDT&E): Air Force acquisition process and, 352, 360; Army acquisition process and, 391; budget for, xiii, 134; industrial base policy and, 498; Section 912 studies and, 316; Yockey and, 83n70. *See also* research and development; science and technology research; *and specific systems*
revolution in military affairs (RMA), 14–16, 17, 224, 552
Rice, Donald B., 353
Rickover, Hyman, 448
roadshows: acquisition workforce and, 536; Air Force, 362, 364, 536; Army, 400–401, 536; Navy, 459, 536
Roberson, Eileen, 458
Robinson, Mike, 340n47
rocket-propelled grenade (RPG), 6
Roche, James G., 367
Rockwell International Corporation, 128, 512
Rollover-Plus approach, 133, 140
Ronald Reagan (CVN 76), USS, 511
Rostker, Bernard D., 544
Roth, William V., Jr., 33, 154n53, 546n5
Roving Sands Exercise (1995), 229
Rowland, John G., 89
R-TOC Pilot Program Forum, 315
Rudman, Warren, 91
Rumsfeld, Donald, 428, 429

S

Sambur, Marvin R., 367
San Antonio (LPD 17) amphibious transport dock ship, USS, *462*, 478–480, *479*
San Antonio-class amphibious ships: acquisition reforms and, xvi, 200, 462–463, 480, 562; development and deployment of, 462–463, 478–479; integrated product and process

development and, 200, 462, 557; MILSPECs reduction and, 200; modeling and simulation and, 463, 479; open systems approach and, 200; Total Ship Systems Engineering and, 470
Sanders, Patricia, 286, 287
SC 21 (Surface Combatant for the 21st Century) program, 468–472
Schaefer, James H., 99, 108–109
Schwarzkopf, H. Norman, Jr., 126–127, 417, 449
Science and Technology Affordability Task Force, 308
science and technology (S&T) research: acquisition reforms and, 137, 554–555; acquisition workforce and, 540–541; advanced concept technology demonstrations and, 219; R&D emphasis over production and, 134–135; technology transition and, 213–214, 214*f*. *See also* research and development; technology
Scowcroft, Brent, 2
Sea Knight helicopter. *See* CH–46 Sea Knight helicopter
Seawolf (SSN 21), USS, 19n20, *88*, 92, 510
Seawolf-class submarines, *88*; acquisition reforms and, 31, 136, 139, 140; industrial base policy and, 521n27; Navy acquisition process and, 463–464, 474; post–Cold War force structure and, 9, 11, 88
Section 800 Panel (Advisory Panel on Streamlining and Codifying Acquisition Laws), 44, 168–171, 199, 554
Section 912 studies and report, 315–318, 317*sb*, 328, 332
Securities and Exchange Commission, 373–374
self-diagnostics, 239, 248n61
Semiconductor Manufacturing Technology (SEMATECH) program, 501–502, 506
Serbia: combat operations in, 7; NATO air campaign in, 198
service acquisition executives (SAEs), 26
Shalikashvili, John M. D., 15–16, 300
Shallow Water Assault Breaching system, 477
Sharp Corporation, 505
Shelton, Henry H., 300
Shewart, Walter, 275
Shinseki, Eric K., 426–427
Ship-To-Objective Maneuver (STOM), 477, 478, 488n85
Short-Range Attack Missile II, 141
Sikorski, Gerald E., 60
Sikorsky Corporation, 285
Simulation and Modeling in Acquisition Requirements and Training (SMART) (Army), 427
Single Acquisition Management Plan (SAMP) (Air Force) 362, 365, 367
Single Process Initiative, 191–192, 205n29
Sisisky, Norman, 374
Slatkin, Nora, 456–457, *457*, 458
Small Business Administration, 194
Smart Ship program, 469
Software Capability Maturity Model, 272
software development, 262–274, 266*f*, 267*t*; for C–17 Globemaster III, 267–268, 371; for Crusader, 426, 429; evolutionary acquisition, 275–280, 279–280*f*, 288; modeling and simulation and, 287–288; program size vs. success rate, 273, 273*t*; spiral process model, 269–271, 271*f*, 288; waterfall model, 269–270, 270*f*
Software Engineering Institute, 268, 272, 340n53
Software Technology Support Center, 273

sole-source (noncompetitive) contracting. *See* contracts/contracting
Soloway, Stan Z., 304, 306, 318
Somalia: combat operations in, 6, 7; command and control communications problems in, 283; peacekeeping operations in, 5–6
Space and Missile Systems Center, 357
Space Based Infrared System, 362
Space and Naval Warfare Systems Command (SPAWAR), 443, 445, 458–459
Special Operations Test & Evaluation Division (Air Force), 268
Specter, Arlen J., 98, 110
Spector, Eleanor R., 69, 74, *74*, 304
Spence, Floyd D., 541, 543
Spinney, Franklin C. "Chuck," *144*, 144–145, 456
spiral development, 269–271, 271*f*, 287–288, 323–327, 324–327*f*, 330, 335, 341n53, 342n59, 557, 563
Spirit aircraft. *See* B–2 Spirit stealth bomber aircraft
Spruance-class destroyers, 468
standards improvement executive (Army), 402–403
Starlifter aircraft. *See* C–141A/B Starlifter transport aircraft
stealth technologies, 234. *See also specific systems*
Stedman, William, 481n17
Steidle, Craig E., 454
Stevens, Paul S., 37
Stevens, Theodore F. "Ted," 100
Stevenson, James P., 66, 81n46
Stone, Robert A., 166
stovepipe systems, 281, 450
Stowsky, Jay, 522n48
Strassmann, Paul A., 258
Strategic Air Command, 122
Strategic Defense Initiative (SDI), 87–88, 89, 90, 92, 94, 131
Strategic Defense Initiative Organization, 135
Strategic Outcome Metrics, 195
Stratford Army Engine Plant, 519n5
Strike Eagle aircraft. *See* F–15E Strike Eagle fighter aircraft
Stryker vehicles, 427
subcontractors, 493*sb*, 519n3
Sullivan, Gordon R., 16, 160, *415*, 415–417, 420, 437n77
Sununu, John H., 500
supercomputing, 265
Super Hornet aircraft. *See* F/A–18E/F Super Hornet fighter aircraft
Super Stallion helicopter. *See* CH–53 Super Stallion helicopter
Super Tomcat aircraft. *See* F–14D Super Tomcat fighter aircraft
SUPSHIPs (supervisors of shipbuilding, conversion, and repair), 444
Surface Combatant for the 21st Century (SC 21) program, 468–472
Synthetic Theater of War–97 ACTD, 218
system of systems, 15, 20–21n32, 408; Global Command and Control System as, 277
system program offices (SPOs), 123, 352, 365, 378

systems commands (SYSCOMs): acquisition reforms and, 185–186; Defense Management Review and Report and, 35; Defense Systems Affordability Council and, 308; evolutionary acquisition and, 333; Reduction of Total Ownership Cost initiative and, 311
Systems Engineering Steering Group, 308

T

Tactical Air Command (TAC), 122, 166
Tactical High-Energy Laser, 216
Tactical Internet (Army), 420, 421
Tactical UAV ACTD. *See* unmanned aerial vehicles (UAVs)
Taft, William H., IV, 27, 60
Tank Automotive Research, Development and Engineering Center (Army), 284
Task Force Ranger, 6
teaming approach: Army use of, 403–405; Navy use of, 467. *See also* integrated product teams
technology, 211–243; advanced concept technology demonstrations and, 219; as advantage over opponents, xiv, 345, 552; Army modernization and, 408; business process reengineering and, 180; command and control systems, 274–283, 279–280*f*; embedded computer systems, 253–257, 254*f*, 282–283, 288n6, 371; as force multiplier, 14, 17, 415; hardware and software development challenges, 262–274, 266*f*, 267*t*; life-cycle mismatch, integrated circuits vs. weapon systems, 265, 265*f*; mission-critical computer systems, 252–253, 255*sb*; modeling and simulation and, 284–285, 285*sb*; new approaches to developing, 552–553; Office of the Secretary of Defense and computer acquisition, 252–262; transition and, 212–214, 214*f*. *See also* information technology and warfare; research and development; research, development, and test and evaluation (RDT&E); science and technology research; *specific technologies and weapon system programs*
technology readiness levels, 333
Technology Reinvestment Project (TRP), 507–508, 509
Technology Strategies and Alliances Inc., 160, 236
Teledyne Inc., 424
Tellep, Daniel L., 514–515
test and evaluation master plan, 437–438n84
Tetrault, Roger E., 139
Texas (SSN 775), USS, 475
Texas Instruments Incorporated, 128, 405, 409, 492; Defense Systems Electronics Group, 191, 493*sb*
Textron Lycoming Turbine Engine Division, 519n5
Thayer, Paul W., 60
Theater Battle Management Core System, 325
Theater High Altitude Area Defense (THAAD): open systems approach and, 138
threat-based force planning, 10, 11
Thunderbolt aircraft. *See* A–10 Thunderbolt II close air support aircraft
Ticonderoga-class cruisers, 468
Tilelli, John H., Jr., 424
tiltrotor aircraft concept, 95, 115n27. *See also* V–22 Osprey
Tilt-Rotor Technology Coalition, 98, 110
Toffler, Alvin, 164
Tollefson, Kenneth, 388n72

Tomahawk cruise missiles, 7
Tomcat aircraft. *See* F–14A Tomcat fighter aircraft
total ownership cost, 310–315, 310*f*, 314*t*, 401, 558. *See also* Reduction of Total Ownership Cost (R-TOC) initiative
Total Ownership Cost Working Group, 315
total quality management (TQM), 54–56, 78n4, 165, 167, 188, 355
Total Ship Systems Engineering, 470
Tower, John G., 33, 54
TOW II missile, 31
Toyota Corporation, 249n63
Training and Doctrine Command (TRADOC). *See* U.S. Army Training and Doctrine Command
Transcendental Aircraft Company, 95
Trident II missile. *See* UGM–133 Submarine-Launched Ballistic Missile
Tri-Service Standoff Attack Missile, 141
Truth in Negotiations Act of 1962, 171
TRW Inc., 158*sb*, 275, 284, 361, 397, 420
Tuguchi, Genichi, 78n4
Twenty-First Century Destroyer Technology study (1992), 468

U

U–2 Dragon Lady reconnaissance aircraft, 232
UAVs. *See* unmanned aerial vehicles
UGM–133 Trident II Submarine-Launched Ballistic Missile: open systems approach and, 200
UH–60 Black Hawk helicopter, 6, *407*; deployment of, 391; integrated product and process development and, 557; joint-industry teams for, 405; modernization of, 410; V–22 Osprey and, 97
underfunding of weapon system programs: Arsenal Ship, 472; Congress and, 144–145; F–22 Raptor, 76, 90, 93; F/A–18E/F Super Hornet, 76; GAO on, 76
under secretary of defense for acquisition (USD[A]): A–12 Avenger II and, 65, 70; acquisition reform, role in, 134, 304, 337n18; Army acquisition process and, 395; authority of, 26, 27–28, 34, 35, 45, 58, 554; Cheney and, 53–54; command and control systems and, 276; Defense Reform Initiative and, 337n18; discipline in acquisition process and, 74–75; dual-use technologies and, 508; establishment of (1987), 25, 554; Operation Desert Storm and, 122; organization for acquisition reform, 181–184, 182*f*. *See also* Costello, Robert B.; Betti, John A.; Deutch, John M.; Yockey, Donald J.
under secretary of defense for acquisition and technology (USD[A&T]), xiii, 306, 308, 337n18. *See also* Deutch, John M.; Kaminski, Paul G.; Gansler, Jacques S.
under secretary of defense for acquisition, technology, and logistics (USD[AT&L]), xiii, 312. *See also* Gansler, Jacques S.; Aldridge, Edward C., Jr.
United Defense Limited Partnership, 405, 424, 425, 426, 429, 433n42
United Kingdom: acquisition system in, 526; advanced concept technology demonstration contributions from, 216
United Nations, post–Cold War role of, 4–5
United Nations Operation in Somalia (UNOSOM), 5–6
unmanned aerial vehicles (UAVs), xv, 211, 218, 223–233, 227–228*f*, 230*t*, 243, 553, 555; RQ Gnat–750, 229; High Altitude Endurance ACTD, 215; RQ–1 Predator, xvi, 211, 221, 229–233, 230*t*, 231, 233, 243, 245n22, 553, 555, 561; RQ–2 Pioneer, 223–224, *224,* 227, 230*t*;

RQ–3 DarkStar, 229, 232, 469; RQ–4 Global Hawk, 229, 230*t*, 232, *232*, 469; RQ–5 Hunter, 227, *228*, 230*t*, 246n37; RQ–6 Outrider Tactical UAV ACTD, 229, 232
U.S. Army Forces Command (FORSCOM), 417
U.S. Army Training and Doctrine Command (TRADOC), 416–418
U.S. Central Command (CENTCOM), 122
U.S. Central Command Air Forces (CENTAF), 122, 129
USD(A). *See* Under Secretary of Defense for Acquisition

V

V–22 Osprey tiltrotor aircraft, 85–113, *103*, *113*; Cheney, opposition to production of, 88, 91, 93, 94, 97, 103–104, 105, 107–109, 113; development and deployment of, 95–97, 105, 108, 112; politics of, xvi, 85, 94–95, 97–105, 106–113, 562; post–Cold War force structure and, 9, 11, 88–89, 90–94, 112–113; prototype, *97*
Vanderpoel, Eric V., 69–70, 82n52
Vazquez, Bud, 389n83
Verdin Communications System, 492
vertical integration (industry), 517, 518
Very High Speed Integrated Circuits, 265
Virginia (SSN 774), USS, 463, *465*, 475
Virginia-class submarines, *464, 465, 475*; acquisition reforms and, xvi, 200, 462, 464, 466, 474, 480, 561; commercial off-the-shelf products and, 466; cost growth and, 474; development and deployment of, xvi, 462–465, 468, 474–475, 552; integrated product and process development and, 464, 474, 557; integrated product teams and, 464, 557; modeling and simulation and, 464, 474; modular construction and, 464–465, 474; open systems approach and, 200; Total Ship Systems Engineering and, 470
Vought Corporation, 512
VTX–TS pilot training system, 76
Vuono, Carl E., 149n11

W

Wagner, Louis P., 395
Wagner, Richard L., 131–132, 134
Wallop, Malcolm, 139
Warfighter Rapid Acquisition Program (Air Force), 221, 331, 553
Warfighting Rapid Acquisition Program (Army), 221, 419, 553
Warner, John W., 91
Warner Amendment, 253, 255, 262
waterfall model of development, 269–270, 270*f*
Waxman, Henry A., 476
weapons of mass destruction (WMDs), 5
Weinberger, Caspar W., 4, 27, 32, 157, 370
Welch, John J., Jr., 58, 352
Welch, Larry D., 54, 99
Weldon, Wayne C. “Curt,” 98, *98*, 100, 107, 109
Werrell, Kenneth P., 149n8, 149n11
West, Togo D., Jr., 399

Westinghouse Electric Corporation, 304, 512
White Paper on the Department of Defense and the Congress (Cheney), 43
Whittle, Richard, 97, 104, 105
Widnall, Sheila, 360, 361
Wilson, James Q., 164
Wind Corrected Munitions Dispenser, 362, 385n37
Wolfowitz, Paul D., 2, 148n5, 335, 429
Worldwide Military Command and Control System, 279

X

X–32 aircraft prototype, *240*, 242
X–35 aircraft prototype, *240*, 242
Xerox Corporation, 510
XV–3 convertiplane, *95*, 95
XV–15 tiltrotor aircraft, *95*, 95–96, 98

Y

Yates, Ronald W., 353, 354, 357
YF–16/YF–17 Light Weight Fighter aircraft program, 241
Yockey, Donald J., *73*; A–12 Avenger II and, 53, 58–59, 62, 71, 75; acquisition workforce and, 546n19; biographical background, 73*sb*; centralization of acquisition authority and, 154n53; Defense Acquisition Workforce Improvement Act and, 529; Operation Desert Storm and, 122, 130; as USD(A), 72–77, 82–83n62, 83n70

Z

Zumwalt, Elmo R., Jr., 32
Zumwalt (DDG 1000), USS, *473*, 473–474
Zumwalt-class destroyers, 82n53, 335, *473*, 473–474