

2

AD-A260 809



Independent Evaluation of The Bay Area Supply Depot Consolidation Prototype

DTIC
ELECTE
FEB 25 1993
S E D

PL101R1

John B. Handy
Samuel J. Mallette
Robert L. Crosslin
William T. James, III
Craig C. Sherbrooke

DISTRIBUTION STATEMENT
Approved for public release
Distribution Unlimited

December 1991

Independent Evaluation of The Bay Area Supply Depot Consolidation Prototype

DTIC QUALITY INSPECTED 3

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced Justification	<input type="checkbox"/>
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

PL101R1

John B. Handy
Samuel J. Mallette
Robert L. Crosslin
William T. James, III
Craig C. Sherbrooke

93-03834



16507

Prepared pursuant to Department of Defense Contract MDA903-90-C-0006. The views expressed here are those of the Logistics Management Institute at the time of issue but not necessarily those of the Department of Defense. Permission to quote or reproduce any part - except for Government purposes - must be obtained from the Logistics Management Institute.

Logistics Management Institute
6400 Goldsboro Road
Bethesda, Maryland 20817-5886

Executive Summary**INDEPENDENT EVALUATION OF THE BAY AREA SUPPLY DEPOT
CONSOLIDATION PROTOTYPE**

In 1990, Defense Management Report Decision (DMRD) 902, Consolidation of Defense Supply Depots, predicted that DoD could realize significant savings if its supply depots were consolidated under the Defense Logistics Agency (DLA) and a uniform automated distribution system were developed to replace the multiple systems then in use. The DMRD projected that the consolidation, while saving money, would not result in decreased performance. The Deputy Secretary of Defense approved the consolidation and directed, as a first step, that five supply depots in the San Francisco Bay Area be consolidated to serve as a prototype. This report presents an analysis of the first year of prototype operations and our independent evaluation of the prototype's effectiveness.

The prototype demonstrated that the Bay Area consolidated supply depots can maintain or improve operations and meet customer mission needs. It has done so in a period that included a steady decline in the depot supply workload throughout DoD (the FY91 Bay Area workload is down 8 percent from the baseline year – FY89) and the turbulent conditions during the Middle East conflict. From our analysis we find that:

- Distribution performance has generally improved in the Bay Area since the baseline year. The exception was that issue performance declined at the Oakland site, where serious complications in converting systems resulted in performance degradation.
- Customer satisfaction has not changed appreciably since consolidation. In fact, many customers were not aware of the change in supply depot management.
- The number of depot employees has significantly decreased since the baseline year; in August 1991, total end strength at the prototype depots was down 693 positions (500 of them full time) from the 5,074 positions in October 1989. Those reductions were the result of normal attrition and have yielded a cost savings of \$24.5 million.

- Regional management has taken numerous steps to improve prototype operations and has reallocated resources within the region to better utilize facilities and personnel. Equipment and storage aids valued at \$2 million have been moved to Bay Area sites where they could be put to more productive use.
- To obtain transportation savings, DLA's Western region has extended lower freight rates to shipments from all sites, synchronized the release of material to individual customers or geographic regions so that shipments can be consolidated more readily, and expanded the use of regional freight consolidation centers. DLA has not claimed those transportation savings for the prototype because they are to be credited to DMRD 915.
- Savings from the closure of a redundant containerization/consolidation point did not occur in FY91 as planned because the redundant site was not closed until expiration of its contract at the end of the year. However, savings are expected in FY92.
- Implementation of the uniform Defense Distribution System (DDS) has not been smooth. The haste to implement multiple hardware and software conversions resulted in system errors, timing problems, and down time. Those problems degraded the performance and productivity of some depot operations at the Oakland site. The DDS installed there is very dependent on multiple interface linkages, and they were not highly reliable. DDS does not yet contain all of the features described in the DLA functional/environmental baseline.
- Stock consolidation between Bay Area sites has been limited. Regional management has taken important steps to prepare for large-scale consolidation at the primary distribution site but, to date, little stock has been consolidated.

Our assessment is that overall performance has improved in the consolidated operation and customers generally remain satisfied. While operational improvements under single management are quite evident, the prototype has not yet demonstrated consolidation savings on the scale of those originally projected. Substantial consolidation savings were to come from productivity gains. Since productivity has remained steady, the significant personnel savings realized since the baseline year are consistent with the declining workload rather than consolidation actions. The uniform DDS has not yet proven successful because of software reliability problems and complex, undependable interfaces. We do not believe that the warehouse control portion of DDS, as presently designed, will improve work force productivity at the Bay Area sites.

We expect the Bay Area depot consolidation to produce savings without diminishing performance. The prototype experienced both the trauma of reorganization and the turbulence of the Gulf war during its first year of operation. Barring the diversions experienced in the first year, the second year of the prototype operations should more clearly demonstrate the scope of savings that can be expected from consolidating supply depots in the Bay Area.

CONTENTS

	<u>Page</u>
Executive Summary	iii
List of Tables	ix
List of Figures	x
Chapter 1. Introduction	1- 1
Background	1- 1
The Prototype Plan	1- 1
The Defense Distribution System	1- 7
The Independent Evaluator	1- 7
Chapter 2. Findings	2- 1
Overview	2- 1
Operating Environment	2- 2
Performance	2-10
Prototype Costs	2-24
Personnel Savings	2-26
Transportation and CCP Savings	2-30
Defense Distribution Region West Management	2-31
Defense Distribution System Characteristics	2-36
DDS Operation	2-36
Defense Distribution System Performance	2-40
Stock Consolidation	2-43
Chapter 3. Assessment	3- 1
Prototype Performance	3- 1
Prototype Savings	3- 3
Consolidation Costs	3- 9
Consolidation Potential in the Bay Area	3-11
Appendix A. Description of Depots	
Appendix B. Prototype Evaluation Plan	
Appendix C. Sources of Information	

CONTENTS (Continued)

Appendix D. DDRW Productivity Calculations

Appendix E. Workload and Performance Data

Appendix F. Service-Unique Workload and Performance Data

TABLES

	<u>Page</u>
1- 1. Site Names	1- 3
1- 2. Projected Savings	1- 4
1- 3. Projected Costs	1- 5
1- 4. Projected Net Savings for First 5 Years	1- 6
2- 1. Depot Processing Time Standards	2-12
2- 2. Performance Measure Definitions	2-13
2- 3. Tracy Site Average Monthly Performance	2-14
2- 4. Sharpe Site Average Monthly Performance	2-16
2- 5. Oakland Site Average Monthly Performance	2-17
2- 6. NISTARS Versus DWASP On-Time Issue Comparison	2-18
2- 7. SRDD Average Monthly Performance	2-20
2- 8. SSDS Average Monthly Performance	2-21
2- 9. Oakland Bearer Walk-Throughs	2-23
2-10. Over-Age High-Priority Requisitions	2-24
2-11. DDRW End Strength	2-27
2-12. Contract Cancellation and Redistribution Savings Claimed by DDRW from Consolidation	2-34
3- 1. Consolidation Costs to Date	3-10

FIGURES

	<u>Page</u>
1-1. Bay Area Supply Depots	1- 3
1-2. Defense Distribution System Architectural Concept	1- 8
2-1. Bay Area Receipts and Issues	2- 5
2-2. Shipping Activity	2- 6
2-3. Percentage of DDRW Issues in Issue Priority Groups 1 and 2	2- 8
2-4. Percentage Change in Monthly Issues Since July 1990	2- 9
2-5. DDRW Productivity	2-29
2-6. Defense Distribution System Conceptual Interconnection	2-37
2-7. Defense Distribution System at Sharpe	2-38
2-8. Defense Distribution System at Oakland	2-39

CHAPTER 1

INTRODUCTION

BACKGROUND

On 12 April 1990, the Deputy Secretary of Defense issued a memorandum approving the consolidation of material distribution functions at defense supply depots. In the same memorandum, he also stipulated that consolidation of the five supply depots in the San Francisco Bay Area would serve as a prototype to be operated in accordance with the DoD *Supply Depot Consolidation Study*.¹

This report documents an independent evaluation of the prototype by the Logistics Management Institute (LMI). It describes how well the prototype has satisfied its goals of maintaining or improving performance, reducing costs, and demonstrating the viability of a uniform automated distribution system. The report presents our findings, assessment, and recommendations after the first year of a 2-year evaluation period.

THE PROTOTYPE PLAN

A plan for the Bay Area prototype, dated 18 April 1990, was included as an appendix to the supply depot consolidation study report. The plan defines the objective and scope of the prototype, describes the Defense Distribution System (or DDS, the uniform automated distribution system to be tested in the Bay Area), and summarizes the costs and savings expected from the Bay Area supply depot consolidation. The plan's main points are summarized below.

According to the plan, the prototype is intended to satisfy the following objectives:

- Demonstrate that consolidated operations can maintain or improve readiness and meet customer mission needs at reduced costs

¹Department of Defense, Office of the Assistant Secretary of Defense (Production and Logistics), Defense Management Review, *Supply Depot Consolidation Study*, May 1990.

- Demonstrate that software and procedures can be implemented which will permit consolidated, effective and efficient distribution processes
- Demonstrate viability of pilot standard receipt, stow, issue and ship operations, which minimizes packing and shipping points
- Utilize the best facilities of the prototype installations to accomplish effective use of storage space
- Obtain savings from the consolidation of operations
- Determine which traditional and planned Army Area Oriented Depot (AOD), Navy Naval Supply Center (NSC), Air Force Air Logistics Center (ALC), and Defense Logistics Agency (DLA) distribution functions can be performed in the combined operation.

The prototype consists of five distribution depots which were originally operated by the Army, Navy, Air Force, and Defense Logistics Agency (DLA). The supply operations that were combined to form the prototype were located at Sharpe Army Depot (SHAD), one of the Army's three area-oriented depots; Sacramento Army Depot (SAAD); Naval Supply Center Oakland (NSCO); Sacramento Air Logistics Center (SAALC); and Defense Depot Tracy, California (DDTC). The locations of those depots are shown in Figure 1-1, and the depots are described in detail in Appendix A.

Consolidation Schedule and Organization

The Bay Area prototype was created in two increments. The first, in June 1990, was the creation of the Defense Distribution Region West (DDRW) and the transfer of DDTC, SHAD, and the distribution functions of the NSCO to DDRW. The second, in April 1991, was the transfer of distribution functions at SAAD and SAALC to DDRW. [In our report, we refer to data from the sites consolidated in June 1990 as "three-site" data and to data for all sites now under DDRW management as "five-site" data.]

The sites have been renamed by DDRW, and the Tracy and Sharpe depots have been combined into a single site – the San Joaquin site – with many shared organizational elements. The new site names are shown in Table 1-1.

In this report, we usually refer to the sites by DDRW's names. The main exception is the San Joaquin Distribution Site; we frequently found it necessary to refer to its Sharpe and Tracy elements separately as the "Sharpe site" or "Tracy site." We also refer to the two Sacramento sites by the acronyms SRDD (Sacramento

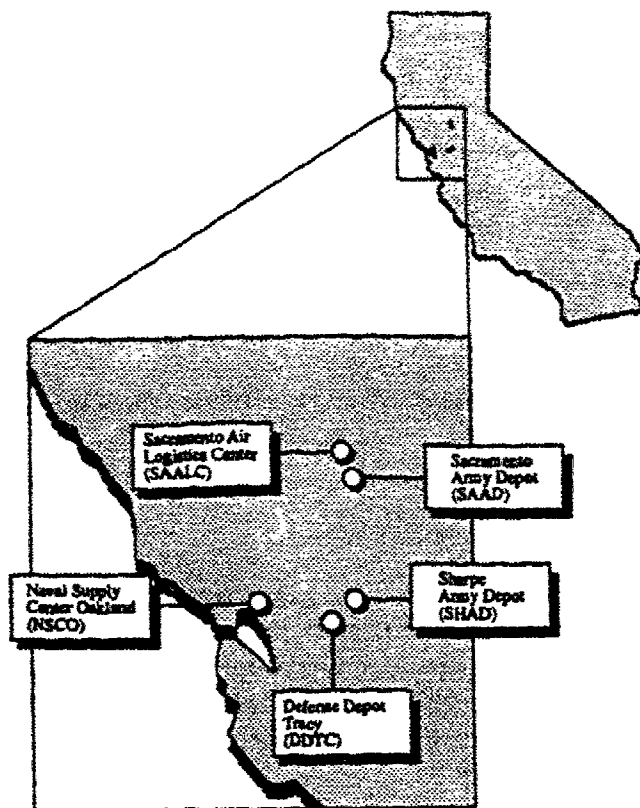


FIG. 1-1. BAY AREA SUPPLY DEPOTS

TABLE 1-1

SITE NAMES

Before consolidation	After consolidation
Defense Depot Tracy Sharpe Army Depot	San Joaquin Distribution Site
Naval Supply Center Oakland Sacramento Army Depot	Oakland Distribution Site Sacramento Remote Distribution Division
Sacramento Air Logistics Center	Sacramento Specialized Distribution Site

Remote Distribution Division – distribution activities at the Sacramento Army Depot) and SSDS (Sacramento Specialized Distribution Site – distribution activities at the Sacramento Air Logistics Center).

Projected Savings from Consolidation

The plan stated that the return on the investment to consolidate depots and implement DDS would be achieved through “system uniformity and operational streamlining,” with savings realized through a combination of overhead reduction, operational improvements from more efficient use of facilities and installation of better mechanization, and reduced transportation costs. Savings were projected to amount to \$165.2 million for the 5-year period from FY91 through FY95. The projected savings are shown by source and year in Table 1-2.

TABLE 1-2
PROJECTED SAVINGS
 (As listed in prototype plan)

Source of savings	Savings (\$ millions)					
	FY91	FY92	FY93	FY94	FY95	Total
Personnel reductions	7.3	18.8	24.2	24.2	24.2	98.7
Transportation consolidation	1.5	3.0	6.0	6.0	6.0	22.5
Closure of one consolidation/ containerization point	1.5	1.5	1.5	1.5	1.5	7.5
Cancellation of programmed construction projects	—	—	24.7	—	—	24.7
Cancellation of mechanization projects	—	—	10.3	1.5	—	11.8
Total	10.3	23.3	66.7	33.2	31.7	165.2

Personnel reductions are the largest source of projected savings from the consolidation, with 77 percent of the operational savings and 60 percent of the total savings over the 5-year period expected from them. The plan calls for personnel equivalents (full-time employees) to be reduced by 807, with 244 of the reductions

expected in FY91, the first full year of operation. The prototype plan bases its savings estimate on achieving the DDTC productivity rate at all Bay Area sites.

Two other sources of savings were expected for the first year. First, depot consolidation was expected to provide more opportunity for freight consolidation than existed with the individual depots, and that improved freight consolidation was expected to result in transportation savings. Second, savings were expected from the closure of one of the two consolidation/containerization points (CCPs) in the region and the associated reduction of contract and administrative expenses.

Projected Costs of Consolidation

Consolidation of the Bay Area supply depots was projected to cost \$43.1 million (\$27.4 million for the development and installation of DDS and \$15.7 million for prototype implementation) as shown in Table 1-3. The DDS costs were to be funded as a Corporate Information Management (CIM) initiative but were included in the plan as automated data processing (ADP) costs for consolidation.

TABLE 1-3
PROJECTED COSTS
(As listed in prototype plan)

Category	Costs (\$ millions)			
	FY90	FY91	FY92	Total
ADP operations and maintenance (O&M)	2.0	7.0	4.3	13.3
ADP procurement defense acquisition (PDA)	1.8	12.3	—	14.1
ADP subtotal	3.8	19.3	4.3	27.4
Implementation O&M	0.3	6.5	3.0	9.8
Implementation PDA	—	5.9	—	5.9
Implementation subtotal	0.3	12.4	3.0	15.7
Total costs	4.1	31.7	7.3	43.1

Projected Net Savings from Consolidation

The net savings estimate from the prototype plan is shown in Table 1-4. Because the FY90 investment costs were not included in the net savings calculation, projected net savings were overstated in the plan by \$4.1 million. The projected net savings by the end of FY95 should total \$122.1 million.

TABLE 1-4
PROJECTED NET SAVINGS FOR FIRST 5 YEARS
(As listed in prototype plan)

Category	Amount (\$ millions)
Total costs (FY90 through FY95)	
O&M	23.1
PDA	20.0
Total costs	43.1
Total savings (FY91 through FY95)	
Personnel reduction	98.7
Transportation consolidation	22.5
Closure of one CCP	7.5
Cancellation of programmed construction projects	24.7
Cancellation of mechanization projects	11.8
Total savings	165.2
Net 5-year savings (FY91 through FY95)	
Total savings	165.2
Total costs (excludes FY90 costs)	39.0
Net savings	126.2

Note: O&M = operations and maintenance; PDA = procurement defense acquisition.

A net savings was not expected in FY91. The prototype plan projected savings for FY91 (\$10.3 million) and projected costs for FY91 (\$31.7 million) resulted in an expected net cost for FY91 of \$21.4 million. FY92 is the first year in which a net savings for consolidation was to occur.

THE DEFENSE DISTRIBUTION SYSTEM

To support depot consolidation, the prototype plan envisioned an ADP system that would improve service and reduce associated system operating costs. Both the improved service and the reduced costs stem from the notion of capturing the best available functional capability with a single, easily maintainable system. The DDS functional baseline requirements stipulated a composition of the following portions from DoD Components' existing systems:

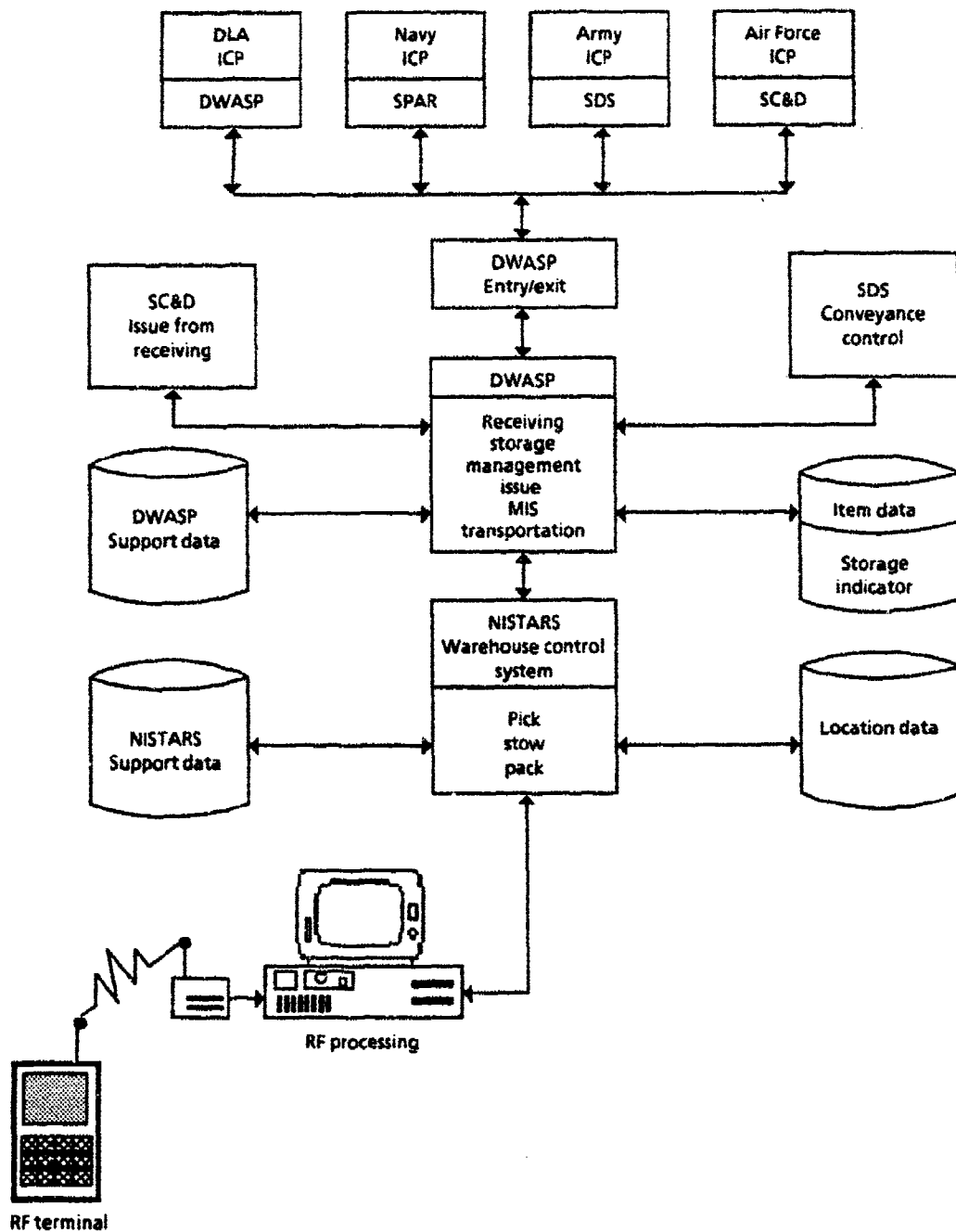
- DLA Warehousing and Shipping Procedures (DWASP): receiving and shipping²
- Air Force Stock Control and Distribution (SC&D) System: issue from receiving
- Naval Integrated Storage, Tracking, and Retrieval System (NISTARS): stowing, picking, and process control using hand-held radio frequency (RF) mobile communications devices and fixed-station terminals
- Army Standard Depot System (SDS): conveyance control, linked to receiving and shipping
- SDS – CCP operation.

The plan stated that overall savings would result from maintaining one rather than many systems, operating fewer data centers at the field level, and enhancing productivity in the distribution operations themselves. Figure 1-2 illustrates the planned system consolidation.

THE INDEPENDENT EVALUATOR

A Test and Evaluation Master Plan (TEMP) was developed jointly by the OSD staff, the Military Services, and DLA to task an independent evaluator to assess the prototype's performance, baseline, costs, and savings relative to the prototype plan. OSD selected LMI as the independent evaluator and the evaluation began on 9 October 1990.

²DWASP shipping function supports material release order (MRO) control (shipment unit consolidation, geographic area scheduling, workload planning, and workload pull). Shipping and transportation functions include fully automated shipment planning, transportation unit consolidation, rating, routing, carrier selection, Government bill of lading (GBL) preparation, small parcel costing and mode selection, and small parcel manifesting. The DWASP shipping function also provides both automated seavan planning and set assembly operations.



Note: ICP = Inventory control point; SPAR = Stock Point ADP Replacement; MIS = management information system.

FIG. 1-2. DEFENSE DISTRIBUTION SYSTEM ARCHITECTURAL CONCEPT

Evaluation Plan

As required by the TEMP, LMI prepared and submitted to the Office of the Assistant Secretary of Defense (Production and Logistics) [OASD(P&L)] a prototype evaluation plan on 31 October 1990. The evaluation plan was accepted by OASD(P&L). It is included as Appendix B. Following the plan, we evaluated four areas:

- *Operating Environment:* The environment consists of the conditions within which the prototype operates that could affect the cost of operations. Of particular interest were the workload mix, operating tempo, distribution mission, and inventory characteristics.
- *Performance:* The measures to be used to evaluate the prototype's performance were well defined in the TEMP. We proposed to identify any other measures that were used locally at the Bay Area depots and to also monitor them. The TEMP's measures largely concerned wholesale activity, and we proposed monitoring retail activity as well.
- *Subjective Performance Measurement:* The TEMP did not mention the degree to which customers were affected by the consolidation as a measure of the prototype's effectiveness. We proposed to try to determine how significant the change was to the depots' customers.
- *Costs:* Unit costs and their supporting data from OASD (Comptroller) were to be used to evaluate both costs and savings of the prototype. We proposed to use the data being collected to produce the unit cost reports as the most appropriate source of cost information since costs would be accrued only for consolidated functions (and not for functions that were retained by the Services). Since the reports were to be produced on a regular basis, they could be used to show cost trends, relate costs to workload, and help identify any savings that resulted from consolidation. Because the functions actually transferred to the prototype were not decided until shortly before the consolidations themselves, accurate cost information was not available for the baseline year, and the raw data needed to construct a baseline are no longer available.

Sources of Information

In Appendix C, we list the sources of the information used in our analysis. Most are on-site data reports and information provided to us during visits to the Bay Area. The appendix also contains the report of a certified public accountant who conducted an audit of the source material and found that it was accurately collected.

CHAPTER 2

FINDINGS

OVERVIEW

The prototype's first year of operation was marked by important changes in its operating environment. Operations Desert Shield and Desert Storm and assistance operations for the Kurdish refugees added temporarily to the workload. The workload declined 8 percent in FY91 from FY89, the baseline year. In the analysis, for valid comparisons to the baseline, we adjusted for much of the impact of the operating environment. Our analysis of the Bay Area supply depot consolidation prototype resulted in the following overall findings:

- Statistics generally show that performance has improved in the Bay Area except at Oakland where problems with ADP systems contributed to the decline in performance. Service-unique performance measures identified in the prototype plan have generally been unchanged, although Direct Supply Support (DSS) performance for Army Forces Command units in the Western U.S. has declined.
- Customer satisfaction with DDRW service has remained stable since consolidation. In fact, many customers were unaware of any change. At Oakland, the Navy's customer service staff has closely monitored DDRW performance and has worked closely with DDRW to help resolve problems.
- Unit cost baselines and reporting systems could not be used to evaluate consolidation savings. We evaluated savings by examining expected sources of savings such as personnel reductions, CCP savings, etc.
 - ▶ The number of personnel dropped by 500 full-time end-strength positions (693 total end-strength positions) through attrition. That reduction accounts for approximately \$24.5 million in payroll savings since the baseline year.
 - ▶ No CCP savings occurred in FY91 as planned. The CCP contract at SSDS expired at the end of FY91 and has not been renewed; therefore, CCP savings are expected in FY92.
 - ▶ Transportation savings are being achieved but are being claimed under Defense Management Report Decision (DMRD) 915, Transportation Cost

Reduction. They are not being claimed as savings from depot consolidation.

- DDRW made numerous management improvements and reallocated resources within the region to better utilize facilities and personnel. Equipment and storage aids valued at \$2.0 million have been moved to Bay Area sites where they could be put to more productive use.
- The DDS installed at Oakland has had compatibility and communications problems as well as malfunctions in the warehouse control system (WCS) software. Systems problems have resulted in reduced performance and lower productivity at the Oakland site.
- Stock consolidation between DDRW sites has been limited. DDRW has taken important steps to prepare for large-scale consolidation at the primary distribution site, but as yet, little actual stock consolidation has taken place.

The remainder of this chapter presents the evaluation findings in more detail.

OPERATING ENVIRONMENT

The prototype's first year of operation was marked by important changes in its operating environment, and some of those changes were significant enough to warrant an adjustment in the analysis. The first change was that workload, measured in terms of issues and receipts (including inductions for maintenance and returns for reparable items), has decreased since the baseline year. That decrease indicates that the level of customer and inventory control point (ICP) activity is down.

Second, the crisis in the Middle East began shortly after consolidation of the first three DDRW sites at Tracy, Sharpe, and Oakland in June 1990. Operation Desert Shield began in August and continued to affect DDRW operations through March 1991. Then, for several more months, DDRW conducted large food assembly operations to support the Kurdish refugees. More recently there have been increases in the number of field returns from Operation Desert Storm. The effect of those changes on DDRW's operations are discussed below.

Third, the consolidation of the three original sites in June 1990 and the Sacramento sites in April 1991 took significant amounts of time. The time spent in transferring personnel, negotiating with unions, and improving facilities, for example, diverted management and support personnel from their normal duties.

Finally, multiple computer system changes over a very short period of time have had major impacts in DDRW, primarily at Oakland. The biggest contributors were the NISTARS RF conversion at Oakland in January 1991, the connection of NISTARS in Oakland to DWASP in Sacramento in April, and the Uniform Automated Data Processing System (UADPS) computer relocation to Sacramento with its associated communications problems. Problems from those changes continue to affect Oakland.

Before discussing those changes in the operating environment, a brief description of our approach to measuring workload and productivity may prove helpful.

Workload Measurement

Throughout this report, the combined volume of DDRW stock receipts and issues is used as a measure of workload. That measure is used for two reasons: first, the prototype plan bases its projected personnel savings on the number of receipts and issues projected to be processed per employee per year. Second, receipts and issues are the primary outputs used to compute unit costs for supply depots under the resourcing guidance of the OASD Comptroller.

Receipts and issues are representative of total workload, particularly in the short term and in a small region, but their use can have some drawbacks.

- They comprise receipts, returns, inductions, and issues – the most important workload measures – but other measures are not counted. At some Bay Area sites (especially at Sharpe), for example, some activities are independent of the receipt, storage, and issue functions to which those workload measures apply. Changes in workload for those activities cannot be detected if receipts and issues are the only workload measures.
- An implicit assumption in the counting of workload is that all units of workload are of equal importance. For example, returns count the same as new receipts. However, returns involve much more effort to research and properly rewarehouse. The importance of returns increased as Operation Desert Storm came to an end earlier this year, and as the U.S. military force-structure declines significantly over the next several years, returns will be – and will remain – an increasing proportion of receipts.
- Changes in the mix of receipts and issues can make workload units less meaningful. For example, DDRW computed that its cost to process an issue

is only about 62 percent of the cost to process a receipt.¹ If the ratio of receipts to issues were to change, the resulting impact on resources needed at DDRW would be very difficult to recognize.

- The cost of an issue is assumed to be independent of the priority, though Issue Priority Group (IPG) 1 and 2 issues are undoubtedly more expensive because they cannot be consolidated into a single package and that inability results in higher packing and transportation costs.

The drawbacks of using the number of issues and receipts as a measure are severe if that measure is used to compare two different sites. In this study, however, we have not done that. Instead, we have focused on either the five individual sites or the region as a whole and used the measure only to monitor progress over time. This approach is appropriate since there have been no dramatic shifts in the kinds of activities that are supported by the five sites. Although some changes occurred during Operation Desert Shield, we have been able to adjust for them as described later.

Productivity Measurement

Productivity is defined as the number of lines received and issued divided by productive work-hours (all work-hours except leave and holidays). This measure is similar to the measure used in the prototype plan as the primary basis for projecting personnel savings arising from the consolidation. We adjusted both the number of lines received and issued and the number of productive work-hours to account for some changes in the prototype's operating environment, specifically subsistence production operations in support of Operations Desert Shield and Desert Storm.

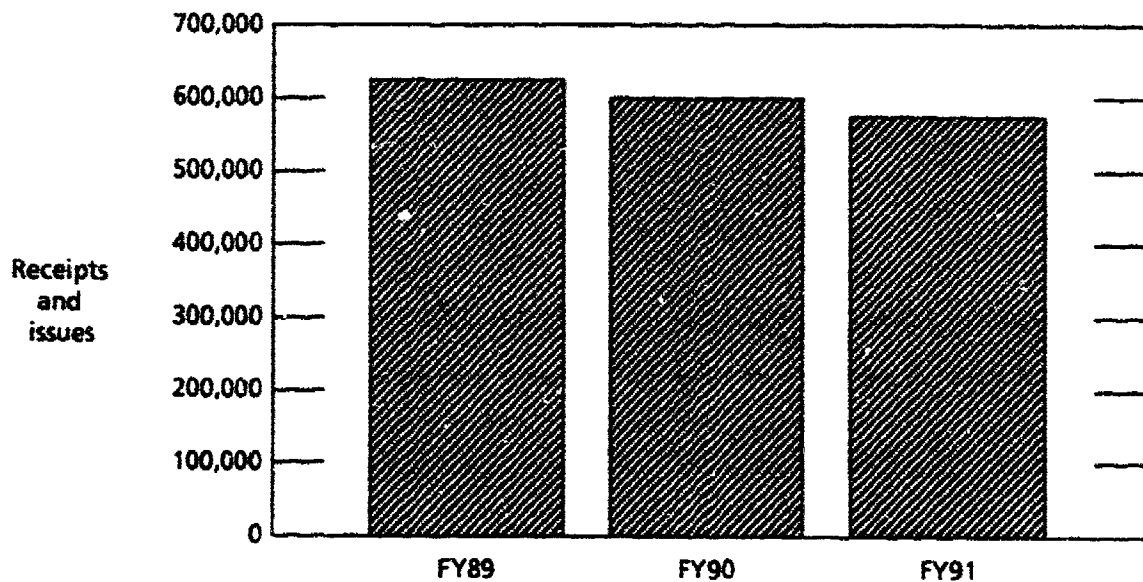
Our productivity measurement focused on the three DDRW sites consolidated in June 1990, where DDRW management has had time to have an effect on productivity. The Sacramento sites were incorporated into DDRW in April 1991, and we have tracked their subsequent productivity. However, productive work-hour data could not be collected by the Service accounting systems prior to April 1991, and, thus, we were unable to compare their productivity now to productivity during the baseline year.

¹These estimates are taken from DDRW's monthly unit cost reports. The costs vary by site and month and can be used only as a rough guide. For the San Joaquin site, the average unit costs for FY91 through June 1991 were:

Receiving - Bin	\$16.72	Shipping - Bin	\$8.10
Receiving - Bulk	\$70.86	Shipping - Bulk	\$46.62

Decrease in Level of Activity from the Baseline Year

Figure 2-1 shows average monthly receipts and issues by fiscal year for the five DDRW sites. On a fiscal year basis, the workload in 1990 averaged 4.2 percent less than in the baseline year of 1989; in 1991 (through August) it averages 8.0 percent less than in 1989. DLA expects that DDRW workload will continue to decline slightly after all the Operation Desert Shield returns have been processed. However, whether or not it declines depends on a number of decisions about how the overall DLA workload is distributed to the several regions and the impact of the sites yet to be consolidated in DDRW, particularly the Naval Supply Centers at San Diego and Puget Sound.



Note: FY91 includes the months of October 1990 through August 1991.

FIG. 2-1. BAY AREA RECEIPTS AND ISSUES
(Average monthly workload by fiscal year)

Postconsolidation Impact of Operations Desert Shield and Desert Storm

For Operations Desert Shield and Desert Storm, DDRW established production operations to assemble MOREs (Meals Operational Ready to Eat) and B-Rations and expended a large number of work-hours on that task. The production activities differed significantly from the normal warehousing functions of receipt, storage, and issue. DDRW had to set up dedicated warehouse space and hire several hundred temporary workers to build the subsistence packages. Furthermore, a single

line-item issue was sometimes several vanloads of meals, considerably different from the issues during the baseline year. As a result of this activity and Operation Provide Comfort, the tonnage handled at the Sharpe and Tracy sites more than doubled for several months as shown in Figure 2-2 (tonnage data were not collected at Oakland at that time).

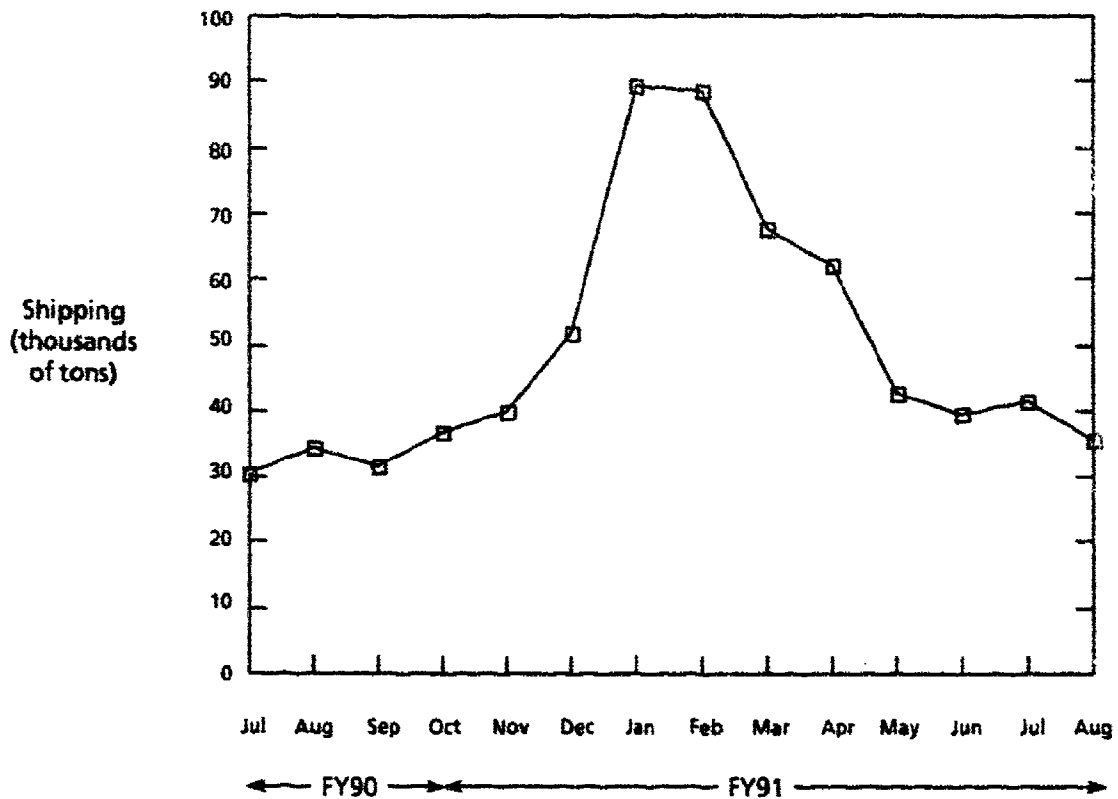


FIG. 2-2. SHIPPING ACTIVITY
(San Joaquin site only)

The DDRW kept track of the lines issued and accounted separately for the hours used for these production operations. To assess the productivity of warehousing operations over time, we subtracted both the workload and the hours for those subsistence production operations. That decrement resulted in about a 1 percent reduction in lines issued/received and a 15 percent reduction in work-hours in the busiest month of Desert Shield. These adjusted data give a more appropriate picture of the month-to-month operations at DDRW.

Other activities associated with Operations Desert Shield and Desert Storm consumed productive hours. For example, the number of set assemblies for chemical warfare defense equipment increased. No adjustment was made for those work-hours. As explained in detail in Appendix D, the decision to adjust for those other activities would have been somewhat arbitrary, and the overall result of the adjustment would have been only a small increase in productivity. Thus, the only adjustment was for the subsistence mission affecting the time period from September 1990 through March 1991.

Another effect of Operation Desert Shield that did not result in an adjustment was the increase in the number of IPG 1 and 2 requisitions as a percent of the total. In July 1990, such high-priority requisitions accounted for about 26 percent of all issues, rising to a high of 39 percent in January 1991 before declining again to the prewar level in March. This fluctuation almost certainly caused both an increase in work-hours for packing and higher transportation costs because little opportunity is available to combine these IPG 1 and 2 issues in a single package. No adjustment was made to the data to reflect this phenomenon for two reasons:

- DDRW had no credible estimate for the increase in cost for an IPG 1 or 2 issue over an IPG 3 issue. Sources at other DoD supply depots indicated that the increase is probably less than 10 percent. Therefore, an adjustment would have only a small effect.
- The percentages of IPG 1 and 2 issues during Operation Desert Shield were not abnormally high when compared with the baseline. Figure 2-3 shows IPG 1 and 2 issues as a percent of all priority group issues by month for the postconsolidation period at the three sites. The percentages were at Desert Shield levels during the baseline year and until June 1990 when DLA obtained authority to decrease a large percent of IPG 1 and 2 issues to IPG 3.² Also, the percentage of IPG 1 and 2 issues quickly declined, dropping to a low of 15 percent in our most recent data for the month of August 1991.

²The IPG 1 or 2 ratings are changed to IPG 3 when the project code and required delivery date entered by the requisitioner are inconsistent with the requisition's priority. Higher priority ratings are retained for priorities that are clearly justified and for foreign military sales. We found no evidence that the customers are dissatisfied with this practice. The change in priority level should result in work-hour savings, which are reflected in the data presented here, and also in reduced costs for packing materials and transportation because of shipment consolidation of IPG 3s.

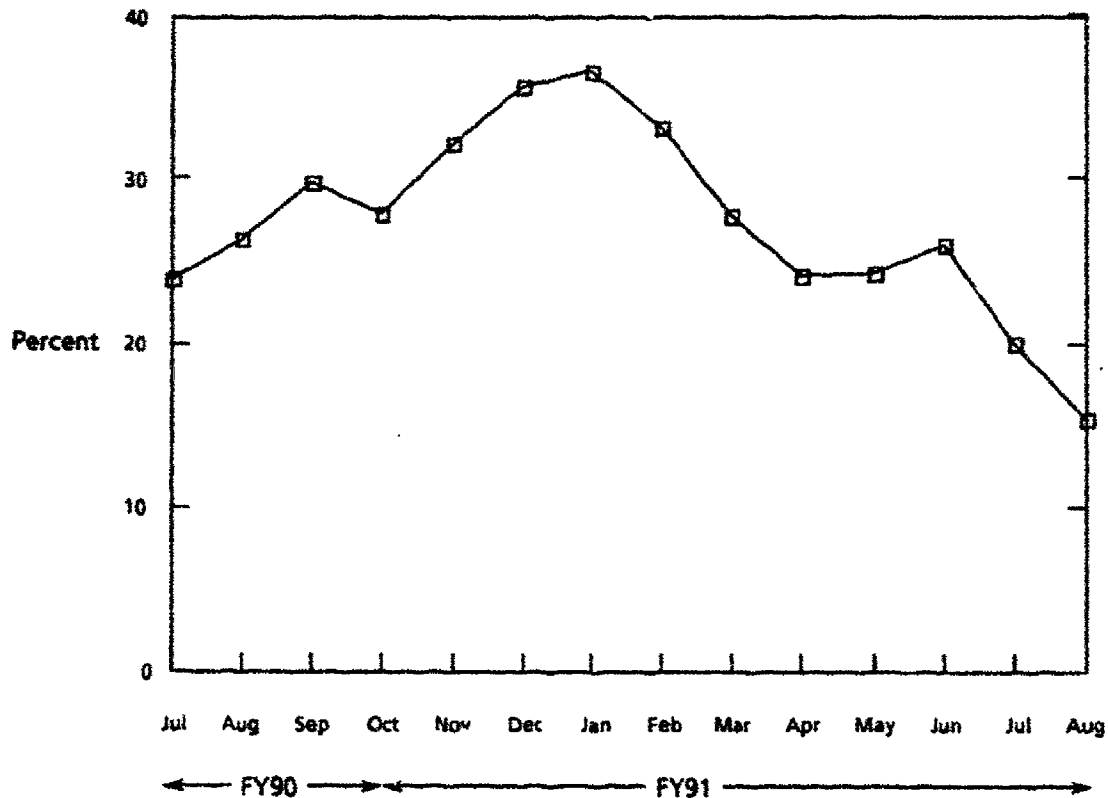


FIG. 2-3. PERCENTAGE OF DDRW ISSUES IN ISSUE PRIORITY GROUPS 1 AND 2

Impact of Depot Consolidation Activities

Consolidation has affected the Bay Area supply depots in that it has consumed many hours of management and overhead time. Experiences at DDRW with, for example, the consolidation of personnel and payroll records required intensive activity and had critical deadlines so that the transfer of personnel and resources occurred smoothly and on schedule.

No adjustment was made for consolidation activities because only a relatively few hours were reported, although we believe many hours spent on consolidation were never captured in DDRW's accounting system. For example, by April 1991, when consolidation activities were at their peak, the average number of hours reported monthly by DDRW accounted for only two personnel equivalents. Yet, we observed many consolidation activities that consumed more hours than that.

Impact of ADP Conversions on DDRW Operations

Conversions of ADP systems have also had pronounced impacts on DDRW, particularly at Oakland. Among those impacts were the expected costs and work-hours needed to convert to DDS, declines in performance because of system down time, and unexpected costs and work-hours required to find and correct DDS-related problems. Continuing DDS difficulties that still affect the Oakland site are described later in this report.

In anticipation of the conversion, DLA diverted as many requisitions for DLA material as possible to other sites. When conversion problems surfaced, the Navy also diverted requisitions to other sites until the problems were solved. The result was a more dramatic reduction in monthly issues at Oakland than at other DDRW sites as shown in Figure 2-4.

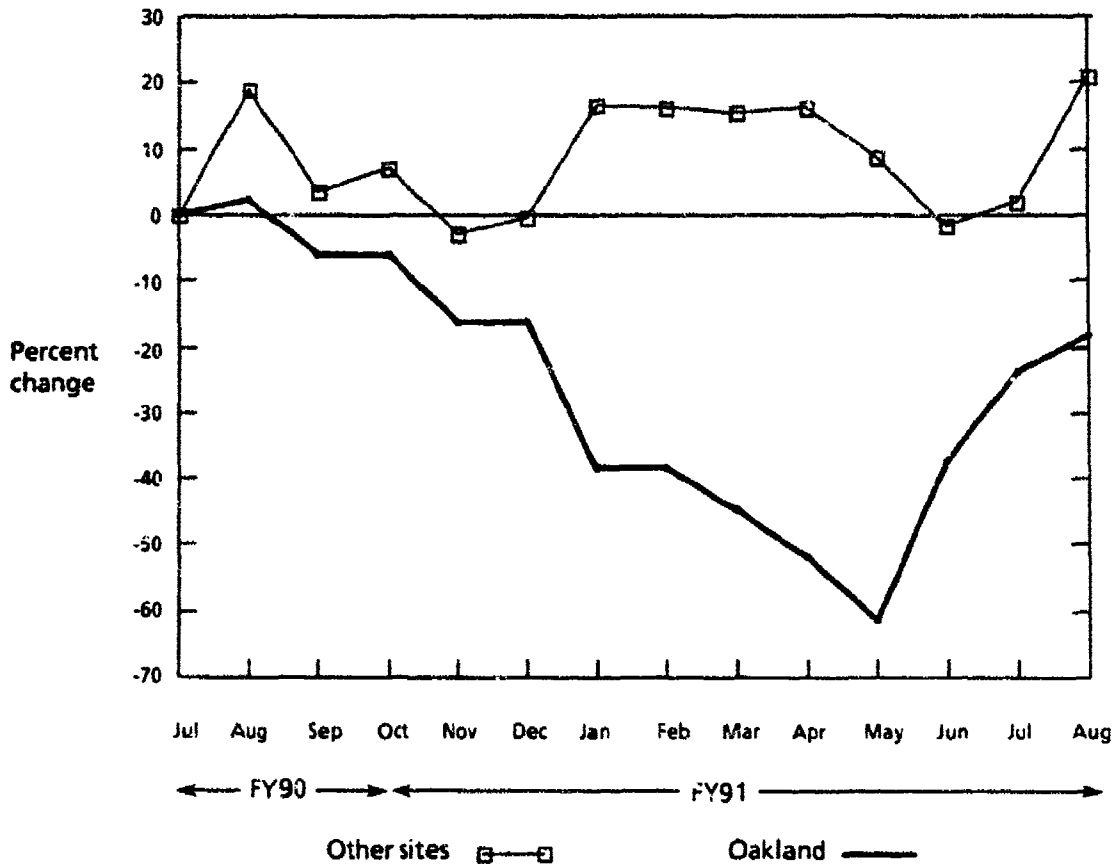


FIG. 2-4. PERCENTAGE CHANGE IN MONTHLY ISSUES SINCE JULY 1990
(Oakland versus other Bay Area sites)

Although volumes have increased in recent months at Oakland, the diversion of requisitions and computer system problems resulted in a decrease in output for several months beginning in January.

Summary

In summary, in the period since the FY89 baseline year, the number of receipts and issues processed at Bay Area depots has declined. Since consolidation began, other changes to the operating environment at DDRW have also taken place. The impact of external events such as Operation Desert Shield and internal events such as the consolidation itself and computer system problems at Oakland have put great pressure on DDRW. We have measured productivity to adjust for the decline in workload and have made other adjustments, where appropriate, to that productivity data so that we can identify trends in productivity since consolidation.

PERFORMANCE

Depot performance has generally stayed high or improved, except at the Oakland site. The Tracy site has maintained the high service levels that existed in FY89, while the Sharpe site has improved substantially. Issue processing timeliness at the Oakland site, however, has deteriorated. SRDD was consolidated into DDRW in late April and is now beginning to show some improvement in issue processing timeliness, while SSDS, which was also consolidated into DDRW at the same time, is showing improvement in receipt processing timeliness.

The TEMP called for FY89 to be used as a baseline for comparison. Some small differences exist between actual baseline performance data presented in the TEMP and data obtained from the Bay Area sites for this study. All figures presented in this report are calculated from actual monthly data obtained through DDRW. In some cases, FY89 data were not available; in those cases, FY90 and FY91 have been used for comparison. In this section, we first discuss the measures used to evaluate performance and then report the actual performance observed at each of the five sites. We also report on subjective performance measures of customer satisfaction.

Performance Measures

We examined all of the measures the TEMP identified as important but focused on the following four categories:

- **Issue Processing Timeliness.** Issue processing time is the period between the time the depot receives the order and the time it releases the order for transportation to the customer. Issue processing timeliness measures indicate how quickly a depot can get material to its customers.³ The specific measure used is the percent of order lines processed at each site within a specified number of days. The specified number of days varies with the site, the reporting system, and the order's IPG. Table 2-1 shows the days allowed for each site, system, and IPG combination. Note that the Oakland and Sharpe sites have changed systems during the consolidation, and as a consequence, their time standards have changed as well.
- **Receipt Processing Timeliness.** Receipt processing time is the period between receiving the material in the warehouse and placing it in a bin. Receipt processing timeliness is important because delays in receiving material can cause delays in issues for that same product. Also, long receipt times could require extra inventory to be added to the system. In effect, receipt processing timeliness balances the cost of receiving economically with the cost of holding extra material in the system to cover longer lead times. The specific measure used in the evaluation is the percent of receipt lines binned within a specified number of days. The allowed number of days varies with the site, the reporting system, and the type of receipt. (See Table 2-1.)
- **Quality.** In a warehouse environment, quality refers to the correctness of the shipment itself. Poor distribution quality can include such things as failure to fill the order as promised, failure to send the customer the material ordered, failure to send the right quantity, or failure to use sufficient packaging to prevent damage.

We studied two measures of quality: denial rate and discrepancy rate. The denial rate is the percentage of line items ordered that could not be found because of incorrect balance information; the ICP thinks the stock is there, but the warehouse worker cannot locate it. It is a measure of customer problems caused by inaccurate information. The discrepancy rate is the number of customer complaints related to warehousing as a percentage of total lines issued. It is a measure of customer dissatisfaction resulting from mistakes made inside the warehouse.

³Undoubtedly, the best measure of issue processing timeliness is the time between order placement and order receipt by the customer. Because it is difficult to determine when a customer actually receives an order and because procedures outside of the depots have not changed under consolidation, we focus our efforts on the actual times required to process orders within the depots.

TABLE 2-1
DEPOT PROCESSING TIME STANDARDS
(Days)

	DLA ^a	Navy ^b	Army ^c	Air Force ^d
Issues				
IPG 1 issues	3 ^e	2 ^f	1	2 ^g
IPG 2 issues	3 ^h	5 ⁱ	2	3
IPG 3 issues	10 ^j	15 ^k	8 ^l	8
Receipts				
Procurements	6	6	7	5
Returns	10	10	10	5

^aDLA's DWASP. Applies to Tracy site, Oakland after May 1991, and Sharpe after August 1991.

^bNavy's UADPS. Applies to Oakland before May 1991.

^cArmy's SDS. Applies to Sharpe before August 1991 and SRDD.

^dAir Force's SC&D. Applies to SSDS.

^eHigh-priority items allowed 1 day; medical and pharmaceutical items allowed 2 days. Standard for high-priority items was changed from 1 day to 3 days in June 1990.

^fStandard is 3 days for local issues. Time is from order receipt to order shipment.

^gOne day allowed for Mission Capable Stock (MICAPS).

^hStandard changed from 2 days to 3 days in June 1990.

ⁱStandard is 6 days for local issues. Time is from order receipt to order shipment.

^jDLA prefers to use 21 days from order receipt at depot until order arrival to customer.

^kStandard is 18 days for local issues and 23 days for issues shipped in seavans. Time is from order receipt to order shipment.

^lDirect Support System issues have a 3-day standard.

- **Record Accuracy.** Record accuracy refers to information about how much of a particular item is stored at the depot and where it is located within the depot. Some measures also incorporate checks on other record information such as unit of issue, expiration date, proper identification, or special packing considerations. We focused on location accuracy.⁴ We examined the number of errors found as a percentage of total location records checked for each site. Location accuracy is a good measure because, in many cases, missing stock is, in fact, a result of incorrect location records. Appendix E discusses site-specific measures of record accuracy.

Record accuracy measures can be misleading. Unless either a random sampling technique is used or a 100 percent record check is performed, measures stating a location accuracy percentage or an inventory accuracy percentage do not reflect the overall accuracy of the balance or location

⁴While balance accuracy is also an important measure of record accuracy, it is not included here because it is not checked at every site and because the measures between sites differ considerably.

records; they only reflect the accuracy found for the particular records examined. Warehouse managers may devote resources to checking record accuracy to fix suspected or potential problems that could hinder shipping productivity. Accuracy statistics resulting from that type of record checking may be lower than the actual accuracy overall.

Table 2-2 defines each of the measures examined in those categories. Those measures are the most important indicators of performance for the Bay Area consolidation. Appendix E addresses them in detail as well as other measures contained in the TEMP. Appendix F addresses those measures identified as unique to the Navy, unique to the Army, or unique to the Air Force.

TABLE 2-2
PERFORMANCE MEASURE DEFINITIONS

Issue processing timeliness^a	
IPG 1 on time	Percent of IPG 1 issue lines processed at depot within specified time period
IPG 2 on time	Percent of IPG 2 issue lines processed at depot within specified time period
IPG 3 on time	Percent of IPG 3 issue lines processed at depot within specified time period
Total on time	Percent of total issue lines processed at depot within specified time period
Receipt processing timeliness^b	
Procurements on time	Percent of procurement receipt lines processed at depot within specified time period
Returns on time	Percent of return receipt lines processed at depot within specified time period
Total on time	Percent of total receipt lines processed at depot within specified time period
Quality	
Denial rate	Number of denials as a percent of line items directed for shipment
Discrepancy rate	Number of customer complaints reported as a percent of issues
Record accuracy	
Location accuracy	Percent of location surveys found to be correctly recorded in computer data base

^aDepot processing time for issues starts when the order is received at the depot and ends when the order is ready for transportation.

^bDepot processing time for receipts starts when the stock is brought into the warehouse and ends when the stock is placed in a bin.

Actual Performance by Site

In this section, we show the measures of performance for each of the five sites and compare the performances after consolidation to those during the FY89 baseline year. We did a statistical test, using the *t*-distribution, to determine if there was any difference in the means of the baseline and postconsolidation data. The details are in Appendix E (p. E-4). In cases in which FY89 data do not exist — denial rate is an example — we compare the postconsolidation performance with performance during more recent periods prior to consolidation.

Tracy Site

The Tracy site performance has remained high after consolidation. Table 2-3 shows baseline and postconsolidation average monthly performance measures.⁵ We found no statistically significant differences between them insofar as

TABLE 2-3
TRACY SITE AVERAGE MONTHLY PERFORMANCE
(Percent)

Performance measure	Goal ^a	Baseline	Post-consolidation ^b	Statistical significance ^c
Issues				
IPG 1 on time	99.0	99.8	99.2	0.4 to 1.0% lower
IPG 2 on time	99.0	99.8	99.3	0.2 to 0.9% lower
IPG 3 on time	95.0	90.2	96.3	1.8 to 10.4% higher
Total on timed	—	93.4	96.9	0.5 to 6.4% higher
Receipts				
Procurements ^e	99.0	—	—	—
Returns ^e	90.0	—	—	—
Totals ^d	—	100.0	100.0	No difference
Quality				
Denial rate ^f	0.80	0.56	0.56	No difference
Discrepancy rate ^{d,f}	—	0.20	0.17	No difference
Record accuracy				
Location accuracy ^f	99.0	99.8	99.8	No difference

^aPrototype plan goal.

^bJuly 1990 through August 1991 (14 months).

^c95 percent confidence interval about the difference between baseline and postconsolidation means.

^dNo goal established for this measure.

^eData requested but not received.

^fFY89 data not available; first 9 months of FY90 used as baseline.

⁵The allowed depot processing time for IPG 1 and IPG 2 on-time issues at Tracy is different for the 1989 baseline data than for current consolidation data. In 1989, IPG 1 orders were considered on time if they were processed within 1 day at the depot, and IPG 2 orders were considered on time if they were processed within 2 days. The current measurement system, DWASP, for Tracy uses 3 days for both IPG 1 and IPG 2 issues with some exceptions. This change was effected for all of DLA (not only the Bay Area) primarily to save labor and transportation costs. However, total delivery time standards (from order receipt to customer receipt) for the Tracy site have not changed during the period. Based on observation of operations at the Tracy site, this change does not appear to be significant since almost all IPG 1 and IPG 2 orders at Tracy are currently processed within 1 day.

receipt timeliness, quality, and record accuracy are concerned.⁶ Some small differences exist in on-time issue performance. Specifically, the following postconsolidation conditions pertain:

- IPG 1 issues processed on time are 0.4 to 1.0 percent lower.
- IPG 2 issues processed on time are 0.2 to 0.9 percent lower.
- IPG 3 issues processed on time are 1.8 to 10.4 percent higher.
- Total issues processed on time are 0.5 to 6.4 percent higher.

Sharpe Site

Performance at the Sharpe site has improved significantly since the baseline period. Table 2-4 shows baseline and postconsolidation average monthly performance measures. No statistically significant differences exist between baseline and postconsolidation measures of discrepancy rate or location accuracy. The following significant postconsolidation differences were noted:

- IPG 1 issues processed on time are 13.8 to 22.9 percent higher.
- IPG 2 issues processed on time are 11.2 to 19.6 percent higher.
- IPG 3 issues processed on time are 12.9 to 23.5 percent higher.
- Total issues processed on time are 12.4 to 21.5 percent higher.
- Total receipts processed on time are 14.9 to 23.3 percent higher.
- Denial rates are 0.33 to 0.68 percent lower.

Appendix E shows specifically how these changes have occurred over time. The Sharpe site has shown a steady improvement in both issue and receipt processing timeliness since the FY89 baseline year.

⁶When the confidence interval includes zero, there is no statistically significant difference between the baseline means and the postconsolidation mean.

TABLE 2-4

SHARPE SITE AVERAGE MONTHLY PERFORMANCE

(Percent)

Performance measure	Goal ^a	Baseline	Post-consolidation ^b	Statistical significance ^c
Issues				
IPG 1 on time	99.0	74.8	93.2	13.8 to 22.9% higher
IPG 2 on time	99.0	79.6	95.1	11.2 to 19.6% higher
IPG 3 on time	95.0	77.2	95.4	12.9 to 23.5% higher
Total on time ^d	—	77.6	94.6	12.4 to 21.5% higher
Receipts				
Procurements ^e	99.0	—	—	—
Returns ^e	90.0	—	—	—
Totals ^d	—	79.4	98.5	14.9 to 23.3% higher
Quality				
Denial rate ^f	0.80	1.18	0.67	0.3 to 0.7% lower
Discrepancy rate ^{d,f}	—	0.15	0.12	No difference
Record accuracy				
Location accuracy ^f	99.0	94.2	96.6	No difference

^aPrototype plan goal.

^bJuly 1990 through August 1991 (14 months).

^c95 percent confidence interval about the baseline and postconsolidation means.

^dNo goal established for this measure.

^eData requested but not received.

^fFY89 data not available; first 9 months of FY90 used as baseline.

Oakland Site

On-time issue performance at the Oakland site has declined since the baseline period. Table 2-5 shows baseline and postconsolidation average monthly performance measures. No statistically significant differences exist between baseline and postconsolidation measures of receipt timeliness, quality, or record accuracy. The following postconsolidation conditions were noted:

- IPG 1 issues processed on time are 3.2 to 26.8 percent lower.
- IPG 2 issues processed on time are 3.6 to 26.9 percent lower.

- IPG 3 issues processed on time showed no statistically significant difference.
- Total issues processed on time are 3.3 to 18.8 percent lower.

TABLE 2-5
OAKLAND SITE AVERAGE MONTHLY PERFORMANCE
(Percent)

Performance measure	Goal ^a	Baseline	Post-consolidation ^b	Statistical significance ^c
Issues				
IPG 1 on time	99.0	92.2	77.2	3.2 to 26.8% lower
IPG 2 on time	99.0	92.0	76.8	3.6 to 26.9% lower
IPG 3 on time	95.0	86.2	76.3	No difference
Total on time ^d	—	89.2	78.2	3.3 to 18.8% lower
Receipts				
Procurements ^e	99.0	—	—	—
Returns ^e	90.0	—	—	—
Totals ^d	—	86.8	87.6	No difference
Quality				
Denial rate ^f	0.80	1.51	1.89	No difference
Discrepancy rate ^{d,f}	—	0.43	0.58	No difference
Record accuracy				
Location accuracy ^f	99.0	94.8	83.4	No difference

^aPrototype plan goal.

^bJuly 1990 through August 1991 (14 months).

^c95 percent confidence interval about the baseline and postconsolidation means.

^dNo goal established for this measure.

^eData requested but not received.

^fFY89 data not available; first 9 months of FY90 used as baseline.

The Oakland performance data on quality may be misleading for two reasons. First, the discrepancies being reported include \$9.2 million worth of material in transit but never received dating back to 1984. These types of discrepancies, called SITRODs (situation reports of discrepancy), have been relatively high during the consolidation period even though the actual problems associated with them occurred well before consolidation. Second, the denial rates include some particularly high

numbers (5 percent) in the month of February 1991 that were in part due to Oakland's inability to keep up with the workload during the RF installation. Because of order banking and the backlog of work, several denials for an item occurred when normally only one would occur before the ICP was alerted of the stockout situation. Although the postconsolidation average monthly measures of quality are different, the result is not statistically significant.

The reliability of the on-time issue performance data supplied by DWASP starting in May of 1991 is questionable. The automated system in place at Oakland was changed from a combination of UADPS and NISTARS to a combination of DWASP and NISTARS (DDS). The NISTARS is able to track the amount of time a line item spends in the warehouse from order receipt by NISTARS until the order is ready for shipping. The DWASP and NISTARS measures can be compared roughly by adding 2 days to the NISTARS processing time to account for dropping the order from DWASP and for offering the product for transportation (those actions may, in fact, take less than 2 days). Table 2-6 shows a comparison between NISTARS data for month to date as of 16 August 1991 and DWASP data for all of August 1991.

TABLE 2-6

NISTARS VERSUS DWASP ON-TIME ISSUE COMPARISON

Issue priority group	NISTARS ^a			DWASP ^b		
	On time	Total	Percent on time	On time	Total	Percent on time
IPG 1	3,985	5,202	76.6	3,749	6,925	54.1
IPG 2	3,276	4,039	81.1	2,022	5,195	38.9
IPG 3	24,397	24,511	99.5	21,329	30,652	69.6
Total	31,658	33,752	93.8	27,100	42,772	63.4

^aNISTARS data for 1 August through 16 August 1991.

^bDWASP data for entire month of August 1991.

The NISTARS performance data differ somewhat from those of DWASP. NISTARS shows the percent on time for all IPGs is 93.8 percent while DWASP shows it to be 63.4 percent. Some of that difference is caused by DWASP holding orders and not releasing them to NISTARS, either intentionally or unintentionally, and some of it may be caused by orders not getting closed out. The first instance affects the customer and should be counted; the second does not and arguably should not be counted. Actual performance is probably somewhere in between the NISTARS measure and the DWASP measure. Although issue timeliness data since May of 1991 are suspect, the monthly data (see Appendix E) show that after the DDS implementation at Oakland, on-time issue performance did decline.

The Oakland site's ability to satisfy customer demand on time has deteriorated. Both issues and receipts processed on time are down. We have not found any statistically significant differences in denial rate, discrepancy rate, or location accuracy.

Sacramento Remote Distribution Division

Performance at SRDD has improved since the consolidation in April 1991 as shown in Table 2-7. Because there are only 4 (or fewer) data points for post-consolidation averages, the percent differences have large variances. The trend is toward improvement in issue processing timeliness, but it is too early to be conclusive in the magnitude of the improvement. In FY90, all inventory balance and location checking was discontinued because of inadequate funding. That action may have caused inaccuracies to perpetuate. In July and August of 1991, DDRW surveyed virtually all locations at SRDD at least once, which may explain the apparent (but statistically insignificant) decrease in location accuracy.

TABLE 2-7

**SRDD AVERAGE MONTHLY PERFORMANCE
(Percent)**

Performance measure	Goal ^a	Baseline	Post-consolidation ^b	Statistical significance ^c
Issues				
IPG 1 on time	99.0	86.4	94.6	1.1 to 15.2% higher
IPG 2 on time	99.0	80.2	92.5	6.1 to 18.7% higher
IPG 3 on time	95.0	88.7	93.6	No difference
Total on time ^d	—	87.2	93.7	0.8 to 12.1% higher
Receipts				
Procurements ^e	99.0	—	—	—
Returns ^e	90.0	—	—	—
Totals ^d	—	82.0	85.0	No difference
Quality				
Denial rate ^f	0.80	1.37	1.41	No difference
Discrepancy rate ^{d,g}	—	0.19	0.34	No difference
Record accuracy				
Location accuracy ^f	99.0	99.6	90.0	No difference

^aPrototype plan goal.

^bMay 1991 through August 1991 (4 months).

^c95 percent confidence interval about the baseline and postconsolidation means.

^dNo goal established for this measure.

^eData requested but not received.

^fFY89 data not available; FY90 used as baseline.

^gFY89 data not available; first 7 months of FY91 used as baseline.

Sacramento Specialized Distribution Site

Performance at the SSDS has been mixed since the site was consolidated into DDRW in April 1991. Table 2-8 shows baseline and postconsolidation average monthly performance measures. There appears to be some improvement in receipt processing timeliness. Again, since there are only 4 (or fewer) data points for the various postconsolidation averages, the percent differences have large variances. It is too early to be conclusive about the magnitude of decreased or improved performance.

TABLE 2-8
SSDS AVERAGE MONTHLY PERFORMANCE
(Percent)

Performance measure	Goal ^a	Baseline	Post-consolidation ^b	Statistical significance ^c
Issues^d				
IPG 1 on time	99.0	97.8	95.8	1.1 to 3.0% lower
IPG 2 on time	99.0	93.7	92.0	No difference
IPG 3 on time	95.0	94.1	90.5	0.1 to 7.1% lower
Total on time ^e	—	95.7	93.5	0.4 to 4.1% lower
Receipts				
Procurements ^f	99.0	—	—	—
Returns ^f	90.0	—	—	—
Totals ^{d,e}	—	85.2	94.9	2.7 to 16.8% higher
Quality^g				
Denial rate	0.80	1.01	1.08	No difference
Discrepancy rates ^e	—	0.19	0.13	No difference
Record accuracy				
Location accuracy	99.0	96.1	98.4	No difference

^aPrototype plan goal.

^bMay 1991 through August 1991 (4 months).

^c95 percent confidence interval about the baseline and postconsolidation means.

^dFY89 data not complete; January 1990 to December 1990 used as baseline.

^eNo goal established for this measure.

^fData requested but not received.

^gFY89 data not available; FY90 used as baseline.

Subjective Performance Measures

In addition to the objective performance statistics for the Bay Area sites, we also collected feedback from customers as a subjective measure of DDRW's performance since consolidation. We were particularly interested in how well DLA serves retail customers, such as the repair facilities at Oakland/Alameda, SAAD, SAALC, and naval ships at Oakland. Since our evaluation began after the initial consolidations had taken place, we were unable to collect a preconsolidation baseline of customer

satisfaction information. The findings in this subsection are presented in that perspective only.

Local Air Force personnel at SAALC and Army personnel at SAAD responsible for the maintenance-supply interface for repair/overhaul activities could detect little difference in supply support since consolidation. With many of the same people doing the same jobs in the two DDRW operations in Sacramento, customers indicated no noticeable changes since consolidation in April.

The Oakland site's customers were more satisfied than expected in light of its performance statistics. We maintained close contact with the Naval Supply Center's (NSC's) customer service staff and attended one of its quarterly meetings with the Assistant Supply Officers from activities afloat and management analysts from the shore activities. The customers were aware of the site's problems but saw them as temporary and believed that the Navy's customer service staff was adequately representing their interests to DDRW.

Three problems appeared to affect Oakland customers. The first was a one-time problem of requisitions that had been closed out but never shipped; the second was "bearer walk-through" (or emergency issue) timeliness; and the third was over-age high-priority requisitions. The problems all seem to stem from Oakland's automation difficulties.

To resolve a problem of requisitions that had not been closed out in May because of DDS difficulties, DDRW closed out 35,000 requisitions by entering a code into the system indicating they had been shipped. Although most had been shipped, an unknown number had not been. Naturally, a number of customers had complaints.

A bearer walk-through occurs when a customer appears at the Supply Center with a request for a priority issue. After checking to make sure that it is not carried in the NSC's SERVMART store, a special procedure is instituted to issue the items. Although the volume of these bearer walk-throughs is low, they are an important segment of the business. Table 2-9 shows the average and the longest waiting times for each week beginning in June 1991 when the bearer requisitions were first handled under DDS.

During the first week in July, when DDRW was plagued by daily computer system down time, one bearer walk-through took 18 hours and 20 minutes and the

TABLE 2-9
OAKLAND BEARER WALK-THROUGHS

Month	Week	How processed	Hours wait		Number of requisitions
			Average	Longest	
June	4	On line	3	12	185
July	1	On line	7	18	138
July	2	Off line	2:37	6:47	145
July	3	Off line	1:34	2:35	174
July	4	Off line	1	4	147
August	1	Off line	1	3:30	139
August	2	Off line	1:14	3	160

average was over 7 hours. When it experienced down-time problems, the customer service staff often resubmitted a requisition when the system went down because no one was certain if the transaction had "dropped out" of the system. It was then necessary to ensure that the requisition was not filled twice.

Since the second week of July, bearer walk-throughs have been processed off-line. The computer is accessed to update balances only after the transaction is completed. Since the change to off-line processing, waiting times have been reduced and customer satisfaction has improved.

The final issue raised by Oakland customers is the number of high-priority requisitions still open more than 2 days after receipt. The inventory record shows a positive balance for an item requisitioned to satisfy Not Mission Capable Supply (NMCS), Partly Mission Capable Supply (PMCS), or other critical needs, but the item has not been shipped to the customer. Although performance data have not been collected continuously for such items, Table 2-10 contains examples obtained from the Navy customer service staff.

Taken at face value, the data show a large increase in the number of over-age, high-priority requisitions from before the consolidation in September 1989 to November 1990, and an even bigger increase in September 1991. Furthermore, the age of the overdue requisitions has been increasing. It is likely that items for some of

TABLE 2-10

OVER-AGE HIGH-PRIORITY REQUISITIONS

Date	Number of days old				
	3 - 5	6 - 10	11 - 20	21 +	Total
26 September 1989	30	7	2	—	39
29 November 1990	40	64	28	10	142
25 September 1991	228	119	137	472	956

the overdue requisitions in the September 1991 count may have been shipped, but the information was lost in DDS as noted above.

Our overall impression based on meetings with DDRW customers is that customer satisfaction levels are stable at all sites with the possible exception of Oakland. At Oakland, there has been measurable degradation of supply performance, but this has been accompanied by greater efforts on the part of Navy customer service to respond to problems — customer hot-line telephone service, closer liaison with ships before arrival at Oakland, and removal of bearer walk-throughs from the computer. It appears that because of Navy customer service efforts, the level of customer satisfaction has not declined as much as performance measures have.

Summary

The only statistically significant performance decline within DDRW has been at the Oakland site. Overall, DDRW performance has improved. The Tracy site has remained stable and the Sharpe site has improved. Early indications are that SRDD's performance is increasing and SSDS's performance is remaining stable. Customer satisfaction has remained stable during the consolidation period.

PROTOTYPE COSTS

The TEMP called an evaluation of the prototype's "ability to reduce the costs of operations and eventually achieve savings through consolidation efficiencies by deriving cost per unit of measurement to compare to baseline data provided by Components . . ." Two sources can provide such unit costs. First, the Defense

Manpower Data Center (DMDC) has been tasked to develop and maintain a standard data base to support the unit cost initiative in DoD. Also, DDRW computes its own unit costs on a monthly basis.

The intent of the TEMP was to engender a comparison of baseline unit costs with postconsolidation unit costs for each site to see whether the unit costs decreased after consolidation. DMDC collected cost and output (i.e., workload) data from the Services and DLA for the Bay Area supply depots for the baseline period and has used those data to calculate baseline unit costs for each depot.

We found several distortions in the unit costs:

- *Indirect labor costs are not correctly allocated:* Since DMDC allocates all of second-line-and-above supervision overhead cost to issues, the cost of issues is overstated and the cost of receipts is understated. If that allocation is not corrected and unless unit costs are recalculated for all periods including the baseline period, unit costs for each site will be inherently biased to unknown degrees that probably vary among sites. Since detailed accounting data to correct this problem are unlikely to exist for the baseline period, DMDC does not believe it can resolve the problem for the Bay Area evaluation.
- *Definitions and measures have changed over time:* In a conscientious effort to identify and correct definitional and measurement problems, DMDC has changed several of its formulas for calculating unit costs at supply depots. However, as those changes have been made, DMDC has not gone back and recalculated unit costs from the baseline period forward. As a result, as quarters have passed and changes have been compounded, comparability with prior periods, especially the baseline period, has been corrupted.
- *Alternative DDRW unit cost measures do not have historical data points:* DDRW calculates unit costs for various outputs at its depots. The main problem with using those unit costs to evaluate the Bay Area prototype is that no historical data points exist for the sites previously operated by the Services. Thus, baseline/postconsolidation comparisons are impossible. Also, these alternative measures are not the same as the DMDC measures and, therefore, are not recognized as the DoD unit cost measures under DMRD 921.

The DMDC has been requested to document definitions and formulas and to revise supply depot unit cost calculations back to the baseline period. However, it has not been able to do so yet. Furthermore, adequate historical data from the Services are not available to resolve all the measurement issues and to allow comparisons with the baseline period in the Bay Area.

For those reasons, we did not use unit costs to evaluate prototype savings. We identified savings in the areas in which they were predicted to occur: personnel reductions, consolidation of CCP operations, and transportation cost reduction. We also evaluated whether management improvements and resource sharing produced savings. Subsequent sections present our findings relative to specific savings expected in the prototype plan.

PERSONNEL SAVINGS

More than 70 percent of the first year's savings projected in the prototype plan were based on projected personnel reductions anticipated because of increases in productivity. Tracking personnel reductions is made difficult by the many different categories of personnel employed at Bay Area depots including full-time permanent, full-time temporary, part-time permanent, part-time temporary, intermittent, and several other categories of personnel. Full-time personnel tell only part of the story because a large increase in temporary part-time personnel occurred during Operation Desert Shield. A better measure is full-time equivalents, but those data do not exist for all sites for the baseline year. DLA has reported savings using monthly end strengths. For sake of consistency, we have used the same measure.

The prototype plan projected a reduction of 807 personnel equivalents from the October 1989 baseline, all to be achieved within the first 3 years of prototype operation (244 positions to be eliminated in FY91 and the remaining 563 positions in FY92 and FY93).

Personnel Reductions

Table 2-11 shows that total personnel in all categories at all five sites have decreased from 5,074 in October 1989 to 4,381 in August 1991, a reduction of 693. The decrease includes all categories of personnel, both full-time and other than full-time. Most employees are full-time, and Table 2-11 shows the number of full-time employees has declined from 4,713 in October 1989 to 4,213 in August 1991, a reduction of 500 personnel. The 500-employee reduction is substantially higher than the planned first-year reduction of 244 employees.

Most of the personnel reductions happened before consolidation. As can be seen in Table 2-11, 240 of the total personnel reductions occurred before the first three depots were consolidated in June 1990. Not apparent in the table are

TABLE 2-11
DDRW END STRENGTH

Month	All personnel	Full-time personnel
October 1989	5,074	4,713
June 1990	4,834	4,486
July 1990	4,809	4,450
August 1990	4,738	4,409
September 1990	4,704	4,440
October 1990	4,642	4,391
November 1990	4,586	4,315
December 1990	4,710	4,301
January 1991	4,867	4,409
February 1991	5,086	4,450
March 1991	4,799	4,345
April 1991	4,642	4,283
May 1991	4,553	4,335
June 1991	4,513	4,301
July 1991	4,417	4,248
August 1991	4,381	4,213
Net reduction October 1989 - August 1991	693	500

reductions at the Sacramento sites prior to April 1991, another 189 positions. Personnel reductions at the three original sites before June 1990 and at the two Sacramento sites before April 1991 accounted for 429 of the 693 total positions (62 percent) and 367 of the 500 full-time positions (73 percent). Since consolidation, reductions amount to 264 end-strength positions, 133 of which were full time.

The plan was based on the assumption of a stable workload, but the workload declined by 8 percent between FY91 and the FY89 baseline. Thus, we were looking for even greater personnel reductions than originally planned.

Productivity

Productivity, the amount of measurable output per employee, provides a better basis than the number of personnel for assessing the personnel savings through consolidation under changing workload conditions. We computed monthly productivity as follows:

$$\text{Productivity} = \left[\frac{\text{Lines received and issued} - \text{Desert Shield subsistence lines}}{\text{Productive hours} - \text{Desert Shield subsistence hours}} \right] \times 1,732 \text{ Productive hours/employee/year.}$$

Productive hours include the paid hours of all DDRW employees but exclude vacations, holidays, sick leave, and other nonproductive time. Using productive hours avoids the artificial understatement of productivity that would result from using total hours in months with large amounts of unproductive time, such as holidays or vacations.

Although personnel data are available from the baseline period to the present, productive-hour data are available only since the dates of consolidation (July 1990 for the first three sites and April 1991 for SRDD). Productive-hour data are not available for SSDS. Figure 2-5 shows DDRW productivity monthly since July 1990 for the three original sites. Both the workload measure of lines issued and received and the productive hours have been adjusted to exclude the impact of subsistence production operations in support of Operation Desert Shield as described in Appendix D.

Productivity declined from March 1991 through July 1991, in large part because of the system conversion and associated problems at Oakland. However, in August 1991, a large increase in the number of receipts and issues led to increased productivity.

Summary

In summary, personnel reductions from the baseline year through August 1991 are greater than the projections in the prototype plan although they are not directly comparable because of the several different personnel categories and unavailability of data on personnel equivalents.

Attributing the personnel reductions to consolidation is made difficult by the fact that workload also declined. When workload and productive hours are correlated

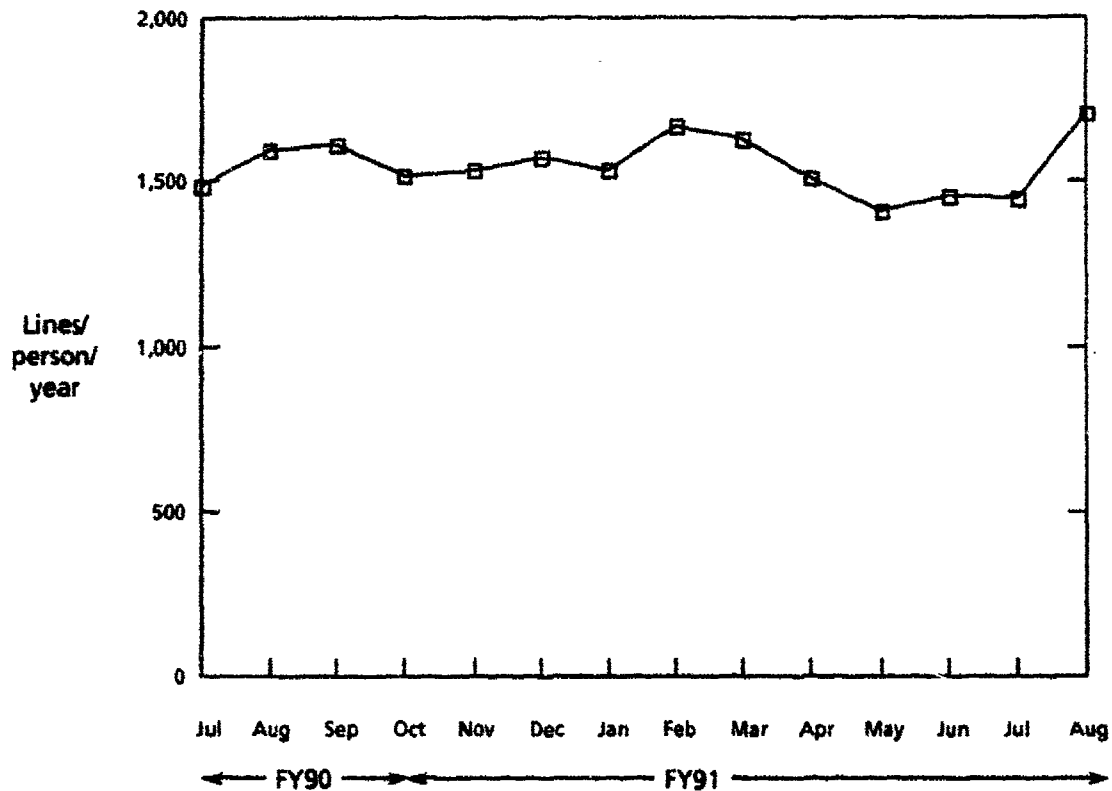


FIG. 2-5. DDRW PRODUCTIVITY
 (Three sites - adjusted for Operation Desert Shield)

and the result is adjusted for temporary changes in the operating environment (such as the unique subsistence production operations in support of Operation Desert Shield), the resulting productivity measure shows little change since consolidation. It reached its lowest values in May through July 1991 primarily because of the computer system conversion at Oakland. The highest productivity in August 1991 may need to be adjusted for Desert Shield returns.⁷

⁷DDRW has provided information on Desert Storm returns (which we have not yet audited) that would permit July and August adjustments for processing those unusually labor-intensive receipt actions. If productivity were adjusted for those returns, there would be a further increase in productivity in the month of August from 1,709 lines/person/year (shown in Figure 2-5) to 1,833 lines/person/year, a 7 percent increase.

TRANSPORTATION AND CCP SAVINGS

The prototype plan called for transportation savings of \$1.5 million and CCP savings of \$1.5 million in FY91. The transportation savings would result from more consolidated shipments and fewer less-than-truckload (LTL) shipments. Transportation savings are not being credited to depot consolidation, but to DMRD 915 instead.

In FY91, DDRW has taken three steps to consolidate more shipments and consequently make fewer LTL shipments:

- It has implemented a guaranteed traffic program at all the sites to take advantage of lower negotiated freight rates with shippers. Because of its large volume, it can obtain large discounts from the published rates by guaranteeing all business on certain traffic segments to one trucking company. Prior to consolidation, the Sharpe and Oakland sites made some limited use of guaranteed traffic and SSDS did not use it at all.
- It is utilizing a computer banking feature in the DWASP system that synchronizes the release of orders going to the same customer or to the same geographical regions. This synchronized release results in fewer shipments of larger amounts going to individual customers and, in the case of geographical banking, allows full truckloads to be shipped to geographical regions of the country. Prior to consolidation at the Sharpe site, this banking by region could only be done by physically staging the product. Computer banking is now in effect at both Oakland and Sharpe as well as at Tracy where it was in effect prior to consolidation.
- It is utilizing the regional freight consolidation centers (RFCCs) for incoming and outgoing products to all of the consolidated sites. The RFCCs consolidate regional LTL shipments from vendors into full truckloads to be delivered to the depots and also break down full truckloads of material arriving from the depots and going to specific geographical regions. Although the RFCCs are available for use by any DoD concern, depot consolidation efforts have provided a means to expand the use of the program since DLA-run depots were using the RFCCs before consolidation while some of the Service-run depots were not.

Because of the consolidation, there will be more full-truckload shipments and fewer LTL shipments resulting in considerable transportation savings.

The CCP savings would result from the consolidation of two CCP operations into one. DDRW recently closed the CCP operation at SSDS by not renewing the existing contract for such work. All CCP workload is now being handled by the CCP

operation at Sharpe. While those actions produced no savings in FY91, DDRW expects to realize savings of \$500,000 in FY92 from them.

DEFENSE DISTRIBUTION REGION WEST MANAGEMENT

We have observed significant management improvement since consolidation, particularly at the Sharpe site but also at the Oakland site and SRDD. We have seen organizational, motivational, and physical process improvements. In some cases, those improvements are a result of DDRW expending resources to fix items or reinstate practices that were neglected by the Services. In other cases, the improvements represent better management methods for the warehouse facilities.⁸ We have witnessed better utilization of resources within the region; DDRW estimates it has saved more than \$2.6 million in FY91 as a result of this increased utilization. The Navy, however, has some concerns about DLA's inventory control practice and philosophy and it questions DLA's ability to meet its specific needs. Both management improvements and Navy concerns are discussed in the following sections.

Improvements

The process improvements at the Sharpe site include the following:

- Correcting design and mechanization flaws in Building 330, including installing a catwalk to allow use of previously unavailable storage locations and modifying conveyance control logic to shut conveyors off when not in use
- Eliminating overpacking of material
- Reducing the handling of small parcel shipments
- Improving the intrasite movement of materials by using transporter trucks and floats
- Replacing a freight staging area with direct loading of trailers in advance of transport
- Establishing standard procedures for freight handling
- Streamlining issue and pack processes from nine steps to five steps

⁸Management improvement is also evident in the performance data. As shown in Appendix E, the variance in postconsolidation data is generally smaller than the variances in the baseline year. That indicates more consistent, steady performance, even in a year of change.

- Installing ramp docks at Building 330 to improve outloading operations
- Removing unused jib cranes to free space for other uses
- Consolidating the receiving and inspection functions
- Reducing shipping supply expenses by using a pallet recycling and repair facility and by using more jiffy bags and fewer cartons.

Most of the above actions should generate savings as a result of improved management by DDRW.

Management improvements at the Sharpe site include the following:

- Higher service standards than those under Army management have led to improved performance.
- Warehouse managers now use internal performance measures to track productivity within specific warehouses allowing them to focus on problem areas and on productivity in general.
- The facility itself is better organized; warehouses are segmented, locations are clearly labeled, lines are painted on the floors, location surveys are performed on a frequent basis, and more attention is paid to cleanliness.
- DDRW has also made quality-of-worklife improvements including the addition of microwave ovens and refrigerators for personnel use, the refurbishing of rest rooms, and other general cleanup activities.

The DDRW has made a number of process improvements at the Oakland site as well. The initiatives include the following:

- Improving transportation document flow
- Streamlining small parcel operations
- Implementing standard procedures in a variety of activities
- Obtaining needed equipment from other DDRW sites
- Installing conveyors in receiving to aid in movement of small parcels
- Obtaining propane fork-lift trucks to replace oil and gas fork lifts and establishing propane refueling areas
- Providing hazardous materials training
- Implementing guaranteed traffic and direct loading of trailers

- Implementing workload release by geographical area.

Management improvements at Oakland include the following:

- Paying much more attention to maintenance of the buildings and equipment. One example of this improvement is a program to repair lighting fixtures and replace lights in all of the facilities. One employee claimed that the lights in her warehouse had not worked properly for 10 of the 12 years she had been there.
- Focusing on instilling new attitudes and higher expectations among the employees at Oakland. Material waiting to be packed for more than a short period of time is no longer an acceptable practice.
- Enhancing the quality of worklife at Oakland by making the site a cleaner and more comfortable place to work.

Although SRDD has only been under DDRW management since the end of April 1991, it also shows evidence of improvement. The most notable was to provide the resources to conduct a 100 percent location survey before the end of the fiscal year. At SRDD there has been no location survey for 18 months due to Army budget constraints.

DDRW believes that better utilization of resources has resulted in immediate savings from consolidation. It claims savings of more than \$2.6 million in FY91 from canceling unnecessary contracts and from redistributing equipment and storage aids. Table 2-12 shows the breakdown of those claimed savings. However, not all that money would have been spent in the absence of consolidation. For instance, the \$575,000 savings resulting from canceling the Oakland inventory contract should not be credited to consolidation because the contract was canceled as a result of implementing NISTARS RF, not as a result of consolidating. The remaining \$900,000 worth of cancellations appear to be a consequence of consolidation, and the \$1.9 million worth of redistributions have provided some benefits that were not available prior to consolidation. DDRW expects to save another \$800,000 in FY92 by implementing a guaranteed local delivery contract at Oakland rather than continuing use of Navy Public Works Center Transportation Services.

Navy Concerns

The Navy is concerned about DDRW management because inventory adjustments appear to be increasing and because fewer persons are devoted to causative research of inventory problems. Appendix F addresses the Navy's gross

TABLE 2-12

**CONTRACT CANCELLATION AND REDISTRIBUTION SAVINGS CLAIMED
BY DDRW FROM CONSOLIDATION**

Contract cancellations	
Inventories at Oakland	\$575,000
Material handling maintenance at Oakland	76,000
Pallet repair at SRDD	16,816
Subtotal	\$667,816
Redistribution of equipment	
Dock levelers – San Joaquin to Oakland	\$20,000
Gravity conveyors – San Joaquin to Oakland	5,000
Jib cranes – San Joaquin to Oakland	45,000
Fork lift – Tracy to SRDD	40,000
Stretch wrap machine – Oakland to San Joaquin site	70,000
Paint booth – Sharpe to SSDS	13,900
Saw – SSDS to Tracy	15,000
Transporter floats – Tracy to Sharpe	225,000
Transporter trucks – Use of idle ones	1,080,000
Subtotal	\$1,513,900
Redistribution of storage aids	
Reutilization of excess racks at Oakland	\$382,000
Pallet racks transferred from SSDS to other sites	13,875
Transfer of pallet stacking frames from SSDS to other sites	71,200
Subtotal	\$467,075
Total savings claimed by DDRW	\$2,648,791

Note: Savings from consolidation do not include manpower savings resulting from process or other improvements.

monetary adjustment rate (GMAR) in detail. While the GMAR has reached some high monthly values (8.7 percent in July 1991), it has not grown larger in the aggregate since consolidation.

The Navy is also concerned that DDRW is not responsive to unique Navy customer needs. One example of this problem is the inability of the DWASP system to apply a "hold" status to orders waiting to be picked up by ships at sea. Holding those orders causes performance statistics to suffer since the DWASP system thinks the orders are late. This is a system problem that DLA must address. The Navy also questions whether DDRW can supply items no longer stocked at Oakland from another DDRW site as responsively as it supplied such items before consolidation. This concern is a valid one but does not appear to be a major problem for DDRW thus far. It will be important for DDRW to understand the unique needs of each of the sites in the consolidation.

The DDRW and Navy philosophies on inventory control and accuracy are antithetical. The Navy's approach has been to instill a number of safeguards and verification checks into the picking process using NISTARS. One order pick may require the warehouse worker to verify stock number, location, and balance in the bin while making the pick. DDRW's approach is to instill good organization and warehouse practices in their facilities. They view the NISTARS approach as unproductive because of the added labor required and believe they can achieve better inventory balance accuracy and location accuracy by concentrating on basic warehousing practices — including frequent location surveys to correct mistakes.

DDRW uses the Tracy site as an example of how good warehousing practice can produce high accuracy and good productivity. The pick process at Tracy is manual and is at least twice as productive as that at Oakland under NISTARS. One reason it is so much more productive is that the manual system does not require item verification, location verification, or inventory balance checks. However, at Tracy the DDRW staff performs at least one and usually two location surveys during the course of the year per location using approximately 2.5 work-years in FY91 to survey over 700,000 locations. They view this as an inexpensive way to find problems and correct them before the customer places an order. The Tracy site has a higher location accuracy rate (99.9 percent) and a lower denial rate (0.56 percent) than any of the other sites.

In summary, management improvements have taken place under DDRW and they have included numerous process improvements and changes in management philosophy.

DEFENSE DISTRIBUTION SYSTEM CHARACTERISTICS

The DDS being tested in the Bay Area is not yet the system described in the DLA Functional/Environmental Baseline. No DDRW location has implemented the entire planned DDS. At most, the test system in the Bay Area is a limited mixture of the listed functions, with the most complete embodiment occurring at Oakland. However, the DDS at Oakland does not include issue from receiving (from SC&D) nor has SDS conveyance control replaced the Oakland conveyance control function. In short, the prototype testing of DDS at the Oakland site involves just the DWASP receiving and shipping functions integrated with the NISTARS WCS. Moreover, some NISTARS shipping and receiving software remain in the Oakland version of DDS.

Figure 2-6 shows the interconnection of the DWASP and NISTARS software packages supporting the Oakland activity. This conceptual portrayal does not reveal the profusion of hardware and communications interfaces existing in the Oakland DDS configuration. The NISTARS WCS also supports hand-held RF terminals via microcomputers linked by modems to the Tandem computer.

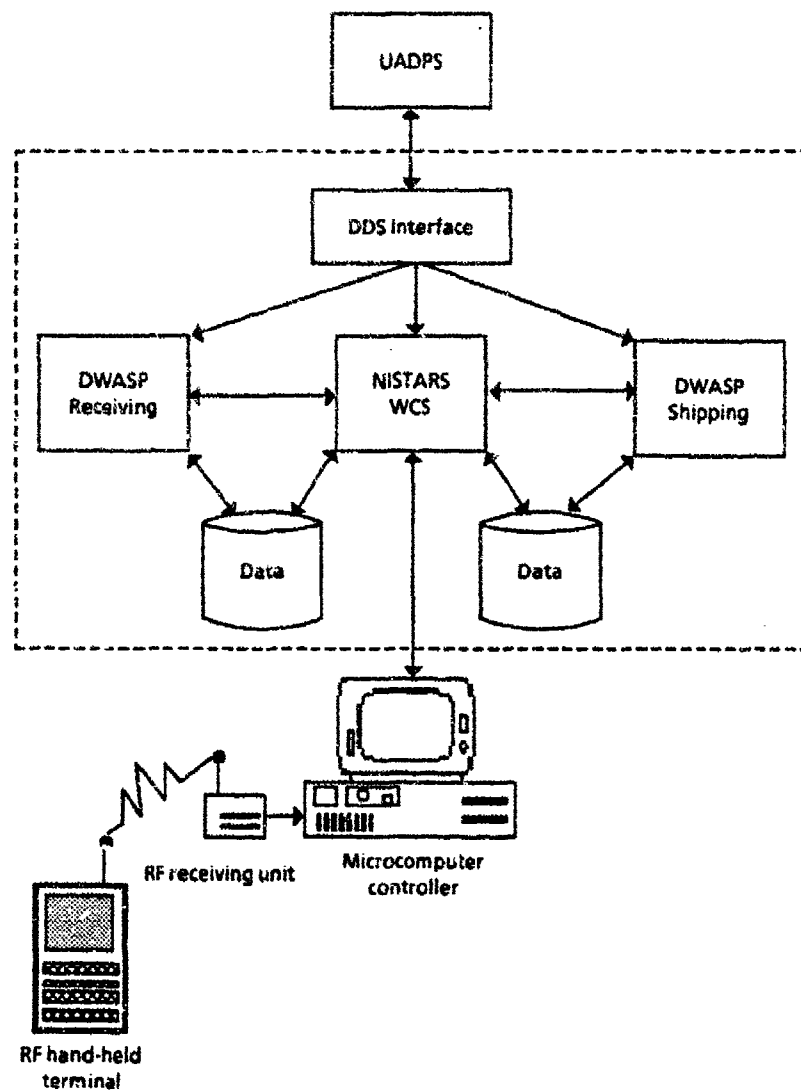
At the Sharpe site, DWASP modules have replaced the previously operational SDS receiving, control, and shipping functions. NISTARS is not yet in operation,⁹ so the work of picking, stowing, and inventory counting remains a manual process. Figure 2-7 depicts the system operating at Sharpe with DWASP module replacement of earlier SDS counterparts.

The system configurations at Tracy and both Sacramento sites have not been changed to DDS.

DDS OPERATION

While Figure 2-6 portrays the conceptual architecture of the Oakland/Sacramento system operation, Figure 2-8 brings it into physical perspective. The DWASP receiving module communicates with the IBM UADPS computer and the Tandem-based NISTARS WCS. Both DWASP and UADPS use the same IBM

⁹On 18 September 1991, Sharpe began testing NISTARS on a single aisle in the mechanized warehouse and one outlying bulk area. The Tandem computer for NISTARS is located at Sharpe.

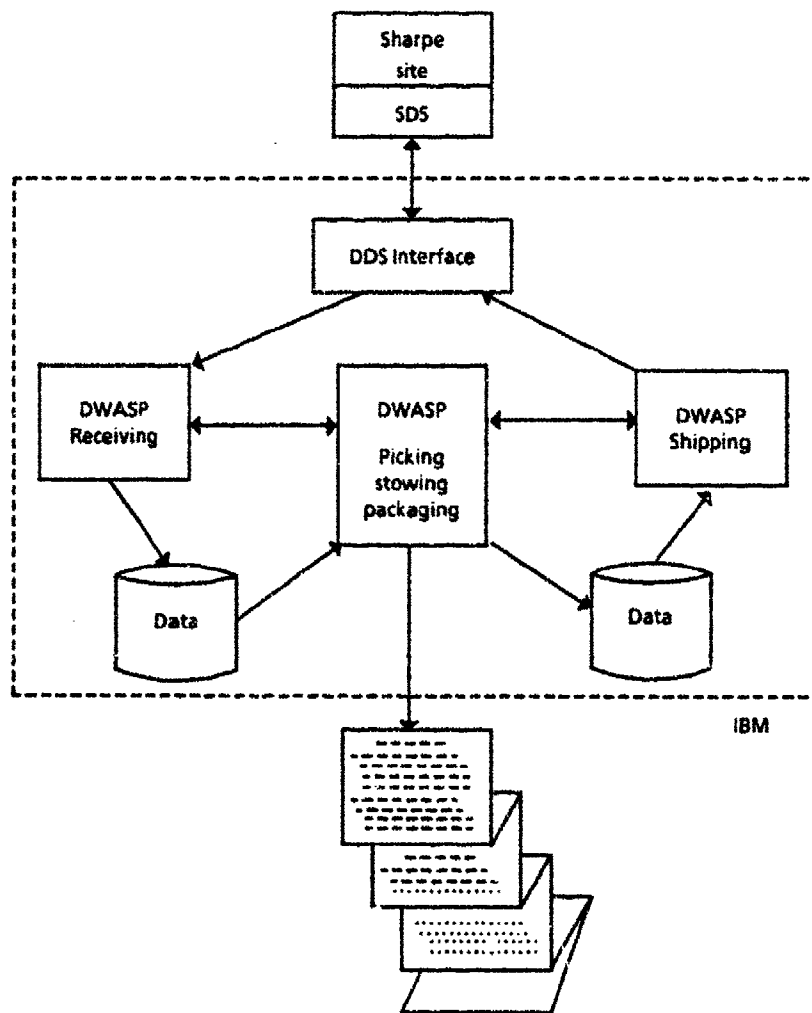


Note: UADPS = Uniform ADP System; DDS = Defense Distribution System; DWASP = DLA Warehousing and Shipping Procedures; NISTARS = Navy Integrated Storage, Tracking, and Retrieval System; WCS = warehouse control system; RF = radio frequency.

FIG. 2-6. DEFENSE DISTRIBUTION SYSTEM CONCEPTUAL INTERCONNECTION

mainframe located at Sacramento, while the NISTARS Tandem computer is at Oakland.

Transactions, transmitted over an American Telephone and Telegraph (AT&T) T1 line between the Sacramento and Oakland sites for processing by the Tandem computer are spooled onto its disk. When the packaging function is finished in the NISTARS WCS process, transactions once again travel the T1 line to the Sacramento



Note: SDS = Army Standard Depot System; DDS = Defense Distribution System; DWASP = DLA Warehousing and Shipping Procedures.

FIG. 2-7. DEFENSE DISTRIBUTION SYSTEM AT SHARPE

DWASP module. However, before exiting Oakland to make that passage, the Tandem again spools those Sacramento-bound transaction data. After arriving in Sacramento for processing, resulting DWASP shipping data required back at Oakland must once more retrace the T1 line from Sacramento to Oakland. As a result, it takes several minutes longer for transactions to complete the circuit than for the items to reach the shipping station. Each of these steps is described in more detail in the next section.

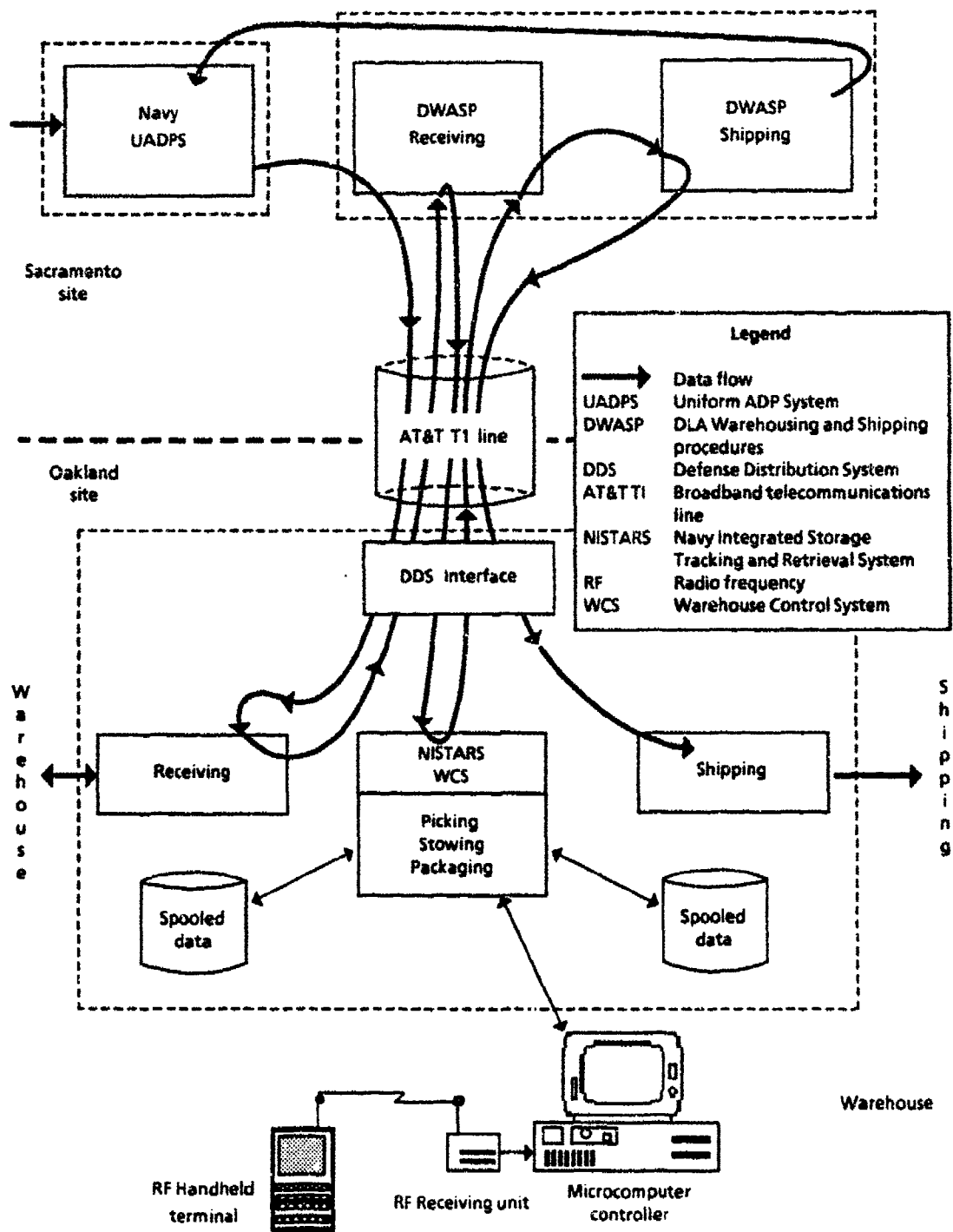


FIG. 2-8. DEFENSE DISTRIBUTION SYSTEM AT OAKLAND

In contrast, although housed in separate mainframes, the DWASP system and Sharpe SDS are located entirely at the Sharpe site. As a result, interfaces are simpler without NISTARS and the telecommunications link and are conducive to timely interaction between the modules of this version of the planned DDS.

DEFENSE DISTRIBUTION SYSTEM PERFORMANCE

Defense Distribution System Installation

The DDS was fielded before all of its operational components were fully tested. Simultaneous upgrades and rewrites of system software impeded the prototype implementation of DDS. These alterations in software include the following:

- Integration with NISTARS of software to support microcomputers controlling the RF terminal process
- A substantially full-scale version change in the NISTARS software at Oakland
- Employment of a T1 telecommunications link between Oakland and Sacramento connecting IBM DWASP with Tandem NISTARS modules
- Conversion, partial revision, and migration of UADPS, formerly residing on Burroughs hardware at Oakland, to its new IBM platform at Sacramento.

Problems were experienced because some of the software upgrades and their interfaces were not tested sufficiently. In particular, it appears that many of the operational problems observed in the NISTARS software were not present in its predecessor.

In addition, the mechanism through which the faulty software is corrected, known as "two-way" communications, did not work. Such communications detail the problems encountered to date and identify what needs to be done; however, the problems were not resolved in a timely manner.

DDS Interfaces

In theory, computer and telecommunications interfaces are transparent to the user. However, in practice, each added interface invites compatibility discrepancies and timing challenges. At Oakland, both are present.

When DDS was first implemented, failure in the telecommunications link between Oakland and Sacramento had a serious effect on production. Week-long

debugging sessions, followed by daily system outages, resulted in very poor reliability. The primary problem eventually proved to be an inconsistency in telecommunication protocols between DWASP and NISTARS software.

System outage at Oakland was a major problem early on; in July, system up-time during working hours was only 84 percent. By August, the telecommunications linkage rendered the system inoperative for about a half hour a day for a 94 percent up-time during working hours. Connection of the telecommunications software in DWASP has all but eliminated the problem.

Other interface (or contention) problems persist. After the picking process is finished, packaging information returned from NISTARS to DWASP over the T1 link has a more serious problem. Spooling the transaction data in the Tandem computer creates a bottleneck. As a consequence, instructions for shipment labels from the DWASP module consistently arrive at Oakland after the packaged materials have reached the shipping station.

Work-around measures at Oakland to offset this late arrival of label data involve "reshipping" most packaged items. Data needed to create shipping labels must be wanded-in a second time. This means, instead of merely scanning the order control number (OCN), the operator must re-enter five or six data fields into the terminal. Not only does that requirement inject an extra step in the work flow, but it is a duplication of work performed previously.

NISTARS RF Terminals

Another NISTARS problem arises in supporting the hand-held RF terminals. The communications link with the microcomputers handling the RF devices creates a timing contention on the Tandem channel resources so that response times to those devices are unacceptable. The problem has been temporarily resolved by restricting some of the background processing such as management reports previously scheduled in the Tandem.

Furthermore, the RF network itself often performs too erratically to be acceptable. That problem has to do with RF wave propagation. For example, in certain areas of the warehouse, standing wave interference is so great that the RF unit must be held outside a window to transmit its keyed-in information. Such radiation problems could be overcome through an improved antenna

arrangement: more antennas proximate to the trouble spots and direct coaxial cable connections between them and the main building. To date, however, the propagation obstacle remains unresolved.

The RF radiation difficulty imposes an additional workload on warehouse workers. To communicate with NISTARS, it is sometimes necessary for the worker to interrupt the picking process, walk to a window, place the hand-held unit outside the window and, after that, to wait an excessively long time for a return signal indicating that NISTARS has received the data entry. While working in those areas of the warehouses affected by the problem, every picked item must be similarly "hand-delivered" to NISTARS.

The effect of these cumulative NISTARS problems is a bin-picking productivity of 12-1/2 lines per hour at its best. Under similar conditions at Tracy, manual bin picking yields 30 to 40 lines per hour.

Faster warehouse control systems, such as the SC&D Automated Warehousing System (AWS) operating at SSDS, require less verification of data and automatically assign and print control labels for each pick. Consequently, even without the hardware and software problems, NISTARS picking is slower than that of other such systems in the Bay Area prototype. NISTARS requires a significant amount of data entry by the operator. The worker must verify item numbers, locations, and sometimes physical bin counts. The operator also wands-in a control number for assignment to the pick. Wand readers, which are both unreliable and clumsy to handle, become even more so when using an RF terminal.

Other chronic RF-terminal-related impediments to the work flow include the terminals themselves, which are unwieldy in their warehouse application. Because the terminals are awkward and too few are available, two workers are assigned to a single terminal at Oakland; one picks and the other records. Therefore, any system-related degradation in performance has a double impact: it reduces the productivity of both workers.

NISTARS Pack Area

Several problems were apparent in the pack area at Oakland. Some of them result from the DDS interface problems already cited, and others arise strictly from NISTARS software malfunctions. They have been reported in "two-way"

communications but have not yet been resolved. The list of observed problems is as follows:

- Large orders are partially packed before all items in the order arrive. When more items for the order arrive, the system doesn't know where to route them.
- Sometimes package identification numbers are lost by the system.
- Slow system response at the packer's station causes lost operator productivity time.
- The system routes some items to a wrong carousel location for consolidation with other items in the same order. Sometimes, the system routes more than one order to the same carousel slot.
- Some multiple-line-item orders are routed to a single- instead of a multiple-line-item chute (carousel station).
- Some items are routed neither to a multiple line-item nor a single line-item station (items must go to one or the other).
- Goods arrive at the DWASP shipping station before labeling information is available to DWASP. As we pointed out, this results from the interface and data spooling requirements between NISTARS, DWASP, and the T1 line.
- Items are not sorted by shipping mode at DWASP stations.
- A single line-item order, with its only item coming from two or more separate locations, is routed to the single line-item station for packing. Orders with these items should be treated as multiple line-item orders so that the items may be consolidated before shipment. Currently, these items are merged manually at the shipping stations.
- Sometimes a particular carousel slot has no material in it even though the system indicates material is there.

STOCK CONSOLIDATION

DDRW plans to stock each national stock number (NSN) at only one location within the region. It also plans to stock similar groups of products at the same location. The following actions have been identified by DDRW as its regional stock plan:

- Move the top 200 duplicate items from the Oakland site to the San Joaquin site. These items account for 10 to 12 percent of Oakland's workload.

- Do not allow new procurements for DLA items to arrive at the Oakland site but instead receive them at the San Joaquin site. This action will result in a 60 percent workload reduction at Oakland over time.
- Eliminate 4,500 duplicate items between Sharpe and Tracy by storing each item at only one of the two sites.
- Move all DLA items from the SSDS to the San Joaquin site.
- Eliminate all items at SRDD over time as a result of base closure. Send items to other Army sites or redistribute them within DDRW.
- Eliminate site duplication for some 160,000 items stored both at Ogden and at least one DDRW site. (Ogden is scheduled for future consolidation into DDRW.)

At the Oakland site, receipts have decreased and some material has been redistributed, but most of the other elements of the DDRW stock consolidation plan have not yet been executed. DDRW has done some preparatory work to accommodate the above actions. It has requested that DLA Headquarters conduct a study to determine the best storage location within the San Joaquin site for each stock class, and it is also taking steps to increase the storage capacity with better storage aids at the San Joaquin site (the primary distribution site for the region). This extra capacity will serve to accommodate material transferred there from other DDRW sites.

Redistribution of material within the region has taken place as follows:

- Air circuit breakers have been moved from Mare Island to Oakland.
- Some petroleum, oil, and lubricants (POL) has been moved from San Joaquin to Ogden.
- Some empty drums have been moved from Point Molate to Oakland.
- Steel products were moved from the Oakland site to the San Joaquin site. (Actually this move was initiated prior to consolidation.)

Although important, they are a very small part of the total plan to rearrange and consolidate stock. As the objectives of the regional stock plan are realized, we expect to see reductions in labor and facility resource requirements needed to receive, store, and ship material.

CHAPTER 3

ASSESSMENT

The Bay Area supply depot consolidation prototype has demonstrated that a consolidated operation can maintain or improve readiness and meet customer mission needs. It has done so under the turbulent conditions of Operations Desert Shield, Desert Storm, and Provide Comfort. While operational improvements under single management are quite evident, the prototype has not yet demonstrated consolidation savings on the scale of those originally projected. Significant personnel savings have been realized since the baseline year, but we attribute those savings to a declining workload rather than to consolidation. The uniform DDS has not yet proven successful because of software reliability problems and complex, undependable interfaces. We do not believe that the warehouse control portion of DDS, as presently designed, will improve work force productivity at the Bay Area sites.

Our assessment of the prototype's first year is:

- Overall performance has improved in the consolidated operations and customers generally remain satisfied.
- Savings have been realized through personnel reduction, but it is not possible to attribute those savings to consolidation since workload has also decreased. Other savings are evident, although they have occurred more slowly than anticipated in the prototype plan. Problems with the uniform DDS implementation have adversely affected performance at Oakland.
- Consolidation costs are slightly below those anticipated in the prototype plan, but not all consolidation costs are being reported.
- Consolidation potential in the Bay Area is still high, with additional savings possible from increasing work force productivity and more quickly consolidating stocks.

PROTOTYPE PERFORMANCE

Performance at the Sharpe site and SRDD has improved since consolidation. Performance at the Tracy site and SSDS has remained high, while Oakland's performance has been off substantially since installing NISTARS RF in January. Despite the problems at Oakland, we believe the consolidation has successfully demonstrated that performance can be maintained or improved. Performance

remained effective under the turbulent conditions imposed by Operations Desert Shield and Desert Storm.

The performance difficulties at the Oakland site are attributable to its automation problems. The NISTARS RF implementation revealed several complications with the new NISTARS software. Its implementation was followed too closely by the implementation of DDS, which itself experienced many unanticipated problems with the NISTARS-DWASP interface, resulting, among other things, in many issue transactions not being properly closed out. Communications difficulties between NISTARS and UADPS resulted in system reliability problems for several months. Oakland's performance suffered because of those problems.

The DDRW claims that the Oakland performance data are erroneous and that the site's performance is higher than the data indicate. Some evidence supports that claim, but it only relates to performance in recent months. However, the poor reliability of the site's automated system has resulted in periods of decreased productivity and in the need to redirect some issues to other stock points.

Representatives of the Naval Supply Systems Command (NAVSUP) stated that many of the NISTARS problems could have been resolved before they became so serious. While DDRW and Oakland personnel had some communications problems — problems that prompted NAVSUP to send assistance teams to the Oakland site — we doubt that the performance problems would have substantially lessened had the Navy retained control of the site and implemented the same systems changes itself. The real problem was the premature fielding of an unreliable combination of systems, and the DDRW staff worked just as hard as would have any of the Service staffs in coping with it.

In terms of customer satisfaction among users of the depots, we found very little change since consolidation. Customer feedback has remained generally positive and has not changed significantly in either quantity or character.

Given the significant demands during Operations Desert Shield and Desert Storm, and the considerable distraction associated both with those operations and with the consolidation itself, the prototype's generally high level of performance leads us to conclude that consolidation itself has not degraded performance. On the contrary, several performance levels are up; and, in the Army's case, up to 24 percent above the levels it had provided itself.

PROTOTYPE SAVINGS

Consolidation savings are much lower than DLA has claimed. Substantial personnel savings from the baseline year are evident; they are attributable more to workload reduction than to consolidation. Transportation and CCP savings have begun to occur, but those transportation savings will be credited to DMRD 915. The CCP savings, anticipated to begin in FY91, were delayed until the contract at SSDS expired at the end of the fiscal year.

Relocation of regional equipment, storage aids, and personnel have occurred regularly and are among the most visible benefits of consolidation. They will result in operational savings in the future.

Personnel Savings

As discussed in Chapter 2, 693 end-strength positions (500 of them full-time) have been vacated at the five Bay Area depots since FY89 and have not been filled. Since the dates of consolidation (June 1990 for the first three sites and April 1991 for the two Sacramento sites), 264 end-strength positions have been vacated (133 of them full-time) through August 1990.¹ DLA has claimed DMRD 902 consolidation savings of over \$24.5 million for all 693 positions vacated since FY89.

We do not attribute those savings to consolidation. As we have already noted, depot workload has decreased roughly in proportion to the reduction in personnel. The planned reduction of 244 personnel equivalents in FY91 was to have been achieved through attrition under the presumption of static workload. The attrition happened, but the effect of the decrease in workload largely upstaged the effect of consolidation.²

¹Some of the Services have stated that any personnel reductions taken before the date of consolidation cannot be attributed to consolidation. However, the Services knew that consolidation would take place and could plan accordingly to reduce the number of slots to be transferred. That planning was especially notable for the Sacramento sites during the period between October 1990 and March 1991 (the 6 months prior to consolidation under DDRW) when the full-time end strength dropped from 1,155 positions to 1,045, a reduction of 110 positions, or nearly 10 percent.

²DLA is reporting DMRD 902 savings correctly in that the reduction in personnel costs has been realized since the baseline year. However, DMRD 902's projected savings were to have been achieved through productivity improvement, not reduced workload. DMRD 902 was never adjusted to account for projected reductions in workload, and DLA has received no OSD instructions to report savings from workload reduction separately from consolidation savings.

Under such circumstances, DLA had two possible courses of action. First, it could continue to reduce the size of the DDRW work force by attrition alone, counting on the likelihood that DDRW's workload would eventually stabilize and the ratio of workload to personnel would improve through further attrition. The second course of action would be to release employees involuntarily to improve that ratio more quickly, resulting in personnel savings that were more than merely proportional to the workload reduction and more in keeping with the prototype plan's projection.

The DLA chose the first course of action, a conservative approach, and one that we consider to have been wise during the uncertain period surrounding Operations Desert Shield and Desert Storm. However, DLA has continued to maintain that course of action. As DoD reduces in size, it is likely that workload will eventually stabilize at an even lower level, but when it will do so is far from certain. Our assessment is that the anticipated FY92 level of work force productivity in the prototype plan will be difficult to achieve if DLA relies only on attrition.

Complicating the work force productivity issue are two other factors. First, with the poor DDS reliability at Oakland, DDRW has been unable to fully utilize the Oakland work force, and that inability has resulted in low productivity about which little could be done. While the net impact of the Oakland problems on total regional productivity has been only secondary, those problems have caused much of DDRW's management attention to be diverted from productivity enhancement to problem solving. Second, DDRW has devoted much effort, particularly at Sharpe, to improving depot performance so that it has now exceeded the level the Army had provided itself. Had DLA set lower performance goals for DDRW's newly acquired operations – more consistent with past performance by some of the Services – it is likely that fewer direct labor hours would have been needed and work force productivity could have increased. OSD should be aware of the cost of DLA's performance goals and determine what expense it is willing to incur to meet them.

More quickly reducing the number of personnel in the Bay Area would accelerate the achievement of personnel savings expected from consolidation. The logic behind the personnel savings projections in the *Supply Depot Consolidation Study* was that the initial personnel savings would come from the elimination of duplicate overhead among the sites and the rest from gradual enhancement of the direct work force's productivity. The region's work force attrition to date has not resulted in as many vacancies in overhead functions as needed to produce the

overhead savings that the Process Action Team had envisioned. In the current Bay Area employment market, personnel in overhead positions are simply not leaving jobs very quickly.

The DDRW does not believe that reductions through the elimination of positions are appropriate. It contends that the positions it would have to eliminate to streamline its overhead functions are needed to undertake future DDRW consolidations. If true, the cost of consolidation in terms of personnel labor is significantly higher than has been reported in the past.

In summary, personnel (and DMRD 902) savings have occurred, but we do not attribute them to consolidation since workload has dropped proportionately. Overhead consolidation has not produced as significant an impact on savings as anticipated by the Process Action Team that proposed supply depot consolidations. Unless workload increases steadily, DLA's goal to achieve higher work force productivity in FY92 and beyond will have to rely on more than attrition to reduce the size of DDRW's work force.

CCP Savings

The prototype plan and the *DDRW On Site Consolidation Plan*, dated 22 June 1990, both called for the consolidation of CCP operations to a single site, which the latter plan said would be Sharpe. Expected FY91 savings were \$1.5 million. The consolidation did not occur in FY91 because DDRW's contract for CCP operation at SSDS was not scheduled to expire until the end of FY91. The contract has since expired and will not be renewed. DDRW expects to obtain FY92 savings of \$500,000 as a result of CCP consolidation.

In future years, DDRW expects to lessen the need for large-scale CCP operations by "banking" requisitions in DDS and releasing them to provide substantially better transportation consolidation opportunities with less material handling. It also intends to rely more heavily on the RFCC at Montebello, CA., and less on local operations.

Transportation Savings

In the prototype plan, transportation savings were expected to begin in FY91 but not to reach their full effect until FY93. Annual savings projections were \$1.5 million in FY91, \$3.0 million in FY92, and \$6.0 million in FY93. Actual savings

are not being claimed as consolidation savings but are to be included in transportation savings credited to DMRD 915.

Most DDRW and DLA initiatives have improved consolidation of shipments for transportation and reduced transportation costs. Most notable are the extension of guaranteed traffic rates to shipments from all Bay Area depots and the timed release of issues to geographic areas, which permit material to be consolidated within and between Bay Area depots.

Construction Savings

The military construction (MILCON) program savings of \$24.7 million projected in the prototype plan will occur in the future. Two FY93 MILCON projects that would have been completed have been canceled: an operations support facility at Tracy (\$16.7 million) and a hazardous material storage facility at Sharpe (\$7.95 million). The prototype plan called for them to be counted as FY93 savings.

From our visits to the Bay Area depots, we have observed that regional warehouse capacity is maintained at a level that gives each depot enough capacity to satisfy anticipated work volume as well as occasional surges. Combined, those facilities offer DDRW a substantial surge capacity and warehousing flexibility. If significant stock is consolidated as a result of depot consolidation, even more space will be made available. Significant additional general capacity is not likely to be needed soon, even to replace aged facilities.

DDS Savings

The idea motivating a single computer support system at DLA-operated depots was that software maintenance costs would be reduced for a single system. No net savings relative to DDS were expected during the 2-year Bay Area evaluation period, and thus far, no savings have been realized.³

Our assessment of DDS is that one system that has multiple interfaces (modules of DWASP, NISTARS, SDS, and SC&D) is just as complex to operate and manage as

³DDS was the DoD standard distribution system envisioned at the time the prototype plan was written. Since that time, DLA and the Services have devoted considerable effort toward identifying the best system to support consolidated supply depot operations. Other systems and combinations of systems are being considered. Our assessment is based only on observed DDS operations in the Bay Area.

multiple systems (existing Service/DLA systems). In the Bay Area, consolidating a proliferation of unlike ADP systems has resulted in a proliferation of complex interfaces to be understood, managed, and maintained.

Secondary savings were expected both from a reduction in the number of data centers operated in the field and from productivity improvements in supply depots. In the Bay Area, DDS does not operate from a single data center, and it has produced no savings in regional ADP operations. As noted earlier, the DWASP "banking" features have enabled DDRW to achieve greater transportation consolidation, but the NISTARS warehouse control system has not produced work force productivity savings.

We only observed NISTARS operating as part of the DDS at Oakland, so our conclusions regarding NISTARS reflect that system only. For the system to aid general productivity, the software errors that affect warehouse operation must be corrected. Even if they are corrected, the DDS NISTARS design would have serious productivity implications if it were to be employed at other DDRW sites. For example, employing NISTARS RF at the Tracy site could result in a direct labor increase of 2-1/2 to 3 times current levels for order picking based on the current NISTARS bin-picking rate of less than 12-1/2 lines per hour compared with Tracy's manual yields of 30 to 40 lines per hour under similar conditions. Moreover, the NISTARS ministacker and crane productivities of 40 and 25 lines per hour, respectively, compare with rates of 80 to 100 lines per hour for similar systems in the private sector. Fixing the software so that the hardware works properly will not alter the NISTARS basic design, which imposes an inordinate data verification and entry requirement on the operator and results in a slow picking process.

Faster warehouse control systems, such as the AWS operating at the SSDS impose fewer requirements for verification of data and automatically assign and print control labels for each pick. This kind of system design results in significantly higher productivity than that of NISTARS.

We believe the Oakland NISTARS, as currently designed, will not demonstrate improved productivity at other DDRW sites. Although the incorporation of the DWASP modules has proven effective at Sharpe, the NISTARS interface with DWASP is a serious problem in the Oakland configuration. If DLA were to install

the Oakland version of DDS at the remaining Bay Area sites (and use the NISTARS component in all facilities), it would risk reduced productivity.⁴

DDRW Actions to Further Reduce Operating Costs

We observed improvements, not identified in the prototype plan, that have resulted from the consolidation. DDRW has put considerable effort during its first year of operation into improving the operations and performance of its "new" depots. The management improvements we have seen, particularly at Sharpe, have both improved performance and saved money, although the savings for the most part are from mechanization improvement that the Army might never have made.

The new Western Distribution Facility at Sharpe was not well designed, having many layout and mechanization flaws. The DDRW staff's use of equipment from other DDRW sites to correct those problems has enabled the facility to be used more effectively without the need for expensive capital outlays and without long delays for equipment funding. The facility was made more useful more quickly than it would have been if it were still operated by the Army, because of DDRW's ability to relocate regional assets. The volume of such activity was well over \$1 million in equipment moved to and from the Sharpe site alone.

No real identifiable savings have yet occurred from those improvements. Nevertheless, they are an important indication that consolidation has made a consequential difference. DDRW has been able both to increase its storage capacity and to improve the performance of its work force as a result of the redistribution of regional resources. That would not have happened without consolidation.

Had the Sharpe site, for example, continued to operate with the limitations designed into its new facility, it would have provided less storage capacity and obtained less output from its workers. With the added capacity, DDRW will be able to consolidate more material from other sites, such as Oakland and SRDD, without significant funding outlays. While the total amount of work per employee has remained constant, the quality of that work has improved, largely because of

⁴NAVSUP has told us that higher warehouse productivity is being achieved at other NISTARS RF sites and that the improved timeliness of inventory balance data and paperless processing have resulted in savings in other depot operations. We have not observed those benefits in the Bay Area. We have recently requested that NAVSUP provide us with evidence of savings at other NISTARS RF sites but have not yet received it.

DDRW's redistribution of regional resources to the site having the greatest need for them.

Had consolidation not occurred, we believe that the Army would ultimately have funded some of the improvements that DDRW has already made, particularly to correct the design flaws in the new facility. It would have taken time to obtain funding, time in which the Sharpe work force would have had operational handicaps and in which storage space limitations would have continued to exist.

Since consolidation, DDRW has redistributed equipment and storage aids valued at \$1.9 million among its Bay Area sites. Such action has resulted in increased storage capacity and increased worker output, improvements that individual Services would have obtained either more slowly or not at all.

CONSOLIDATION COSTS

The costs of the Bay Area consolidation have been below those anticipated in the prototype plan. Our cost information came from three sources: DLA Headquarters collected prototype implementation and contract ADP development costs, the DLA Systems Automation Center (DSAC) provided labor costs for ADP development, and DDRW collected its personnel costs for consolidation and for DDS installation and training. The planned and cumulative actual costs to date (both FY90 and FY91) are shown in Table 3-1.

The DDS costs are lower than planned, but the prototype plan called for 84 percent of DDS funding (and 95 percent of hardware/software funding) to be expended by the end of FY91. With DDS only partially installed at three of the five sites, the actual status of the DDS project is well behind the schedule originally proposed, and it is logical that costs should also be lower than planned.

There are other DDS costs that are neither in the prototype plan nor in Table 3-1. Labor at the DSAC Central Design Agency (CDA) in Ogden, UT, amounted to \$4.1 million, and DDRW has accumulated \$2.7 million in costs for DDS implementation and training. We believe that both are legitimate DDS costs and should be included in the total cost of DDS. Combined with the \$17.9 million shown in Table 3-1, the total cost of DDS to date, therefore, is approximately \$24.7 million.

Prototype implementation costs are also lower than planned, again, because projects forecast for completion by now have not yet been finished. In addition to the

TABLE 3-1
CONSOLIDATION COSTS TO DATE
(\$ millions)

Cost category	Planned cost (FY90 and FY91)	Actual costs (FY90 and FY91)
ADP development costs		
O&M	9.0	9.6
PDA	14.1	8.3
Subtotal	23.1	17.9
Prototype implementation costs		
O&M	6.8	3.9
PDA	5.9	2.1
Subtotal	12.7	6.0
Total	35.8	23.9

Note: O&M = operations and maintenance; PDA = procurement defense acquisition.

\$6.0 million shown in Table 3-1, DDRW charged \$3.3 million of consolidation costs to its accounting system. We believe that DDRW's consolidation costs are really somewhat higher, since the criteria established for charging to its consolidation job order have prevented the inclusion of some consolidation activity costs (for example, not included are the extraordinary effort by DDRW's staff to convert personnel records from Service to DLA formats and the time spent with union representatives addressing consolidation concerns). DDRW has told us that it is unable to release many of the employees identified as surplus because they are still needed to perform consolidation duties. Also, rewarehousing costs are not documented. The \$9.3 million total is a conservative approximation of prototype implementation costs to date.

In summary, the cost to date of consolidation has been approximately \$34 million, over 70 percent of which has been for the development and installation of DDS.

CONSOLIDATION POTENTIAL IN THE BAY AREA

It is our assessment that the Bay Area consolidation can produce significant additional cost savings while maintaining or improving service to customers. One way to realize those savings as scheduled is to accelerate the following actions:

- Increase productivity to increase personnel savings.
- Consolidate stocks within the region.
 - ▶ Have Service ICPs view DDRW as one location. The decision to stock an item at a particular site within the region should be made by the regional management.
 - ▶ Eliminate occurrences of items stocked at multiple locations within the region.
- Identify and satisfy the needs of local customers.

As these actions are taken, DDRW can expect to achieve significantly higher savings than those achieved to date, savings on the magnitude of those expressed in the prototype plan.

Personnel Savings

The first step in achieving personnel savings is to identify surplus positions. DDRW is already conducting "functional area analyses" (FAA). These FAAs report the number of current personnel in each functional area and the number that are surplus under consolidated management. They address both direct and nondirect (indirect and overhead) personnel. Analyses for the three original sites identified 168 nondirect persons as excess.⁵ DDRW is slowly realizing reductions through attrition; however, because of declining workload and poor economic conditions, the rate of attrition is too slow for DDRW to realize the full savings in a timely fashion. DDRW needs to find a means to achieve the identified reductions faster if productivity is to be increased.

⁵Although additional FAAs are being conducted, we have not seen their results.

Stock Consolidation

Further consolidation savings will result from the elimination of multiple stock points for a specific item within the region:

- The elimination of stockage points for a particular item will allow the ICPs to reduce required safety stocks and will result in lower inventory investment.
- Fewer total receipts will need to be processed, resulting in lower cost.
- Less storage space will be required, resulting in a smaller facilities requirement.
- Miscellaneous handling costs will be reduced by conducting fewer location checks, inventory counts, rewarehousing moves, etc.
- Fewer total issues will be needed, because the risk of not having enough stock at any one site to fully satisfy a particular customer requirement will be minimized and fewer partial issues will occur.
- The cost of issues that do occur will be minimized as a result of stocking the item at the facility able to receive, store, and ship that item at the lowest cost.
- As a result of less direct cost and less required space, overhead reduction will be possible.

Two things must occur before these savings can be realized. First, the Service ICPs must view DDRW as one physical site. By doing that, they cannot designate multiple stock locations within the region. Thus, DDRW is able to manage its own locations completely within the region. Specifically, DLA could take the following two actions. First, it could publish and disseminate guidance to the ICPs, including Service ICPs, on the appropriate locations for wholesale material in the Bay Area. It would need to monitor compliance with that guidance. Second, it could create and use a reporting system that would allow its headquarters to monitor the number of items stored at more than one Bay Area site. Goals could be set for reducing such duplication as soon as economically feasible. Performance toward those goals could be monitored.

The second step to achieving savings is that DDRW must actively identify and eliminate items stocked at multiple sites. It can either redirect new receipts for such items to the most appropriate sites while drawing down stocks at other sites or physically relocate items from one site to another (the prototype plan anticipated a

consolidation cost of \$2 million for physical stock relocation). Only by consolidating items will DDRW be able to take advantage of the benefits associated with single-location item stockage.

Customer Needs

Until recently, most of DDRW's workload volume was for off-base shipments. With the addition of the Sacramento sites to DDRW, it now has a significant amount of on-base issues and receipts. Special considerations should be given to ensuring that the needs of the local customers can be met. These needs relate primarily to fast turnaround time for certain emergency orders. When considering changes in its distribution network, DDRW must ensure that it identifies and satisfies the true needs of its local customers. This is particularly applicable to facility closures and elimination of multiple stock locations for items.

APPENDIX A

DESCRIPTION OF DEPOTS

DESCRIPTION OF DEPOTS

Five California supply depots are included in the Bay Area Consolidation Prototype. They were known before consolidation as:

- Defense Logistics Agency's (DLA's) Defense Depot Tracy
- Sharpe Army Depot
- Naval Supply Center Oakland
- Sacramento Air Logistics Center (ALC)
- Sacramento Army Depot.

The Tracy and Sharpe sites are now being collectively termed the San Joaquin site because of their geographical proximity. The Sacramento ALC and Army sites have been renamed Sacramento Specialized Distribution Site (SSDS) and Sacramento Remote Distribution Division (SRDD), respectively. The San Joaquin site serves as the headquarters for Defense Distribution Region West (DDRW) and is approximately 60 miles from the Sacramento sites and about 50 miles from the Oakland site. Oakland and Sacramento are about 90 miles apart.

The sizes of the five sites vary significantly. Table A-1 shows square footage, number of national stock number (NSN) items stored, average daily workload, and number of employees. Table A-2 shows the primary missions for each of the sites.

TRACY SITE

The Tracy site has the largest level of volume. It was managed by the DLA prior to Bay Area Consolidation and is being managed the same way by the same individuals under DDRW. The site processes approximately 15,000 issues and receipts daily and employs about 1,500 persons. DLA owns almost all of the 300,000 items stored there. Most of the items at Tracy are shipped to destinations in either the western continental United States or in the Pacific. All functions at the Tracy site are part of DDRW.

The Tracy site has some relatively basic forms of automation. Workers pick orders using either hand trucks, horizontal carousels, or wire-guided, man-aboard

TABLE A-1
DDRW FIVE-SITE SUMMARY

Characteristic	Tracy	Sharpe	Oakland	SRDD	SSDS
Square footage (000)	4,233	3,296	7,102	2,498	1,639
NSNs stored (approximate)	300,000	170,000	650,000	75,000	368,000
Average daily volume (FY91 through August)					
Issues	12,349	2,750	2,765	715	3,577
Receipts	2,373	383	779	383	2,222
Set assembly (approximate)	6,500	200	0	0	300
CCP operation (approximate)	0	2,500	0	0	1,500
Employees (August 1991)	1,509	1,160	622	321	769
On-site maintenance facility	No	No	No	Yes	Yes

Note: CCP = Consolidation/containerization point.

TABLE A-2
MISSION BY SITE

Site	Mission
Tracy	Receive, store, and issue DLA-managed and other DoD items. Service primarily western CONUS and Pacific.
Sharpe	Receive, store, and distribute secondary items to Pacific, Alaska, and western CONUS.
Oakland	Provide supply and support services to Fleet units and shore activities. Support Naval Aviation Depot at Alameda and Naval Shipyard at Mare Island.
SRDD	Provide supply support for communications-electronics, avionics, night vision, and electronic warfare systems and associated components.
SSDS	Worldwide logistics management responsibility for various weapon systems and support for depot maintenance function.

pick vehicles. A sortation system is then used to consolidate the line items picked. Conveyors are used extensively for transporting both small items and pallet loads. The Tracy site uses DLA's Defense Warehousing and Shipping Procedures (DWASP) automated system.

SHARPE SITE

The Sharpe site processes about 3,000 issues and receipts daily and employs over 1,100 persons. It also has a consolidation/containerization point (CCP) operation that handles 2,500 line items per day. Most material is shipped to destinations in either the Pacific or the western continental United States. All activities at the Sharpe site have been turned over to DDRW by the Army.

The Sharpe site utilizes some automation including towline systems and conveyance systems to transport material. The site has a high-rise, narrow-aisle storage warehouse with crane access and a sortation system to consolidate multiple-line-item orders. The main facility at Sharpe is relatively new, and a considerable amount of space is underutilized. The Sharpe site used the Army's Standard Depot System (SDS) as its automated system until August 1991 when it was partially converted to the Defense Distribution System (DDS). Full implementation of the Navy Integrated Storage, Tracking, and Retrieval System (NISTARS) as part of the overall DDS is scheduled to occur in the near future.

OAKLAND SITE

The Oakland site has the greatest number of items stored and the greatest square footage of storage space. It processes about 3,500 issues and receipts daily and employs more than 600 persons. The Navy has retained control of a number of activities including transshipments of material, customer service, pierside procurements, and SERVMART operations.

The Oakland site operates using significant levels of automation. Its supply operation is divided into mechanized and nonmechanized areas and, within the nonmechanized areas, into bin and bulk. The mechanized areas are physically located in one building and the nonmechanized areas are spread out over approximately 50 other buildings. Within the mechanized areas, items are stored in either a mini-load tray system with automated access or in a narrow-aisle, high-rise rack system utilizing wire-guided, man-aboard pick vehicles. Operators of both

systems are directed by computer terminals located at the employee workstations. Until May 1991, the Oakland site used the Navy's Uniform Automated Data Processing System (UADPS) in conjunction with NISTARS as its automated system. It is now using DWASP in conjunction with NISTARS under the DDS.

SACRAMENTO SPECIALIZED DISTRIBUTION SITE

The SSDS, located at McClellan Air Force Base, has the second largest volume in the region. It processes about 6,000 issues and receipts daily and employs over 700 persons. Over 60 percent of the daily issues at SSDS are on-base issues, either to the maintenance mission or as part of the Standard Base Supply System. Off-base shipments are destined for locations worldwide. The Sacramento ALC also had a CCP operation that has recently been discontinued by DDRW. Functions retained by the Air Force at the Sacramento ALC include activities supporting the inventory control point (ICP) and the air freight terminal operation, two formal supply warehouses that support flying units, and local delivery services.

The SSDS contains a relatively advanced order-picking system but a basic packing-and-shipping system. Virtually all of the material is picked from wire-guided, man-aboard pick vehicles equipped with built-in computer terminals that direct the pick-and-receive actions. The pick vehicle is controlled by the system, not the picker. The pack and ship functions have conveyance systems, but no automated sortation is available for consolidating multiple-line-item orders to be shipped off-base. One interesting and relatively advanced piece of machinery that can be found at this site is an automatic weight-and-cube machine that can measure a package's dimensions and weight at the same time. SSDS uses the Automated Warehousing System (AWS) operating in conjunction with the Air Force's Stock Control and Distribution (SC&D) system as its warehouse control system.

SACRAMENTO REGIONAL DISTRIBUTION DIVISION

The SRDD, located at the Sacramento Army Depot, is the smallest site under DDRW. It processes about 1,100 issues and receipts per day and employs over 300 persons. Almost 50 percent of the issues are on-base issues of parts or repairable items to the local Army maintenance function. A few off-base issues are reimbursable by tenant organizations. With the exception of some horizontal

carousels, SRDD has virtually no automation. SRDD uses the Army's SDS as its automated system.

APPENDIX B

PROTOTYPE EVALUATION PLAN

PROTOTYPE EVALUATION PLAN

As required by the Test and Evaluation Master Plan, Logistics Management Institute prepared and submitted to the Assistant Secretary of Defense (Production and Logistics) a formal prototype evaluation plan on 31 October 1990. The evaluation plan follows in its entirety.

**PROPOSAL FOR INDEPENDENT EVALUATION
OF THE
BAY AREA SUPPLY DEPOT CONSOLIDATION**

INTRODUCTION

Depot Consolidation Prototype

In a prototype effort, the Department of Defense is combining the San Francisco Bay area distribution depots of the Army, Navy, and Air Force into one distribution system managed by the Defense Logistics Agency (DLA). The basis for that action is the Defense Management Review Supply Depot Consolidation Study, which projected that the prototype would save \$126 million in the first 5 years without degrading performance. According to the study, savings are expected to result from reduced overhead, reduced construction requirements, transportation consolidation, improved use of existing depot capacity, and more efficient warehouse operations.

The Bay Area Prototype Plan established criteria for a successful prototype. To meet those criteria, the prototype must perform as follows:

- Successfully use uniform distribution software within the specified time frames called for in the plan without degradation of service to customers
- Achieve expected cost benefits and economies of operation
- Meet or exceed the best performance attained by individual Service depots and maintain or improve readiness
- Retain the ability to expand peacetime operations to meet contingencies
- Produce expected results with a minimum of transitional turbulence.

Independent Evaluator

The Office of the Assistant Secretary of Defense (Production and Logistics) [OASD(P&L)] selected the Logistics Management Institute as the independent evaluator of the Bay Area consolidation prototype to monitor its progress and evaluate its results. In that capacity, we are to do the following:

- Keep OASD(P&L) informed about the progress of the prototype
- Fulfill the OASD(P&L) commitment to the Services for an independent evaluation
- Provide an unbiased analytical basis for making additional depot consolidation decisions
- Assist DOD in responding to external questions from the Government Accounting Office (GAO) and others.

While each of those responsibilities is important, we see the second and third as particularly critical. The Services have expressed concerns about several aspects of the Bay Area prototype, and an independent appraisal of the costs, benefits, and service impact of the consolidated operation will help demonstrate the degree to which those concerns must be addressed. If the prototype is successful, the evaluation will provide the data on which future consolidations may be based.

As an independent evaluator, we must first make sure DLA and the individual Service depots operate fairly and maintain accurate cost and performance data. Second, we must judge the true costs and savings of each of the consolidated operation's savings initiatives and provide an independent third-party assessment of each initiative's value. Third, we must assess performance of the consolidated operation compared with the actual performance of the Service and DLA depots before consolidation. We must then periodically report on prototype progress, make pertinent observations to help identify problems, record lessons learned, and make recommendations for future consolidation efforts.

PROPOSED APPROACH

To accomplish our responsibilities, we will interview Service and DLA representatives to obtain all parties' detailed views of what must be evaluated to determine whether the prototype is successful. We will then review the unit cost baseline data to validate their accuracy. We will visit the bay area supply depots to develop an understanding of their missions, organizational objectives, management strategies, resources, operating processes, and cost and performance accounting systems. We will also contact a sample of their customers to define what they look for in a successful supply support system.

We believe that our evaluation should include more than merely an evaluation of the costs, performance measures, and savings outlined in the Test and Evaluation

Master Plan. We propose to collect two other kinds of data. The first is information on changes to the environment in which the prototype is operating: the workload mix, the size and scope of inventory under which it operates, and the mission and operating tempo. Such information will allow us to accurately evaluate the costs and performance of the prototype in light of changing missions or demand. The second kind of data is information of a generally subjective nature that will demonstrate the success of the prototype in the view of those who use it. That information will prevent us from presenting an inaccurate picture of prototype performance — one based solely on objective performance measures that fails to measure the impact of changes on the prototype's customers (i.e., workarounds).

In the following sections, we discuss our approach to measuring the operating environment, evaluating the costs and savings, and measuring the performance (both objectively and subjectively) of the prototype operation.

Operating Environment

We must explain the environment in which the prototype operates before evaluating its efficiency or effectiveness. To document that environment, we propose to measure several elements and evaluate the trends in those measures over time. The elements include the following:

- Changes in customer ordering patterns, including shifts in requisition and transportation priorities or storage patterns that result from perceived prototype support levels
- Changes in inventory levels resulting from Service inventory management actions, by storage site
- Mission changes for locally assigned units
- Changes that exercises or world events cause in overall operating tempo.

We expect there will be other environmental factors we have not anticipated, and we will document them as their influence becomes evident. In most cases, measurable environmental data are readily available in the Service and DLA management information systems. We intend to extract it using standard data reports. In some cases, quantification may not be possible and we shall rely on subjective measures. In all cases, we expect to portray environmental measures chronologically to show the cumulative impact over the life of the evaluation.

Costs

Unit costs for the individual depots have been provided to us by the OASD (Comptroller). As the prototype continues, those data will continue to be collected and provided to us. If the unit costs are calculated using an appropriate and comparable mix of direct and indirect expenditures, they will provide a logical gross indication of the cost of supply depot operations. We intend to verify the accuracy of the data and ensure their comparability and then use those data to demonstrate changes in the aggregate costs of bay area supply operations.

It is possible, however, that not all changes to the unit costs can be attributed to the impact of consolidation under a single manager. The environmental considerations discussed above, for example, may change unit costs significantly. To demonstrate whether savings result from the consolidation, it will be necessary to identify the initiatives that are expected to produce savings and to collect information when those initiatives are implemented to show what they cost and what they save. Such information will also be necessary for planning future consolidations in other geographic areas because it will attribute to those initiatives the measured and estimated cost savings that are the source, or cause, of savings.

We propose to work closely with the on-site director to identify those initiatives that are expected to produce savings. We will identify what it costs to implement the initiatives, and we will develop a baseline of costs before implementation. We will then develop ways to measure the resulting costs and savings attributable to each initiative within the consolidated operation and within the users' organizations. We will design a measurement methodology for the initiatives on a case-by-case basis.

The Test and Evaluation Master Plan has led us to believe that savings are anticipated primarily from the following initiatives:

- Use of a single automated stock point management system, eliminating the need for duplicate system design and maintenance capabilities
- Productivity improvements within the depots as a result of better access to productivity-enhancing automated support systems
- Administrative and management efficiencies, such as work force reductions, that result from consolidation of operations and workforce under a single management structure

- Storage and transportation efficiencies from consolidation
- Cost avoidance for Military Construction (MILCON) and other capital expenditures made unnecessary by the consolidation.

In every case, we will define the specific ways in which anticipated savings are to be achieved and define a methodology to collect costs and savings to demonstrate the actual impact of each initiative.

Performance Levels

Annex D of the Bay Area Prototype Plan provides a list of performance measurement goals and actual performance achievement by Service. The most important goals are those that relate directly to customer service such as the denial rate, depot processing time lines, and on-time issues. DLA standards and actual performance for the first two measures are better than those for any of the Services; on-time issues is a factor measured only by the Army.

Several other measures that relate less directly to customer support will also be monitored. Those are primarily in the area of record keeping accuracy and include on-time receipt reporting, location survey, and location reconciliation. Again, DLA standards and actuals are better than those respective measures for the Services.

Our first task in assessing service measures will be to make sure that each measure is comparable and meaningful for each Service. Then, each measure that is meaningful will be monitored both by Service and overall. That selection process is important because many of the items managed by DLA now are less critical to weapon support than those whose management is still retained by the Services. If measures for one Service fall below the preconsolidation values for that Service, it is important to find out why.

Second, we will make sure that we also consider any other measures not included in the list that are meaningful to a Service. For example, the Air Force argues that its depots are postured for integrated support of maintenance. It claims that nearly half of the depot-level supply activity is for in-house support. Thus, we must consider appropriate measures for those functions to the extent that they are not already included in the DLA list of performance measures. The Army and Navy have similar readiness, sustainability, and mobilization planning concerns. For

example, the Navy indicates that it measures "walkthrough" requisition responsiveness rates, a measure that we will review and consider.

Such performance measures will be identified in interviews with Service supply personnel who are familiar with the details of their missions. One potential problem is that the DLA performance measures primarily relate to whether a customer demand can be filled and not to how long the customer whose requisition cannot be filled must wait for a back order to be satisfied. That is an important distinction; all optimal inventory models concerned with weapon system availability are based on the latter criterion. Indeed, research shows that an inventory system that measures only fill-rate can perform badly.

Both costs and performance are likely to change as a result of the consolidation. If costs decrease and most performance measures increase, the consolidation will most likely be deemed a success; the opposite condition is likely to be viewed as a failure. However, it is possible that both will decrease or both will increase. Thus, it may be necessary to measure the increase or decrease in performance and assign a cost to it in order to evaluate the consolidation. We are in a strong position to make an assessment since we have considerable experience designing and using logistics models that perform the required type of cost-effectiveness tradeoffs.

Subjective Performance Measures

Subjective information is also needed for a full understanding of the prototype's effectiveness. The Test and Evaluation Master Plan contains objective performance measures, both in Paragraph 3.2.1 and in Appendix B, and we can use those measures to evaluate prototype effectiveness. We have also mentioned that some of the Services informally collect other performance measures, and can also use those measures in our evaluation of the prototype's effectiveness. All of those are objective measures, however, and they concentrate on the performance within the depots and give no information on customer satisfaction or the degree to which customer operations are – or are not – affected by depot consolidation.

We propose to collect such information with quarterly user surveys. By contacting a statistically significant sample of customers, randomly selected from records of active customers, we will identify significant changes in the level of user satisfaction with supply depot service, specific service problems (which we will pass to the on-site director), and any changes to customer procedures or operations that

may have resulted from the depot consolidation. Such changes may contribute to the overall costs or savings of the consolidation.

The surveys will give us an opportunity to show how well the prototype operations support the Service missions and will give us and the on-site director clear indications of actual and perceived inefficiencies in the prototype operation and its interface with its customers.

The survey instrument will be designed and sample sizes determined after our initial site visits and interviews with Service and DLA points of contact. We plan to conduct the baseline survey in January.

EVALUATION MILESTONES

We expect the first quarter of the evaluation period to be spent making contact with Service representatives, validating the unit cost and other baseline data, visiting the prototype sites, and determining how data are to be collected for evaluation. In subsequent quarters, we expect to follow a regular routine to perform the various evaluation measures, collect subjective performance measures, and meet with Service and DLA representatives.

We propose to meet monthly with the Services and DLA. By meeting frequently, we will be able to keep them apprised of our efforts, which will help prevent surprises and will create an effective means for communicating prototype events and problems that our on-site visits might not have uncovered.

Our task order calls for us to brief OASD(P&L) quarterly. For our first quarterly briefing at the beginning of February 1991, we expect to concentrate on baseline validation. Thereafter, however, we anticipate falling into a routine where each briefing will have the following core agenda:

- Prototype implementation progress
- Pertinent observations
- Recommendations

In describing prototype progress, we will describe the operating environment, observed costs and savings, service levels, and subjective performance measures. We will then present our observations on the operation of the prototype and comment on our impressions of its efficiency and effectiveness. Finally, we will make

recommendations concerning the Bay Area prototype and the applicability of our findings to other consolidation efforts.

At the end of October 1991, we will issue an annual report documenting our first evaluation year. Our findings and recommendations from each quarterly briefing will be a prominent part of that report. We expect to use a similar approach for the second evaluation year.

APPENDIX C

SOURCES OF INFORMATION

SOURCES OF INFORMATION

We have used a number of different sources for obtaining data on the Bay Area consolidation. Most of the data are taken from reports produced by the following automated systems:

- DWASP – Defense Logistics Agency (DLA) Warehousing and Shipping Procedures
- UADPS – Uniform Automated Data Processing System (Navy)
- SDS – Standard Depot System (Army)
- SC&D – Stock Control and Distribution System (Air Force)
- APCAPS – Automated Payroll, Cost, and Personnel System.

We obtained all of the data from these systems through sources at the various Defense Distribution Region West (DDRW) sites. Table C-1 shows the actual data sources for all performance and cost data used to evaluate the Bay Area consolidation.

We conducted an audit of key data items provided by DDRW to Logistics Management Institute (LMI) from standard reporting systems. The audit was performed to verify that the data fairly represented the workload and hours contained in official DDRW reporting systems. The audit did not investigate the validity of the data itself from these sources. Some of the data provided to LMI were calculated by DDRW from other data elements provided by the reporting systems; the audit did verify the accuracy of these calculations. An example of this DDRW-calculated data is productive hours net of Desert Storm impacts.

The audit was conducted according to generally accepted auditing standards. It was limited to the Oakland, Sharpe, and Tracy sites for the time period between July 1990 and July 1991 (13 months). The following data were audited:

- On-time and total receipts
- On-time and total issues by issue priority group
- Denials

- Location accuracy
- Productive work-hours (net of leave, etc.).

The audit showed that DDRW-reported data had no material errors or misrepresentations. A statement from a certified public accountant about the audit appears on page C-6.

TABLE C-1
DDRW DATA SOURCE SUMMARY

Data item	Tracy Sharpe (since mid-July 1991) Oakland (since mid-May 1991)	Sharpe (before mid-July 1991)	Oakland (before mid-May 1991)
Issues and on-time performance	DWASP UWF009 Report	SDS 304 and 305 Reports	UADPS UA26 Report
Receipts and on-time performance	DWASP UWF009 Report	SDS 304 and 305 Reports	UADPS U801 Report
Location accuracy	DWASP UWF154 Report	SDS 304 and 305 Reports	Oakland Inventory Group
Denials	DWASP UWF009 Report	SDS 304 and 305 Reports	UADPS UA26 Report
Bin/bulk breakout	DWASP UWF009 Report		UADPS U190 Report
Tons shipped	DWASP UWF009 Report	SDS 304 and 305 Reports	
Hours	APCAPS UPCC760A and UPCE100A Reports	APCAPS UPCC760A and UPCE100A Reports	APCAPS UPCC760A and UPCE100A Reports
Cost	APCAPS	APCAPS	APCAPS
Total delay time	DWASP UWF061 Report		
Number of employees	DDRW personnel department and APCAPS UPEC300X Report	DDRW personnel department and APCAPS UPEC300X Report	DDRW personnel department and APCAPS UPEC300X Report
Square/cubic footage	DDRW measurements		
Line items in store	DWASP UWF063 Report	SDS 304 and 305 Reports	UADPS UA53 Report
Inventory counts/accuracy	Tracy Inventory Group		Oakland Inventory Group; Naval Supply Systems Command
Discrepancies	Compiled by DDRW Quality Group	Compiled by DDRW Quality Group	Compiled by DDRW Quality Group; Naval Supply Systems Command

TABLE C-1

DDRW DATA SOURCE SUMMARY (Continued)

Data item	SRDD	SSDS
Issues and on-time performance	From SDS 304 and 305	D009, D033/035, D002 System Reports
Receipts and on-time performance	From SDS 304 and 305	D009, D033/035, D002 System Reports
Location accuracy	SRDD Inventory Control Group	D009, D033/035, D002 System Reports
Denials	From SDS 304 and 305	D009, D033/035, D002 System Reports
Bin/bulk breakout		
Tons shipped	From SDS 304 and 305	
Hours	APCAPS UPCC760A and UPEC100A Reports	
Cost	APCAPS	
Total delay time		
Number of employees	DDRW personnel department and APCAPS UPEC300X Report	DDRW personnel department and APCAPS UPEC300X Report
Square/cubic footage		
Line items in store		
Inventory counts/ accuracy	SRDD Inventory Group	McClellan AFB Inventory Group
Discrepancies	Compiled by DDRW Quality Group	Compiled by DDRW Quality Group

Note: SRDD = Sacramento Remote Distribution Division; SSDS = Sacramento Specialized Distribution Site.

Robert L. Crosslin, PhD, CPA
11212 Stephalee Lane
Rockville, Maryland 20852
(301) 984-0816

October 28, 1991

Ms. Joan Habermann, Vice-President
Logistics Management Institute
6400 Goldsboro Road
Bethesda, MD 20817

Dear Ms. Habermann:

As you requested, we have conducted an audit of specified workload and hours data reported to the Logistics Management Institute by the Defense Logistics Agency's (DLA) Defense Distribution Region-West (DDRW). Our audit was conducted during the period September 18, 1991 to October 11, 1991, and consisted of (1) interviews with key personnel at DDRW, (2) review of operational guidelines for compiling and submitting the data to LMI, and (3) review of data samples from Navy, Army and DLA official reporting system reports. The time period covered by our audit was limited to July 1, 1990 to July 31, 1991, with the exception of workload accuracy data for the Sharpe site which was limited to March 1, 1991 to June 30, 1991. Our examination was conducted according to generally accepted auditing standards, and accordingly, included such tests of the DDRW-to-LMI reports and such other auditing procedures as we considered necessary in the circumstances.

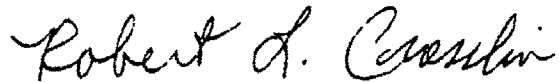
Scope Limitation

Our audit was limited to the Oakland, Sharpe and Tracy DDRW sites and to the following specified data for those sites: (1) total receipts, (2) total receipts on-time performance, (3) total issues, (4) total issues on-time performance, (5) total denials, (6) inventory location accuracy, and (7) productive work-hours. Our audit of those specified data was limited to an examination of the Navy, Army and DLA official reports generated by Navy, Army and DLA official reporting systems; no attempt was made to audit those official reporting systems.

Opinion

In our opinion, the data submitted to LMI by DDRW, for the data items specified above for the Oakland, Sharpe and Tracy sites, for the time period July 1, 1990 to July 31, 1991 except as noted above, fairly represents the workload and work-hours generated by Navy, Army and DLA official reporting systems for those sites.

Sincerely,

A handwritten signature in cursive script that reads "Robert L. Crosslin".

Robert L. Crosslin, PhD, CPA

APPENDIX D

DDRW PRODUCTIVITY CALCULATIONS

DDRW PRODUCTIVITY CALCULATIONS

BACKGROUND

In this appendix, we show the details underlying the calculation of productivity. We noted in the body of the report several limitations of the productivity measure. However, we believe that at the present time it is the best measure of performance trends over time for a given set of facilities. Productivity was used in the prototype plan as the primary basis for projecting manpower savings due to the consolidation.

Productivity is defined as lines issued and received divided by productive hours (all work-hours except vacation, sick leave, or holiday time incurred by any DDRW employee). Naturally, productivity is reduced by any activities that consume productive time without producing an issue or a receipt. During Operations Desert Storm, Desert Shield, and Provide Comfort, DDRW spent many man-hours in production operations to assemble MOREs (Meals Operational Ready to Eat) and B-Rations.¹ These production activities differ significantly from the normal warehousing functions of receipt, storage, and issue. It was necessary to set up dedicated warehouse space and hire several hundred temporary workers to build the subsistence packages. Furthermore, a single line-item issue could be several vanloads of meals. As a result of this activity, the tons handled at Sharpe/Tracy nearly doubled during Desert Shield. For this reason, we have adjusted the lines and productive man-hours during the August 1990 – May 1991 time period as described below.

Our focus is the three sites originally consolidated in late June 1990, because there has been enough time for DDRW management to have had an impact. The Sacramento sites were incorporated into DDRW in April 1991, and we will be able to track their productivity in subsequent reports. However, productive hour data were not collected prior to April 1991, so that it is not possible to track their productivity before consolidation.

¹Other changes to DDRW operations which were caused by Operations Desert Storm and Desert Shield are described in Chapter 2, beginning on page 2-5.

If we had productivity data for months prior to April 1991 for the Sacramento sites, the overall DDRW productivity results would be affected to only a limited degree. This is because the three original sites constitute 75 percent of the total DDRW five-site workload as measured by issues to date during FY91.

The first three columns of Table D-1 show the raw monthly data for lines issued/received, productive hours, and productivity (lines issued/received divided by hours – multiplied by 1,732 productive hours/year to convert to an annualized rate for comparison with the Prototype Plan).² July 1990 was the first month for which productive-hour data were available.

TABLE D-1
DDRW PRODUCTIVITY

	Lines issued and received	Productive hours	Productivity	Lines issued and received net of Desert Storm	Productive hours net of Desert Storm	Adjusted productivity
July 1990	422,563	501,885	1,458	422,563	493,321	1,484
August 1990	480,704	535,644	1,554	480,611	521,701	1,596
September 1990	420,040	467,390	1,557	419,924	451,300	1,612
October 1990	435,019	512,305	1,471	434,899	497,563	1,514
November 1990	395,015	461,277	1,483	394,733	445,930	1,533
December 1990	401,017	477,209	1,455	400,134	440,336	1,574
January 1991	430,570	549,943	1,356	429,581	484,597	1,535
February 1991	447,334	543,178	1,426	444,664	461,525	1,669
March 1991	457,265	566,416	1,398	456,232	486,223	1,625
April 1991	447,173	540,596	1,433	446,799	511,407	1,513
May 1991	414,245	519,822	1,380	414,245	509,219	1,409
June 1991	390,113	465,106	1,453			
July 1991	411,973	494,143	1,444			
August 1991	514,299	521,362	1,709			

²DDRW uses 1,732 hours per year as the average number of productive hours per employee after subtracting vacation, holidays, and sick leave. Of course, this does not affect the month-to-month comparisons.

The DDRW kept track of the lines issued and the productive hours for the subsistence production operations to support Desert Shield and Provide Comfort. In order to provide a better picture of DDRW warehousing productivity over time, we subtracted both the workload and the hours for these production operations to obtain columns 4 and 5 of Table D-1. Note that the adjustment to the number of lines is very small, below 1 percent in all cases. The adjustment to hours is more significant, reaching a maximum of 15 percent in February 1991.

The adjusted productivity is computed from lines (less Desert Shield) divided by hours (less Desert Shield). No adjustments are made for months starting with June 1991. We believe that the adjusted productivity provides a better picture of DDRW capability over time.

It should be noted that there are other adjustments that could be made to the productive hours. If we are comparing postconsolidation productivity to the FY89 baseline, it would make sense to adjust for activities that consume productive hours during FY91 but which did not exist during the baseline or which were at much lower levels of activity.

Table D-2 shows several special projects identified by DDRW including the Defense Distribution System (DDS) installation in DDRW [not the Central Design Activity (CDA) or Headquarters activity], set assembly operations for chemical warfare kits, depot consolidation, expedited handling of issues for medical supplies, and performance-oriented packaging. In our earlier evaluations, we adjusted for the first three special projects, a reduction of 8,983 hours per month. This was because those activities could be viewed as one-time events related to either consolidation or Desert Shield. This adjustment is about 2 percent of the productive hours.

After further consideration, we eliminated this adjustment for several reasons: (1) the decision as to which projects to include or exclude is somewhat arbitrary; (2) we had year-to-date information rather than monthly data, so that each data point was affected by the same amount; (3) the source data would be hard to audit as they do not come from routine data collection systems; (4) there may have been special projects that existed in FY89 that we are unaware of in FY91; and (5) an adjustment of 2 percent does not make a significant difference.

TABLE D-2

AVERAGE MONTHLY HOURS

Specific projects	FY89	FY91 (through May)	Difference between FY91 and FY89
DDS	0	5,154	5,154
Set assembly	0	3,470	3,470
Consolidation	0	359	359
Medical	2,688	4,289	1,601
Performance-oriented packaging	0	159	159
Total	2,688	13,431	10,743

Our overall conclusion is that it is best to provide a picture of DDRW that involves only those adjustments that would otherwise badly distort comparisons between months and with the baseline.

APPENDIX E

WORKLOAD AND PERFORMANCE DATA

WORKLOAD AND PERFORMANCE DATA

In this appendix, we present statistical analyses and graphs of the workload and of each of the key measures discussed in Chapter 2 of the main text. We show observations by month for all five sites:

- Tracy site
- Sharpe site
- Oakland site at the Naval Supply Center Oakland
- Sacramento Remote Distribution Division (SRDD) at Sacramento Army Depot
- Sacramento Specialized Distribution Site (SSDS) at Sacramento Air Logistics Center.

We then discuss measurement of total delivery time as defined by the time between receiving an order at the depot and the filled order arriving to the customer, and we present some recent observations of that measure. Finally, we compare the total year-to-date location surveys performed at each site with the total number of items stocked at each site.

STATISTICAL ANALYSIS

Our methodology for analyzing workload and key performance data consisted of statistically comparing baseline data with postconsolidation data. The Test and Evaluation Master Plan (TEMP) specified FY89 as the baseline for comparison purposes. Where FY89 data were either incomplete or not available, we used other time periods prior to consolidation for comparison. The baseline data are compared to the following postconsolidation time periods:

- Tracy, Sharpe, Oakland sites: July 1990 through August 1991 (14 months)
- Sacramento sites: May 1991 through August 1991 (4 months).

Those dates include all postconsolidation months for each of the five sites.

We made the following assumptions:

- Each monthly performance measure is assumed to be a normal random variable with mean, μ , and variance, σ^2 . The sample average of the 12 baseline data points is an unbiased estimate of μ . The sample variance is an unbiased estimate of σ^2 .
- We assumed that the means between the baseline and postconsolidation periods could differ but that the variances of the two are equal. Since the sample sizes of the baseline and postconsolidation observations are almost equal (for the first three sites), the confidence interval around the difference in means should be valid even if the assumption about equal variances is not correct.¹
- The hypothesis that the baseline mean (μ_b) equals the postconsolidation mean (μ_c) can be tested using a two-sided 95 percent confidence interval from the Student's *t* Distribution.² (Rejection of this hypothesis indicates a performance change between the baseline and the postconsolidation periods.)

We performed three kinds of statistical analyses on the workload and key performance data:

- We performed regression analyses on baseline and postconsolidation data to examine possible linear trends. These analyses proved to be inconclusive in almost all cases and are not presented.
- We computed averages for baseline data and for postconsolidation data and then determined whether they differed "significantly" by computing a 95 percent confidence interval about the difference between them. If the confidence interval included a zero value, then we accepted the hypothesis that there was no statistically significant difference between baseline and postconsolidation performance.
- We computed sample variances for baseline data and for postconsolidation data and then determined whether they were significantly different by comparing the ratio of the two variances to a computed range for the *F* distribution at a 95 percent confidence level.³

A variance ratio inside the computed range indicates no statistically significant difference between the two at a 95 percent confidence level, and in such cases we concluded that the baseline and postconsolidation periods were equally consistent. A

¹Henry Scheffe, *The Analysis of Variance*, John Wiley and Sons, 1967, pp. 339–341.

²Herbert Robbins and John Van Ryzin, *Introduction to Statistics*, Science Research Associates, Inc., 1975, pp. 214–217.

³*Ibid.*, pp. 232–233. The *F* distribution is used to compute the 95 percent confidence level range for the ratio of baseline to postconsolidation sample variance.

variance ratio value higher or lower than the acceptable range allowed us to conclude which data set (baseline or postconsolidation) was more consistent. Consistency is important from a customer's viewpoint because it allows planning around certain expectations.

The results of the above analyses are shown below with the graphs for workload and for each of the key performance measures by site.

WORKLOAD

Total workload has decreased since FY89 by 8 percent. Issues have shown a downward trend and until very recently receipts were decreasing; returns from Operation Desert Storm are now causing a spike in receipt lines processed.

Table E-1 shows that average monthly issue lines have decreased from 391,000 in FY89 to 358,000 in FY91 for the original three consolidation sites and from 497,000 to 447,000 for all five Bay Area consolidation sites.⁴ Average monthly receipts for the three original sites decreased from 70,000 in FY89 to 62,000 in FY90 but then increased to 74,000 in FY91. Similarly, receipts for all five Bay Area sites decreased from 128,000 in FY89 to 117,000 in FY90 but then increased back to 128,000 in FY91. The increase in receipts for FY91 has been caused primarily by returns from Operation Desert Storm that were processed as receipts during August 1991.

TABLE E-1

DDRW AVERAGE MONTHLY ISSUES AND RECEIPTS

	Time period	Issue lines	Receipt lines
3 sites	FY89	391,451	70,115
	FY90	387,772	62,159
	FY91*	357,672	73,603
5 sites	FY89	496,781	127,871
	FY90	481,606	117,306
	FY91*	447,017	127,843

*Through August 1991.

⁴Total issues and total receipts reflect an adjustment made to Defense Distribution Region West (DDRW)-supplied data to account for some unavailable monthly data values for SSDS in FY89.

Figures E-1 and E-2 illustrate the monthly observations and associated statistical analyses for DDRW total issues and receipts, respectively. The issues are trending downward although we saw some increased activity during July and August this year. The receipts trended downward until January 1991 when we began to see an upward trend that is still continuing. From a statistical standpoint, issues are lower and receipts are unchanged for the postconsolidation periods compared to the baseline periods. Receipts are not expected to remain at the current level once all of the Desert Storm returns are processed.

KEY PERFORMANCE MEASURES

Figures E-3 to E-42 (at the end of this appendix) illustrate monthly values for performance measures presented in Chapter 2 of the main text for each of the five Bay Area consolidation sites. Each figure also shows cumulative performance during the baseline and consolidation periods and provides a statistical analysis of monthly performance.

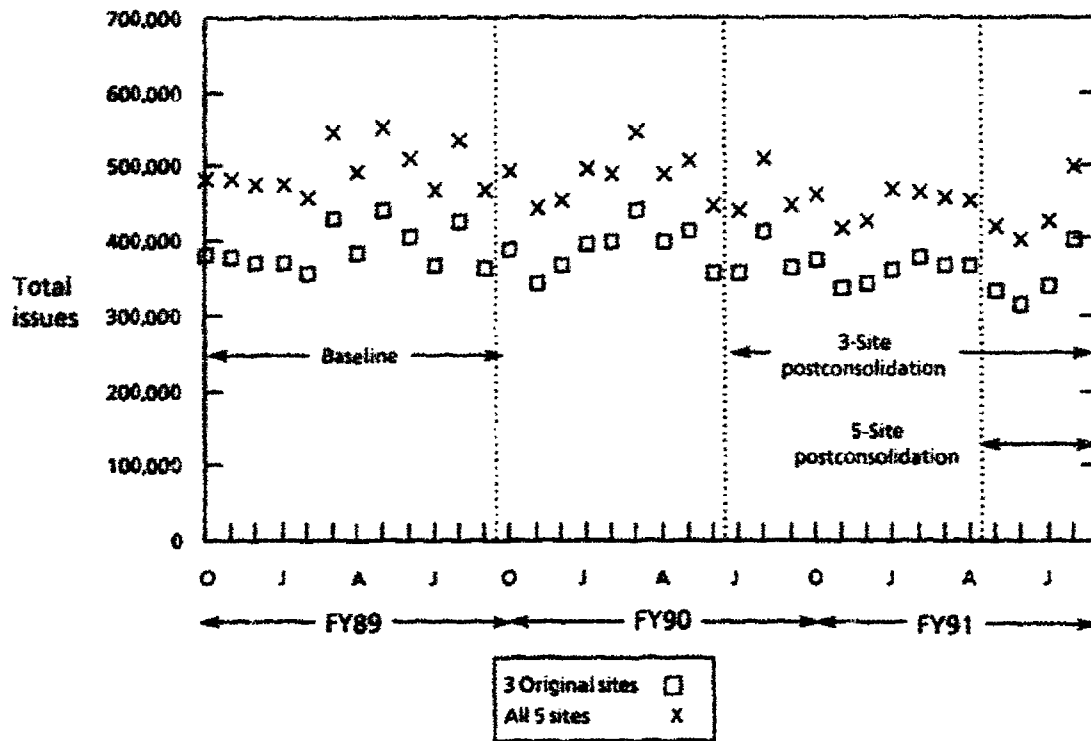
Tracy Site

All of the key measures at the Tracy site either remained stable from the baseline to the postconsolidation periods or showed significant but small changes.⁵ The two exceptions were Issue Priority Group (IPG) 3 issues and total issues:

- IPG 3 on-time issues increased 6.1 percent \pm 4.3 percent and showed more consistency.
- Total on-time issues increased 3.5 percent \pm 3.0 percent and showed more consistency.

Figures E-3 through E-10 show monthly observations and statistical analysis for each of the key measures.

⁵Baseline and postconsolidation depot processing time standards are different at the Tracy site for Issue Priority Group (IPG) 1 and IPG 2 issues. See Table 2-1 (Chapter 2 of the main text).



3-Site Analysis

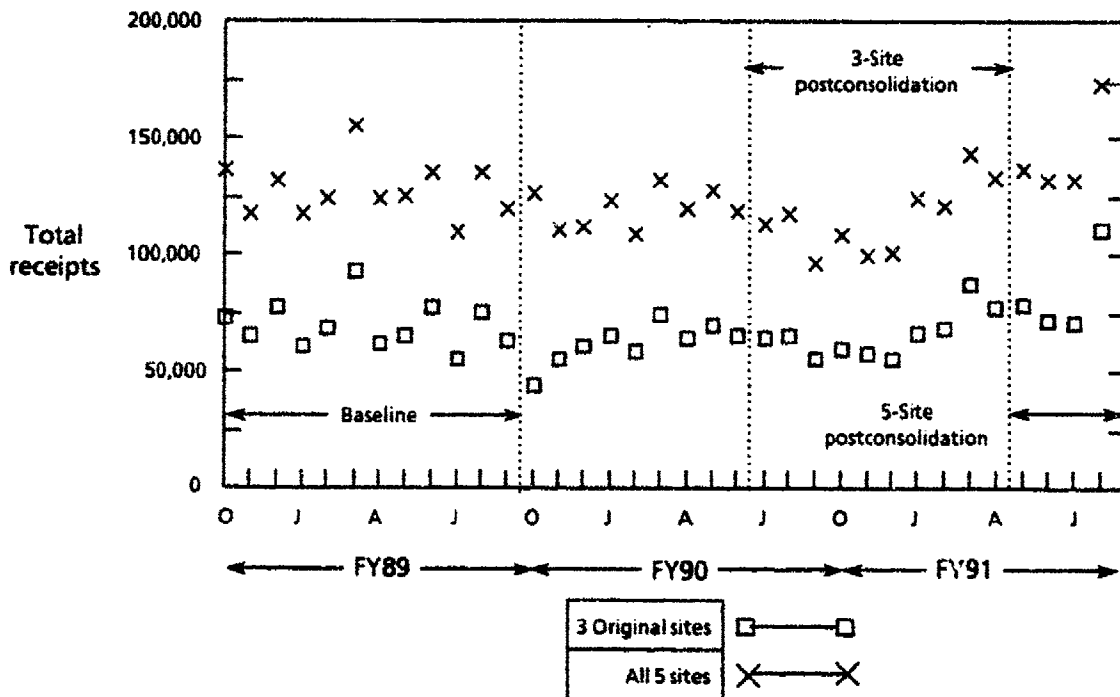
Baseline average ^a	391,451	
Postconsolidation average ^b	362,256	
Statistical difference ^c	7.5% ± 5.7% lower	(Postconsolidation significantly lower)
F statistic ^d	1.19	(Equally consistent)

5-Site Analysis

Baseline average ^a	496,781	
Postconsolidation average ^b	439,602	
Statistical difference ^c	11.5% ± 8.6% lower	(Postconsolidation significantly lower)
F statistic ^d	0.56	(Equally consistent)

^aFY89 is baseline.
^bJuly 1990 through August 1991 is postconsolidation period for 3-site analysis.
^c95 percent confidence interval about the difference between 3-site baseline and postconsolidation averages.
^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence interval).
^eMay 1990 through August 1991 is postconsolidation period for 5-site analysis.
^f95 percent confidence interval about the difference between 5-site baseline and postconsolidation averages.
^gRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and post consolidation variances (95 percent confidence interval).

FIG. E-1. DDRW TOTAL MONTHLY ISSUES (FY89 to FY91)



3-Site Analysis

Baseline ^a	70,115	
Postconsolidation ^b	71,124	
Statistical difference ^c	1.4% ± 14.9%	(No significant difference)
F statistic ^d	0.45	(Equally consistent)

5-Site Analysis

Baseline average ^a	127,871	
Postconsolidation average ^e	143,734	
Statistical difference ^f	12.4% ± 13.7%	(No significant difference)
F statistic ^g	0.36	(Equally consistent)

^aFY89 is baseline.
^bJuly 1990 through August 1991 is postconsolidation period for 3-site analysis.
^c95 percent confidence interval about the difference between 3-site baseline and postconsolidation averages.
^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence interval).
^eMay 1990 through August 1991 is postconsolidation period for 5-site analysis.
^f95 percent confidence interval about the difference between 5-site baseline and postconsolidation averages.
^gRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence interval).

**FIG. E-2. DDRW TOTAL MONTHLY RECEIPTS
(FY89 to FY91)**

Sharpe Site

Most of the key measures at the Sharpe site show continued improvement both before and during the consolidation (see Figures E-11 through E-18).⁶ We found the following statistically significant changes:

- IPG 1 on-time issues improved 18.4 percent \pm 4.5 percent and became more consistent.
- IPG 2 on-time issues improved 15.4 percent \pm 4.2 percent and became more consistent.
- IPG 3 on-time issues improved 18.2 percent \pm 5.3 percent and became more consistent.
- Total on-time issues improved 17.0 percent \pm 4.6 percent and became more consistent.
- Receipts on time improved 19.1 percent \pm 4.2 percent and became more consistent.
- Denial rate decreased .51 percent \pm .18 percent but showed no significant change in consistency.

Although some of this improvement occurred during FY90 prior to consolidation, the graphs all show continued improvement during the postconsolidation period as well.

Oakland Site

The Oakland key measures show mixed results (see Figures E-19 through E-26).⁷ We found the following significant changes:

- IPG 1 on-time issues decreased 15.0 percent \pm 11.8 percent and showed less consistency.
- IPG 2 on-time issues decreased 15.2 percent \pm 11.7 percent and showed less consistency.

⁶Data for the Sharpe site were obtained from Army Standard Depot System (SDS) reports prior to August 1991 and from the Defense Logistics Agency (DLA) Warehousing and Shipping Procedures (DWASP) system reports for August 1991. The depot processing time standards used in the two systems are different. See Table 2-1 (Chapter 2 of the main text).

⁷Data for the Oakland site were obtained from Navy Uniform Automated Data Processing System (UADPS) reports prior to May 1991 and from DWASP system reports since May 1991. The depot processing time standards used in the two systems are different. See Table 2-1 (Chapter 2 of the main text).

- IPG 3 on-time issues did not decrease significantly but did show less consistency.
- Total on-time issues decreased 11.0 percent \pm 7.8 percent and showed less consistency.
- Denial rate did not increase significantly but did show less consistency.
- Location accuracy did not decrease significantly but showed less consistency.

In general, Oakland's measures of on-time issue performance have shown serious decline since consolidation. Receipts on time have remained stable and quality measures (denials and discrepancies) have fluctuated considerably. Record accuracy has also fluctuated.

Sacramento Remote Distribution Division

The SRDD has shown some improvement since its consolidation into DDRW (see Figures E-27 through E-34). We found the following significant changes:

- IPG 1 on-time issues increased 8.1 percent \pm 7.1 percent.
- IPG 2 on-time issues increased 12.4 percent \pm 6.3 percent.
- Total on-time issues increased 6.4 percent \pm 5.7 percent.
- Location accuracy decreased 9.6 percent \pm 4.8 percent.

Because of the small sample size for postconsolidation data, we were not able to calculate any changes in consistency. Location surveys showed near 100 percent accuracy in FY89 but were discontinued in FY90 under Army management. Since consolidation, survey information has been collected only for 2 months.

Sacramento Specialized Distribution Site

Most of the key measures at SSDS either remained stable from the baseline to the postconsolidation periods or showed significant but small changes (see Figures E-35 through E-42). We noted three exceptions:

- Receipts on time improved 9.8 percent \pm 7.1 percent.
- Denial rate and location accuracy showed no significant difference.

Because of the small postconsolidation sample size (four observations), we were not able to detect any other changes at SSDS.

TOTAL DELIVERY TIME

As we discussed in Chapter 2 of the main text, the ideal way to measure issue processing timeliness is to measure the time between when the order is received at the depot and the time that the customer receives the completed order. With freight shipments, DDRW is actually able to determine when an order arrives at the customer's place of business because the freight trucking company is required to provide such data on the shipment bill of lading in order to receive payment. Small package shippers such as United Parcel Service (UPS) or the U.S. Postal Service (USPS) do not normally provide that information unless the shipper is willing to fill out extra paperwork and pay a premium for it. Order acknowledgments are not currently provided to DDRW for small package shipments.

The Defense Logistics Agency (DLA) Warehousing and Shipping Procedures (DWASP) system has been set up to capture order receipt dates for freight shipments. The IPG 3 on-time issues for the Tracy site reported by DDRW measure the percentage of freight shipments delivered on time (total depot processing time plus transportation). In August 1991, we began to obtain on-time delivery data for all IPGs at each of the three DDRW sites now currently on the DWASP system (Tracy, Sharpe, and Oakland). The prototype plan standards for on-time deliveries are 6 days for IPG 1 issues, 10 days for IPG 2 issues, and 21 days for IPG 3 issues.

By examining the percentage of freight shipments delivered to the customer on time, we can calculate the maximum on-time delivery percentage for all shipments. Table E-2 shows for the month of August 1991 the percentage of on-time deliveries for each IPG by site, the percentages of total order lines that were shipped by freight mode, and the calculated maximum percentage of total lines shipped on time. The calculated maximum assumes that all small shipments are delivered to the customer on time; that calculation is optimistic but not a totally unreasonable assumption since small parcels are usually shipped within 3 to 5 days by land or 1 to 2 days by air. In any case, the maximum on-time delivery percentage is simply an upper bound on the true delivery time percentage, i.e., the true value must be equal to or lower than the maximum.

From Table E-2 we see that 96.6 percent of Tracy's freight order lines (all IPGs), 88.9 percent of Sharpe's freight order lines, and 62.2 percent of Oakland's freight order lines were shipped on time during August. We also see that 31.7 percent of

TABLE E-2
MAXIMUM ON-TIME DELIVERY PERCENTAGE BY SITE
(August 1991)

	Tracy site (%)	Sharpe site (%)	Oakland site (%)
Percent of freight lines delivered on time			
IPG 1	88.1	71.8	61.7
IPG 2	97.7	94.0	70.6
IPG 3	97.6	90.6	60.8
All IPGs	96.6	88.9	62.2
Percent of total lines shipped freight			
IPG 1	32.3	41.0	12.7
IPG 2	25.0	34.1	8.5
IPG 3	32.4	74.6	7.5
All IPGs	31.7	65.9	8.5
Maximum percent total lines shipped on time^a			
IPG 1	96.2	88.5	95.1
IPG 2	99.4	97.9	97.5
IPG 3	99.2	93.0	97.0
All IPGs	98.9	92.7	96.8

Note: On-time goals: IPG 1 - delivered within 4 days; IPG 2 - delivered within 8 days; IPG 3 - delivered within 21 days.

^aAssumes all small package items (nonfreight) delivered on time.

Tracy's order lines, 65.9 percent of Sharpe's order lines, and only 8.5 percent of Oakland's order lines were shipped as freight during the month of August. These numbers translate into maximum on-time delivery percentages of 98.9 percent, 92.7 percent, and 96.8 percent for Tracy, Sharpe, and Oakland, respectively.

Although the percent of issues processed on time at the Oakland depot have deteriorated since consolidation, the impact on total delivery time to the customer may be small. While Oakland is not processing some orders at the depot on time, it may, in fact, be shipping those orders to the customers ahead of schedule. Since most of their issues are shipped as small parcels, and since small parcels typically have

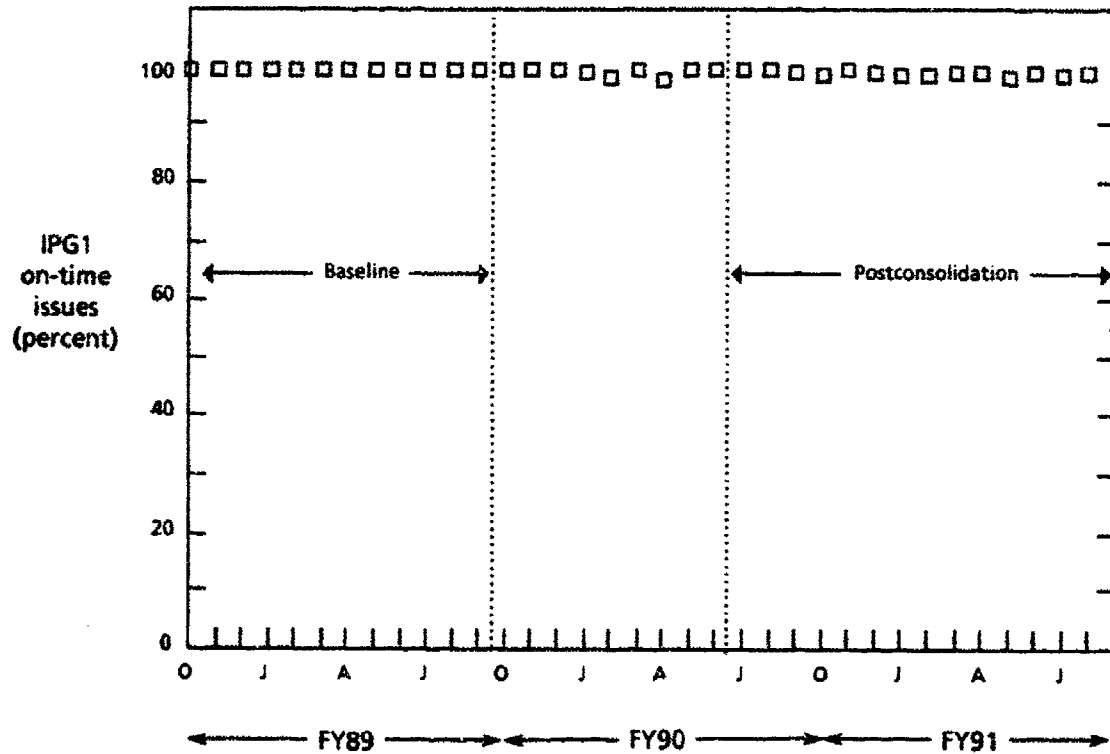
fast delivery times (5 days or less), IPG 3 orders can easily be delivered to customers within the allocated 21-day total delivery time even when the order is not processed within the 10-day time limit at the depot. The same logic applies to IPG 2 orders, which are allowed 10 days total delivery time.

We expect to continue receiving data on total delivery timeliness for all freight issues in all IPGs. We also expect to obtain these same data for small package shipments made with USPS. As more data are obtained, we can better report true order processing timeliness from the customer's point of view.

LOCATION SURVEYS

In addition to tracking percentage location accuracy, we examined the total number of location surveys performed annually at each site in comparison to the total number of items at that site. From a warehouse management standpoint, it is important to correct record accuracy mistakes that have been made over time. The higher the number of location surveys, the more opportunities there are to correct for mislocated product or misidentified material.

Figure E-43 shows the total number of location surveys by site in FY91 (through August) as compared to the total number of items stocked at that site. The Tracy, Sharpe, and SRDD sites all have performed a number of location surveys that is equal to or greater than the total number of items stocked at that site. This is a good indication that every location has been checked at least once during the course of the year. All of the checks at SRDD were done after the consolidation in late April. In the case of Tracy and Sharpe, locations appear to have been checked at least twice during the year. In the case of Oakland, the Navy had been using a statistical measurement program called STATLOC to determine where problems existed and then concentrating resources on the problem areas rather than on the entire inventory. In any case, fewer locations as a percent of total items are currently being surveyed at the Oakland and SSDS sites than at the Tracy, Sharpe, and SRDD sites.



Cumulative performance

Baseline	99.9%
Consolidation	99.1%

Monthly performance

Baseline average ^a	99.8%
Postconsolidation average ^b	99.2%
Statistical difference ^c	0.7% ± 0.3% (Baseline significantly higher)
F statistic ^d	0.04 (Baseline more consistent)

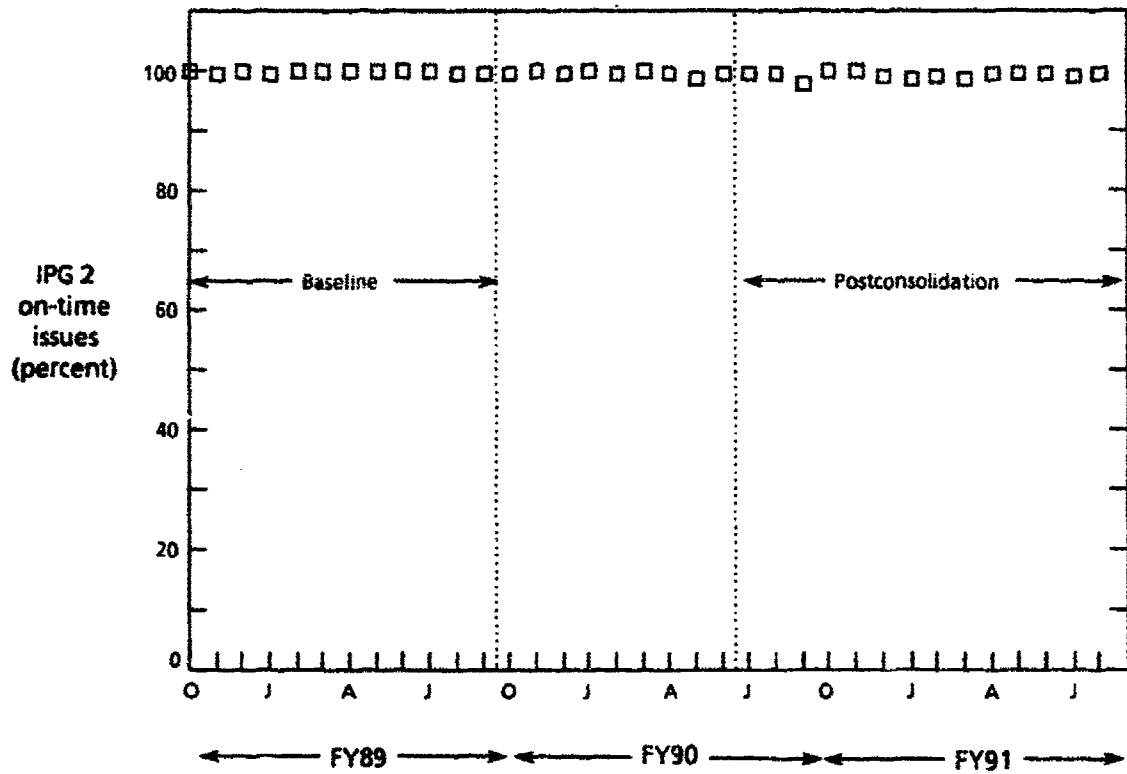
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-3. IPG 1 ISSUES ON TIME – TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	99.8%
Consolidation	99.3%

Monthly performance

Baseline average ^a	99.8%	
Postconsolidation average ^b	99.2%	
Statistical difference ^c	0.5% ± 0.4%	(Baseline significantly higher)
F statistic ^d	0.02	(Baseline more consistent)

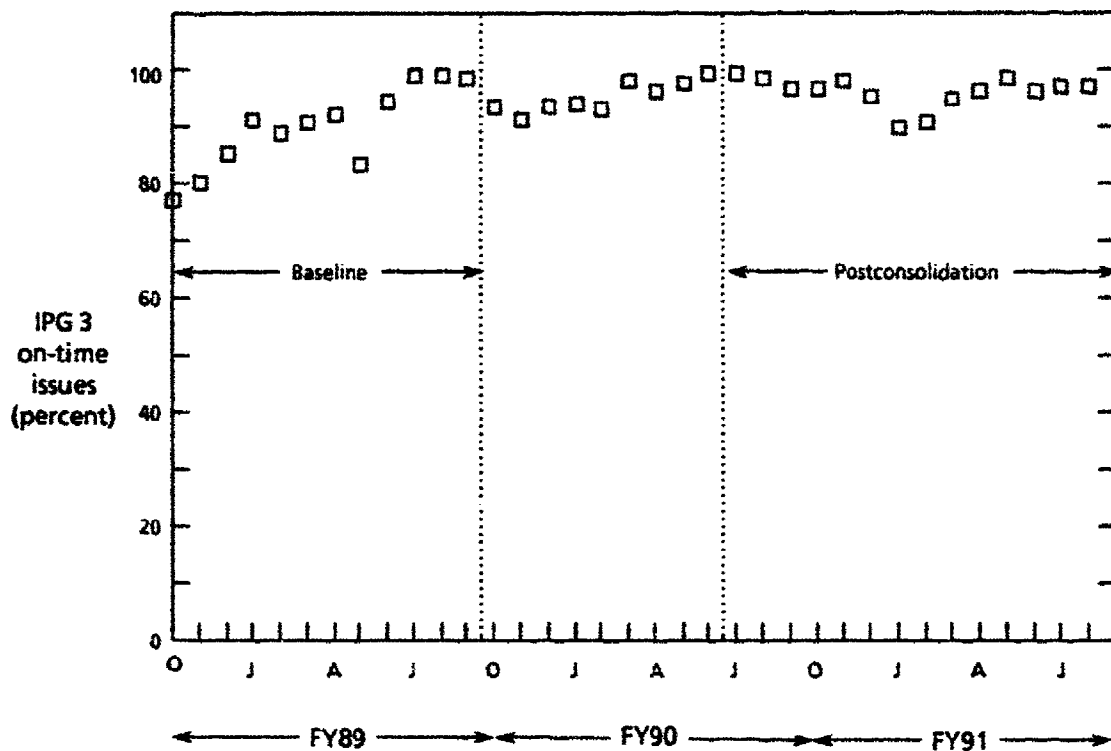
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-4. IPG 2 ISSUES ON TIME – TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	90.0%
Consolidation	96.3%

Monthly performance

Baseline average ^a	90.2%	
Postconsolidation average ^b	96.3%	
Statistical difference ^c	6.1% ± 4.3%	(Postconsolidation significantly higher)
F statistic ^d	7.27	(Postconsolidation more consistent)

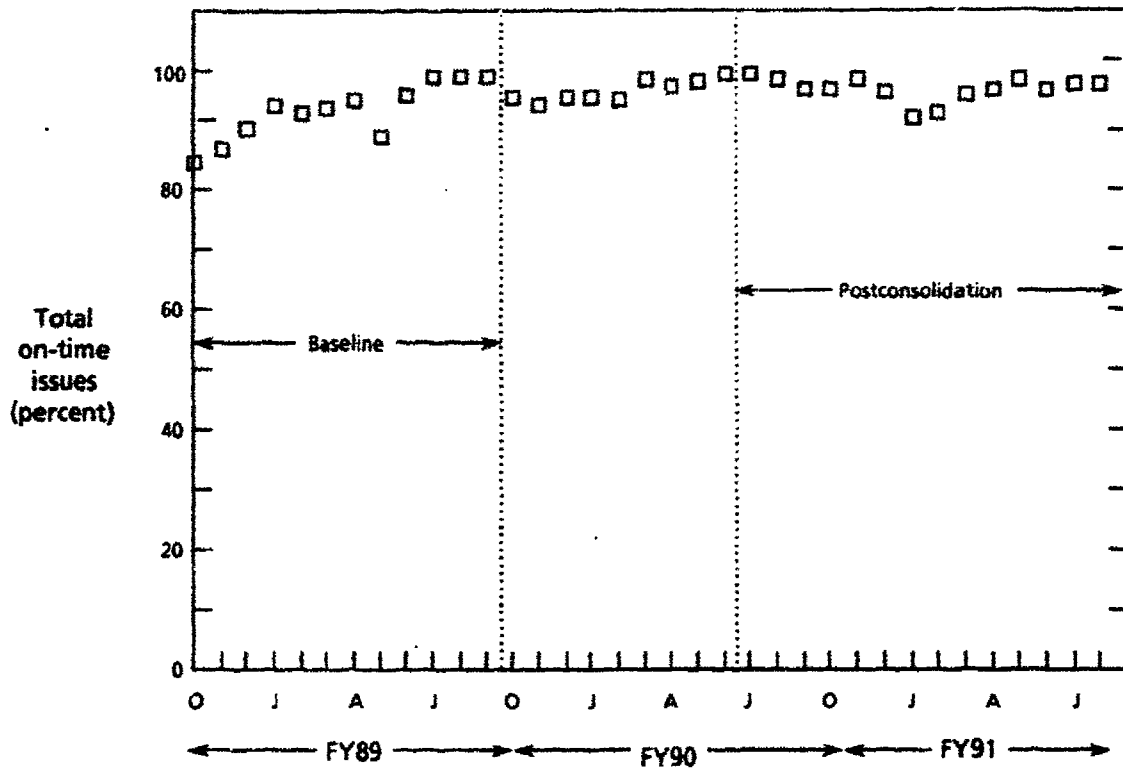
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-5. IPG 3 ISSUES ON TIME -- TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	93.4%
Consolidation	96.8%

Monthly performance

Baseline average ^a	93.4%	
Postconsolidation average ^b	96.9%	
Statistical difference ^c	3.5% ± 3.0%	(Postconsolidation significantly higher)
F statistic ^d	5.65	(Postconsolidation more consistent)

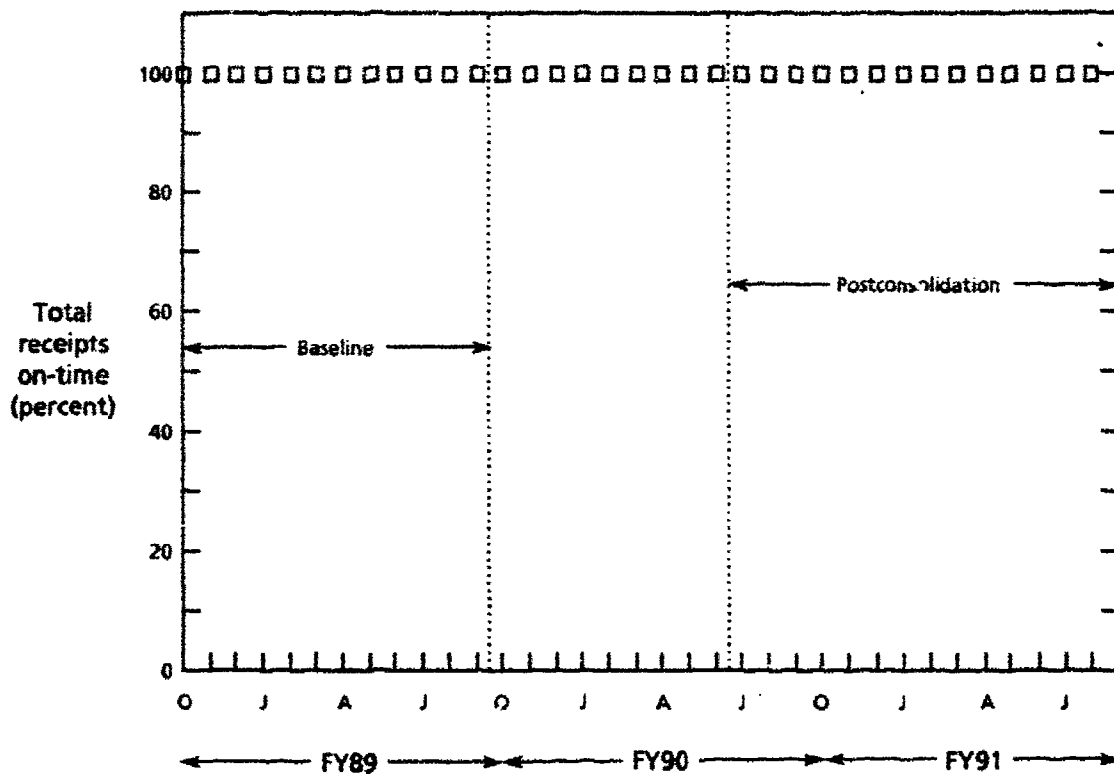
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-6. TOTAL ISSUES ON TIME - TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	100.0%
Consolidation	100.0%

Monthly performance

Baseline average ^a	100.0%	
Postconsolidation average ^b	100.0%	
Statistical difference ^c	0.0% ± 0.0%	(No significant difference)
F statistic ^d	4.79	(Postconsolidation more consistent)

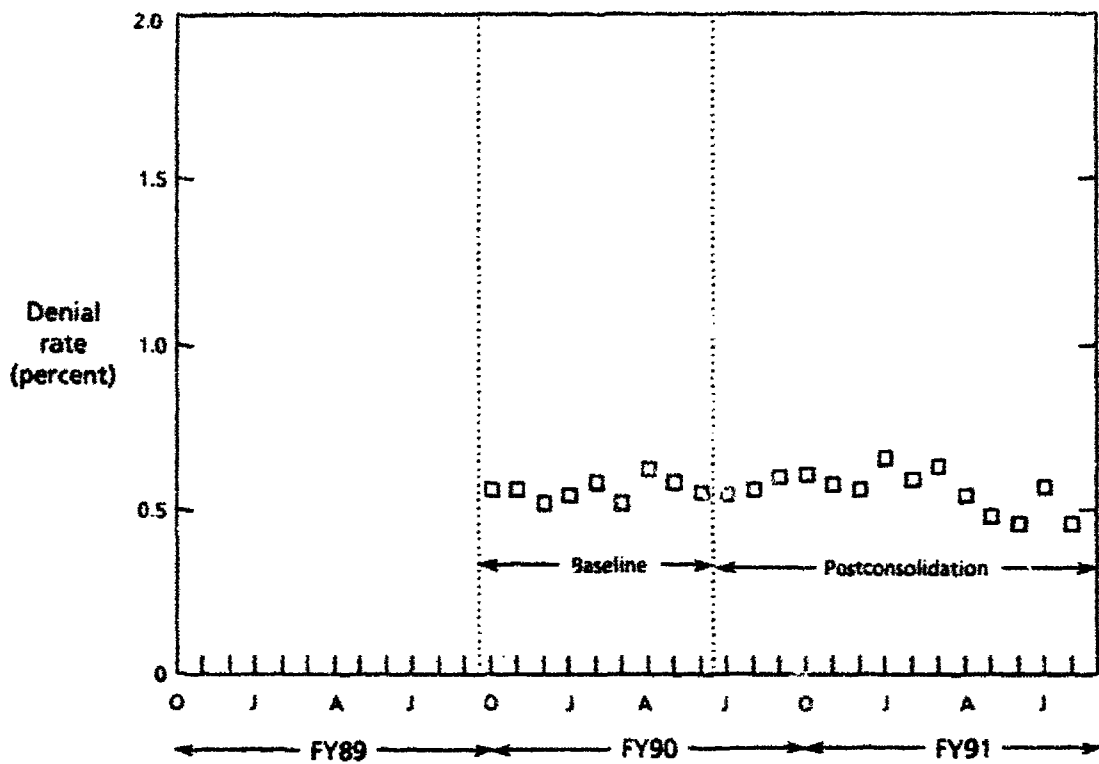
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-7. TOTAL RECEIPTS ON TIME - TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	0.56%
Consolidation	0.56%

Monthly performance

Baseline average ^a	0.56%	
Postconsolidation average ^b	0.56%	
Statistical difference ^c	0.00% ± 0.04%	(No significant difference)
F statistic ^d	2.38	(Equally consistent)

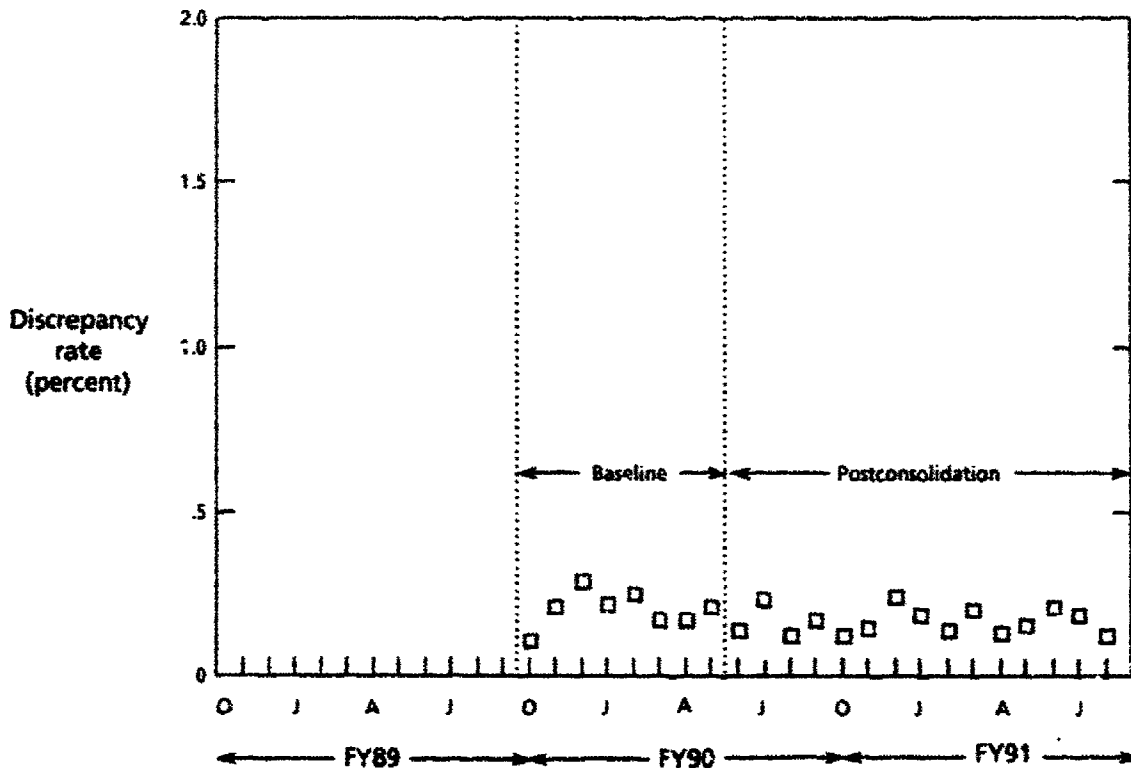
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-8. DENIAL RATE - TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	0.20%
Consolidation	0.17%

Monthly performance

Baseline average ^a	0.20%	
Postconsolidation average ^b	0.17%	
Statistical difference ^c	0.03% ± 0.03%	(No statistical significance)
F statistic ^d	1.91	(Equally consistent)

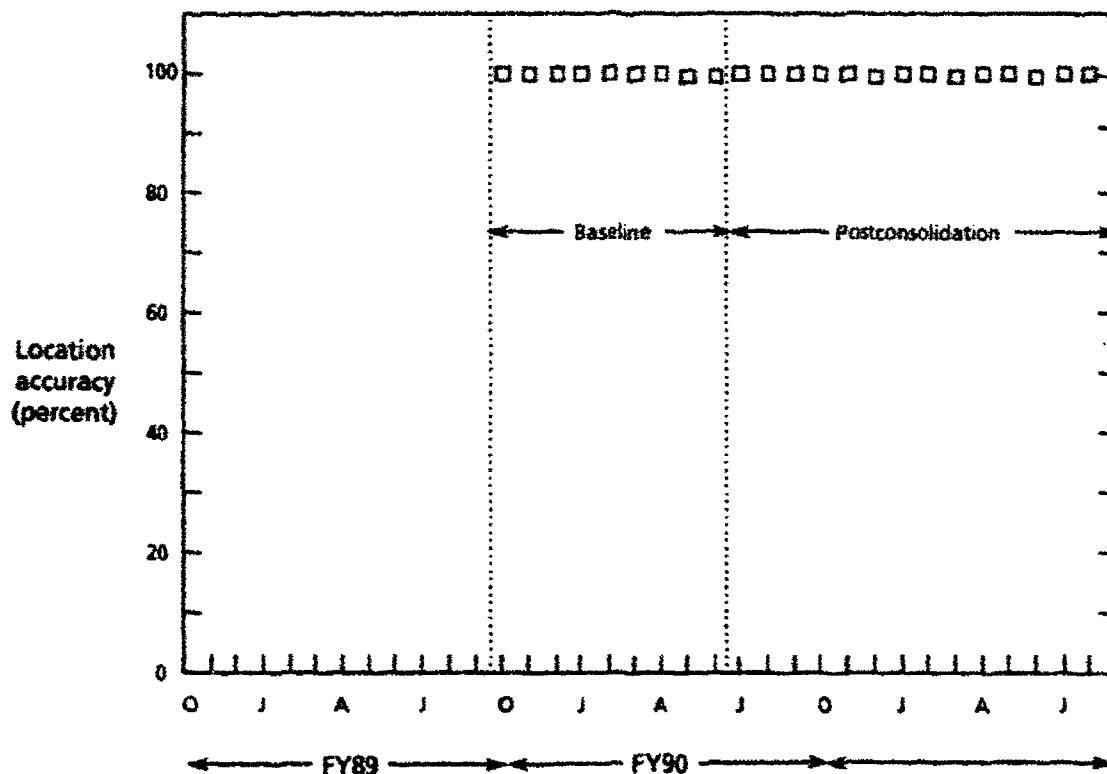
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-9. DISCREPANCY RATE - TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	99.8%
Consolidation	99.8%

Monthly performance

Baseline average ^a	99.8%	
Postconsolidation average ^b	99.8%	
Statistical difference ^c	0.0% ± 0.1%	(No significant difference)
F statistic ^d	0.26	(Baseline more consistent)

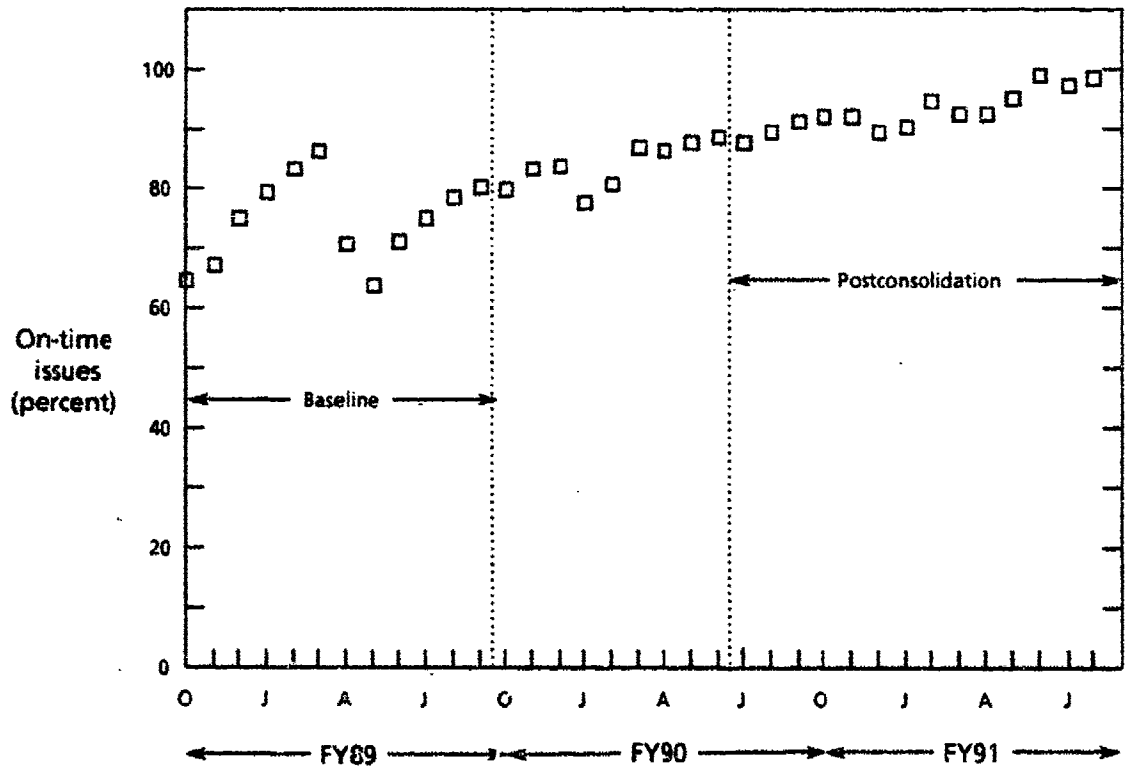
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level)

**FIG. E-10. LOCATION ACCURACY - TRACY SITE
(FY89 to FY91)**



Cumulative performance

Baseline	74.8%
Consolidation	92.4%

Monthly performance

Baseline average ^a	74.8%	
Postconsolidation average ^b	93.2%	
Statistical difference ^c	18.4% ± 4.5%	(Postconsolidation significantly higher)
F statistic ^d	4.36	(Postconsolidation more consistent)

^aFY89 is baseline.

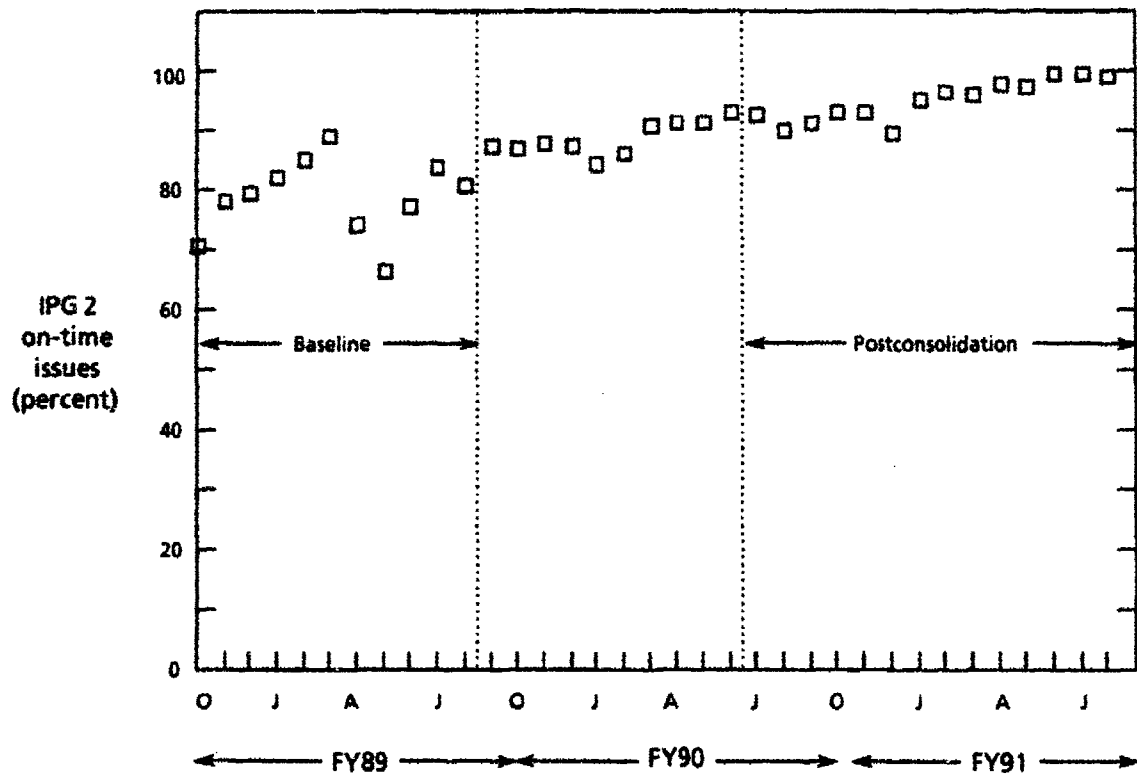
^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

FIG. E-11. IPG 1 ISSUES ON TIME - SHARPE SITE

(FY89 to FY91)



Cumulative performance

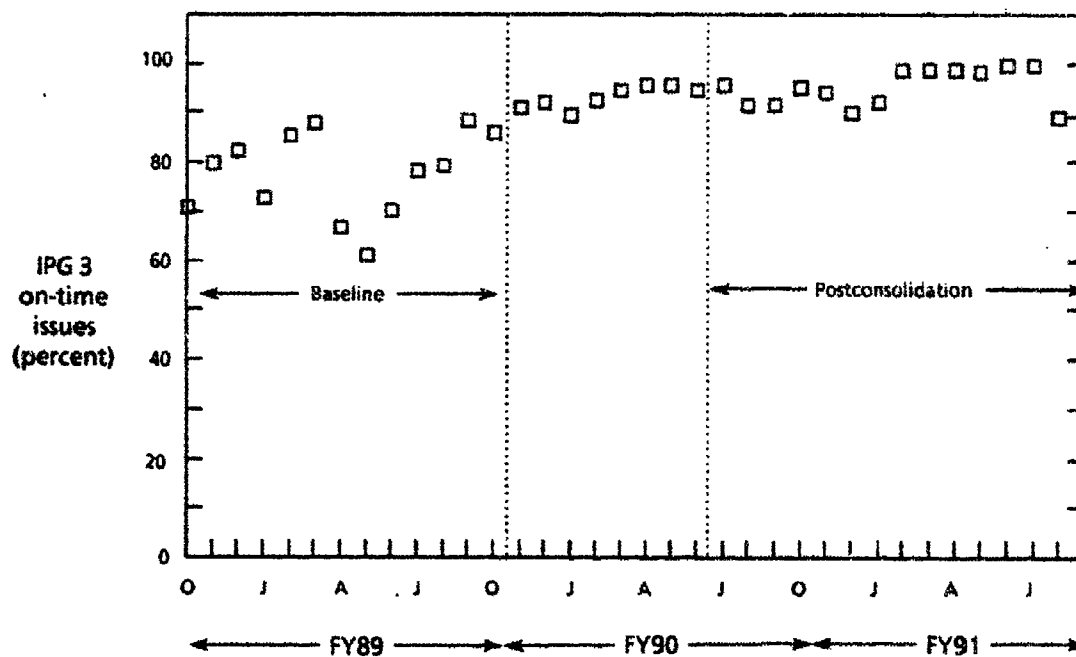
Baseline	79.5%
Consolidation	94.6%

Monthly performance

Baseline average ^a	79.6%	
Postconsolidation average ^b	95.1%	
Statistical difference ^c	15.4% ± 4.2%	(Postconsolidation significantly higher)
F statistic ^d	3.55	(Postconsolidation more consistent)

^aFY89 is baseline.
^bJuly 1990 through August 1991 is postconsolidation period.
^c95 percent confidence interval about the difference between baseline and postconsolidation averages.
^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

FIG. E-12. IPG 2 ISSUES ON TIME - SHARPE SITE
 (FY89 to FY91)



Cumulative performance

Baseline	77.3%
Consolidation	95.7%

Monthly performance

Baseline average ^a	77.2%	
Postconsolidation average ^b	95.4%	
Statistical difference ^c	18.2% ± 5.3%	(Postconsolidation significantly higher)
F statistic ^d	5.36	(Postconsolidation more consistent)

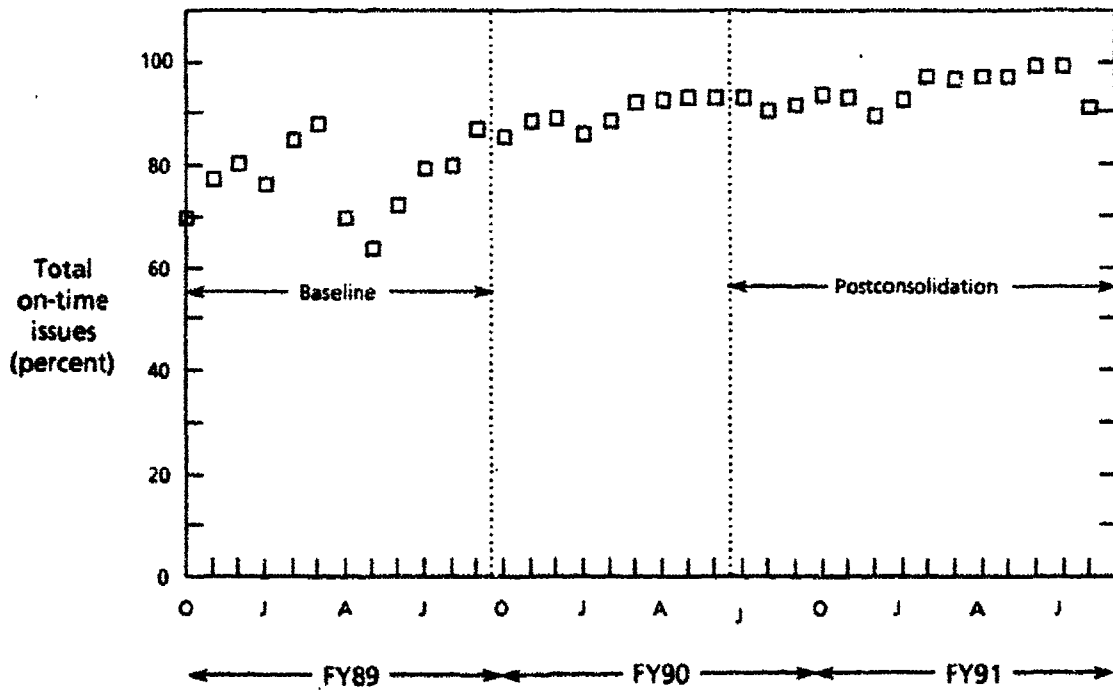
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-13. IPG 3 ISSUES ON TIME – SHARPE SITE
(FY89 to FY91)**



Cumulative performance

Baseline	77.6%
Consolidation	94.5%

Monthly performance

Baseline average ^a	77.6%	
Postconsolidation average ^b	94.6%	
Statistical difference ^c	17.0% ± 4.6%	(Postconsolidation significantly higher)
F statistic ^d	5.25	(Postconsolidation more consistent)

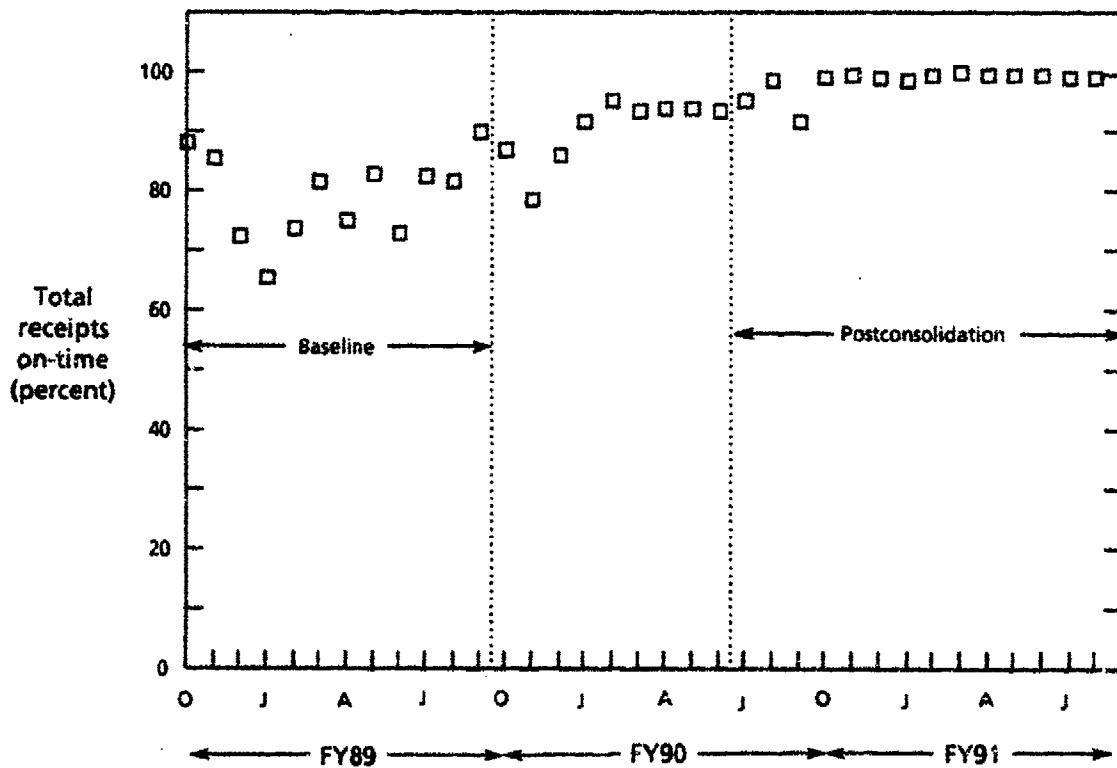
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-14. TOTAL ISSUES ON TIME – SHARPE SITE
(FY89 to FY91)**



Cumulative performance

Baseline	79.2%
Consolidation	98.1%

Monthly performance

Baseline average ^a	79.4%	
Postconsolidation average ^b	98.5%	
Statistical difference ^c	19.1% ± 4.2%	(Postconsolidation significantly higher)
F statistic ^d	11.22	(Postconsolidation more consistent)

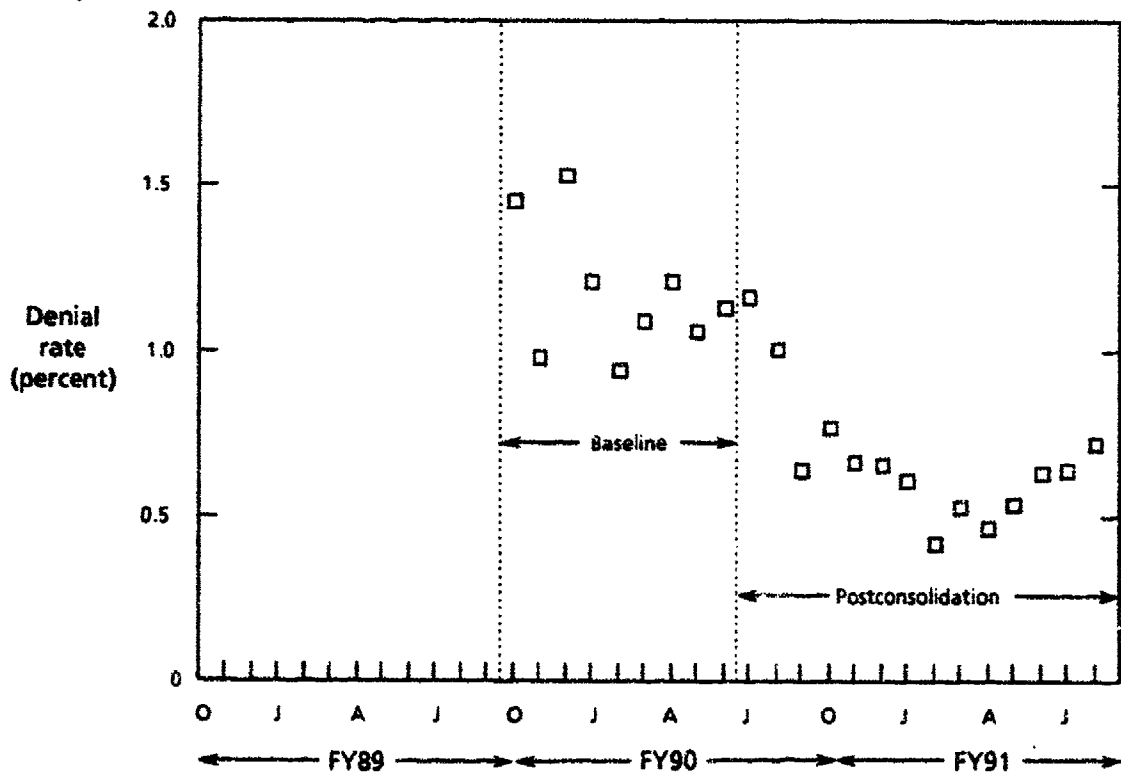
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-15. TOTAL RECEIPTS ON TIME – SHARPE SITE
(FY89 to FY91)**



Cumulative performance

Baseline	1.18%
Consolidation	0.67%

Monthly performance

Baseline average ^a	1.18%	
Postconsolidation average ^b	0.67%	
Statistical difference ^c	0.51% ± 0.18%	(Baseline significantly higher)
F statistic ^d	1.01	(Equally consistent)

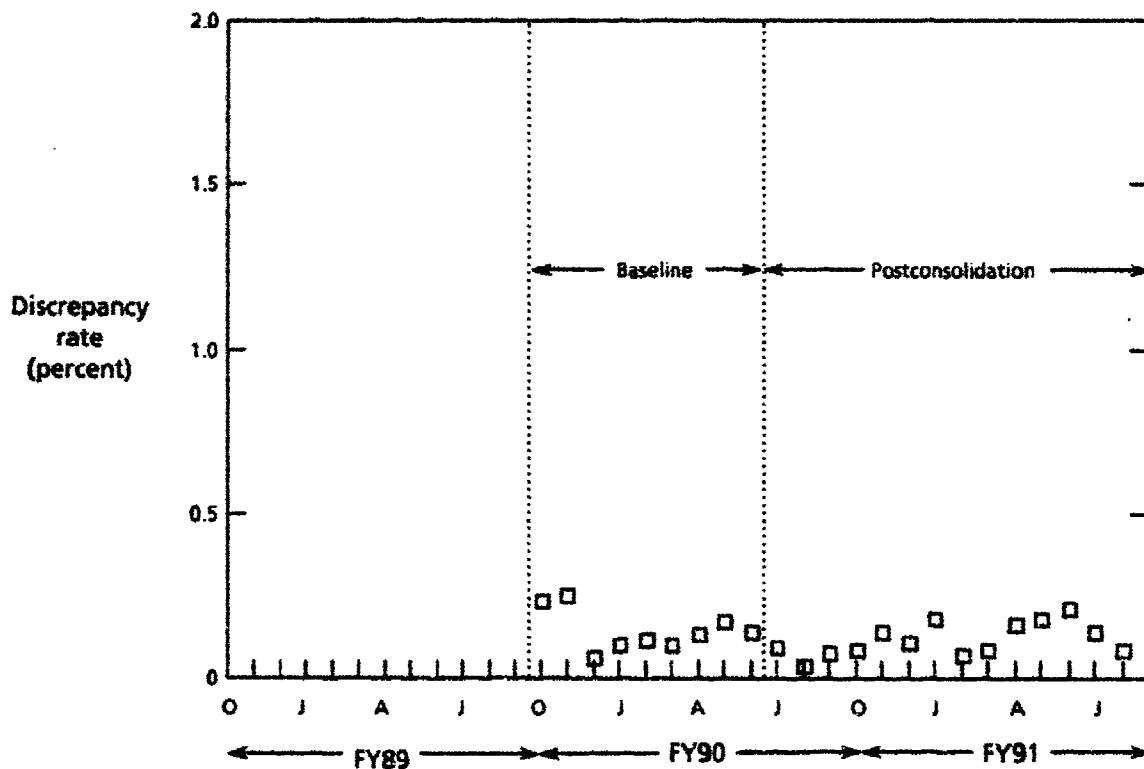
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-16. DENIAL RATE – SHARPE SITE
(FY89 to FY91)**



Cumulative performance

Baseline	0.15%
Consolidation	0.12%

Monthly performance

Baseline average ^a	0.15%	
Postconsolidation average ^b	0.12%	
Statistical difference ^c	0.03% ± 0.05%	(No significant difference)
F statistic ^d	1.55	(Equally consistent)

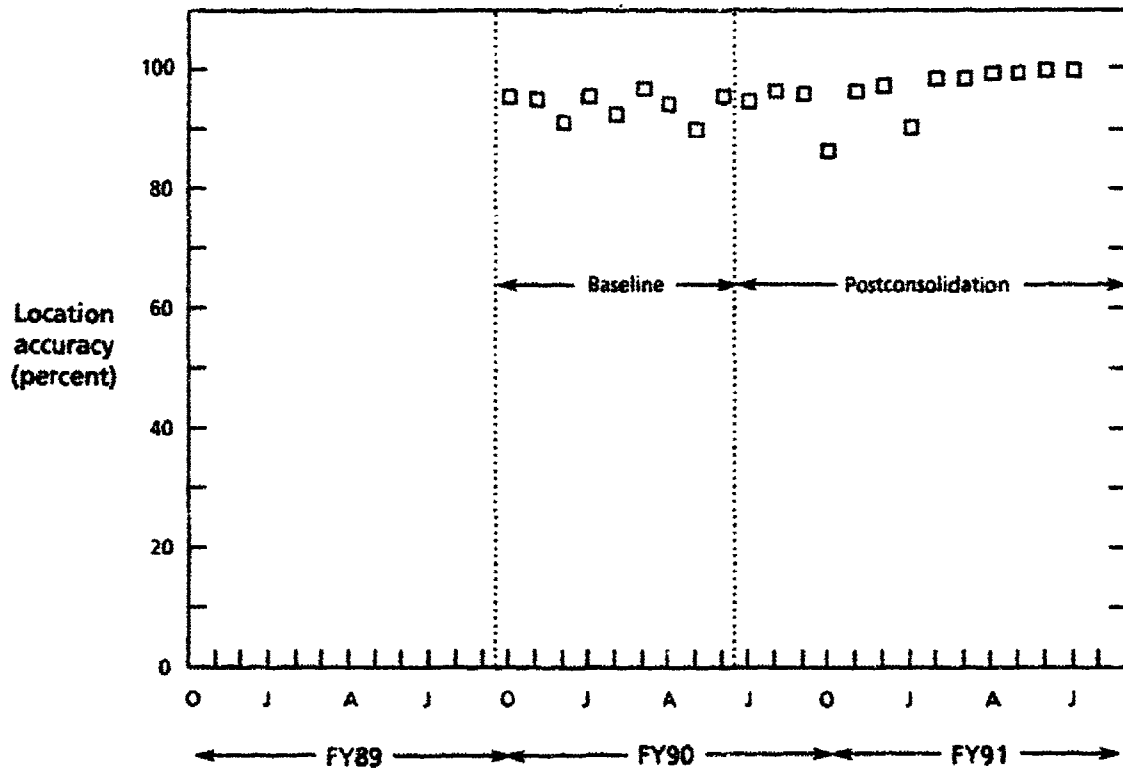
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.28 and 4.20 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-17. DISCREPANCY RATE – SHARPE SITE
(FY89 to FY91)**



Cumulative performance

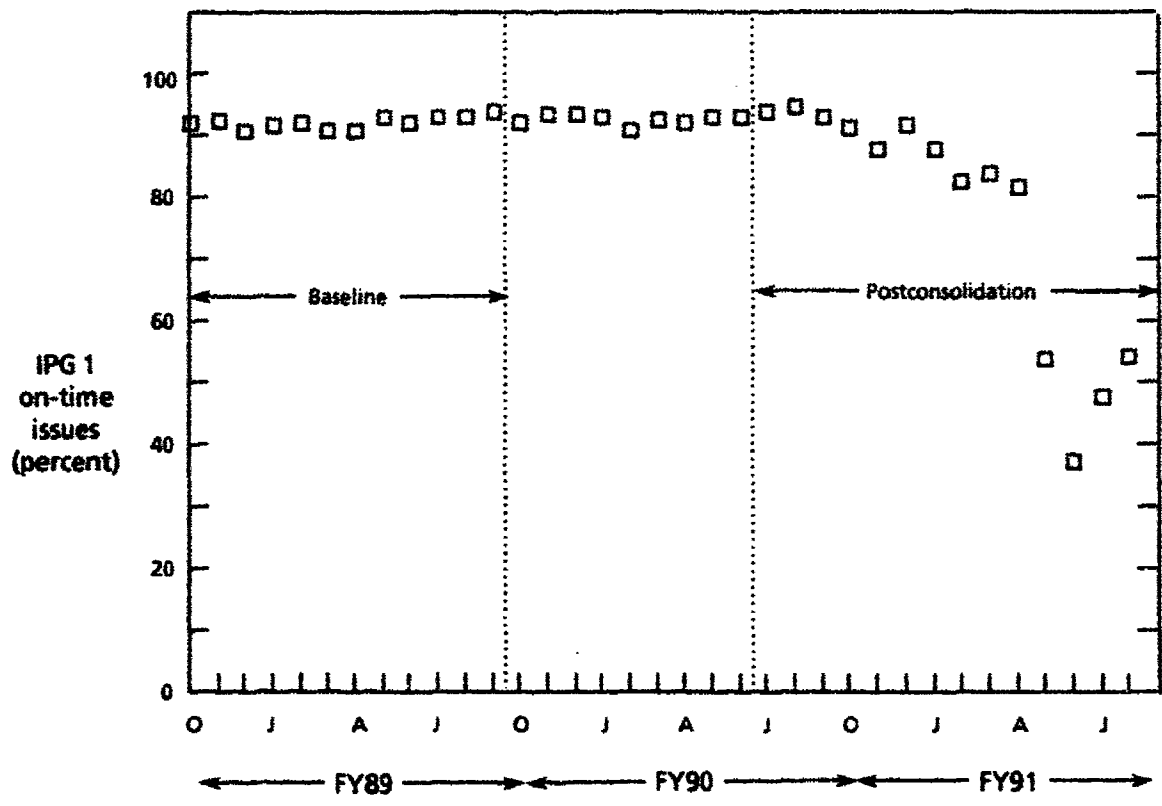
Baseline	not available
Consolidation	not available

Monthly performance

Baseline average ^a	94.2%	
Postconsolidation average ^b	96.6%	
Statistical difference ^c	2.4% ± 3.1%	(No significant difference)
F statistic ^d	0.36	(Equally consistent)

^aFirst 9 months of FY90 is baseline.
^bJuly 1990 through July 1991 is postconsolidation period.
^c95 percent confidence interval about the difference between baseline and postconsolidation averages.
^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.28 and 4.20 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-18. LOCATION ACCURACY - SHARPE SITE
(FY89 to FY91)**



Cumulative performance

Baseline	92.2%
Consolidation	81.6%

Monthly performance

Baseline average ^a	92.6%	
Postconsolidation average ^b	77.2%	
Statistical difference ^c	15.0% ± 11.8%	(Baseline significantly higher)
F statistic ^d	0.00	(Baseline more consistent)

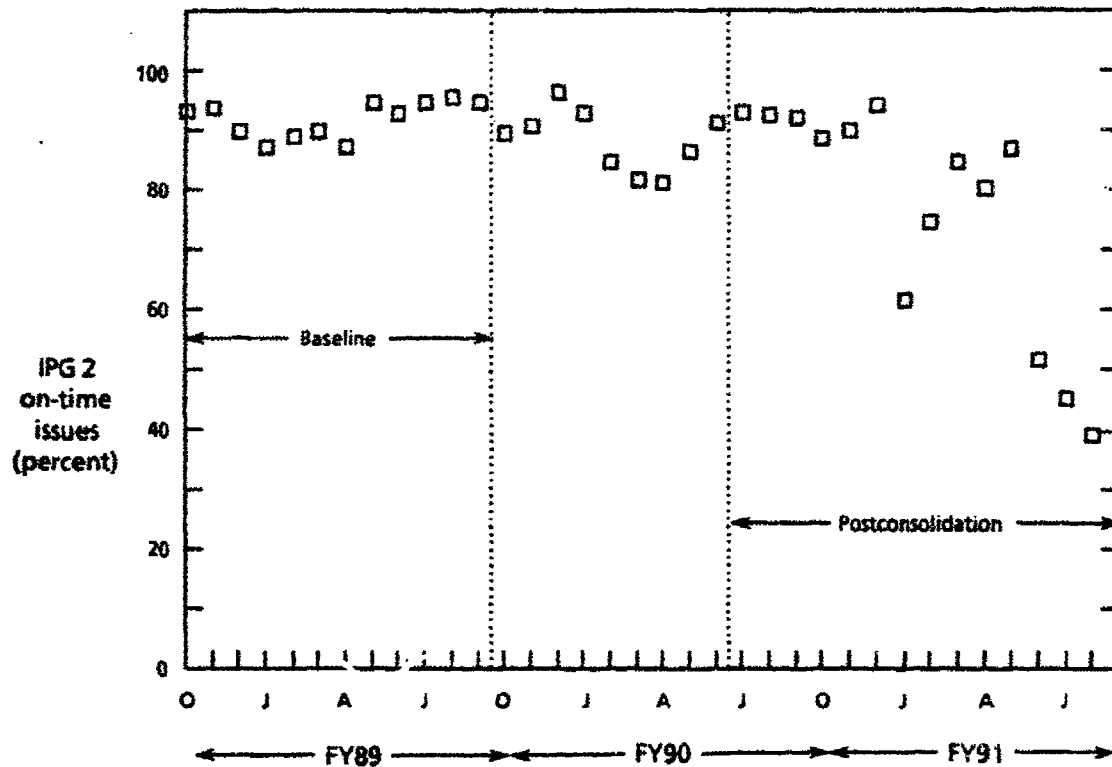
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-19. IPG 1 ISSUES ON TIME – OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	92.1%
Consolidation	82.8%

Monthly performance

Baseline average ^a	92.0%	
Postconsolidation average ^b	76.8%	
Statistical difference ^c	15.2% ± 11.7%	(Baseline significantly higher)
F statistic ^d	0.03	(Baseline more consistent)

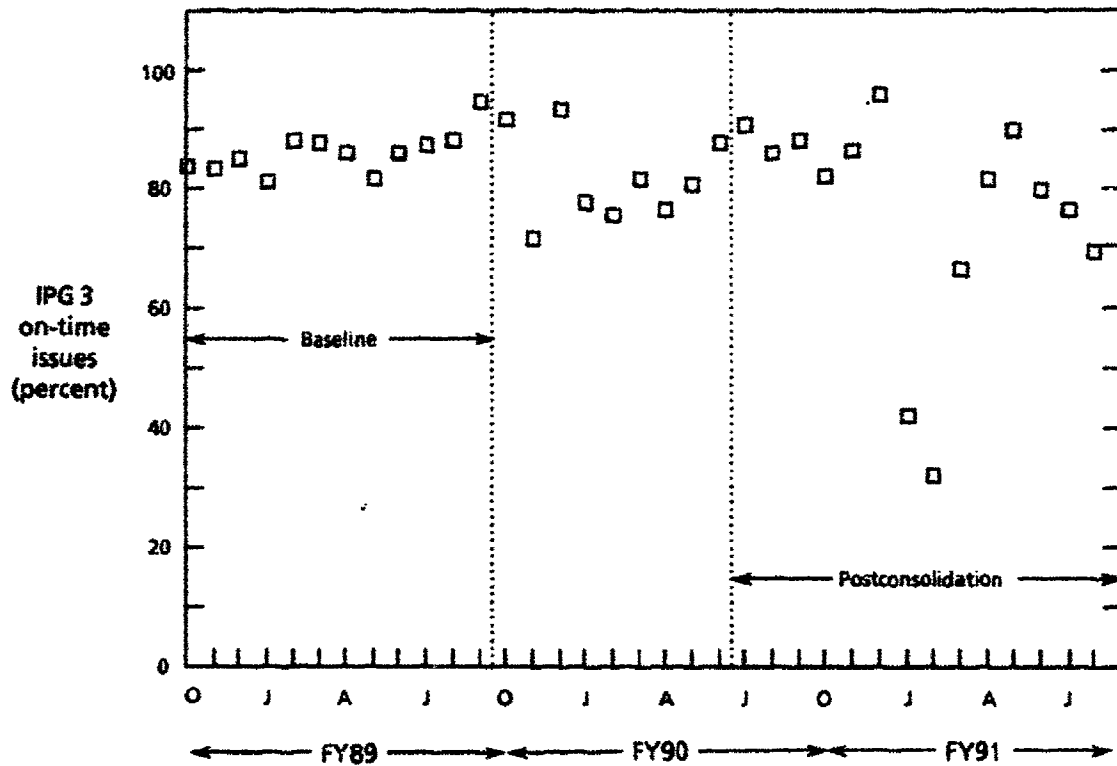
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-20. IPG 2 ISSUES ON TIME - OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	96.0%
Consolidation	78.7%

Monthly performance

Baseline average ^a	86.2%	
Postconsolidation average ^b	76.3%	
Statistical difference ^c	9.9% ± 11.3%	(No significant difference)
F statistic ^d	0.04	(Baseline more consistent)

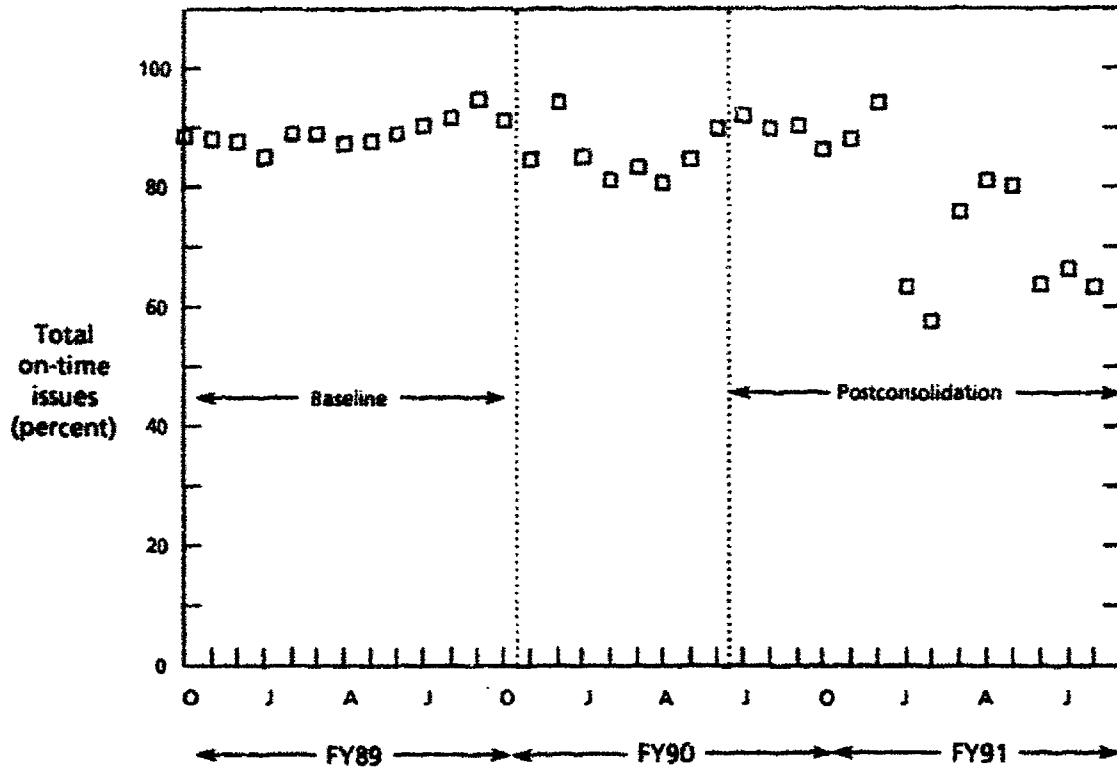
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-21. IPG 3 ISSUES ON TIME – OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	89.2%
Consolidation	80.6%

Monthly performance

Baseline average ^a	89.2%	
Postconsolidation average ^b	78.2%	
Statistical difference ^c	11.0% ± 7.8%	(Baseline significantly higher)
F statistic ^d	0.04	(Baseline more consistent)

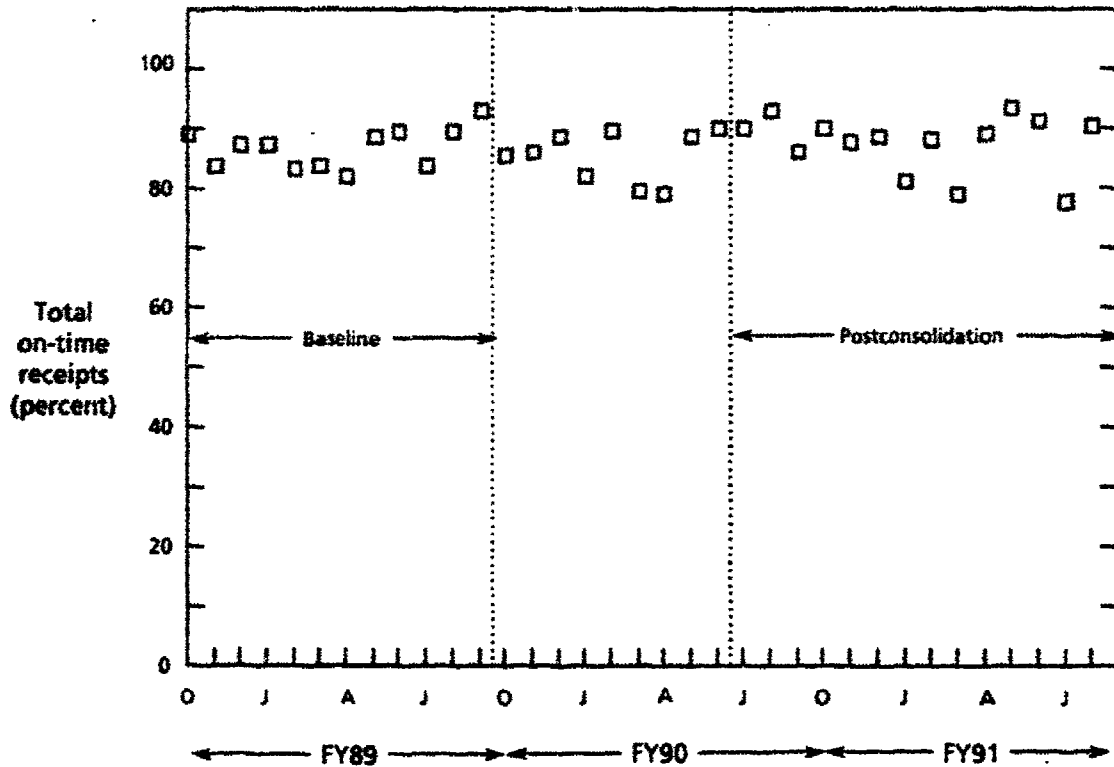
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-22. TOTAL ISSUES ON TIME - OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	86.6%
Consolidation	87.4%

Monthly performance

Baseline average ^a	86.8%	
Postconsolidation average ^b	87.6%	
Statistical difference ^c	0.8% ± 3.5%	(No significant difference)
F statistic ^d	0.46	(Equally consistent)

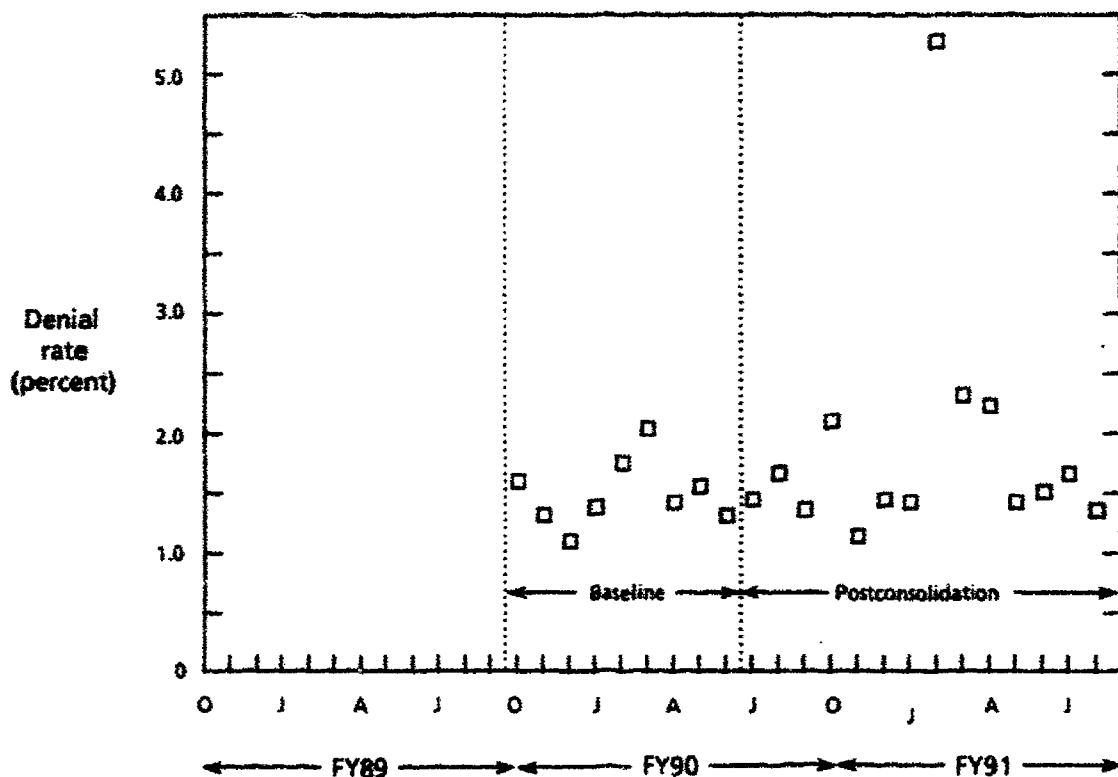
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-23. TOTAL RECEIPTS ON TIME – OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	1.51%
Consolidation	1.75%

Monthly performance

Baseline average ^a	1.51%	
Postconsolidation average ^b	1.89%	
Statistical difference ^c	0.38% ± 0.74%	(No significant difference)
F statistic ^d	0.07	(Baseline more consistent)

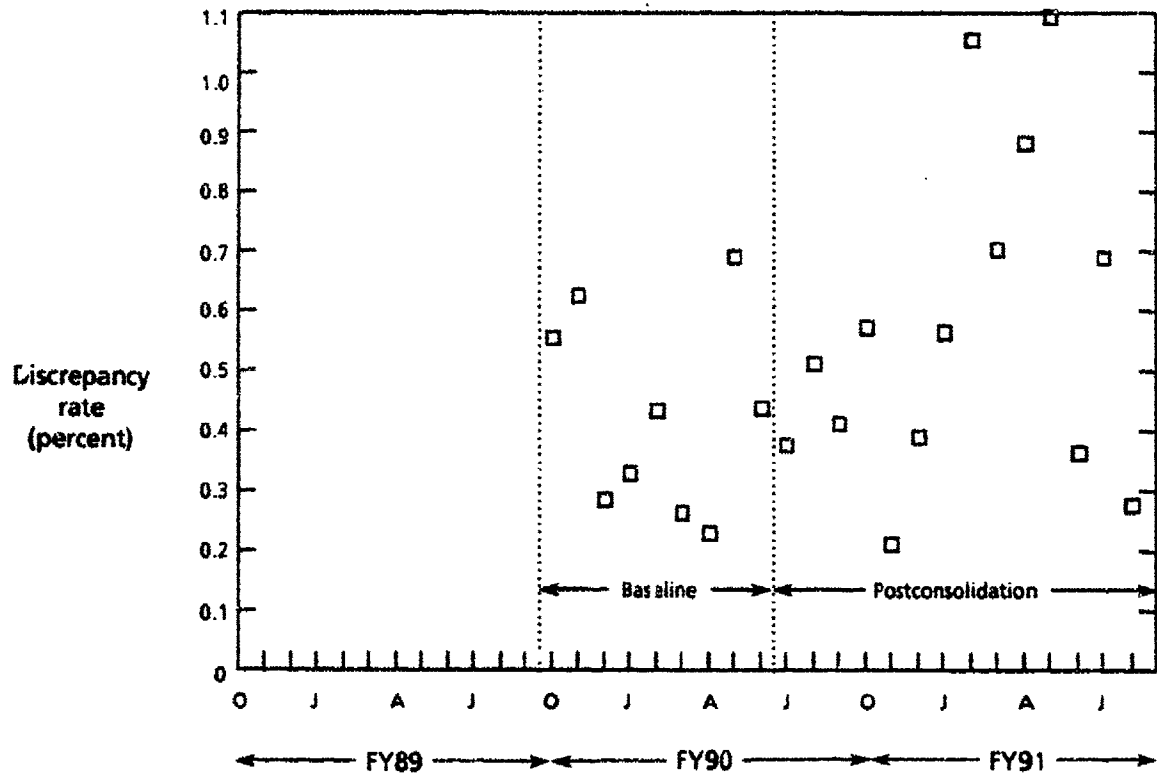
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-24. DENIAL RATE - OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	0.40%
Consolidation	0.52%

Monthly performance

Baseline average ^a	0.43%	
Postconsolidation average ^b	0.58%	
Statistical difference ^c	0.15% ± 0.22%	(No significant difference)
F statistic ^d	0.36	(Equally consistent)

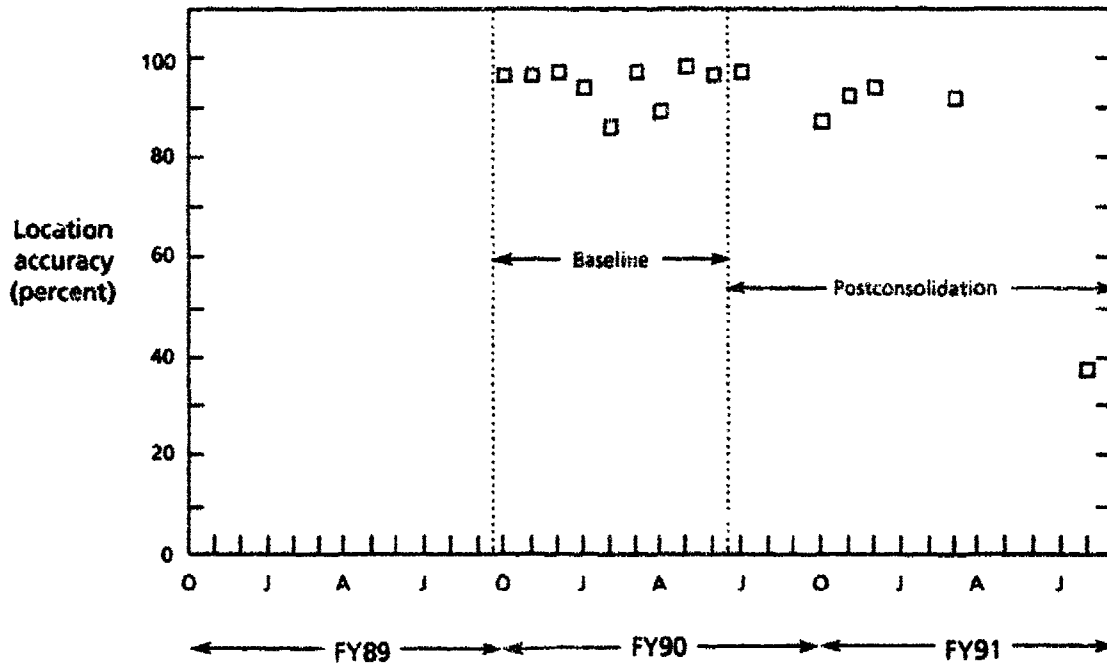
^aFirst 9 months of FY90 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.29 and 4.17 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-25. DISCREPANCY RATE – OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

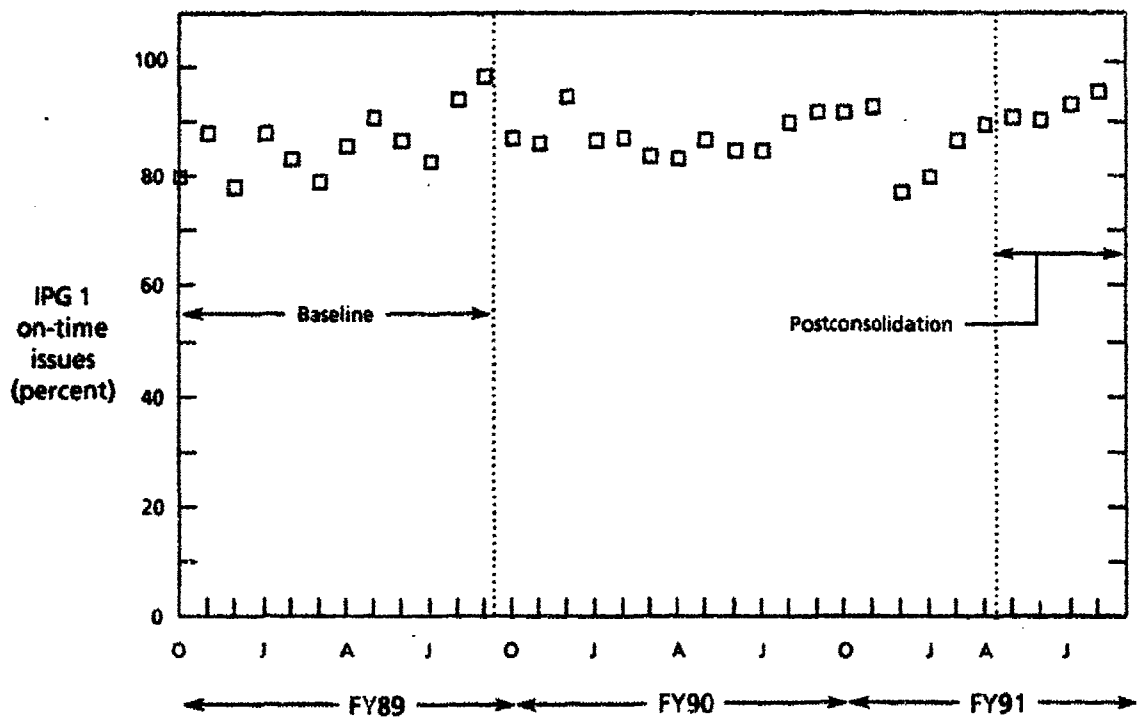
Baseline	Not available
Consolidation	Not available

Monthly performance

Baseline average ^a	94.8%	
Postconsolidation average ^b	83.4%	
Statistical difference ^c	11.4% ± 16.5%	(No significant difference)
F statistic ^d	0.03	(Baseline more consistent)

^aFirst 9 months of FY90 is baseline.
^bJuly 1990 through August 1991 is postconsolidation period.
^c95 percent confidence interval about the difference between baseline and postconsolidation averages.
^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.15 and 4.82 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-26. LOCATION ACCURACY – OAKLAND SITE
(FY89 to FY91)**



Cumulative performance

Baseline	87.5%
Consolidation	94.7%

Monthly performance

Baseline average ^a	86.4%	
Postconsolidation average ^b	94.6%	
Statistical difference ^c	8.1% ± 7.1%	(Postconsolidation significantly higher)
F statistic ^d	3.29	(Equally consistent)

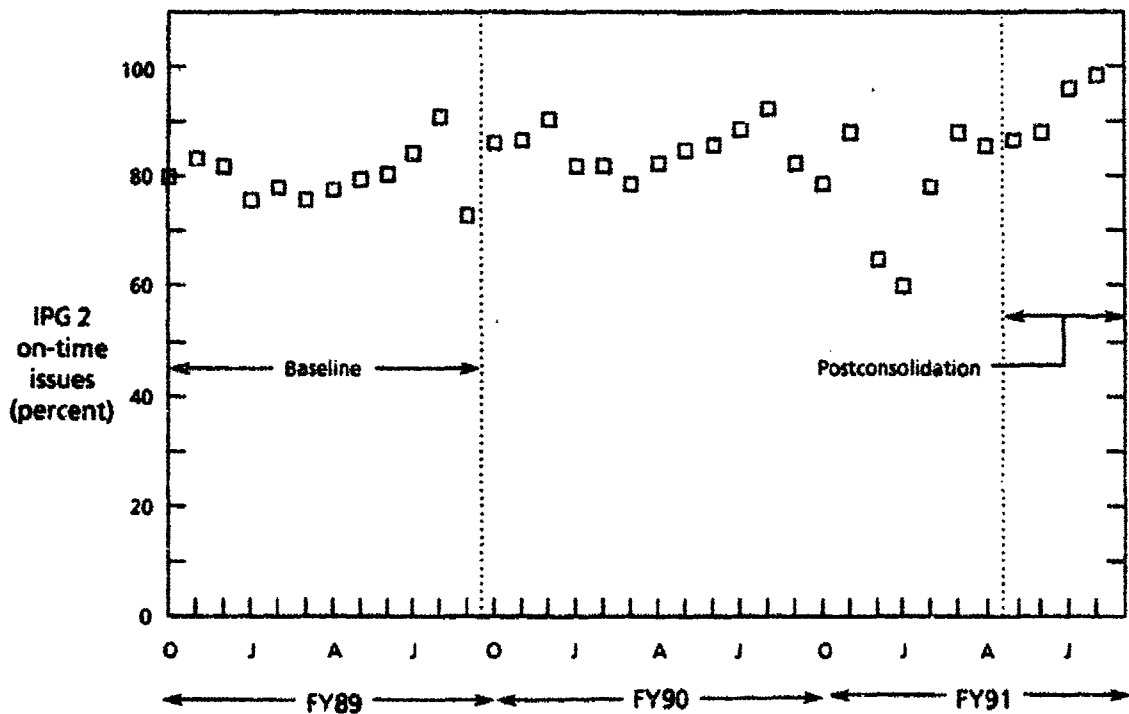
^aFY89 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-27. IPG 1 ISSUES ON TIME - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	80.1%
Consolidation	93.4%

Monthly performance

Baseline average ^a	80.2%	
Postconsolidation average ^b	92.5%	
Statistical difference ^c	12.4% ± 6.3%	(Postconsolidation significantly higher)
F statistic ^d	0.67	(Equally consistent)

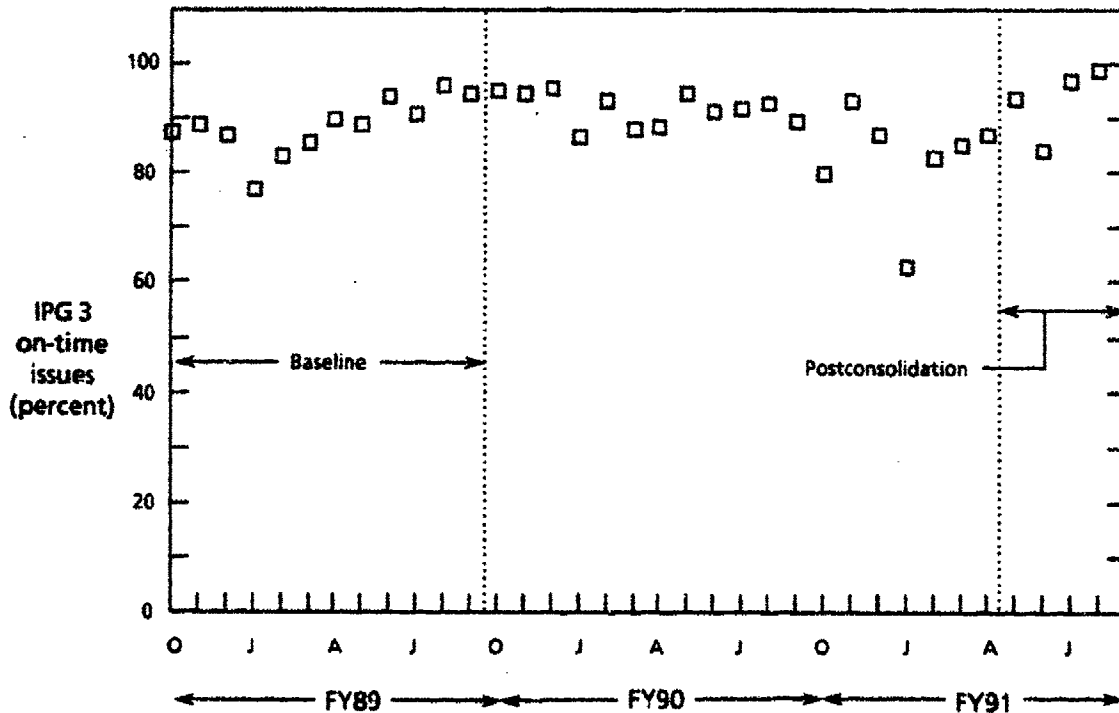
^aFY89 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-28. IPG 2 ISSUES ON TIME - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	88.9%
Consolidation	93.8%

Monthly performance

Baseline average ^a	88.7%	
Postconsolidation average ^b	93.6%	
Statistical difference ^c	4.8% ± 6.9%	(No significant difference)
F statistic ^d	0.66	(Equally consistent)

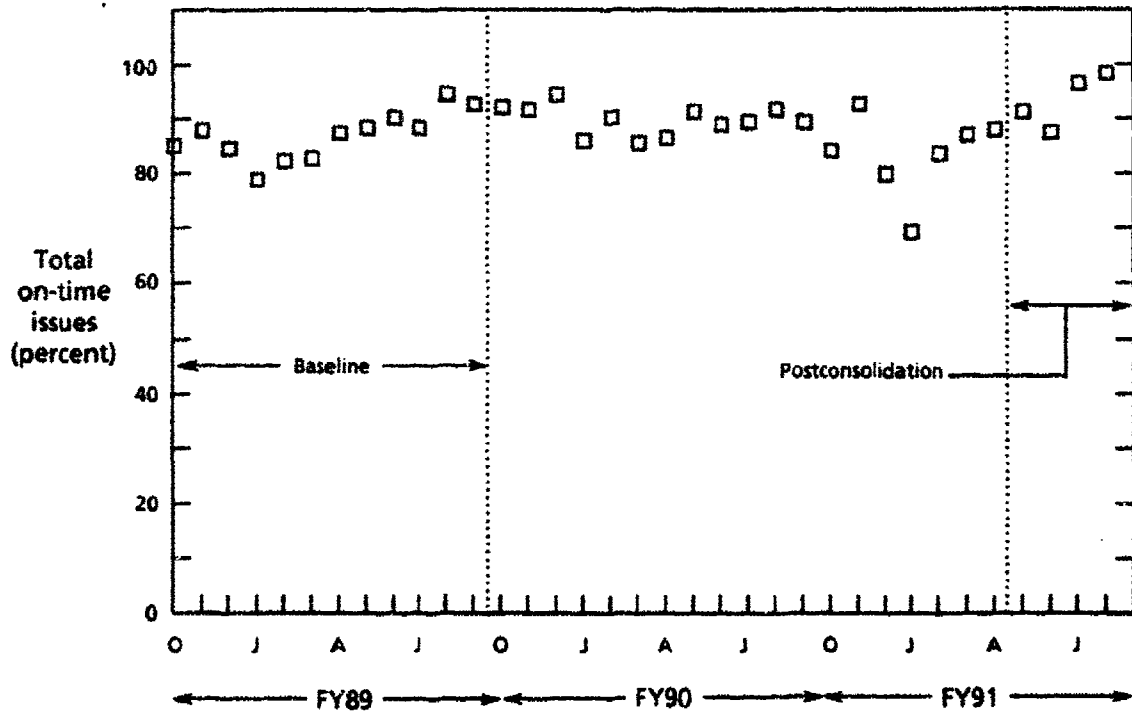
^aFY89 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-29. IPG 3 ISSUES ON TIME – SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	87.4%
Consolidation	94.0%

Monthly performance

Baseline average ^a	87.2%	
Postconsolidation average ^b	93.7%	
Statistical difference ^c	6.4% ± 5.7%	(Postconsolidation significantly higher)
F statistic ^d	0.77	(Equally consistent)

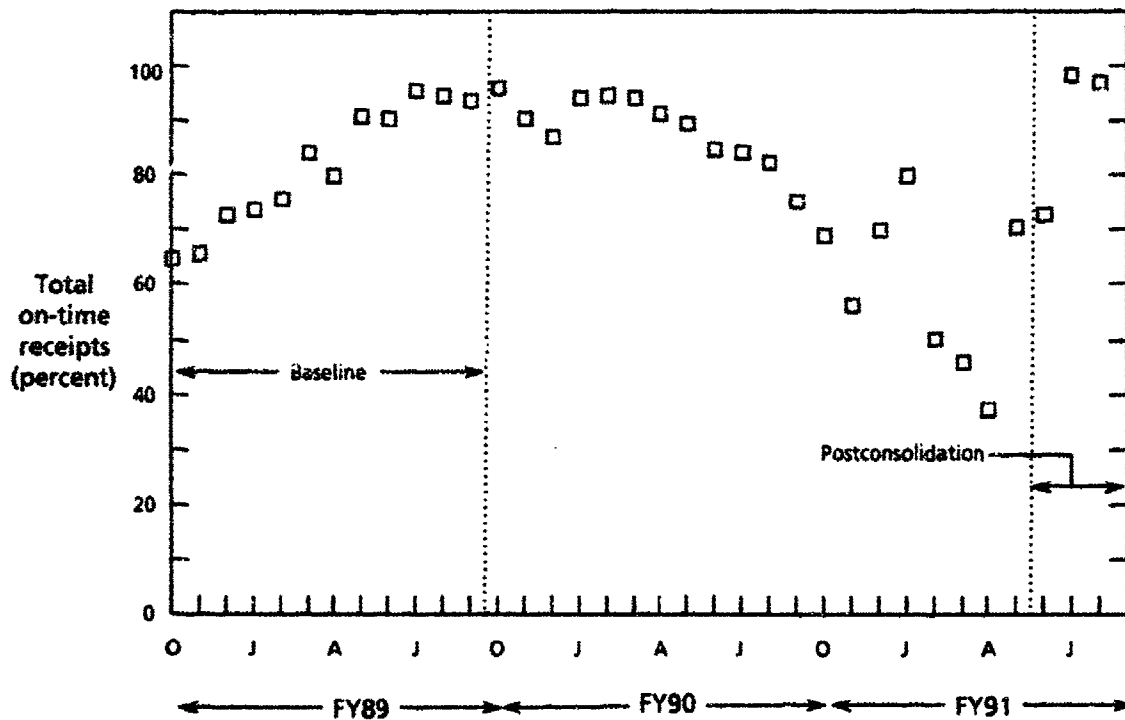
^aFY89 is baseline.

^bJuly 1990 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-30. TOTAL ISSUES ON TIME - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	82.8%
Consolidation	83.4%

Monthly performance

Baseline average ^a	82.0%	
Postconsolidation average ^b	85.0%	
Statistical difference ^c	2.9% ± 15.1%	(No significant difference)
F statistic ^d	0.55	(Equally consistent)

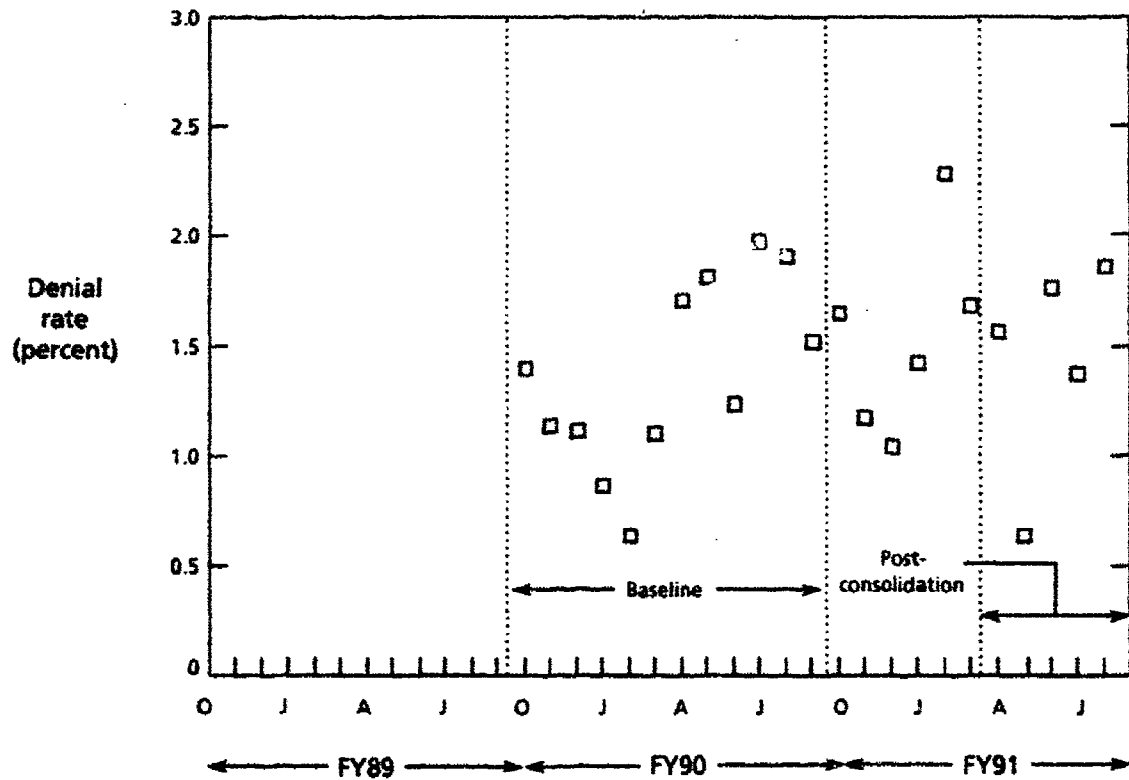
^aFY89 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-31. TOTAL RECEIPTS ON TIME - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	1.35%
Consolidation	1.44%

Monthly performance

Baseline average ^a	1.37%	
Postconsolidation average ^b	1.41%	
Statistical difference ^c	0.04% ± 0.57%	(No significant difference)
F statistic ^d	0.59	(Equally consistent)

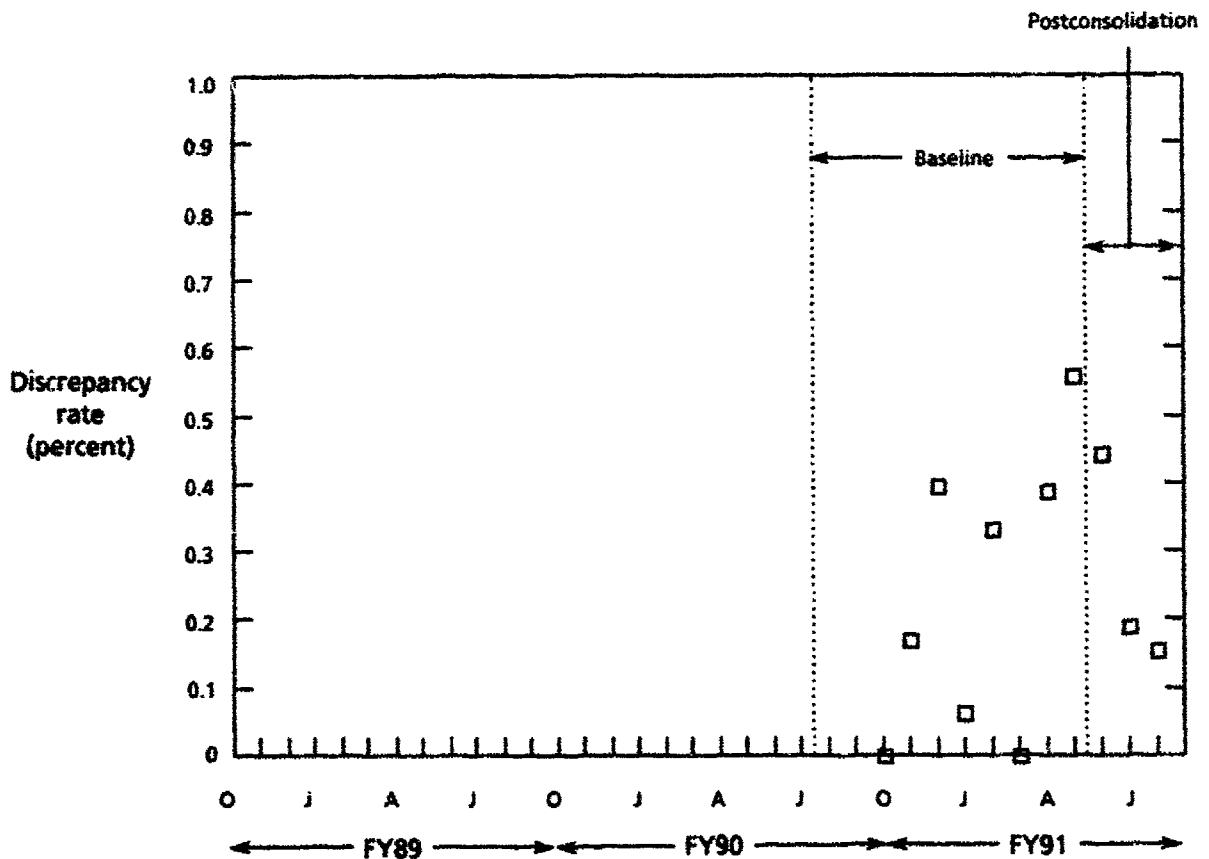
^aFY90 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-32. DENIAL RATE - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	0.19%
Consolidation	0.31%

Monthly performance

Baseline average ^a	0.19%	
Postconsolidation average ^b	0.34%	
Statistical difference ^c	0.14% ± 0.26%	(No significant difference)
F statistic ^d	0.83	(Equally consistent)

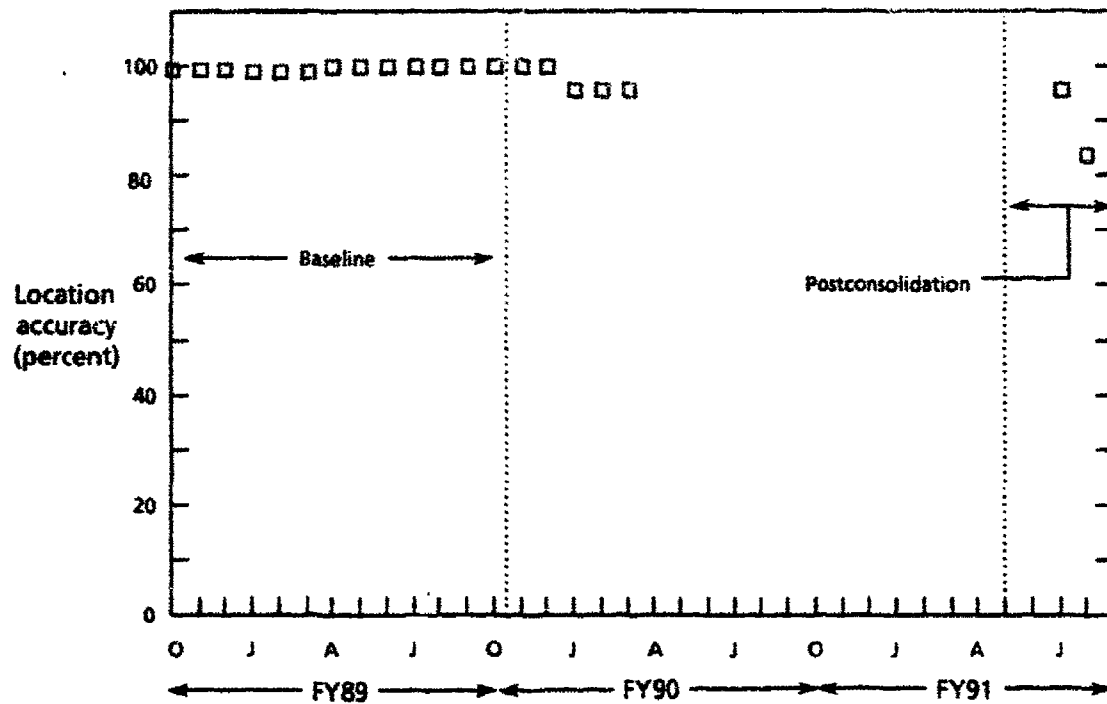
^aFirst 7 months of FY91 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 6.60 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-33. DISCREPANCY RATE - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	99.6%
Consolidation	94.5%

Monthly performance

Baseline average ^a	99.6%	
Postconsolidation average ^b	90.0%	
Statistical difference ^c	9.6% ± 4.8%	(Baseline significantly higher)
F statistic ^d		(Equally consistent)

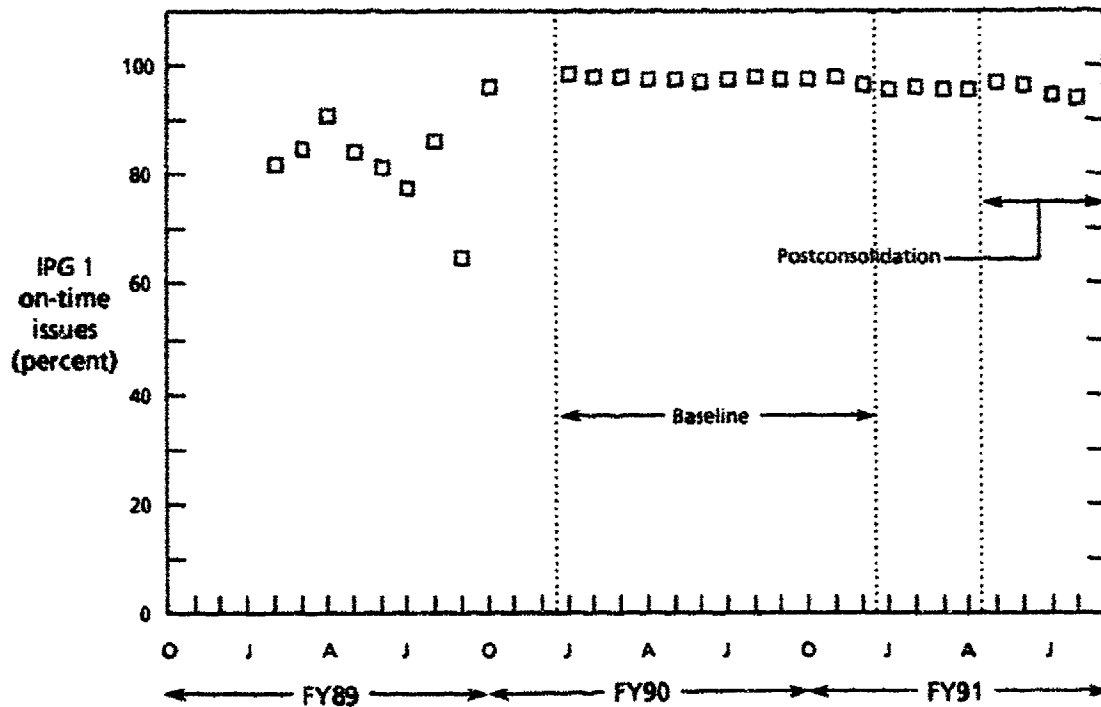
^aFY89 is baseline.

^bJuly 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.00 and 6.72 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-34. LOCATION ACCURACY - SRDD
(FY89 to FY91)**



Cumulative performance

Baseline	97.8%
Consolidation	95.8%

Monthly performance

Baseline average ^a	97.8%	
Postconsolidation average ^b	95.8%	
Statistical difference ^c	2.0% ± 1.0%	(Baseline significantly higher)
F statistic ^d	0.11	(Equally consistent)

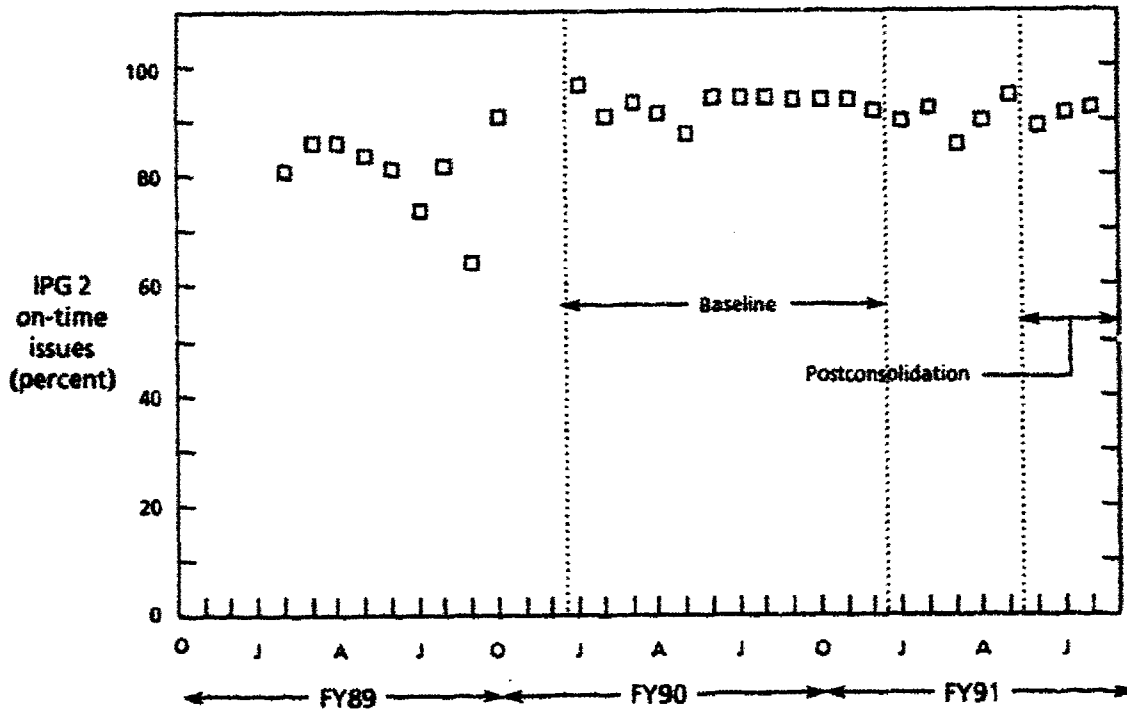
^aJanuary 1990 through December 1990 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-35. IPG 1 ISSUES ON TIME - SSOS
(FY89 to FY91)**



Cumulative performance

Baseline	93.0%
Consolidation	92.1%

Monthly performance

Baseline average ^a	93.1%	
Postconsolidation average ^b	92.0%	
Statistical difference ^c	1.0% ± 2.8%	(No significant difference)
F statistic ^d	0.88	(Equally consistent)

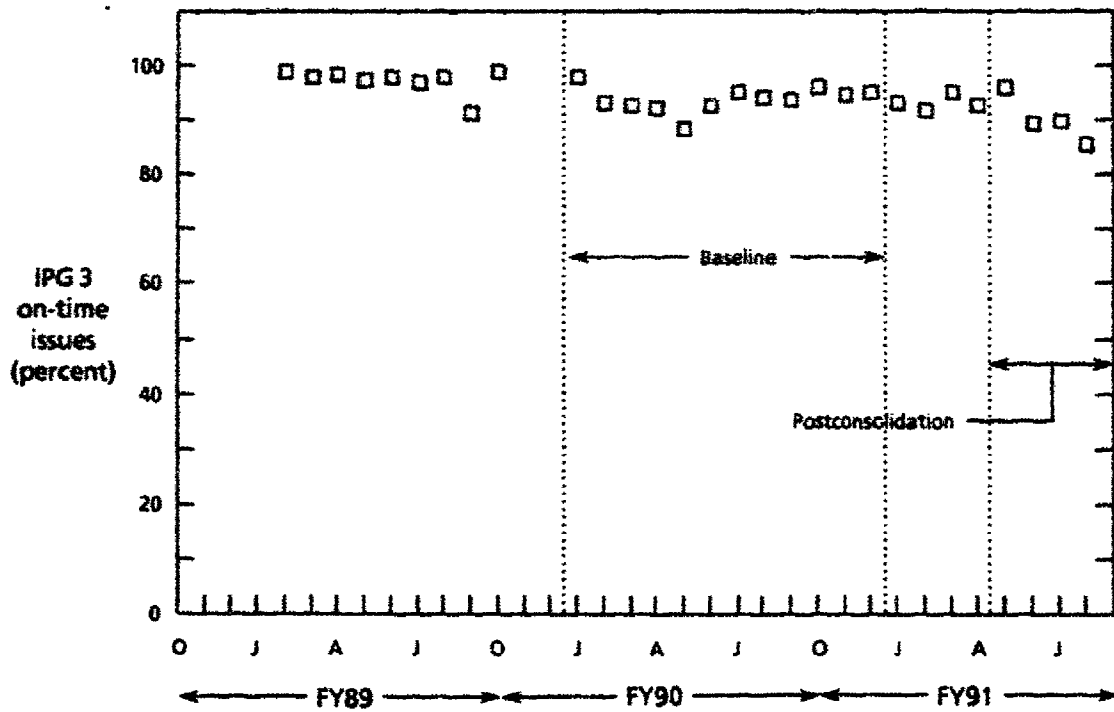
^aJanuary 1990 through December 1990 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.31 and 3.40 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-36. IPG 2 ISSUES ON TIME - SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	93.9%
Consolidation	90.1%

Monthly performance

Baseline average ^a	94.1%	
Postconsolidation average ^b	90.5%	
Statistical difference ^c	3.6% ± 3.5%	(Baseline significantly higher)
F statistic ^d	0.29	(Equally consistent)

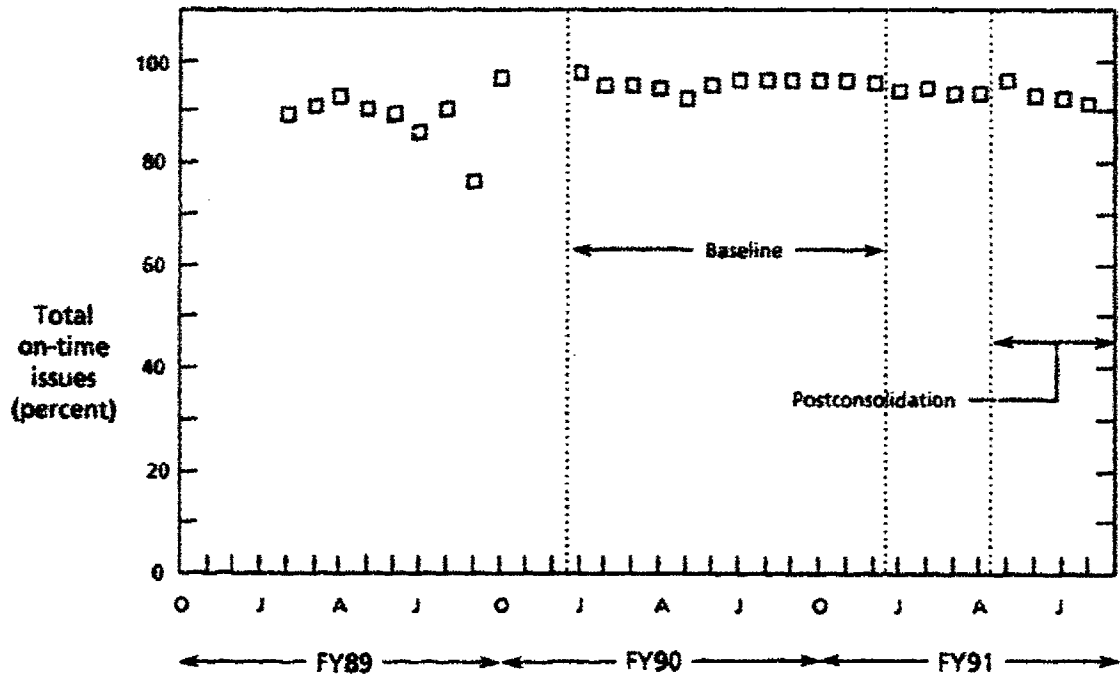
^aJanuary 1990 through December 1990 is baseline.

^bMay 1991 through August 1991 is baseline.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-37. IPG 3 ISSUES ON TIME - SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	95.7%
Consolidation	93.5%

Monthly performance

Baseline average ^a	95.7%	
Postconsolidation average ^b	93.5%	
Statistical difference ^c	2.2% ± 1.9%	(Baseline significantly higher)
F statistic ^d	0.38	(Equally consistent)

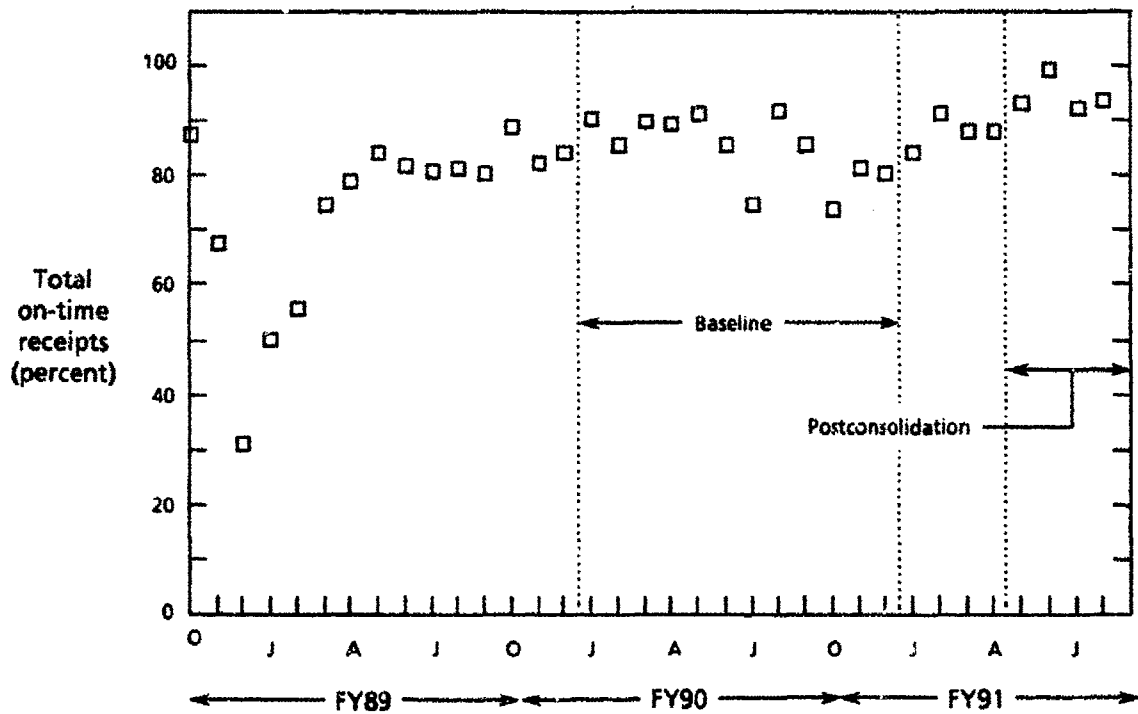
^aJanuary 1990 through December 1990 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-38. TOTAL ISSUES ON TIME -- SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	85.5%
Consolidation	94.8%

Monthly performance

Baseline average ^a	85.2%	
Postconsolidation average ^b	94.9%	
Statistical difference ^c	9.8% ± 7.1%	(Postconsolidation significantly higher)
F statistic ^d	3.89	(Equally consistent)

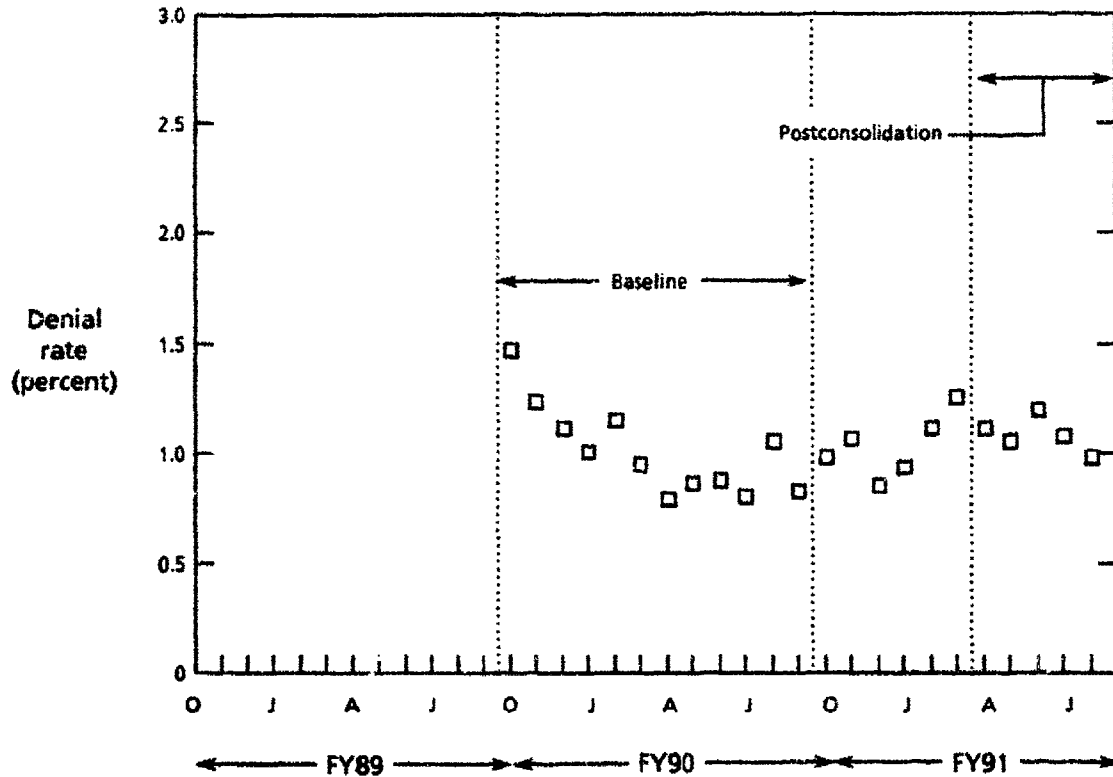
^aJanuary 1990 through December 1990 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-39. TOTAL RECEIPTS ON TIME – SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	0.94%
Consolidation	1.07%

Monthly performance

Baseline average ^a	1.01%	
Postconsolidation average ^b	1.08%	
Statistical difference ^c	0.06% ± 0.23%	(No significant difference)
F statistic ^d	5.55	(Postconsolidation more consistent)

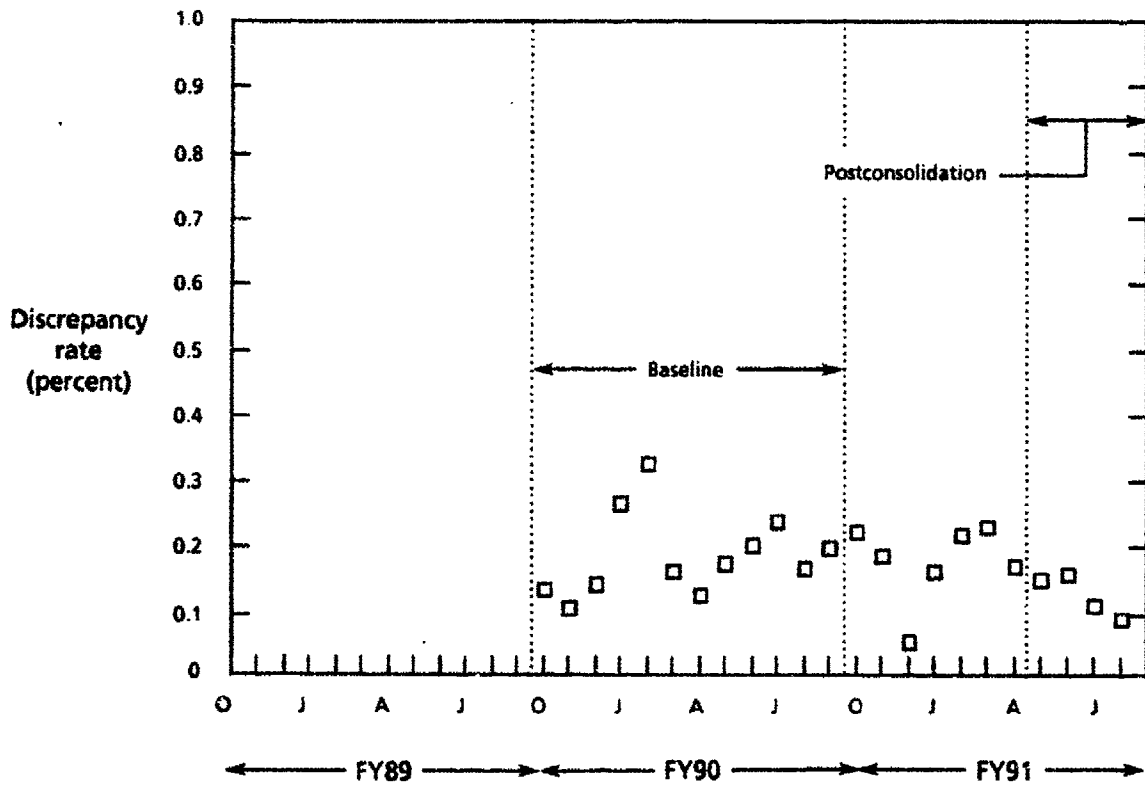
^aFY90 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.6 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-40. DENIAL RATE - SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	0.20%
Consolidation	0.13%

Monthly performance

Baseline average ^a	0.19%	
Postconsolidation average ^b	0.13%	
Statistical difference ^c	0.06% ± 0.07%	(No significant difference)
F statistic ^d	3.72	(Equally consistent)

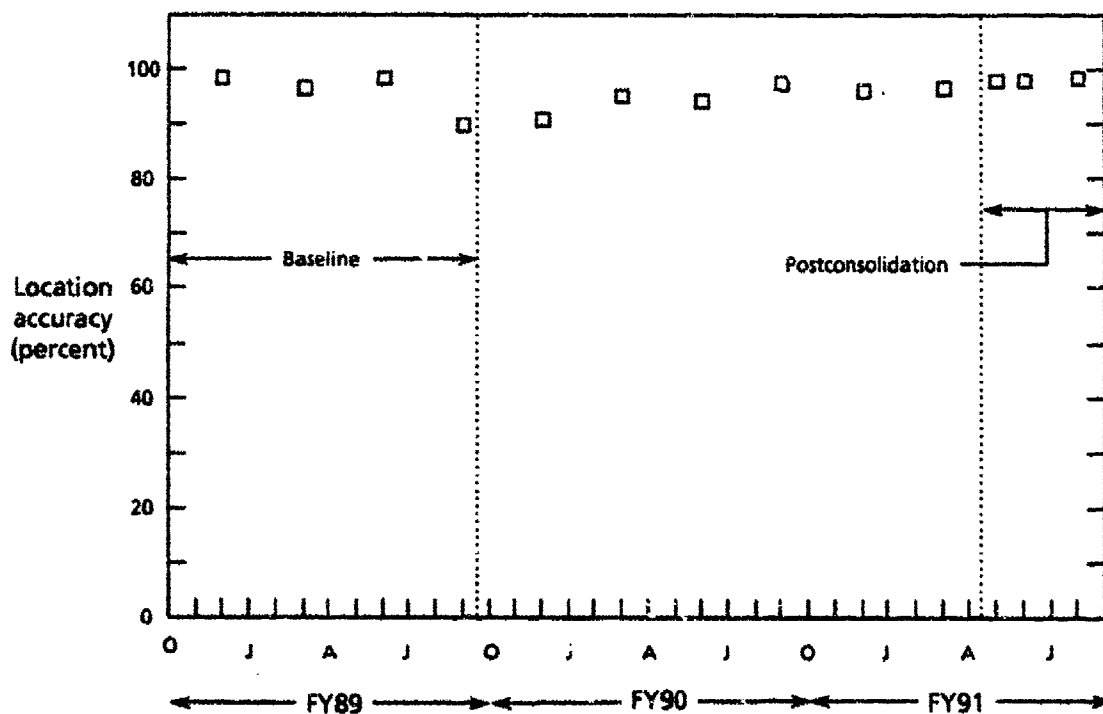
^aFY90 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.07 and 4.63 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-41. DISCREPANCY RATE – SSDS
(FY89 to FY91)**



Cumulative performance

Baseline	95.6%
Consolidation	98.2%

Monthly performance

Baseline average ^a	96.1%	
Postconsolidation average ^b	98.4%	
Statistical difference ^c	2.3% ± 6.2%	(No significant difference)
F statistic ^d	193.36	(Postconsolidation more consistent)

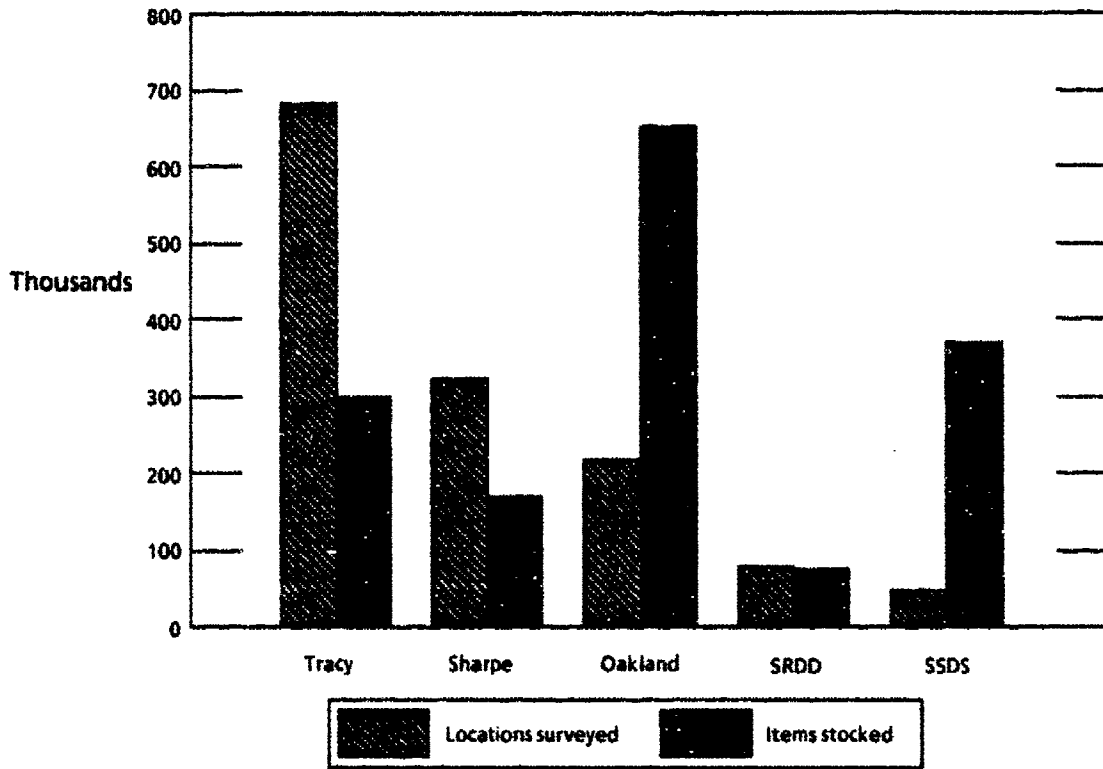
^aFY89 is baseline.

^bMay 1991 through August 1991 is postconsolidation period.

^c95 percent confidence interval about the difference between baseline and postconsolidation averages.

^dRatio of baseline sample variance to postconsolidation sample variance. A value between 0.03 and 16.04 indicates no significant difference between baseline and postconsolidation variances (95 percent confidence level).

**FIG. E-42. LOCATION ACCURACY - SSDS
(FY89 to FY91)**



**FIG. E-43. LOCATION SURVEYS VERSUS ITEMS STOCKED
(FY91 through August)**

APPENDIX F

**SERVICE-UNIQUE WORKLOAD
AND PERFORMANCE DATA**

SERVICE-UNIQUE WORKLOAD AND PERFORMANCE DATA

In this appendix, we discuss Navy-unique measures, Air Force-unique measures, and Army-unique measures defined in the Test and Evaluation Master Plan (TEMP).

NAVY-UNIQUE MEASURES

The TEMP for the Bay Area prototype called for us to track Navy-unique measures relating to inventory accuracy and reports of discrepancies at the Oakland site. Specifically, we were to track the following measures:

- Class A item inventory accuracy from STATMAN program
- Class B item inventory accuracy from STATMAN program
- Class C item inventory accuracy from STATMAN program
- Class D item inventory accuracy from STATMAN program
- Reports of discrepancies (RODs) as a percentage of issues
- Percentage of RODs processed on time (within 45 days).

Table F-1 shows quarterly values for each of these measures from FY89 to FY91.

The STATMAN inventory accuracy program provides a statistically meaningful measure of inventory accuracy for each of the four Navy material classifications. Unfortunately, only one STATMAN inventory sampling program has been run since the consolidation. It was run in the fourth quarter of FY90 and showed no statistically significant differences from measures recorded prior to consolidation. The Navy planned to conduct a STATMAN inventory during the fourth quarter of FY91, but we have not yet obtained the results. The Defense Logistics Agency (DLA) is somewhat concerned that a current STATMAN inventory will yield results that are not meaningful until the Navy Integrated Storage, Tracking, and Retrieval System (NISTARS) inventory balances are reconciled against the Uniform Automated Data Processing System (UADPS) inventory

balances. The STATMAN program compares physical counts to UADPS counts, not to NISTARS counts.

TABLE F-1
NAVY-UNIQUE MEASURES

Quarter	STATMAN (% accuracy)				RODs	
	Class A	Class B	Class C	Class D	% of issues	% on time
1Q89	93.61	63.45	75.23	81.88	0.30	87.36
2Q89	94.11	62.48	79.25	78.33	0.28	98.32
3Q89	92.86	62.97	76.57	78.60	0.25	97.87
4Q89	91.74	61.07	81.19	79.56	0.25	98.02
1Q90	—	—	—	—	0.34	94.84
2Q90	91.12	66.40	75.26	81.31	0.26	98.37
3Q90	91.73	62.86	76.47	75.75	0.33	77.22
4Q90	91.00	62.77	76.00	80.96	0.52	95.59
1Q91	—	—	—	—	0.48	100.00
2Q91	—	—	—	—	0.76	100.00
3Q91	—	—	—	—	0.63	99.90
4Q91	—	—	—	—	—	—

By any measure, RODs have risen dramatically at Oakland but nearly all have been processed within the 45-day time period. The data presented in Table F-1 are different from those presented in Chapter 2 or in Appendix E, Figure E-25. The data in Table F-1 were obtained from the Naval Supply Systems Command (NAVSUP) and are calculated by dividing the total number of valid RODs by the total number of issues for the quarter. A valid ROD is one for which the customer was given credit or another shipment was made to correct the error.

The ROD rate rose from between 0.25 percent and 0.30 percent in FY89 to between 0.48 percent and 0.76 percent in FY91. The RODs processed within 45 days rose from between 87 percent and 98 percent in FY89 to virtually 100 percent in FY91.

The Navy has shown considerable interest in the amount of inventory adjustments taking place at the Oakland site. It is particularly concerned because some high monetary adjustments have occurred in recent months: 8.7 percent in July 1991 and 4.7 percent in June 1991. Although it was not identified in the TEMP, we tracked the gross monetary adjustment rate (GMAR) at the Oakland site. (It is the dollar amount of inventory adjustments as a percent of total dollars inventoried.) Inventory adjustments are calculated by adding gains and losses and subtracting reversals of gains and reversals of losses.

The GMAR is a measure of the dollar impact of inventory adjustments. It is not a good measure of accuracy since it is not necessarily representative of the inventory as a whole.

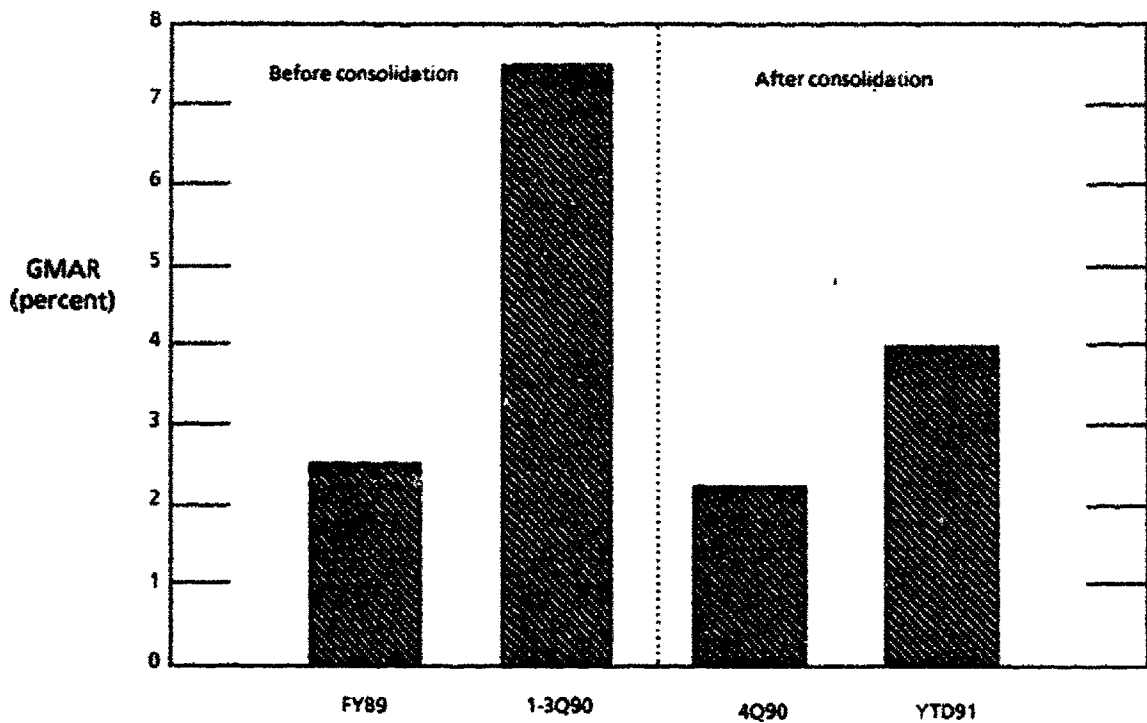
The GMAR has not risen since consolidation. Figure F-1 illustrates the GMAR prior to and after consolidation. Prior to consolidation, the GMAR was 2.5 percent in FY89 and 7.5 percent during the first three quarters of FY90. After consolidation, the GMAR was 2.2 percent during the fourth quarter of FY90 and 4.0 percent for FY91 through August.

AIR FORCE-UNIQUE MEASURES

The TEMP listed a number of Air Force-unique measures to be tracked. Some of those measures are not, in fact, unique to the Air Force, and many of them were not tracked by the Air Force prior to consolidation. These measures are as follows:

- RODs as a percentage of off-base shipments
- On-base supply response time
- Depot processing timeliness
- Inventory Prioritization Model goals
- Receiving performance
- Warehouse refusal rate for Standard Base Supply System (SBSS) items
- Percent of receiving rejects more than one duty day old
- Percent of in-line processing hours for warehouse support.

We discuss each of these measures below.



**FIG. F-1. GROSS MONETARY ADJUSTMENT RATE - NSC OAKLAND
(FY89 to FY91)**

RODs as a Percentage of Off-Base Shipments

Measurement of RODs is not a Service-unique measure and has been presented both in Chapter 2 and in Appendix E under "Key Performance Measures" (see Figure E-41).

On-Base Supply Response Time

Although the Air Force has time standards for measuring the supply response time for on-base shipments, those standards are not being tracked at the Sacramento Specialized Distribution Site (SSDS). Instead, the supply function there has agreed to provide the maintenance function with material by noon the day following order placement. In the case of high-priority requisitions, the SSDS warehouse control system is equipped with the capability to respond within approximately 20 minutes to these requests.

Since no tracking is performed, we were not able to evaluate how SSDS is performing with respect to the Air Force goals.

Depot Processing Timeliness

Depot processing timeliness is covered in detail in both Chapter 2 of the main text and in Appendix E under "Key Performance Measures" (see Figures E-35 through E-38). To date, data supplied for these calculations are for off-base shipments only.

Inventory Prioritization Model Goals

The Air Force Inventory Prioritization Model provides the Sacramento Air Logistics Center (ALC) with useful information about which items are most important to inventory; however, the model did not achieve its goals prior to consolidation and those same goals are not being achieved now.

The Inventory Prioritization Model divides all stocked product into 49 cells or categories. Each of those categories is ranked in order of importance and is assigned an inventory frequency. The current frequencies are assigned in such a way that 268 items must be counted every year, another 3,345 items every 2 years, another 7,026 items every 2.5 years, and the remaining 381,215 items every 5 years. This translates into 80,994 inventories per year. At its best, Sacramento ALC is only able to handle about half that number of total inventories per year (scheduled and unscheduled). Because of limited resources, Sacramento ALC has concentrated on the highest priority items and on unscheduled (result of problem with item) inventories, and will continue to do so. They also perform quarterly random sample inventories on 500 items.

Receiving Performance

The Air Force maintains the following goals for receipt of product:

- Post 90 percent of receipts within 1 day of arrival
- Bin 70 percent of receipts within 2 days of arrival
- Post 100 percent of receipts within 3 days of arrival
- Bin 100 percent of receipts within 5 days of arrival.

To date, we have only tracked the latter measure which is discussed in Chapter 2 of the main text and illustrated in Appendix E, Figure E-39.

Warehouse Refusal Rate for SBSS Items

To date, we have not obtained data that tracks SBSS issues separately from other issues. We have tracked denial rates at Sacramento ALC and they are shown in Appendix E, Figure E-40.

Percent of Receiving Rejects More Than One Duty Day Old

To date, we have not obtained either a definition of this measure or its values over time.

Percent of In-Line Processing Hours for Warehouse Support

To date, we have not obtained either a definition of this measure or its values over time.

ARMY-UNIQUE MEASURES

The Army Direct Support System (DSS) is the Army standard supply distribution system which provides for direct delivery of shipments of certain supply classes from CONUS wholesale depots to supply support activities. Air Lines of Communication (ALOC) provides air delivery of routine priority material to eligible Army combat service support units outside CONUS. Both DSS and ALOC expedite depot processing of Priority 9 through Priority 15 issues to minimize order and ship time (OST) and inventory pipeline costs.

The prototype plan contains DSS OST goals and FY89 Sharpe depot performance for issues to Korea, Alaska, Hawaii, Japan, Okinawa, and Forces Command-West (FORSCOM-West). It does the same for ALOC issues to Korea, Alaska, Hawaii, and Japan. The FY89 performance is shown as an annual average only. We were unable to obtain complete, detailed data from the Army Materiel Command (AMC) for the baseline year.

We compared the baseline data to monthly performance since the Sharpe Area Oriented Depot's (AOD's) consolidation under Defense Distribution Region West (DDRW). The performance data were obtained from AMC's Report No. RCS CSGLD 1557, *Direct Support System and Air Line of Communication Monthly Performance*

Evaluation, and a special report prepared by AMC's Logistics Control Activity that portrays the Sharpe site's performance in supporting supply support activities in the Western United States (FORSCOM-West). We compared total OST for actions processed through Sharpe to the baseline performance [the reports also contain OST data for actions from other depots that are simply consolidated in the Sharpe consolidation/containerization point (CCP)].

The OST includes processing segments not under DDRW's management control (such as transportation time). While changes from baseline performance may have been due to consolidation, they may also have been the result of other factors. A more pertinent performance measure may be depot processing time, which is also collected by AMC, but for which we have no baseline information.

Table F-2 shows the number of days of OST for issues to DSS and ALOC destinations for the FY89 baseline period and for the postconsolidation months of July 1990 through September 1991. Using a *t*-Test for significant differences in each pair of mean values at the 95 percent level, we found two significant improvements and one significant degradation in the 10 comparisons.

With the exception of DSS issues to FORSCOM-West, the prototype has satisfied its goal of providing service that is equal or better than the baseline year. We discussed the degradation in DSS support of FORSCOM-West with both AMC and DLA. The cause was DLA's inability to recognize requisitions from qualified customers in its automated management systems. That problem is being addressed by both organizations, but the FORSCOM-West performance problem has not yet been resolved.

TABLE F-2

ARMY DSS AND ALOC ORDER SHIP TIME

Destination	Actions through Sharpe ^a	FY89 baseline (days)	Post-consolidation (days) ^a	Percent change (if statistically significant)
ALOC				
Korea	1,061	21.4	23.8	
Alaska	439	23.3	19.5	-16.3
Hawaii	434	21.1	20.3	
Japan	13	24.6	23.9	
DSS				
Korea	971	47.6	47.2	
Alaska	49	41.6	33.1	-20.4
Hawaii	144	40.3	39.9	
Japan	21	41.1	42.3	
Okinawa	2	66.0	48.0	
FORSCOM-West	2,934	22.4	36.9	64.7

^aIncludes months from July 1990 through September 1991. ALOC averages exclude months of August through November 1990 when shipments were curtailed due to budget constraints.

REPORT DOCUMENTATION PAGE

Form Approved
OPM No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering, and maintaining the data needed, and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

1. AGENCY USE ONLY (Leave Blank)		2. REPORT DATE December 1991	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE Independent Evaluation of the Bay Area Supply Depot Consolidation Prototype			5. FUNDING NUMBERS C MDA903-90-C-0006 PE 0902198D	
6. AUTHOR(S) John B. Handy, Samuel J. Mallette, Robert L. Crumlin, William T. James, III, Craig C. Sherbrooke				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Logistics Management Institute 6400 Goldsboro Road Bethesda, MD 20817-5886			8. PERFORMING ORGANIZATION REPORT NUMBER LMI-PL101R1	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Ms. Diane K. Morales Deputy Assistant Secretary (Logistics) OASD(P&L) Room 3E788 The Pentagon Washington, D.C. 20301			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT A: Approved for public release; distribution unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) DMRD 902 projected that significant savings could be realized if defense supply depots were consolidated under DLA and a uniform automated distribution system were developed to replace the multiple systems then in use. The five supply depots in the San Francisco Bay Area were selected to serve as a prototype. This report presents an independent assessment of the first year of operation of the prototype. The prototype has generally maintained or improved performance compared to the FY89 baseline period, despite the turbulent conditions imposed by the Gulf war. Customer satisfaction appears to have been maintained. Implementation of the Defense Distribution System (DDS) has not gone smoothly. Major systems conversion and communications problems combined to degrade performance of some depot operations at Oakland. We are concerned that DDS is unlikely to produce expected savings. Most savings for the prototype's first year were expected from personnel reductions. Reductions did occur, but roughly in proportion to a decrease in depot workload. We were unable to attribute personnel savings to consolidation. Transportation savings were not claimed to avoid double counting with savings claimed from another DMRD. Many actions have been taken, however, to reduce transportation costs. Management improvements and more productive use of regional assets were also evident.				
14. SUBJECT TERMS Supply Depot Consolidation Defense Management Report Decision			15. NUMBER OF PAGES 176	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	