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Program Manager Decision Making in Complex and Chaotic Program Environments

June 2023

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Prepared for the Naval Postgraduate School, Monterey, CA 93943

ACQUISITION RESEARCH PROGRAM
DEPARTMENT OF DEFENSE MANAGEMENT
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ABSTRACT

Our project focuses on the decision-making process of a program manager. A defense program manager is routinely exposed to chaotic and complex environments that require skilled leadership and decision-making. Exploring the decision-making process in these environments may help current and future defense programs to better project the outcome of future decisions. Through our research, we identified five categories as decision-making pitfalls for PMs: overly optimistic, risk aversion, stovepipe design, strategic networking in the acquisition environment, and communication skills. We recommend conducting future research to validate the findings of our study. Once validated, we recommend refining PM training to focus on the decision-making categories we identified to help PMs navigate programs more successfully.

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ABOUT THE AUTHOR

LT Mathew Morales is from Corpus Christi, TX and graduated from Texas A&M Corpus Christ with a Bachelor of Science in Kinesiology. He was commissioned in the Navy through Officer Candidate School December 2017.

His initial fleet assignment in 2018 was to USS SCOUT (MCM 8) in San Diego, CA where he served as the Combat Information Officer. He then served as the Training Officer on USS ANTIETAM (CG 54) in 7th Fleet. As a Surface Warfare Officer he was selected for the Talent Management Program. He is currently attending Naval Postgraduate School where he is earning a Masters of Business Administration in Financial Management.

His personal decorations include the Navy and Marine Corps Commendation Medal and various unit and campaign awards.

LT Morales is happily married to his wife, Daisy and has a wonderful 9-month-old son, Jeremiah.

LT Brian Sexson completed enlisted nuclear power training pipeline in December 2010 as an electrician's mate. He was selected as a junior staff instructor, training future nuclear operators from 2010 to 2013. He was selected to the FY-13 STA-21 commissioning program.

In 2016 he received his commission after graduating from the University of Arizona with a Bachelor of Science in Mathematics. He completed officer nuclear power training in Charleston, SC and Ballston Spa, NY.

From 2018 through 2021, LT Sexson served as the Main Propulsion Assistant, Damage Control Assistant, Ship's Diving Officer, and Assistant Engineer. He completed one shipyard availability and one western pacific deployment.

His personal decorations include the Navy and Marine Corps Commendation Medal and four Navy and Marine Corps Achievement Medals. He received recognition as the LCDR Mush Morton warfighter of the year award for 2021.

LT Keith Hantla is from Sandy, UT and graduated from the University of Utah with a Bachelor of Science in Physics. He was commissioned through the STA-21 program in May 2017.

His initial fleet assignment in 2018 was to USS GEORGIA (SSGN 729) in Kings Bay, GA where he served as the Electrical Assistant and Tactical Systems Officer. He is currently attending Naval Postgraduate School where he is earning a Masters of Business Administration in Financial Management.

His personal decorations include the Navy and Marine Corps Commendation Medal and three Navy and Marine Corps Achievement Medals.

LT Hantla is happily married to his wife, Annika and together they raise their four children; Ottalie, Wolfrik, Olivet, and Killian.

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—Keith Hantla

The only way I was able to achieve this milestone was through the commitment and support from my beautiful wife, Daisy. Thank you for everything you do for me and our son.

—Mathew Morales

I would like to thank my partners, friends, and family who have supported me throughout my career. Without their support I would never have made it this far, I am tremendously grateful for this opportunity.

—Brian Sexson

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

AAW	anti-air warfare
ABL	airborne laser
ACATs	acquisition categories
AoA	analysis of alternatives
BCA	Budget Control Act
BMD	Ballistic Missile Defense
CG	Guided Missile Cruiser
CRS	Congressional Research Service
DAS	Defense Acquisition System
DAVE	defense acquisition visibility environment
DCMA	Defense Contract Management Agency
DFARS	Defense Federal Acquisition Regulation Supplement
DoD	Department of Defense
EFV	Expeditionary Fighting Vehicle
FAR	Federal Acquisition Regulation
FCS	Future Combat System
FY	fiscal year
GAO	Government Accountability Office
JDM	judgement and decision making
JTRS	joint tactical radio systems
KEI	kinetic energy interceptor
LCS	Littoral Combat Ship
NASA	National Aeronautics and Space Administration
NDM	naturalistic decision making
NPOESS	National Polar-Orbiting Operational Environment Satellite System
PM	program manager
RPD	recognition primed decision-making

SA	situational awareness
TCA	Transformation Communications Architecture
TDG	tactical decision games
TRL	technology readiness level
TSAT	Transformational Satellite Communications

I. INTRODUCTION

Throughout history, leadership and decision-making have been cited as the cause of success or failure. Leaders are expected to make decisions that will create or utilize an advantage to achieve their goals. Government and corporate leaders are faced with similar challenges because of their responsibility to their stakeholders and future prosperity. This responsibility creates a need to understand the inner workings of how an individual makes these important decisions and how outside factors affect their decision-making process.

In the Department of Defense (DoD) acquisitions program, the program manager (PM) is responsible for making decisions or recommendations that determine the program trajectory. These recommendations and decisions are routinely the determining factor of program success and are often made in stressful and chaotic environments. Unfortunately, the decision-making environment is unique to each problem. The method used to solve yesterday's problem may not be adequate for tomorrow's problem, thus requiring continuous assessment and the ability to apply multiple decision-making methods.

Rapid technological advancements have made program success incredibly difficult to ensure. When a PM's decisions lead to program failure, the DoD loses resources and capabilities that ultimately diminish the ability to defend national interests. A decision-making process that assists program managers to make the best decisions in a chaotic environment is necessary to provide the greatest chance for program success.

A. PURPOSE

The purpose of this qualitative study is to explore how a PM's decision-making affects program performance. Complex and chaotic environments will continue to define acquisition programs in the future and leveraging the lessons of the past will help PMs to navigate a program's problems more effectively.

B. BACKGROUND

The art and science of decision-making are professionally researched areas of study, but there is no decision-making framework that allows decision-makers to routinely make successful decisions. Decision-making can be generalized as the process of problem-solving, identifying vulnerabilities, assessing risk, and implementing measures to mitigate risk while proceeding with a course of action. This process is straightforward when there is a simple, single variable problem where the cause-and-effect relationship is understood.

However, the decision-makers of defense acquisition programs are routinely charged with innovative technology, processes, or new material challenges that have multiple variables and unclear projections. These defense acquisition programs are the building block of each force's future capabilities, each with the possibility of becoming a critical strength that will help win the war of tomorrow.

C. PROBLEM

The DoD has been riddled with underperforming acquisition programs that have been reported by the media, generating questions about PMs' decision-making. Recent public failures include the littoral combat ship (LCS), the Zumwalt-class destroyer, and the F-35 Joint Strike Fighter. Each of these programs experienced significant schedule delays, cost growth, and poor technical performance. In the defense acquisition program assessment, PMs were identified as one of the primary reasons for underperforming programs (Wood, 2010). Defense acquisition programs are entrusted to help maintain the U.S. military technical advantage as the complexity of the battlefield continues to evolve. PMs must be able to navigate the context of their program and employ good decision-making processes as their programs routinely shift from simple to chaotic. This study employs past lessons learned to describe how a more equipped PM would employ decision-making skills to ensure the success of their program.

The DoD continues to make efforts to improve acquisition programs. The latest DoD Instruction 5000.02, *Operation of the Adaptive Acquisition Framework*, released in 2022, discussed program inefficiencies and expresses the need for better execution

(Department of Defense [DoD], 2022). An example that illustrates how PM decisions affect national defense is the propulsion train on the Freedom-class, a failing acquisition program. If the Freedom-class program was terminated right now, the estimated sunk cost is approximately $3.3 billion (Maurer, 2022). This highlights the significant impact to American taxpayers and military readiness. Congress grants appropriations with specific guidance regarding purpose, time, and amount. These laws do not guarantee program acquisitions that are on time, within cost, or meet performance standards. These issues highlight the importance of a PM's decision-making process and exemplify the cost of failure.

There has been limited research on the factors that affect PM decision-making in a chaotic environment. Previous studies identified the need for decision-making analysis, but also that further research is required to narrow the process and structure for decision-making in highly complex scenarios, including large DoD programs or similar scale corporate programs. For this study, we examine the PM's decision-making process and use that information to improve program performance.

"Knowledge is an antecedent of the ability to make sense of situations and of sound decision making in the course of dealing with those situations" (Holsapple & Burstein, 2008, p. XIII). Utilizing past problems for sense-making allows our research to build knowledge on the context surrounding decision-making. The potential application for this research extends past the immediate goal of PMs in the defense acquisition program. Complex and chaotic decision-making environments affect industry as well as other portions of the government, leaving each with a need for better tools to achieve success in the future.

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II. LITERATURE REVIEW

In this section, we identify and explain key contributions to the decision-making field as well as the defense acquisition process. We examine the environment that decision-makers face and indicate how the environment often shapes the choices available to PMs. The defense acquisition process is complicated and often shapes the decision-making environment that a PM will encounter. Finally, we address decision-making as a whole and provide background information on published articles that have shaped our understanding of the decision-making process.

A. DECISION-MAKING ENVIRONMENT

Snowden and Boone (2007) introduced a decision-making framework, Figure 1, that defines problems by their environment. The Cynefin Framework helps decision-makers by highlighting key attributes that define the context of their problem and provides methods for the decision-maker to make better decisions. Their assertion that "Good leadership is not a one-size fits-all proposition" (p. 2) is the foundation for their framework, which describes decision-making through the lens of five different contexts. Simple, complicated, complex, chaotic, and disorder are used to describe different landscapes that present unique challenges and opportunities for a decision-maker to falter. In their article, *A Leader's Framework for Decision Making*, Snowden and Boone (2007) described context as "the relationship between cause and effect" (p. 3).

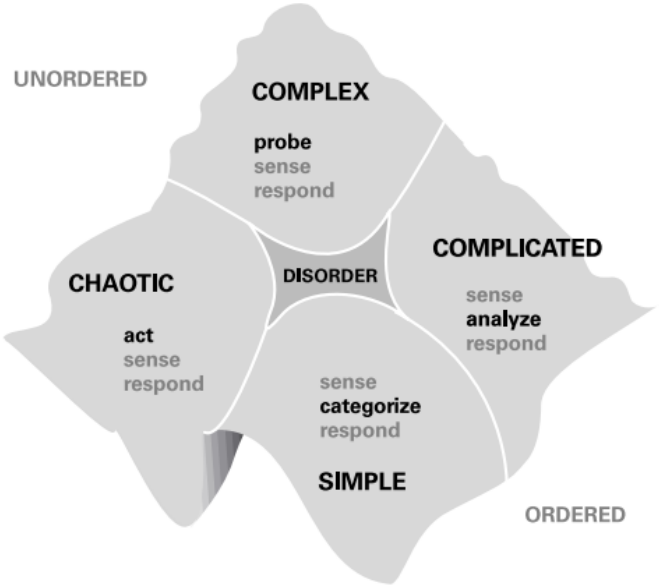

Figure 1. A Leader's Framework for Decision-Making. Source: Snowden and Boone (2007).

Simple contexts can be described as clear cause-and-effect relationships where processes can normally be utilized to make good decisions consistently. In this environment, there is little variability, and there are no second- or third-order consequences to the decision. Often these decisions can remain at a low level and then be reported to the lead decision-maker once the consequence of the decision is realized. Allowing subordinates to make these decisions enables the leader to free up bandwidth to deal with more challenging problems. Rapidly identifying simple contexts is important for any leader who desires subordinates to operate with initiative. This context provides the opportunity for the PM to delegate early in the process, helping to engage subordinates and clearing bandwidth for the more complex problems on the horizon.

Conversely, *complicated* contexts typically require expert opinions because the relationship between cause and effect is not obvious. In complicated contexts, multiple correct decisions may exist and have significant second- and third-order consequences. Without carefully considering the ramifications of a specific decision, particularly in a system of systems, the decision-maker can create havoc in other areas of the program while attempting to solve the current problem.

Complex contexts explain situations where there are unknown outcomes, meaning that notable change surrounding an issue creates uncertain cause and effect. This situation requires detailed decision-making with plans for various outcomes. Without mapping out results and creating branches of decision points, the decision-maker will be unable to mitigate the follow-on risks or anticipate ramifications.

Finally, the fourth context is *chaotic*, where there is no cause and effect and no discernable pattern. When more than one context applies to an issue, the authors described this situation as disorder, where the decision-maker must parse the issue into smaller problems that fit a context (Snowden & Boone, 2007).

Many of the acquisition programs that will be discussed later fall into the latter categories because of the ever-changing modern battlefield. Technology is rapidly becoming obsolete, making it imperative to invest in future technologies and capabilities. This is further complicated by the difficulties of projecting the next conflict and the corresponding capability gaps. Capability gaps are a function of projected warfare domains, current capabilities, and current investments. The context of a program is incredibly important because PM's typically have multiple years of problem-solving at the onset of the program. Without carefully considering the cause and effect of each decision, PM's and their programs are in jeopardy even before their program becomes a program of record.

B. DOD ACQUISITIONS

Defense acquisition management is a unique system that must account for many uncommon and sometimes complicated ways of conducting business and policies. The PM is expected to be an overall leader, responsible and accountable for planning, organizing, staffing, controlling, and leading all personnel associated with a program. Defense acquisition assigns a single leader to the acquisition program to allow for a single point of contact and accountability; while this is good for senior leadership to track and assess points of failure, it does add a significant amount of stress to the PM while leading their program, due to the high level of responsibility.

The acquisition process is complex and involves a range of stakeholders, including Congress, industry, and the military. The acquisition process typically begins with the identification of a need. This could be based on a new military requirement, an anticipated shortfall in existing capabilities, or a change in mission or strategy. The need is then translated into a formal requirement and an acquisition strategy, which outlines how the requirement will be met.

Next, the requirement is advertised to industry, typically through a request for proposal (RFP). This is an invitation to potential contractors to submit a bid to meet the requirement. The RFP includes details like the scope of work and performance and evaluation criteria.

Throughout the acquisition process, there are various checks and balances to ensure that the process is fair, transparent, and efficient. For example, Congress has oversight authority over DoD acquisitions and can influence the process through legislation and appropriations. The Government Accountability Office (GAO) also audits and evaluates acquisition programs to ensure they are being executed in accordance with the law and best practices.

Overall, the acquisition process for the DoD is complex and involves a range of stakeholders. It is designed to ensure that the military has the goods and services it needs to support its mission and objectives, while also being fair, transparent, and efficient. The PM is responsible for ensuring the program operates within laws and regulations and is efficient.

The DoD is one of the largest buyers of goods and services in the world, and its acquisitions can involve billions of dollars and multi-year contracts. These acquisitions are also often highly complex and involve advanced technologies. All defense acquisition programs fall into one of three acquisition categories (ACATs); each of these categories is typically determined by the dollar value of the program and the principal decision authority. The higher the ACAT, the more money spent on the program resulting in more pressure on the PM, because more money is lost if the program fails. One of the main differences between civilian and defense acquisitions is the legal and regulatory framework. The DoD is subject to a unique set of laws and regulations that govern its

acquisitions, including the Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation Supplement (DFARS). These regulations are designed to ensure that defense acquisitions are fair, transparent, and efficient, and they provide specific guidance on a range of issues, such as procurement methods and contract types. (Brown, 2010)

Another key difference between defense and civilian acquisitions is the stakeholders involved. In the case of the DoD, the acquisition process involves a range of stakeholders, including Congress, the military services, industry, and other government agencies. The military services also play a key role in defining requirements and evaluating bids, and they have a stake in the outcome of the acquisition process. Industry is also a critical stakeholder, as it provides the goods and services that the DoD needs to support its mission.

In contrast, the acquisition process for civilian agencies is typically more centralized and involves fewer stakeholders. The procurement office or contracting office is typically responsible for managing the process, and there is less involvement from Congress and the military services. Industry is still an important stakeholder, but the contracts are typically smaller and less complex than those for defense acquisitions.

Overall, the acquisition process for the DoD is complex and involves a range of stakeholders. It is designed to ensure that the military has the goods and services it needs to support its mission and objectives, while also being fair, transparent, and efficient. DoD Directive 5000.01 defines the defense acquisition objective as follows: "The acquisition system will be designed to acquire products and services that satisfy user needs with measurable and timely improvements to mission capability, material readiness, and operational support, at a fair and reasonable price" (Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, 2016, p. 4).

C. WHAT IS DECISION-MAKING?

Managers routinely make decisions that have a direct impact on the success of their organization. In general, senior leadership decision-making is often chaotic and subject to unforgiving time restraints and either information overload or incomplete

information. Managers must make good decisions and rely on their personal and business ethics when making decisions. According to Black and Bright (2019), decision-making is defined as "the action or process of thinking through possible options and selecting one" (p. 6.1). Research shows the definition of decision-making can be simple or complex, depending on who you ask.

As an overview of decision-making, we discuss certain key elements. The brain utilizes two different systems to process information and make decisions (Black & Bright, 2019). These two systems are required due to the complexity added by the time variable. When there is sufficient time to make decisions, the brain utilizes the reflective system to solve problems rationally and logically. Decisions that require an immediate solution are processed by the reactive system. For major decisions the reflective system should be used to determine a way forward.

Managers face a variety of barriers that hinder favorable decision-making. PMs are constrained by their capacity to process data, having too many options, and time constraints (Black & Bright, 2019). Human biases are also a barrier to micro-cognition and judgement and decision-making (JDM). By becoming more aware of their biases, PMs can hope to make better decisions that are not based on their personal preferences.

PMs can also improve their decision-making skills through experience, whether authentic or controlled. PMs should also consider doing research and collecting data if time permits. They should evaluate the quality of data being received and consider long-term decisions and ethical implications (Black & Bright, 2019).

Teamwork provides a breadth of experience, knowledge, and perspectives for decision-making, which could lead to better solutions. However, PMs must beware of *group think*, which "occurs when group members choose not to voice their concerns or objections because they would rather keep the peace and not annoy or antagonize others" (Black & Bright, 2019, 6.6). Other times, group think could occur because an antagonistic group member forces other members of the team to dissent (Black & Bright, 2019). Now that we have reviewed decision-making, we look at different research methods in detail, starting with JDM and then naturalistic decision-making (NDM).

D. JUDGEMENT DECISION-MAKING

JDM is an avenue that could be used to study and analyze human judgments and decisions. This form uses theoretical or applied perspectives, experiments, surveys, and analysis of existing data to learn more about judgments and decisions. The JDM paradigm considers various personal judgements and biases that people have, to be able to determine the most likely outcome given a specific decision-making scenario (Hoffman, 2015). The rite of passage was the Decision-Analytic Model, as seen in Figure 2, which was adopted and described as the top choice for decision-makers (Hoffman, 2015).

Although the Decision-Analytic Model was widely accepted, it started receiving criticism due to the controlled environment experiments and the excessive amount of time required to apply the model. The Decision-Analytic Model states that a good decision- maker

- specifies all the objectives, or the criteria for a solution;
- lays out all the alternative actions;
- weighs the benefits versus the costs or risks of each alternative ("utility analysis");
- conducts a multiattribute evaluation of the alternatives;
- orders the alternatives in terms of their satisfaction of the criteria;
- selects one option for implementation; and
- engages in contingency planning. (Hoffman, 2015, p. 54)

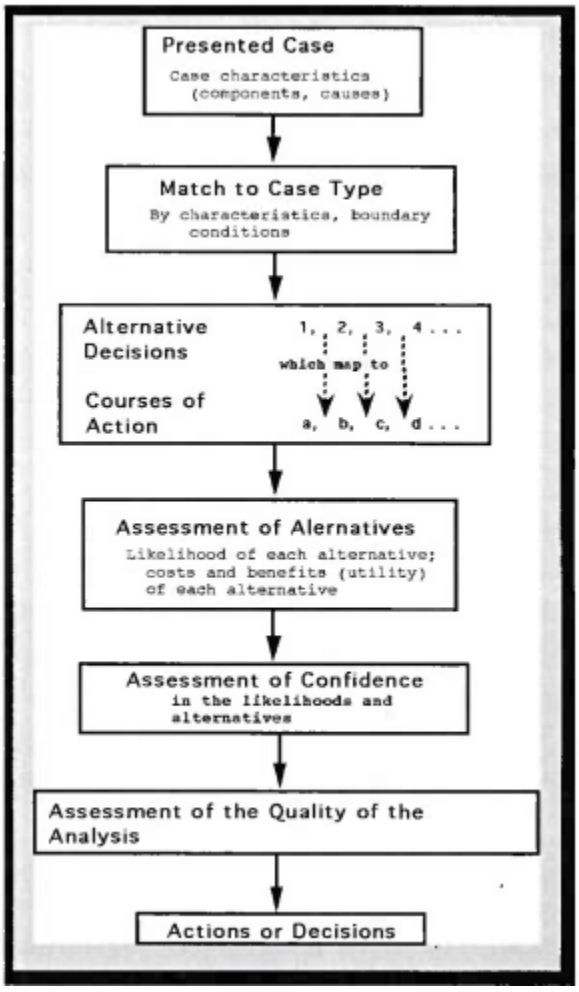

Figure 2. Decision-Analytic Model. Source: Moore & Hoffman (2011).

The Decision-Analytic Model was built for economics and business decision-making within the JDM paradigm (Hoffman, 2015). These studies should not be dismissed but built upon and used to enrich further research.

E. NATURALISTIC DECISION-MAKING

NDM is used to study how people make decisions in real-world operations rather than artificial environments (Hoffman, 2015). Sense-making is a key aspect of NDM and refers to information overload, ambiguous and contradictory information, and training for knowledge acquisition (Hoffman, 2015). The following characteristics have defined NDM as a paradigm that involves

- a focus on the examination of decision-making in "everyday" situations, both routine and non-routine situations, both simple and complex;
- a focus on decision making by experienced, knowledgeable individuals; and
- the examination of decision-making in "real world" job contexts anchors NDM in the study of decision-making in domains that are especially important to business, government, and society at large. (Hoffman, 2015, p. 59)

These characteristics and understanding can be extremely useful in the fields of business, government and society and can easily translate to a PMs responsibility (Hoffman, 2015).

NDM has contributed two main theoretical contributions: the recognition primed decision-making (RPD) model and the integrated theory of situational awareness (SA) (Hoffman, 2015). Later, we discuss the RPD model in more depth, but in short, RPD was used to dispute the Decision-Analytic Model, with time constraint being the key difference between the two (Hoffman, 2015).

The theory of SA underlines the importance of the ongoing awareness of one's environment. There are three levels of SA:

- meaningful interpretation of data, resulting in information;
- comprehension of information, resulting in a mental model, or higher order understanding prioritized according to how it related to achieving goals; and
- the mental or imaginal projection of events into a possible future. (Hoffman, 2015, p. 51)

NDM is the opposite of the JDM paradigms due to NDM's real-world scenarios, which are in contrast with the JDM paradigm's controlled experiments (Klein, 2016). While the NDM approach creates excitement in the field, others have doubts about its benefits (Klein, 2016). They are afraid that knowledge can only be gained in a controlled environment. To challenge this thinking, we compare examples in which decision-makers are tested in controlled and real-world environments. The old belief was that good decision-makers would generate several options and determine which one was best, but NDM research identified that decision-makers rely on patterns to predict the outcome of an individual decision. They do not contrast different options to identify a path forward.

The belief that more information is better for decision-making, is in fact contrary, too much information may decrease framing skills, causing more uncertainty (Klein, 2016). The NDM way of thinking and experimenting has opened new doors to decision-making.

NDM is also used to seek a better understanding of the cognitive process in SA, sense-making, problem detection, and anticipatory thinking (Klein, 2016) This type of study is a macro-cognition phenomena study. Based on a PM's record of accomplishment and constant issues with cost, schedule, and performance, a new way of thinking could be in order, and NDM could provide a way forward.

The starting point to sense-making is acknowledging the problem when presented in a framework or story (Moore & Hoffman, 2011). Moore and Hoffman provided more explanation by stating, "The determination of an initial understanding is referred to as a frame" (Moore & Hoffman, 2011, p. 147). When collecting this frame, one decides what is relevant and what is not, creating an explanation for what is occurring (Moore & Hoffman, 2011). After the initial frame, an alternative comes to mind, and one is to question that frame. This leads to further inquiry or developing an alternative frame, called *framing* (Moore & Hoffman, 2011). When added information develops, that's when elaboration and reframing occur most often. Framing means one is engaged with the process to find explanations and causes for what is occurring (Moore & Hoffman, 2011).

The Data-Frame Model is another method for sense-making. There is no entrance or exit lines, but a continuous process of questioning a frame, reframing, elaborating a frame, recognizing or constructing a frame, and connecting and filtering the data within the frame, Figure 3 is a visual of the process. Frames are developed by prior knowledge and how a person relates to the frame. That person's prior knowledge filters through frames and creates and discards the data you receive (Moore & Hoffman, 2011) Applying the Data-Frame Model brings to the forefront skillful critical thinking and makes thoughts explicit (Moore & Hoffman, 2011). This is sense-making in time-sensitive matters being received in real time.

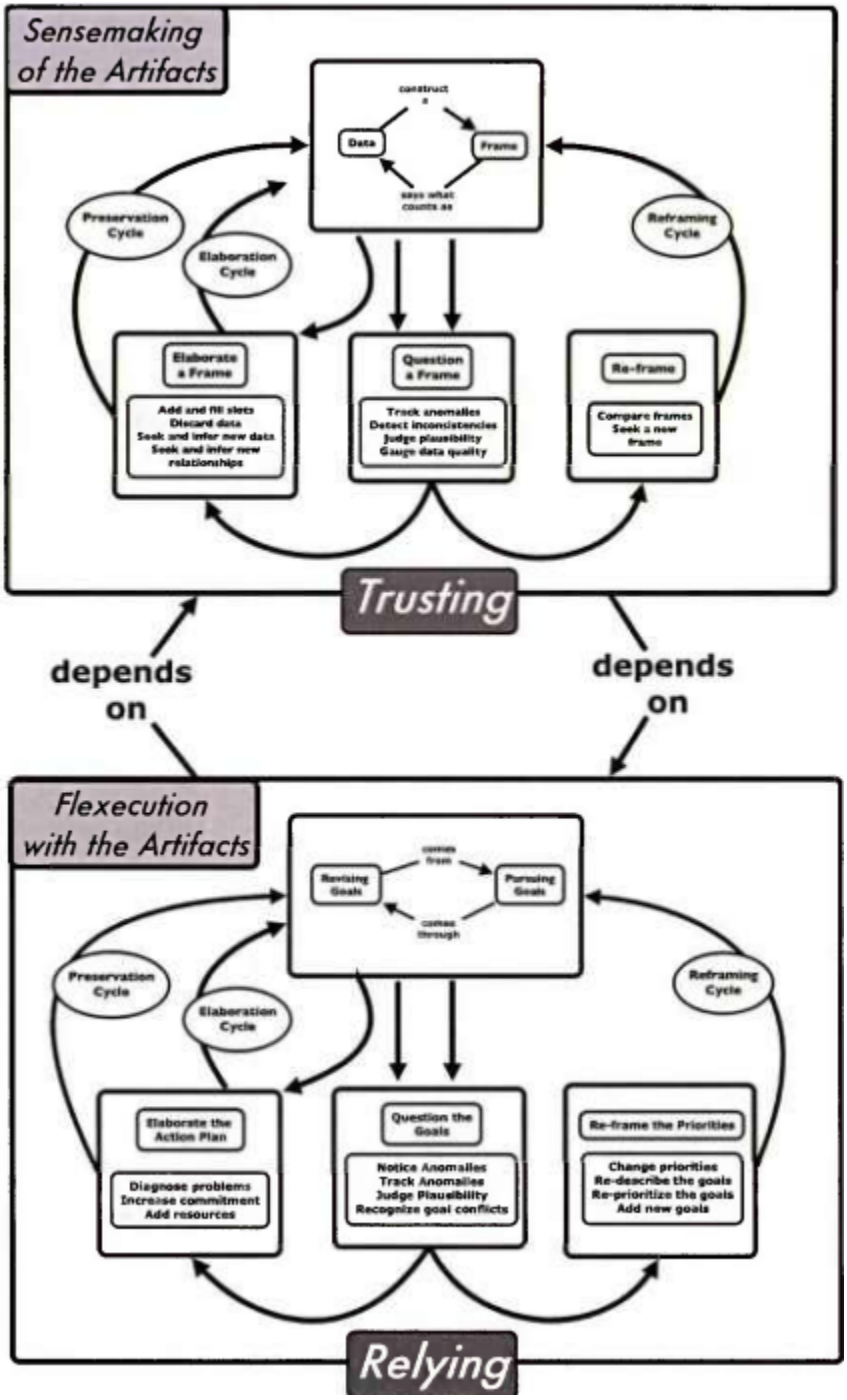

Figure 3. Data-Frame Model. Source: Moore & Hoffman (2011).

Another way to enhance your decision-making is to rely on intuition. Intuitive decision-making is described as something that is perceived, understood, or believed by instinct to be correct without actual supporting data. Intuition can be strengthened by building experiences that gain insight into tacit knowledge. Building intuition is

indicative of the growth process, moving from a novice to an expert. (Klein, 2015). Discussing intuition is discussing tacit knowledge. Five approaches on how to build tacit knowledge are

- use tactical decision games (TDGs);
- link TDGs to military doctrine;
- use TDGs to teach structural relations;
- rely on actual workplace experiences to provide on-the-job learning; and
- use scenario-based methods akin to TDG. (Klein, 2015, pp. 166–167)

According to Klein (2015) TDGs are "short paper-and pencil scenarios that describe a situation and the resources available to the decision-maker, plus the mission, and then introduce an unexpected and challenging twist requiring a rapid decision" (p.166) These approaches could benefit present and future PMs' decision-making confidence and skills. We conduct further research into PMs' current decision-making in an effort to improve future decisions and outcomes.

III. METHODOLOGY

Our research was based on a qualitative assessment of previous case studies. Previously failed programs provide a good source of lessons learned and root causes that provide opportunities for improvement. We focused on identifying the root causes of acquisition program failure and the extent that PM decision-making determines a program's level of success. The PM's decision-making in complex and chaotic environments is a critical component of this analysis because of the rapidly changing dynamic of the acquisition process. To address the topic we used Grounded Theory, qualitative assessment.

A. SCOPE

The scope required a thorough analysis of 30 programs, including DoD- and industry-based programs. The analysis was conducted by means of documented case studies and reports. We gathered DoD reports from various sites, including the GAO, the Congressional Research Service (CRS), RAND research reports, and the Defense Acquisition Visibility Environment (DAVE). Our non-DoD reports were gathered through Google Scholar, which gave us access to academic articles and reports. We conducted our research on the bandwidth that time allowed.

Due to time constraints, we primarily focused on programs that failed. Therefore, we used failed programs to draw our conclusions and supplemented our conclusions with program successes. Failed programs were defined as programs that were excessively behind schedule, over cost estimates, or were terminated due to lack of necessity. Our data represent the late 1950s (one case) to the present, while most cases take place in the early 2000s. When selecting case studies, we chose to extract a wide window of evidence that either had theory or hypotheses in mind. We did not wish to collect data within a specified time, cost, nor objective. By doing so we were able to maintain a large data set and retain theoretical flexibility.

With the scope mentioned above, we randomly selected 18 programs which are summarized in Chapter IV. Overall, the scope of literature ranges from DoD to industry

and across 8 decades. The breadth of this research was bounded by time but intended to add literature to the topic for further study.

B. RESEARCH METHODS

Grounded Theory encompasses gathering qualitative data and conducting a data analysis to produce categories that explain the studied interest. As the theory name (i.e., Grounded Theory) suggests, the theory or hypothesis is evidence *grounded* in the data. It is best used when establishing a new theory or when the topic of interest has minute research available. (Chong & Yeo, 2015) Grounded Theory was appropriate for our research because it has been overlooked in literature. The reason to conduct this type of research is to generate a new theory and discover commonality. Grounded Theory falls under the spectrum of qualitative research.

Qualitative research is viewing a subject of interest in its natural form and making sense of the product. This was accomplished through our field notes on case studies. Individual assumptions were required to interpret the data collected. Interpretations are based on life experience, education, and other various influences that mold someone into the person they are today. Our research was conducted through case studies and did not include interviews. All research conducted was accomplished with due ethical regard (Chong & Yeo, 2015).

Key characteristics of Grounded Theory research that were used to conduct our research include

- **process approach:** We gathered and interpreted data according to the group of researchers.
- **theoretical sampling:** This refers to continuously gathering data and grouping the data into related categories. The purpose is to pull the most significant data from the subject studied to create a hypothesis.
- **constant comparative:** The process of comparing the data to one another and identifying a pattern. The pattern emphasized commonalities to lead towards a conclusion.
- **a core category:** After producing and comparing all the data, we developed a core category. The core category emerged often in the data and is used in theory generation. This will also be the purpose for further study.

- **theory generation:** Derived from the core category we were able to produce a theory. The theory is shown as a hypothesis, although it could take different forms like a visual coding paradigm or narrative story.
- **memos:** We have documented memos that were kept throughout our research journey. These memos contributed to our theory generation (Chong & Yeo, 2015, pp. 260-261).

The research method used to conduct this project has several strengths and weaknesses. The strengths include personal interpretation of the data and how it is applied. This creates freedom without being constrained by other theories. Second, the theory is built from within the data collected, which creates greater detail and understanding. Also, it allows new data to always be introduced until the point of theoretical saturation. Finally, the approach is systematic. It starts with the basic descriptions, then conceptual ordering, and ends with theory formation (Chong & Yeo, 2015).

Limitations of the research method are the inverse of its strengths. The freedom and flexibility could lead to harm for the novice researcher. Another issue is the biases that may be applied, whether intentionally or unintentionally. The data reported are subjective and can lead to a weak theory. To counter our biases, we committed to relieving ourselves of our natural bias and anchoring our conclusions in the data (Chong & Yeo, 2015).

The data collection process and analysis occurred simultaneously. We analyzed the literature of 30 programs, producing codes and categories that summarized the commodities. The process continued until the point of data saturation. Once data saturation was achieved, no new data were identified, and relationships between case studies were recognizable (Chong & Yeo, 2015). When establishing categories, we made professional assumptions during the literature review. The common theme found in the literature led us to code each individual program, which we then broke down further into categories.

The five categories were portrayed by PMs in their decision-making process consistent throughout our literature review. Categories included excess optimism, risk aversion, stovepipe design, strategic networking in the acquisitions environment, and

poor communications skills. The five categories pose potential risk to PMs and the success of their programs. We used Grounded Theory and qualitative study to formulate a conclusion on how PMs' decision-making affects the overall program.

IV. DATA ANALYSIS AND FINDINGS

After studying more than 30 failed programs of record, we focused on 18 programs that shared key commonalities that directly led to program failures. From the program summaries we concluded that there were five major issues that were not adequately managed by the PMs, causing their programs to fail.

A. PROGRAM SUMMARIES

1. Littoral Combat Ship

The mission of the LCS is to conduct operations in littoral waters. The ship has had several major issues in all aspects, from engineering to operational capabilities. The cost estimates are changing due to the maintenance plan and the Navy is still trying to figure out the ship's mission. The external sociopolitical pressure places undue stress on the PM to have operational ships available. Due to pressure, the planning, testing, and other objectives are required to be executed on a compressed timeline. This creates confusion and leads to poor communication. PMs become overly optimistic and tend to fall victim to escalation of commitment. PMs must be able to communicate and respond to the political pressure so these ships can contribute to the fleet (Maurer, 2022).

2. CG(X)

In 2009, the Navy decided to cancel the CG(X) cruiser and alternatively procure a more advanced Arleigh Burke–class Aegis destroyer. The CG(X) high projected cost was not favorable and did not require capabilities to perform antiair warfare (AAW) and ballistic missile defense (BMD) missions. The CG(X) went through an extensive Analysis of Alternatives (AoA) and concluded with a mass of different options. The Navy recommendation to Congress to defund the program was a positive display of communication and response to the burden of political pressure on PMs. This is an example of a good PM not falling victim to their own biases (O'Rourke, 2009).

3. Expeditionary Fighting Vehicle

The Expeditionary Fighting Vehicle (EFV) was supposed to supersede the Marine Corps' amphibious assault vehicle (AAV). During the operational assessment, the EFV experienced significant reliability problems. The reliability issues were both out at sea and on land. The evaluation of the EFV was in question, and an expedited timeline led to additional risk. The program also had cost growth expenses related to redesign efforts, schedule extensions, and performance failures. The overly optimistic estimates and lack of acquisitions environmental pressure resulted in poor decisions from the PM (Sullivan, 2010).

4. Future Combat System

The Army introduced the Future Combat Systems (FCS) program in 2003, as an answer to future warfare with an interrelated system of systems. FCS was supposed to reshape warfighting by providing vastly improved situational awareness through a network of real-time sensors shared by manned and unmanned systems (GAO, 2009). However, FCS program assumptions were overly optimistic, and the technology readiness levels were not enough to allow accurate projections on cost or schedule. Overreliance on new technologies to forecast program capabilities prevented an accurate understanding of both key performance parameters for individual systems, as well as the interoperability of the system of systems. Inability to deliver on cost, schedule, and performance led to the program's cancellation in 2009, as the war on terrorism continued to prove costly.

5. Joint Tactical Radio System

In 1997, the DoD began a force improvement initiative that would reduce the decision-making life cycle by leveraging new software and sensor technology. Joint tactical radio systems (JTRS) would be capable of real-time information sharing with voice and video capabilities that could interoperate with current communication equipment and battlefield sensors. Unfortunately, the rapid technological advancements produced shifting requirements that helped undermine unrealistic schedule projections. Additionally, the joint nature of the program reduced performance, requiring additional

program restructuring. The first decade and a half of the program observed a cost of over $6 billion without fielding a radio, with cost growth projected to $37 billion (Government Accountability Office [GAO], 2006a). Although the program was never cancelled, the program required multiple restructurings and observed significant cost and schedule growth.

6. Airborne Laser

The demise of the Airborne Laser (ABL) program officially came in 2013 when Congress officially cut all funding to the program. Over 16 years, the program cost the DoD $5 billion, $4 billion over the first cost estimate, and did not provide any military use for antiballistic missile capability (Collina & Davenport, 2015). Program failure was due to poor practices, which led to a rise in costs throughout program life and a delay in schedule. PMs failed to identify issues in the program and should have given a recommendation to terminate the program at an earlier date. Ending the program would have saved the DoD an estimated more than $4 billion of time and resources had they cancelled the program approximately 9 years into being a program of record. Instead, the program continued to drain time and resources from the budget, without ever producing any useful products for the DoD missile defense system.

7. F-35 Joint Strike Fighter

There is a multinational effort to develop the next-generation fighter to replace aging F-16 and F/A-18 fighter jets. A GAO report found that the F-35 program faces significant sustainment challenges, including limited reliability and maintainability, high operating and support costs, and inadequate supply chain management. These challenges could result in reduced availability and increased costs for the F-35 fleet over time (GAO, 2022). Due to the multinational nature of the effort and multiple U.S. services adopting the F-35 for use, PM strategic networking is imperative to meet requirements, maintain cost estimates, and meet schedule deadlines.

8. Kinetic Energy Interceptor

Ballistic Missile Defense (BMD) is continually searching for innovative technology and means to disable ballistic missiles to protect the United States and its

allies. During the development of one of these technologies, the Kinetic Energy Interceptor (KEI) program was unable to adapt to meet changing requirements and was cancelled, costing $1.7 billion without producing a usable missile defense. This is an example of a program, despite coming close to capabilities, where the PM was unable to adapt to specific requirements and displayed poor communication skills when conveying issues to Congress and others within BMD. This led to Congress cancelling the program in 2009, even though the technology developed was near completion and had successful testing completed in 2007.

9. Transformational Satellite Communication System

The Transformational Satellite Communication System (TSAT) experienced cost growth and schedule delays throughout the program's life. An initial cost estimate of $15.5 billion was exceeded, and the time for an initial satellite launch was over 3 years past the estimated date in 2014 (GAO, 2006b). A major factor in the program's delays was knowledge gaps and the program being unable to meet expected requirements. Due to poor communication of the PM, the need for reduced requirements was not properly conveyed to all stakeholders, and requirements were not adjusted promptly. The TSAT program also fit into a global network of then new Transformation Communications Architecture (TCA), and the PM did not coordinate with TCA for requirement expectations to meet TCA standards established.

10. National Polar Operational Environmental Satellite System

Due to multiple delays and workmanship issues, the National Polar Operational Environmental Satellite System (NPOESS) program was forced to restructure the acquisition and renegotiate the NPOESS contract (GAO, 2008). This program required a significant amount of coordination with the National Oceanic and Atmospheric Administration (NOAA), the DoD, and the National Aeronautics and Space Administration (NASA). The required coordination strained the program requirements since each agency had high performance demands. The coordination between agencies was poorly managed, leading to the requirement for restructuring, cost growth, and schedule delays.

11. Comanche

The RAH 66 Comanche program was introduced in the early 1980s as the light heavyweight experimental (LHX) program, the U.S. Army's future rotary wing aircraft. Initially, the Army leaned on the requirements from the Vietnam era for a better attack helicopter with improved armament and armor. However, as the Cold War ended, an imperative was placed on improving technology. This shift to a more sensor capable model coincided with a reduction in priority for the Army. Once the number one priority for the U.S. Army, the RAH 66 Comanche endured 20 years of shifting requirements that ultimately created an unsustainable program cost growth. In 2004, the program was cancelled as the ongoing wars in Afghanistan and Iraq created a need to improve and overhaul existing rotary wing aircraft. Unlike many other failed acquisition programs, the DoD did not direct the termination of the program; program termination was decided within the service to restore budgetary balance (Defense Acquisition University, 2012).

12. Deepwater

The Deepwater program was a major acquisition program initiated by the U.S. Coast Guard in the late 1990s to modernize its fleet of ships and aircraft. The program aimed to acquire a range of new vessels and aircraft, including patrol boats, cutters, helicopters, and fixed-wing aircraft, to support the Coast Guard's mission of protecting the U.S. maritime domain. The Deepwater program faced challenges, including inadequate requirements definition and insufficient program oversight. These challenges resulted in cost overruns, schedule delays, and performance shortfalls, leading to the program not meeting expectations and goals (O'Rourke, 2005).

13. Ford Edsel

Ford Motor Company brought to market a medium-priced Edsel. The automobile lasted 2 years on the market. Sales were down, and producing more vehicles was not profitable, especially during a time when there was a shortage of steel. The company was forced to sell Ford stock, worth an estimated $155 million, to mitigate loss. The Edsel was wrong in every way imaginable and missed the intended market. Ford had spent over 10 years researching and designing the Edsel. The estimated cost of research, design, and

overhead was $250 million (Rothman, 2014). The time delay from research to product cost Ford tremendous amounts of money. It emphasized the importance of speed to the market. The program displayed poor communication and inaccurate deadlines, which contributed to its failure (Bailey, 2018).

14. National Health Service

The United Kingdom had intentions of building a massive computer system that would be compatible with the National Health Service (NHS) (Wright, 2011). These electronic health records would be integrated across hospitals and community care. The government consumed 10 years of effort and expended roughly £11 billion on the NHS computer project. The first warning sign became known when they missed their first deadline in 2007 (Wright, 2011). The ongoing changes to specifications and other technical issues caused the delay and increased costs. Leadership is cited as having direct cause for the failure due to poor communication with health professionals. The government has elected to negotiate with contractors in the hope of retrieving capital. Mismanagement and use of tax-payer dollars has caused mistrust from the population. The government and the PM must salvage this product to regain the trust of their citizens. This case study highlights the importance of flexibility and communication for complex projects. It is difficult but required to identify potential problems before they occur to best manage the program (Bailey, 2018).

15. Airbus A380

The Airbus A380 was the largest aircraft of its kind. It required specific parts manufactured from around the world. These parts were built and then sent to a specified location to be assembled. When the plane was being put together, the team realized that not all parts used the same computer-aided design programs. This meant the parts were not interoperable. This was a hard lesson learned that cost the company $6 billion and set the project back a couple of years (Cusmano, 2022). The challenge of working on a massive project is exponential when working remotely. Communication must be overemphasized to ensure production requirements are met. While the Airbus did

successfully run for over a decade, in 2019 the program began to be sun downed. The cost and lack of demand was the overall issue (Bailey, 2018).

16. Knight Capital

Knight Capital is a trading firm that took a significant blow to its capital base. The money they used to conduct business was unrecoverable because of a flaw in their new specialized software. The glitch caused an estimated loss of $440 million in just 45 minutes (Popper, 2012). The error in the software was attributed to an overoptimistic deadline. The external pressure to install the new software forced unrealistic deadlines, and the firm decided to move into the production phase with a test code. This decision of leadership and PM cost the company hundreds of millions of dollars (Bailey, 2018).

17. XM 2001 Crusader

The XM 2001 Crusader was a classic example of stovepipe design that essentially recreated a program with similar capabilities. As the U.S. Army looked to improve their self-propelled artillery capabilities, they failed to rectify this program solution with their ongoing service redesign (Congressional Research Service, 2002). Along with improving the propulsion and armament, the XM2001 Crusader would share the same engine as the M1 Abrams tank. Although there would undoubtedly be some cost savings with the shared engines, changing requirements and cost growth plagued the program. In parallel with the XM2001 Crusader development, the FCS program developed the FCS howitzer, essentially developing a similar platform tailored to different mission sets. Ultimately the secretary of defense decided to cancel the program, allocating some of the budget to the FCS howitzer.

18. Javelin Antitank

In the early 1990s, the U.S. Army initiated the replacement for the Dragon II antitank weapon. The Javelin offered an improvement in range, lethality, and ease of operation. Cost and schedule growth plagued the program throughout the 1990s due to leveraging new technologies with inadequate readiness levels. Specifically, cost grew more than 50%, and schedule delays of more than 18 months led the GAO to recommend delaying the full rate production decision. Instead of iteratively testing design changes,

the program moved forward with more than 50 changes to the original design in the final operational testing phase (GAO, 1996). The PM was not risk averse in this approach, allowing the program to realize cost savings in the testing portion and an improvement to projected schedule delays.

B. HYPOTHESES

PMs that avoid the following decision-making pitfalls—overly optimistic, risk aversion, stovepipe design, strategic networking in the acquisitions environment, and poor communications skills—have a higher chance of successfully navigating the acquisition process. Table 1 is a graphic display of the summarized programs, identifying which of the five categories the PM failed to manage effectively.

Table 1. PM Decision-Making Categories

Program	Overly Optimistic	Risk Aversion	Stovepipe Design	Strategic Networking in the Acquisitions Environment	Communication Skills
LCS	X			X	X
CG(X)	X*		X*	X*	
EFV	X	X		X	X
FCS	X		X		X
JTRS	X	X			X
ABL	X		X		X
F-35	X			X	X
KEI	X		X		X
TSAT			X	X	X
NPOESS		X		X	X
Comanche	X		X	X	
Deepwater	X	X			X
Edsel	X	X	X		X
Airbus A380		X	X	X	
Knight Capital	X		X		X
XM 2001 Crusader			X	X	X
Javelin	X	X*			X*

Note: * indicates positive observation.

C. DECISION-MAKING CATEGORIES

The five decision-making categories are areas of concern in a PM's decision-making process and can be directly intertwined with the odds of success for an acquisition program. In our research, we define what these categories mean and how they are applicable to PMs.

1. Overly Optimistic

The overly optimistic decision-making category represents a PM's tendency to underestimate risks and overestimate potential benefits. PMs may be overly confident in their ability to achieve desired outcomes and overlook obstacles or challenges. This can lead to decisions based on incomplete or unrealistic assumptions, resulting in project failure or missed opportunities. While optimism can be an asset in program management, it must be balanced with a practical assessment of risks and challenges. Effective PMs incorporate measurable data to ensure that realistic data guide their decisions, thereby improving their assumptions. By balancing optimism with a thorough analysis of potential outcomes, PMs can make more effective decisions that lead to success.

2. Risk Aversion

The risk aversion decision-making category represents a PM's tendency to avoid taking risks due to a possible negative outcome. PMs who exhibit risk aversion may prioritize the avoidance of failure or negative consequences over the pursuit of potential benefits. This approach can result in conservative decision-making that prioritizes program stability over innovation and growth. While risk aversion can help PMs avoid disastrous outcomes, it can also lead to missed opportunities for growth and progress. Effective program management requires a balance between risk-taking and risk aversion, with decisions based on a thorough analysis of potential outcomes and consideration of both the risks and benefits.

3. Stovepipe Design

The stovepipe design decision-making category represents a PM's tendency to work on developing solutions in isolation, failing to consider their impact on other areas

of the organization or other similar programs of acquisition. PMs may develop solutions that are effective within their responsibility but fail to consider the broader context in which their program operates. This can lead to inefficiencies and redundancies, as well as missed opportunities for collaboration and innovation. Effective program management requires an integrated approach that considers the needs and perspectives of all stakeholders and the broader organizational context. Through avoiding stovepipe design, PMs are more easily able to identify alternative means and can identify when outside assistance or collaboration is required to improve program performance.

4. Strategic Networking in the Acquisitions Environment

The strategic networking decision-making category represents a PM's ability to build and maintain relationships with key stakeholders in the acquisition environment. PMs must understand the importance of networking and collaboration in achieving successful acquisition programs. Through building strong relationships with key stakeholders—such as industry partners, customers, government agencies, and Congress—PMs can gain valuable insights into program trends and requirements. Strategic networking can also facilitate knowledge sharing and collaboration among stakeholders. Effective PMs prioritize networking as a strategic activity, investing time and resources in building and maintaining relationships with key stakeholders. By leveraging their networks, PMs can make informed decisions and create success for their program.

5. Communication Skills

The communication skills decision-making category represents a PM's ability or inability to effectively convey information and ideas to stakeholders. PMs may struggle to communicate project goals, requirements, and timelines clearly, leading to misunderstandings and delays. Poor communication skills can also hinder collaboration and coordination among team members, other programs, and those funding the program, leading to inefficiencies, and missed opportunities. Effective program management requires effective communication skills, including the ability to listen actively, ask the right questions, and convey information clearly and concisely. By improving

communication skills, PMs have a clearer picture for making decisions, leading to a higher rate of program success.

D. THEORY

To improve on these five categories, a PM must first become aware and open to the idea of improving. The categories carry negative connotation, and the PM may be resistant to claim these as their own, but it is required to improve. The point is to gain a better understanding of one's self, which enables them to gain insight into the decision-making process.

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V. CONCLUSION AND RECOMMENDATIONS

Our research of the acquisition process, decision-making literature, and failed program case studies provides the basis for our conclusion and recommendations. Managing multi-billion dollar acquisition projects will remain a significant challenge for U.S. government and companies around the world in the future, creating a substantial need to continuously improve the processes that PMs use to shape program success.

A. CONCLUSION

The purpose of our research was to study PM decision-making in a complex and chaotic environment, identifying how PMs' decisions impacted the success of the program. After researching over 30 articles utilizing coding analysis, we generated five categories that influence the PM decision-making process. The five categories included overly optimistic, risk aversion, stovepipe design, strategic networking in the acquisition environment, and communication skills. Our hypothesis leverages these categories to provide insight to PMs' decision-making process in a complex environment. Additional research and testing will help build upon these categories, which could save the DoD and industry time and money. Improving PM decision-making improves productivity and reduces waste.

B. RECOMMENDATIONS

This research was limited by time constraints and requires further study. Further study should be conducted on PM decision-making in a complex and chaotic environment. Recommendations include a similar study based in Grounded Theory with a broader scope and industry leader perspectives of other acquisition programs. To test the hypothesis, it may be completed in several ways, but here are two suggestions. One method is to have the PM identify their strengths and weaknesses pertaining to their leadership and decision-making styles in relation to the categories identified. Another method would be to identify successful programs and utilize a questionnaire that has subordinates rank the PM based on the five categories identified. This research may be conducted to validate the five categories identified. Educational and practical training can

be designed to improve PM decision-making in relation to the identified categories if they are substantiated. PMs with improved decision-making skills would navigate programs more successfully, resulting in improved warfighter readiness and fiscal responsibility.

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