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THESIS

BUILDING THE DECISION-MAKING ENVIRONMENT IN THE INFORMATION AGE: AN ANALYSIS OF DEFENSE PROGRAM MANAGER DECISION-MAKING IN COMPLEX AND CHAOTIC PROGRAM ENVIRONMENTS

by

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In order to better understand how a program manager creates situational awareness and understanding in chaotic program environments, this project focuses on how a program manager gains insight in the decision-making process. The non-linearity of events in which human decision-making is predicated is chaotic and may have certain similarities and patterns that can be studied with regard to their association with the individual(s) involved in the decision-making process. If we better understood the human-in-the-loop influence on decision-making in the modern, information-supersaturated environment, perhaps future organizational and leadership theories and methods could be better tailored to the environment, ultimately leading to more predictable outcomes. This case study will begin to provide a greater level of insight into these issues and will be the basis of future research.

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LIST OF ACRONYMS AND ABBREVIATIONS

DAU	Defense Acquisition University
DoA	Department of the Army
DoD	Department of Defense
FAR	Federal Acquisition Regulation
FORSCOM	Forces Command
GAO	Government Accountability Office
MDA	Milestone Decision Authority
MDMP	Military Decision-Making Process
SOP	Standard Operating Procedure

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I. INTRODUCTION

In modern Department of Defense (DoD) acquisition programs, countless decisions need to be made, varying from day-to-day operations, acquisition strategies, source selections, or even project terminations. The single individual who makes a majority of these decisions (or prepares the analysis for a more senior decision-maker) is the program manager. The sum of these decisions could determine whether a program succeeds or fails. Recent program failures, often from cost overruns and schedule slips, have resulted in delayed delivery of capabilities to the warfighter and wasted taxpayer funds. Past fixes to this issue have come in the form of policy changes in an attempt to control and coerce the system into an efficient state, but with so many decisions being made, it is impossible to control them all through policy.

Through proper selection and training of the right individuals to serve as program managers, the DoD can empower individuals to navigate their programs through the countless decisions that must be made. This selection and empowerment process is in place now, but program failures still occur, suggesting that programs managers have yet to reach their full potential. As the DoD continues to expand its capabilities through a lean, agile force, the decision-making environment needs to be analyzed in order to capture how good decisions are made. By establishing a decision-making framework, program managers could be trained to apply this new paradigm and the DoD could see increased efficiencies, decreased cost and schedule overruns, and increase performance, ultimately delivering more capability to the warfighter.

A. BACKGROUND

"Just manage the cost, schedule, and performance" is the first thing many aspiring Army program managers hear when they delve into the world of acquisition. But how does one effectively manage cost, schedule, and performance when stacked against competing requirements, ever-changing budgets, and attempts to leverage immature technologies into the next advances in warfighting? A classic military response is that Soldiers must manage their product through leadership. This is one reason why Army program managers are

assessed into acquisition at the midpoint of their careers, after they have proven themselves as effective company commanders and leaders.

The Army values operational experience above all else, so this transition from operational to acquisition at the midpoint is logical; however, successful company command at the tactical level does not always equate to success as an acquisitions officer. This is perhaps why the Air Force takes the vastly different approach of placing officers into its Acquisitions Corps at initial entry into the military. This allows officers to gain valuable experience within this profession. They may, however, lack a warfighting operational perspective, considered important in the development of well-rounded senior leaders. The Air Force method is much more direct than the Army's method, but is it better? What is interesting is that no service within the DoD has the same process, and no service is without its share of acquisition failures.

No matter which path officers take to becoming acquisitions officers, it remains true that a cornerstone of leadership is effective, efficient, and expeditious decision-making. In warfighting, sometimes the speed of a decision outweighs the quality of that decision, lending an advantage to those who can process the situation quickly and determine which facts are crucial and which can be omitted from the thought process. This process is what drives the purpose of this research. If leaders can better identify what the issues are for people attempting to execute the duties assigned within this profession, perhaps they can improve processes or training for future generations.

When individuals transfer from the rapid decision-making of combat to the slower, business-based decision cycle of program management, they bring with them their basic framework of how to quickly frame problems and make a decision. The purpose of this research is to analyze decisions that senior leaders have made and, through personal accounts, attempt to identify common themes that ultimately led to making the right decisions and those themes that did not.

Over time, emphasis changes within any organization, and the DoD is no different. When the department was without all the bureaucratic entanglement that currently plagues the system, the systems were simpler and less expensive. As these systems continued to

get more and more complicated, costs began to skyrocket. With an increasing frequency of system cost overruns, top-level leaders instituted reform. The Better Buying Power program, implemented in 2010, looked to reform the DoD acquisition institution by focusing on cost and future cost savings, driving program managers to strive for a "should-cost" of the program, which was based on the cost that the government thought industry should be able to produce it at. While the program has been a successful cost saver since its implementation, it has also encouraged a risk-averse environment, stifling the pursuit of cutting-edge technologies (Kendall, 2015, p. iv).

In program execution, cost avoidance in combination with an overly risk-averse culture requires decisions to be elevated to the highest levels for almost all system-related questions or issues. A way to cut costs is to avoid testing or to speed up production to have a greater output, but with each decision, more risk is placed on the warfighter. The emphasis on cost reductions increases programmatic risk and leaves many program managers in a precarious position of needing a decision to move forward with the program. Mainly, do we save money or lower risk?

All these efforts culminate in a cycle that relies more and more on upper level leadership to make decisions. This in turn requires more staff and support functions to help prepare and prioritize the information, while simultaneously distancing the leadership from it. The result is more bureaucracy within the DoD acquisition system, which could lead to program managers feeling like they do not actually make decisions.

B. PURPOSE

The purpose of this research is to gather collective experiences to better understand why and how decisions are formulated. By getting into program managers' thought processes, we are looking to understand how they structure their views and apply their experiences and training to the situations presented before them. With the DoD controlling the required training needed to become a program manager, as well as the experiences it desires to be present in program manager development, the DoD has the ability to affect the development of the individuals in that decision-making moment.

C. PROBLEM

A lack of insight exists into how program managers frame their understanding into a specific problem. While there are many factors that can result in program success or failure, we look to better understand the differential in decision-making lenses that exists between varying program managers. A lack of literature that goes into the decision-making of DoD program managers has inspired this research in order to bridge the knowledge gap. This problem leads us to our first question: How do program managers deal with the issues? By gathering answers to this question, we hope to gain novel insight into how their decisions are formulated.

A second aspect of our research delves into the environment in which decisions are made. Decision-making in war has a deep body of knowledge, but this knowledge cannot be applied to acquisition decision-making, as the business world is a very different environment when compared to that of the frontline. A historical benefit in a program manager's transition from combat arms to the Acquisition Corps is the slower pace of decision cycles in the business world when compared to combat. This differential in the "flash to bang" of decisions has eroded as the world has transitioned from that of the industrial age to that of the information age, where decisions and feedback are literally happening at the speed of light.

The evolution from the industrial age to the information age brings about the difficulty of decision-making in an information-supersaturated environment. Today, the information flow is non-stop, with the only limiting factor being the human in the loop. Soldiers are limited, whereas the systems we develop and operate are not, so much so that the decisions become exponentially harder to make and require more and more time to formulate. This brings about our second question: How has the speed of information affected the acquisition decision-making environment? By answering this question, we hope to shape a future vision for successful acquisition decision-making.

D. METHOD

To address our first question, we conducted a quasi-grounded theory-based, qualitative assessment. We analyzed our interviews through the codes and categories that

are summarized in the literature review. By establishing these categories, we normalized the information presented by each subject in order to develop a summative analysis of the data we collected. To address our second research question, we analyzed the overall message presented by the subjects and interrelated it to the information presented in the literature review.

E. SCOPE

We believe the simplest way to gather information is to allow acquisition professionals to tell us about the programs they manage. However, with limited resources, specifically time, we focused on the focal point of any program, its leadership. We were most interested in finding a program manager of a program or project who is low enough to be focused on a few lines of effort and not an entire portfolio, but is still a key figure within the office. Based on our underlying problem of decision-making in a complex environment and how program managers frame and make decisions, we chose to achieve our research through a qualitative study of subjects within the acquisition career field. Specifically, we looked to focus on current and past program managers. This allowed us to gather the most pertinent information in the time allotted.

We gathered data through these interviews to see if patterns emerged. Given our limited research time, we were only able to interview two program managers. Having only two data points is not enough for conclusions, but these data points may provide insight for further research.

During our interviews, our focus was to get program managers to tell us a story in which they faced a difficult problem. By delving into a situation in which they may have felt great pressure, they were likely to recall the total environment more accurately than if the situation had been more mundane. The interviews were conducted in person to accurately gauge interest and body language and lasted 30 to 60 minutes each. The interviews were recorded and then transposed to text for analysis.

Once the interviews were complete, we analyzed the interviews by first taking the basic instinct we had during the interview and the interview notes to develop a rough sketch of the decision-making environment the interviewee described. Once a basic vision was

established, we revisited the transcript of the interview to expand and modify the environment based on congruence with the frameworks we uncovered in our literature reviews. When our model had an unsupported aspect, we revisited our literature review to expand on the subject and create other connections.

By focusing on creating distinct models for each interview, we were able to compare and contrast them to find trends that could be indicative of larger issues. As we proceed through our analysis, we propose theories that are supported by the data.

F. SUMMARY

To answer our research questions, we propose and support theories based on the data in an attempt to further the research of decision-making. This could ultimately lead to gained efficiencies within the DoD, which could significantly enhance program effectiveness with updated training and development of future program managers, as well as enhanced decision-making theories and methods.

II. LITERATURE REVIEW

The purpose of this chapter is to conduct an exploratory literature review into the nature of decision-making, individual biases, and how the mind works to capture and catalog information, as well as how these concepts apply to the modern information age.

A. THE DECISION-MAKING PROCESS

A vast majority of U.S. Army program managers are active duty military officers who have risen through the ranks and conducted the mandatory Professional Military Education. Much of this training focuses on the tactical and operational employment of forces and the decision-making that goes along with it. These decisions can have great effects on the overall outcome of battles. Due to this, the Army has developed a process that commanders can lean on to better their chances of success. This process is aptly named the Military Decision-Making Process (MDMP) and is outlined in *The Operations Process* (Department of the Army [DoA], 2012). The process is a methodical, seven-step system for commanders and staff to utilize in deliberate planning to "understand the situation and mission, develop a course of action, and produce an operation plan or order" (DoA, 2012, p. Glossary-4). By conducting a thorough pre-assessment of their own forces, the operating environment, and the opposing force, commanders are able to make better decisions going into an operation.

Once the operation is underway, commanders shift their focus to assessing the ongoing operation and intervening as necessary. The two main decisions by commanders during an operation are execution decisions, those that were forethought and had pre-planned decision points, and adjustment decisions, in which commanders must react to a new, unforeseen situation in order to maintain the path towards their envisioned end state. This flow can be seen in Figure 1.

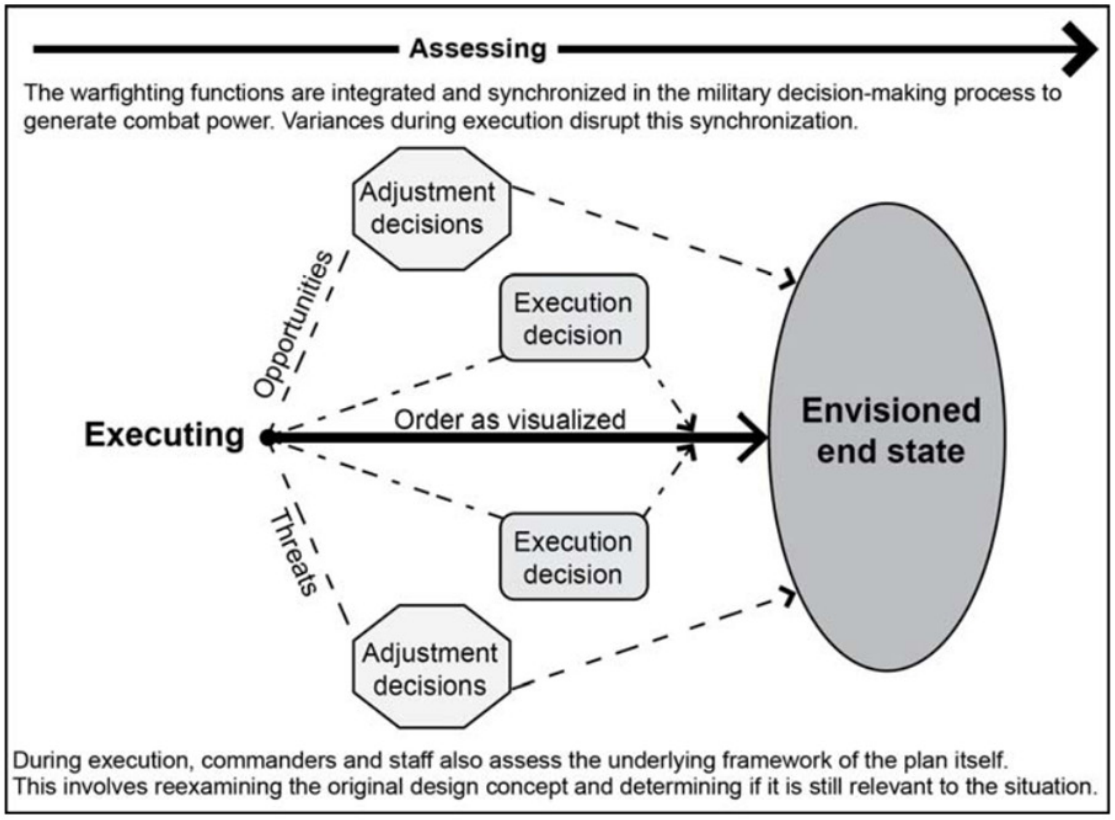

Figure 1. MDMP Decisions in Execution. Source: DoA (2012).

When a variance or unforeseen threat or opportunity arises, rapid decision-making may be required, and *The Operations Process* has guidance on that as well (DoA, 2012). In the rapid decision-making and synchronization process, commanders must first determine if the situation is a variance from the base order and if a decision is required. Once it is determined that a new course of action is required, commanders can use mental or group war game to quickly refine and validate the option and then implement the new course of action. The MDMP is the foundation to every program manager's career development and is likely present, in some form or another, in their current decision-making models.

B. DECISION-MAKING IN OTHER COUNTRIES

Our next goal was to shift the focus from a purely military decision-making model to that of the United States as a whole. By comparing our country's decision-making

model, which is likely present in many of our commercial partners, to that of other countries, we can attempt to gain a perspective of possible benefits and risks to each model. Troy Hall (2013) contrasted the main approaches to decision-making in the United States and Japan. He ascertains that no matter the leadership style, decisions are made based on factors that are "culturally derived, data driven, and resource dependent" (Hall, 2013, para. 1). By looking at different countries, it can be seen how various cultures can affect where and how decisions are made. The culture is defined by its norms, rituals, and stories and creates an overall preference that can span an entire generation. The two main approaches toward decision-making are through either an authoritarian approach or a collaborative approach.

Through the Industrial Revolution, the United States developed a style of decision-making that was based on a "strong need for individual achievement and recognition" (Hall, 2013, para. 6). From Henry Ford to Steve Jobs to Elon Musk, this "cult of personalities" created solutions that resulted in these individuals being in the spotlight for their efforts. This has led to a formalized decision-making process in which the senior leaders' personal interests drive the decisions more than the cultural norms do. This can be seen in the MDMP, where the entire process is to feed commanders the information they need so they may personally make the decision. This process has resulted in competitive, results-oriented decisions that have resulted in low group collectivism and fewer family attachments when compared to other countries.

The main approach for decision-making in the United States is through a lens of rationality, where the leader has unlimited information, is intelligent enough to use the information wisely, understands the strengths and weaknesses of all courses of actions, and can logically choose a best course of action (Hall, 2013). Since the United States has a strong sense of individualism, the decision-maker is on the line for the success or failure associated with the decision. With so much power resting at the highest level, creative thinking is limited. With a large portion of leadership in the United States having some experience with U.S. industry (or at a minimum U.S. higher education institutions), it can be inferred that this decision-making model is prevalent within the DoD.

In Japan, the feudal history of the country grew from the value of collective community work for the greater good, with the decision-making authority resting on the village elders (Hall, 2013). This created a modern culture with a "mindset of affiliation and personal power" with a tendency to preserve old relationships rather than pursue new ones (Hall, T., 2013, para. 5). This emotional approach towards decision-making, in which a collaboration is favored, results in strong relationship-building to reach an agreed-upon consensus as compared to a basic, confrontational negation process. This results in rapid adoption of new ideas among those who may have traditionally dissented after losing a heated negotiation.

This is perhaps why the new idea of distributed leadership has emerged in the United States; this increasingly popular practice has resulted in decisions being made as close as possible to the operational level (Hall, T., 2013). By allowing those nearest (and most invested and informed) to the operation to make the decisions, the process relies on "context, perception, cues, nuances, decision-maker values, and cultural distinction" (Hall, 2013, para. 2).

While there may still be a single authoritarian decision-maker at the operational level, it is still best for decision-making to be done at a level closest to the operation. This results in decisions being made based more on a culturally collaborative approach (similar to that in Japan), and less out of an illusion of a single intelligent decision-maker who has been granted perfect information but may have individual biases. If the DoD were able to adopt this mindset, it might increase some risk across the department, but it would incentivize individual program teams to come to a decision together and increase the speed of innovation.

C. BIASES IN DECISION-MAKING

After establishing a base understanding of our military's culture of decision-making, the next logical step is to expand on the decision-makers themselves and what drives their personal process. The famed world champion poker player and psychologist Annie Duke (2018) delved into decision-making under uncertainty and the biases that can develop when one draws experience from good results versus good decisions. By

"resulting," a good result is assumed to be due to an individual's good decision, and not simply good luck (Duke, 2018, pp. 7–11). This would be the case if the world was like a chess match, where there is perfect information and a correct answer. In reality, however, there are many unknowns and unknown unknowns, forcing risk, uncertainty, and luck into the outcome of a decision (Duke, 2018, p. 21). When it comes to personal reflection, human lives are too short to capture enough data to evaluate decision quality. When we make a decision, we reject all other options and their associated futures, and we never know the outcomes of the rejected decisions. This limits us to ascertaining if a decision was good or bad, and not if it was the best or worst decision possible at the time (Duke, 2018, p. 25). Our world of incomplete information and factors that we have no control over make all of our choices uncertain. Our decisions are only our best guess based on what we know and what we do not know. Our personal and organizational beliefs drive how we treat what we do not know, as we must speculate on what it could be. This makes the accuracy of our beliefs the bedrock of a better decision (Duke, 2018, p. 48).

Studies of how humans believe what we do have uncovered that it is easier for a person to believe an observation than it is to doubt it (Duke, 2018, p. 52). This stems from a primal survival mode, in which a false positive (Type I error) can result in a person fleeing from shadows (but surviving), and a false negative (Type II error) can result in that person discounting the predator lurking in the bush (and, ultimately, being killed). This system is very functional when the observations occur in our own environment and with our own sight and hearing. However, since the invention of communication, other people's messages, no matter the factuality, could be transmitted and received as truths.

Beyond the fallacy of trusting everything we observe, we can also fall into the trap of interpreting data as we desire it to be. One study into motivated reasoning determined that the more intelligent a person is, the more likely that he or she would misinterpret the data to support his or her individual biases. This fact is troubling given that all organizations strive to promote their best and brightest to serve in high capacities. In an attempt to maintain impartiality, the acquisition community has independent test organizations with distinct evaluation organizations to remove any bias from the final evaluation (Hall, 2017, p. 13).

Additionally, biases can be displayed through the declaration of 100% certainty of a fact (Duke, 2018, p. 71). Asserting total confidence in an item not only shows that an individual is unwilling to accept any other alternative, but it also scares away any contrary voices that may provide additional relevant information to the situation.

Despite living a finite life that limits personal observations leading toward total decision confidence, people can experience group and organizational learning. Learning can be defined as receiving feedback that is closely tied to an action or decision, and experience is what people do with that learning (Duke, 2018, p. 78). By looking at a decision's outcome, individuals can examine the beliefs that were used to justify the decisions and reduce uncertainty in future decisions. The larger issue that must be accounted for is what other influences, beyond our decision, affected the outcome in question. With a negative outcome, it is normal to go back and conduct a "post mortem" on the decision to see why it went wrong, even if it was simply due to bad luck (Duke, 2018, p. 86). In the opposite case, it is easy to continue with the status quo after a positive outcome, as that decision now appears validated.

How we gauge a result also depends on whether it was our decision or someone else's decision. A self-serving bias deceives individuals into attributing all of their success to their personal skill and their failure to bad luck. This bias goes on to distort our view of others' achievements, so that we attribute their successes to good luck and their failures to their lack of skill. This is apparent in the MacCoun study, which found that 91% of multi-vehicle accident victims blamed someone else, and 37% of single-vehicle accident victims projected the blame beyond themselves (Duke, 2018, p. 90).

When we are able to remove the self-serving bias, we have a very powerful tool of learning from others' experiences (Duke, 2018, p. 97). The acquisition education program is rife with this method of learning in the form of case studies and Government Accountability Office (GAO) reports. The GAO website, as of this publishing, has over 1,100 reports and testimonies related to defense procurement (GAO, 2018). The power in this mode of learning is through the reports' ambiguity; since the decision-maker is now nameless, we are less likely to impart the self-serving bias. Additionally, it has been found that if a decision-maker is under the purview of an agency that places an emphasis on

accuracy, such as the GAO or Congress, and holds the decision-maker accountable, open-mindedness is encouraged in the decision-maker (Duke, 2018, p. 129).

Having an open mind encourages diversity in thought and dissent in opinion, leading to increased accuracy. By exposing the decision-maker to alternative hypotheses and other viewpoints, we increase the chance of decision accuracy (Duke, 2018, p. 138). To encourage multiple viewpoints, operational military units contain diverse staff from multiple functional areas and backgrounds. Unfortunately, as commanders provide initial guidance in step 1 of the MDMP, their personal and professional biases can shape the final decision before mission analysis even begins (DoA, 2012, p. 2-12). The pressure of performance evaluations can also weigh heavily on personal decisions as his or her rater is their immediate supervisor, and the rater's supervisor serves as the senior rater (DoA, 2015b, pp. 8, 10). In this prescribed rating chain, it is common for commanders to evaluate the personnel tasked with providing them unbiased information. The threat of conformity bias, where individuals attempt to conform with a commander's initial guidance, could stifle how much the staff is willing to constructively dissent (Prentice, n.d.). Interestingly, it has been found that an individual's willingness to provide opinions increases when the objective is to win a bet versus conforming to maintain amicability within a group or with a superior (Duke, 2018, p. 150). To counter this command influence, red-teaming (when individuals formally take up an adversarial role) can force an individual to find a dissenting viewpoint. The red team can then ask pointed, dissent-focused questions, inviting in alternative points of view that are not seen as oppositional (Duke, 2018, p. 171).

Beyond the invitation of additional data and viewpoints, it is also important to highlight the data that may become purposefully omitted. Richard Feynman described a level of brutal honesty that involves reporting on anything that may invalidate a researcher's hypothesis; anything that you may be inclined to omit are the details that must be expanded upon in order to maintain accuracy and transparency (as cited in Duke, 2018, p. 156). Maintaining integrity of the data is crucial to the development of a full picture of the situation. Only then can we accurately assess if a decision was correct or not. This is why the GAO checks and references all numbers and statements in the more than 900

products it produces per year (GAO, 2018). Only by weighing all of the factors that go into the decision can we determine if the outcome was due to skill or luck (Duke, 2018, p. 159).

The perceived accuracy of the information can be based on the opinion we hold of the individual delivering the message (Duke, 2018, p. 161). This perception could be based on a past record of accurate information or based on a personal opinion of the individual. Regardless of the messenger, a statement's accuracy should always be assessed independently of the opinion of those delivering it.

The concept of loss aversion simply states that it is better to start with a loss and finish on a gain than it is to start on a gain and finish on a loss, even if the two results are the same. The following is one example of this: If a program made great achievements and was ahead of schedule and under budget prior to Milestone B but could not make it through production, it would be perceived as a negative outcome. However, had the program run long and been costly in the Engineering, Manufacturing, and Development phase but sailed through production, it would have been perceived as a successful project even if it ended up at the same final cost and schedule figures (Duke, 2018, p. 195). Dealing with loss aversion can be a challenge in an environment where the warfighter needs a product now and is always looking for ways to "just get it to Milestone B," despite the product not having the requisite technological readiness. This push is due to the fact that at Milestone B, the program becomes a Program of Record and receives dedicated funding in the budget (Defense Acquisition University [DAU], n.d.). Delaying a product until it has the appropriate readiness levels can avert a loss situation that would carry a negative perception.

As a constantly forward-moving organization, the Army must focus on the hazards that may lay ahead. By forecasting where we anticipate challenges, we can press for pre-decisions now; that way we can create a course of action that can be implemented should a challenge arise (Duke, 2018, p. 207). This could prove advantageous in the acquisition community by establishing courses of action that are pre-approved by the Milestone Decision Authority (MDA) to reduce reaction time if a contingency were to occur. Commanders on the operational side of the military prepare these pre-approved battle drills in order to expedite and simplify actions and reduce indecision time (DoA, 2017, p. 3-9).

D. THINKING, FAST AND SLOW

After looking into Duke's interpretation on how individuals take in experiences and represent them in the forms of biases, we will now look into the mechanics of the human mind and how its processes affect decision-making. The Nobel Prize–winning psychologist Daniel Kahneman (2011) writes of the two systems that operate within our minds, System 1 and System 2 (pp. 20–21). The first system is fast, an automatic function that acts quickly and involuntarily to process information. This function can be thought of as reflexes or the portion of our mind that is working when we arrive at a destination with no recollection of the drive that brought us there. The second system is slow, an effortful function, and concerns itself with mental activities that take tangible effort. This can be thought of as deliberate thought and concentration.

The two systems are separate but can help each other, such as when you are looking for a specific person at a train station, your System 2 mind recalls the characteristics of the individual and it then informs your System 1 mind to look for those simple characteristics (Kahneman, 2011, p. 23). System 2 is the portion of our mind that regulates self-control and must override System 1's impulses.

It is apparent that System 2 is the mind that we would like to have in control as much as possible. The problem with System 2 is that it requires much more energy than System 1. When System 2 becomes fatigued, it is known as ego deletion (Kahneman, 2011, p. 49). This is apparent when people overspend, react overly aggressively, or make poor decisions. It is for these reasons that the military believes in training and standard operating procedures (SOPs; DoA, 2011, p. 2-11). When a person becomes depleted (as is common in combat) and System 2 can no longer remain engaged, SOPs and training help an individual's System 1 perform as it should in a given situation. It is also the case that as the intensity increases, the necessary speed of decision-making also increases, and the System 2 mind may not be able to keep up. By conducting a System 2 analysis outside of the situation that would necessitate the SOP, we are able to calmly frame the problem and develop the best map that can be used in a later situation.

Prospect theory builds off the concept of loss aversion, stating that people are more likely to decide to avert a loss than to achieve a gain (Kahneman, 2011, p. 283). This was found in people's willingness to accept a lesser value on an outcome that is certain than they would on an uncertain outcome, even if the probability in the uncertain case was to make a higher return. This is simple risk aversion.

Once a decision is made and an outcome is realized, the way it is fielded can change the perception of the result. The framing effect states that people would prefer a treatment with a 90% survivability rate over a treatment with a 10% mortality rate, no matter the fact that the results are the same (Kahneman, 2011, p. 367). This importance of framing is apparent in the DoD's (2008) concept of strategic communication, which is "the orchestration and/or synchronization of actions, images, and words to achieve a desired effect" (para. 1). In strategic communication, the leaders are tasked with leading the process and placing the communication effort as their core responsibility, and this is no different within acquisition.

The concept of the sunk cost fallacy explains the situation when people continue to invest in projects with a poor rate of return in order to avoid regret (Kahneman, 2011, p. 343). This concept may be apparent within acquisition when we have a program that is not performing at its baseline and we hope that continuing the program will eventually provide results. This is due to a System 1 reaction where it appears that there is much to lose with a program cancellation, when in fact a System 2 analysis would see that there is no possible way of recouping the lost effort, which is a sunk cost. In reality, we must be forward-focused and analyze if cancelling the program and pushing for a "new start" would deliver the capability to the warfighter sooner or cheaper than the current program.

E. SENSEMAKING

Now that we have researched how individuals take in experiences to define their past self, and the mechanics of both rapid and slow decision-making, we will now delve into how that knowledge is applied to future decisions. Karl Weick (1995, pg. 4) coined the term *sensemaking* to simply mean "the making of sense." It is the process through which we take the world we live in and transcribe it into words that enable our actions

(Weick, 1995). Sensemaking is the translation of data into information as it moves from disorder to order that can be unified in a common theory.

This aligns with the Army's vision of problem framing, which is "selecting, organizing, interpreting, and making sense of an operational environment" (DoA, 2012, p. 2-5). This can be done a variety of ways, and each way can produce different results in decision-making. The Army's way of framing is to conduct a group dialogue while considering the perspective of others. Framing this way enhances the commanders' understanding of a problem and allows them to act.

The need for sensemaking is growing by the day as the global environment is growing. In a historical comparison looking back within the DoD, the 1907 Signal Corps Specification, No. 486, which would lead to the development of the Wright Brothers airplane, was only four pages long (Wright-Brothers, n.d.). Conversely, the Air Force's Request for Proposal for its next trainer aircraft has 37 pages of key performance parameters and another 87 pages for system specifications, with countless other pages buried in over 250 other supporting documents (Federal Business Opportunities, 2018). This growth is indicative of the modern complexity of DoD acquisition and how it has grown exponentially through the industrial and information ages. Sensemaking becomes a key tool when we look to interpret the data points in those hundreds of documents.

Sensemaking is the building of a map that stakeholders and decision-makers can see, understand how the mapmakers envision the problem, and make a decision. Deborah Ancona (n.d.) stated that "maps can provide hope, confidence, and the means to move from anxiety to action" (p. 6). The map does not provide the answer but creates "an emerging picture that becomes more comprehensive through data collection, action, experience, and conversation" (Ancona, n.d., p. 6). These four actions that build the map easily relate to the actions of a program manager. Even if a map is not perfectly made, it can inspire purposeful action with a vision of the destination that helps navigators find their way when they find themselves at a crossroads. It is for these reasons that the Defense Acquisition (DAU) Life Cycle Chart, or "horse blanket" as it is affectionately called, is created to visualize the process described in DoD Instruction 5000.02 (DAU, 2018). This "eye chart," much like a map of a nation, can be overwhelming at first glance, but knowing where you

are and what is on your immediate horizon builds the decision-maker's apparent ability to affect change on the current situation.

The three core elements of sensemaking are "exploring the wider system, creating a map of the current system, and acting to change the system to learn more about it" (Ancona, n.d., p. 7). These elements can be further broken down into individual behaviors.

Exploration of the wider system is done through the seeking of multiple types and origins of data, involving others in the collective effort when mapping new situations, seeing beyond stereotypes and labels, and monitoring those closest to the crux of the situation, as information and trends at that point carry the greatest value to sensemaking (Ancona, n.d., p. 8). A major part of gathering a wide range of information is for leaders to hold their comments and creation of opinions until enough information has been gathered. By delaying judgment, the decision-maker can avoid imposing bias onto his or her subordinates and ultimately avoid engraining themselves in their own biases. It is important to listen to both the internal and external stakeholders and gather multiple perspectives on the problem. If a decision-maker has only a couple of perspectives captured, the model could become based too heavily on historical solutions that will not create the desired paradigm shift.

The main artifact of sensemaking is the creation of a map that captures the situation the organization faces. A key aspect of this map is that it must be shared among all stakeholders so they can have an accurate picture of the situation (Ancona, n.d., p. 9). This map is likely a perishable item as information becomes stale in an ever-changing environment. This is why sensemaking is an endeavor unique to every situation, and one should not overly rely on an old map when encountering a new situation (although many times action based on an old map can be more beneficial than inaction). A way of applying an old solution to a new problem is to engage the new problem with different questions that are less restrictive and able to be answered freely. Once the questions are answered, it is important to look beyond the basic data points and observe the greater picture, but this may require stepping outside of the system in order to view the pattern.

Decisions are made in order to create change. When we act to change the system, we should observe the feedback provided by the system (Ancona, n.d., p. 10). It is beneficial to start small when starting something new in order for the risk of negative feedback to be minimized. Once the feedback loop is understood, the action can be amplified or diminished depending on the outcomes.

The sensemaking flow of exploring the system, creating a map of the system, and then testing the map of the system to verify its accuracy is very beneficial to making the best possible decision given the information at hand. Unfortunately, certain human traits can get in the way of effective sensemaking. The first of these is rigidity, in which an organization has a historically proven model that no one is willing to go against because the model has a stellar reputation, and it is thought that no decision based on it could be wrong (Ancona, n.d., p. 12). This can become the case when a model may have gotten lucky in the past and the analysis has not been done to see if it was in fact the best decision at the time.

Secondly, when threatened with uncertainty, the tendency is for an individual to look for someone to provide direction (Ancona, n.d., p. 12). This is easily one of the greatest inhibitors to sensemaking in the military, as we constantly face new problems and always have a hierarchical structure above us with leaders who have more breadth of experience, albeit not firsthand of the present situation. This dependence of direction can cause an organization to fall back into the fault of rigidity as the senior leaders may base their decisions on their past, and now outdated, decision models. Instead of jumping in with solutions, leaders should help facilitate the discussion and listen to the subordinates' concerns and views. This not only brings out information closest to the issue, but also builds the leaders' credibility among their staff.

The final problem that arises is when people become impatient waiting for an outcome and change the variables before the previous feedback loop has a chance to complete and be analyzed properly (Ancona, n.d., p. 12). By avoiding these erratic behaviors, not forcing subordinates to deliver at a similarly impatient rate, and not rewarding immediate results, we can focus our decision cycles through Suzy Welch's 10-10-10 rule, in which individuals assess how a decision will affect their organization in 10

minutes, 10 months, and 10 years (as cited in Duke, 2018, p. 186). Only by getting out of the reactionary decision cycle and focusing on long-term user needs can we begin to shape the future warfighting environment.

F. NOUSMAKING

Through our research into sensemaking, we found that it, along with three other categories, were present in other researchers' theoretical decision-making models. One such decision-making model was that of *nousmaking,* presented by Raymond Jones. The premise is that sensemaking, combined with trust, tacit knowledge, and explicit knowledge, combine to allow the decision-maker to "interpret and come to a state of reality (nous)" (Jones, 2018, p. 6). Jones developed this model by interviewing special-operations Soldiers on how they made decisions, analyzing what was said, categorizing the responses, and then creating a summation of the population. These results are shown in Figure 2.

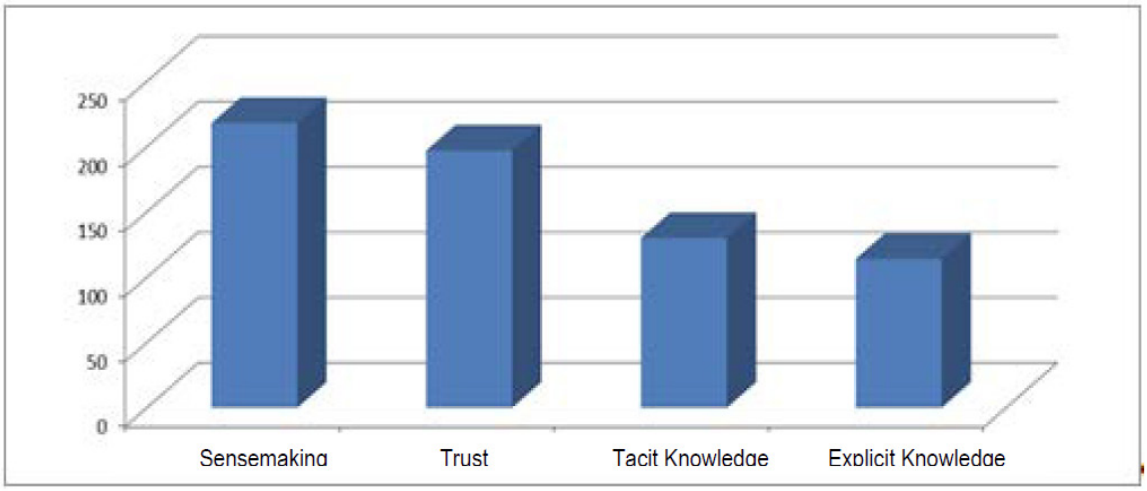

Figure 2. Summary of Nousmaking Decision-Making Observations. Source: Jones (2018).

Elaborating on the other categories that make up nousmaking, trust is "the willingness of an individual to be vulnerable to the actions of another" (Jones, 2018, p. 12). Tacit knowledge is knowledge that is difficult to pass on to someone else and must be gained through experience to generate know-how. Alternatively, explicit knowledge is that

which can be inferred through observation and deduction, and thus is easier to package and transmit to another, as an individual must only transfer the data along with their reasoning for another to come to the same logical conclusion (Jones, 2018, p. 13).

Jones goes on to propose that, based on his interviews, decision-velocity and decision-quality are critical in the ability of nousmaking to deliver decision-effectiveness (Jones, 2018, p. 32). This process can be seen in Figure 3.

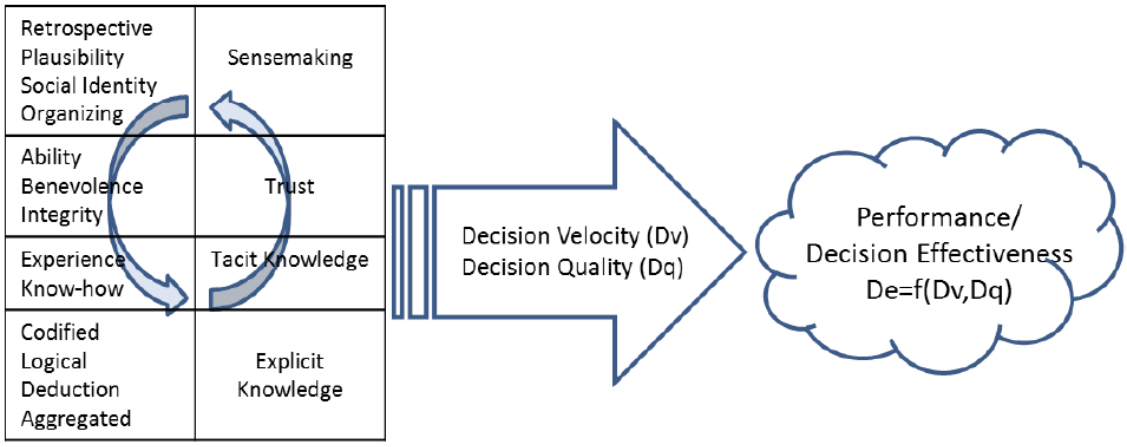

Figure 3. Relationship between Nousmaking and Decision-Effectiveness. Source: Jones (2018).

The basis behind this flow is that if a decision is quickly made, but the choice itself is not a quality decision, the result will be poor. Conversely, if a quality decision is delayed in its implementation, the outcome could be equally ineffective. This is very telling, given the high-pace, high-risk environment the special-operations Soldiers operate within. The nousmaking model clearly benefits and applies to those Soldiers operating in life or death situations, and we will expand on how it can apply to that of the slower paced, business world of Army acquisition.

G. DECISION-MAKING IN THE INFORMATION AGE

With so much of decision-making coming down to the understanding of the environment you are in, we must look into the era when the process operates to address our second problem. With a firm understanding in the decision-making models that can apply

in fast-paced, combat operations, we expanded our search into the modern business environment where acquisition program managers make decisions. In 2018 the world is considered to be operating in the "information age," or "the period beginning around 1970 and noted for the abundant publication, consumption, and manipulation of information, especially by computers and computer networks" ("Information Age," n.d.). As humanity has evolved out of the industrial age and into the information age, it created "new ways of working, living, and competing" (Cowings, 2012). The information transmitted daily has increased exponentially, as seen in Figure 4.

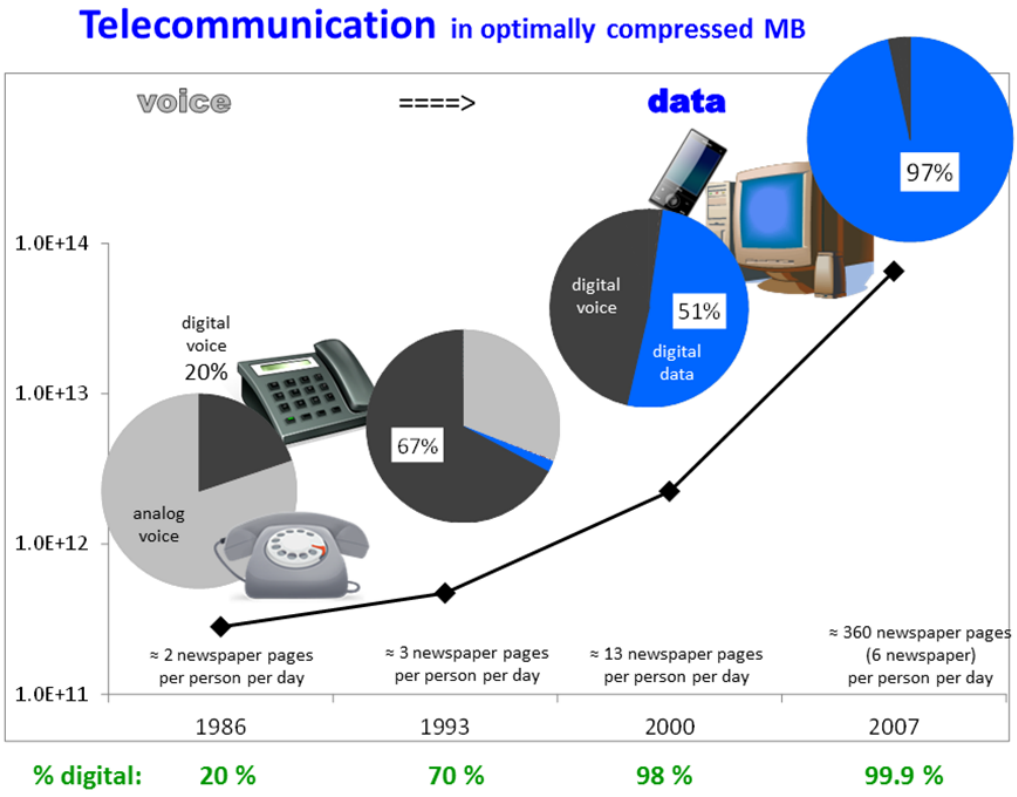

Figure 4. Worldwide Telecommunication Rates. Source: Hilbert (2011).

These numbers become somewhat skewed as modern video content is much denser in data than that of simple text. Conversely, the adage "a picture is worth a thousand words" still rings true to the amount of information carried in these bits and bytes. This increase in

information should make it possible to quickly create a more accurate and complete map of the situation in which decision-makers may find themselves.

The information age has provided humans with a highway of information and disinformation that enters our System 1 brain "pre-chewed" and allows our System 2 brain to rest and take the information as fact (Ropeik, 2014). This goes back to the Type I and Type II errors that lead us to believe what we observe, potentially creating flaws in our sensemaking map. Disinformation had previously been possible through spoken word or newspapers (the tabloid *National Enquirer* started in 1926), but the effort required to reproduce those sensational inaccuracies had been herculean (National Enquirer Staff, 2016). The efforts necessary to mass-produce information would require the System 2 brain to engage and determine that spreading the likely falsehood that "Dick Cheney is a robot" was not worth the cost of a printing press (Ryan, 2004). This is no longer the case, as the internet has made everyone an information distributor, and social media has transformed everyone into a news contributor (Boston University, 2017).

Even more alarming is an 11-year study into the spread of truths and falsehoods on Twitter. The study determined that false news spread "farther, faster, deeper, and more broadly than the truth," reaching up to 10 times further than the truths (Vosoughi, Rou, & Aral, 2018). This is compounded with the Internet's ability to offer us information that is pre-tailored to our biases, as seen in Facebook's presentation of bias confirming political ads during the 2016 election (Duke, 2018, pp. 59–61). Additionally, during the 2016 election, Facebook's 20 top-read hoax stories created nearly 9 million shares, reactions, or comments (Boston University, 2018).

The information age has truly accelerated the pace at which individuals can access information, but a person's ability to process this information has lagged behind. To assess how this shift can affect the acquisition process, we can look to analogies in other federal entities, such as Congress.

H. CONGRESS, INFORMATION TECHNOLOGY, AND THE USE OF FORCE

Congress is the main organization that wields much of the governmental power over the DoD. It authorizes the military's budget, appropriates funding to programs, and authorizes the military to war (U.S. Const. art. 1, § 8). It comprises 535 individuals who represent the people of their district or state and thus can and should be influenced by public opinion (GovTrack, n.d.). Historically, Congress has been driven by "patriotism, money, organized lobbying, constituent opinion, and the search for political advantage" (Record, 1997, p. 197). As Congress entered the information age, those influences became amplified, leading to an exponential growth in the late 1960s in congressional professional staff and specialized committees (Record, 1997, p. 198). DoD acquisition has likely experienced a similar growth in order to handle the same expanding information environment and support decision-makers.

Another influence the information age has had on Congress and how our nation conducts its wars is the "public and congressional hyper-sensitivity to casualties" (Record, 1997, p. 203). This became the norm during the Vietnam War and was further reinforced with the successful minimization of casualties during Desert Storm. This sensitivity has created a risk aversion within our government that has transferred to our DoD acquisition programs.

The information age and social media have also accelerated expectations for organizations' response speeds. A Red Cross survey found that 76% of those surveyed expect disaster relief within three hours of requesting help on social media (Straus & Glassman, 2016). While such rapid response may not be expected in Congress, the survey is indicative of the expectation that the speed of response should mirror the speed of request.

The information age has also seen an increase in the volume of correspondence submitted to representatives, as indicated in Figure 5.

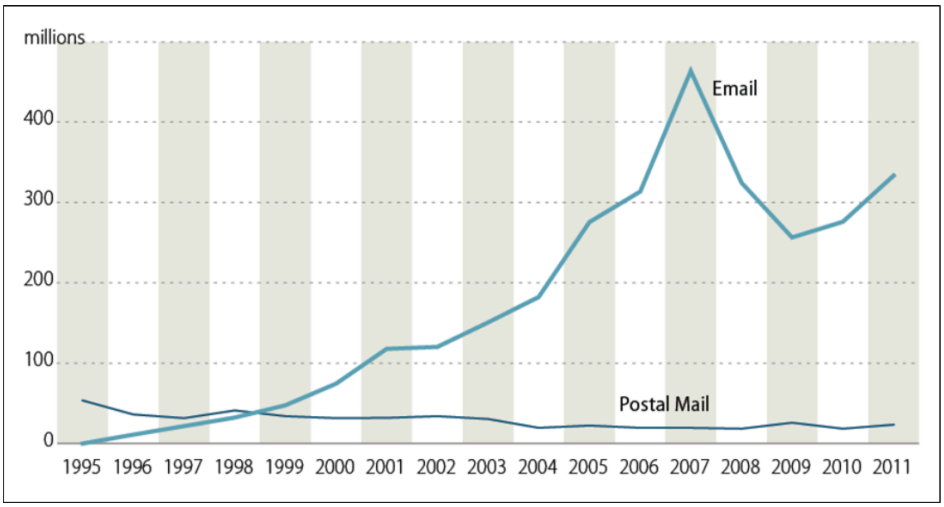

Figure 5. Email and Postal Mail to Congress, 1995–2011. Source: Straus and Glassman (2016).

This drastic increase is not only representative of a more engaged constituency but could also be a sign of growing engagement of individuals outside of a representative's district. With the ability of email and social media messages to be transmitted anonymously, it becomes possible for individuals to voice their opinions to all of the representatives, not only their own. With electronic communications being free and fast, it is possible for representatives to become influenced by the side of an issue that becomes the most vocal in effort instead of in quantity (Glassman, 2016). This ease with which people can voice their opinion, combined with the speed at which information and disinformation spread without analysis, can create a situation where congressional representatives hear a message that their constituents may not actually support.

Looking at this information from the perspective of DoD acquisition, it is easy to see how budgets, requirements, and readiness could be micromanaged from the Congressional level, driving increased scrutiny on any decision made within the process.

I. INFORMATION AGE AND STRATEGIC DECISION-MAKING

The information age has had a radical effect on how the world and the United States look to fight future wars. Admiral William A. Owens, the former vice chairman of the Joint Chiefs of Staff, noted that our national security environment has undergone three

consecutive revolutions (Cowing, 2012). The first revolution began with the collapse of the Soviet Union. This resulted in the second revolution, the reduction of the defense budget, which had become 6.6% of the gross domestic product (GDP) in 1982 and fell to 2.9% in 2001, and only peaked at 4.6% during the Global War on Terrorism, as seen in Figure 6.

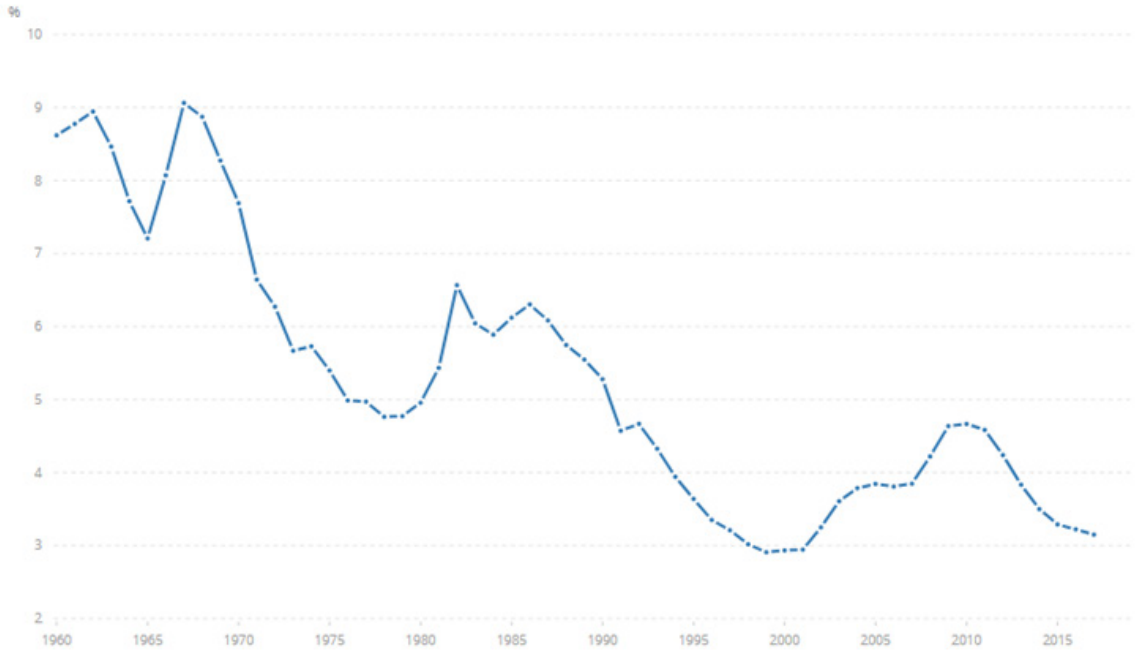

Figure 6. U.S. Defense Spending as a Percentage of GDP. Source: World Bank (2018).

The third national security revolution was the "revolution in military affairs" that brought about technological advances that enabled the more effective use of military forces. This shift in efficiency was not only seen in the military, but in companies as well, as they began to offer more specialty products and less mass production (Cowings, 2012). This can be seen in the creation of smaller and more tailorable military units, such as special operation forces or aviation task forces, that have the same capability mix at the battalion level that was once two levels higher at the division level (DoA, 2015a, p. 2-15).

A thinning of the force is easy to apply to production numbers, but it is difficult to provide this tailorability in programs that still require large industrial bases that have also become even more complicated, as evidenced by the lines of code needed to produce an F-22 (2 million) versus an F-35 (24 million; Desjardins, 2017). The trend toward lean efficiency in the DoD spurred "Augustine's Law," written by Norman Augustine, past chairman of Martin Marietta. He jokes that in 2054, the DoD's entire budget will buy a single aircraft that will be loaned between the Navy and Air Force for 3.5 days per week, and the Marines will get it on leap days (Fallows, 2002). This trend is apparent in U.S. fighter aircraft purchases: 29,000 fighters were built during World War II; 13,000 during the Korean War; 5,200 F-4s during the Vietnam War; 2,200 F-16s from 1974 to 1996; and only a scant 195 of the modern F-22 (Combat Aircraft, 2012).

This leaning of the force has created added stresses on the smaller quantities we do buy, creating a zero-defect mentality and overall increasing scrutiny from a more focused and informed public, Congress, and cohort of senior leaders (Kissel, 1999).

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III. ANALYSIS OF DATA RECEIVED

The purpose of this chapter is to present the data from each of our subjects and conduct an analysis to determine their overall decision-making model as well as friction points they described in the execution of their program. Both subjects chose to remain anonymous for the purpose of this research.

A. SUBJECT A

The data being presented is from one-on-one interviews with senior members of the acquisition profession that were conducted as we gathered information for this research. The interviews were conducted in person to gain a better understanding of what was and was not being said. Words alone are not enough to conduct this research; we are trying to get at what these professionals are also trying to tell us through their body language and other subtle nuances.

The questions were developed to identify the greatest challenges facing these leaders. Once the challenges were identified, the question became whether we could direct training to address these issues for future leaders in DoD acquisitions. The interview started with a very open-ended question in an attempt to get the subject to discuss their current program or project. Ideally, we wanted the subject to tell us a story that we could later break down using transcripts with the hope of conducting a more in-depth analysis on what was said during the interview.

The first individual we chose to interview was the program manager of an ACAT 1 program. This person is referred to as Subject A.

1. Background and Vignettes

The interview of Subject A evolved into a discussion about the program manager's day. By following the program manager's time expenditures, time being the currency of a program manager, you can find the inefficiencies. Having Subject A describe what they do reveals what the subject's priority is and, in turn, what the subject finds important.

We could break down the workday of Subject A into four primary categories: (a) receiving data (understanding the environment), (b) processing the data (formulating the message), (c) decision-making, and (d) waiting. Decision-making can be further broken down into programmatic decisions and deciding when to present data to leadership or the MDA. Additionally, waiting can be broken down into two subcategories of waiting on administrative issues (e.g., contracting, funding, etc.) and waiting on a decision to be made. In Figure 7, it can been seen that there is no one person to blame, and there is ambiguity about who is ultimately responsible for the program's success or failure.

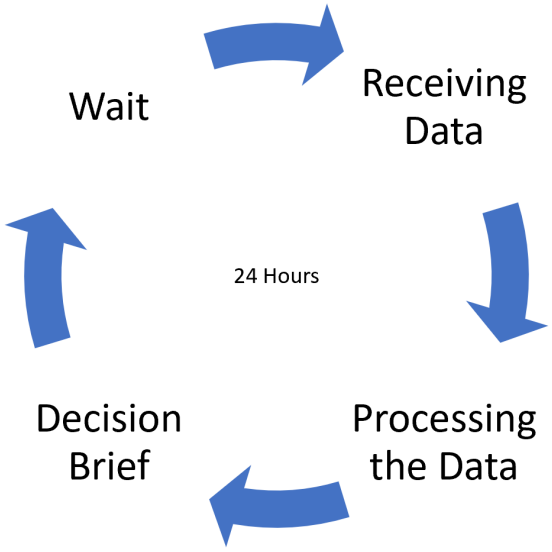

Figure 7. Subject A's Time Commitments

Another strong correlation with time seems to evolve around ownership of the program or process within these offices. Within the interview of Subject A, we started to notice a trend of speech that indicated decisions were out of that leader's hands. Special attention was given to this type of speech. The indication of "we" (a team effort) was counted separate from the indication of "they" (something the leader had no part in). We calculated a staggering 2:1 ratio between these two speech patterns. The word "we" was used 173 times during the interviews. However, other references were made to who held a decision and ownership was also taken into consideration. Of the 173 times "we" was

mentioned, Subject A said it 83 times. Within those 83 "we" statements, over 50 were directed away from Subject A in the proverbial "we."

The question then became whether or not the acquisition system could increase efficiency if the leader felt like they had more control over the program's decisions resulting in success or failure. Should the focus then be on how to create an entrepreneur rather than creating a manager of programs? By applying the four main categories of nousmaking (sensemaking, trust, tact knowledge, and explicit knowledge) in the confines of this interview, we gathered a sense of what this program manager saw as criteria that leads to decision-making (see Figure 8).

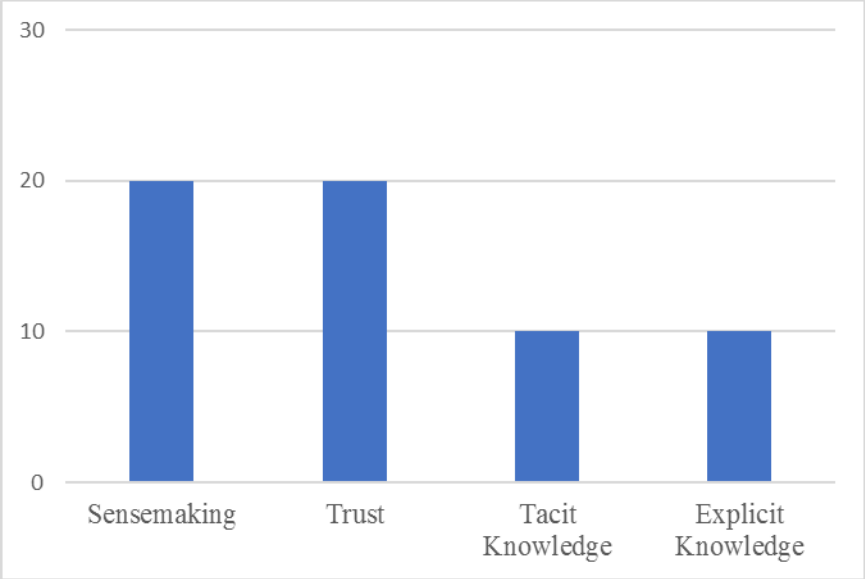

Figure 8. Subject A's Nousmaking Categories

To gain more insight into the categories, we further broke them down to capture if the subject mentioned it in a positive or negative way and if the category had been required by senior decision-makers for their own decision-making (see Figure 9). Oddly enough, trust and sensemaking, the greatest factors in the normalized view, actually carried negative connotations towards decision-making, meaning that while they were important to decision-making, the subject either felt that it was lacking or that it produced negative results. The real positive associations were with tact and explicit knowledge.

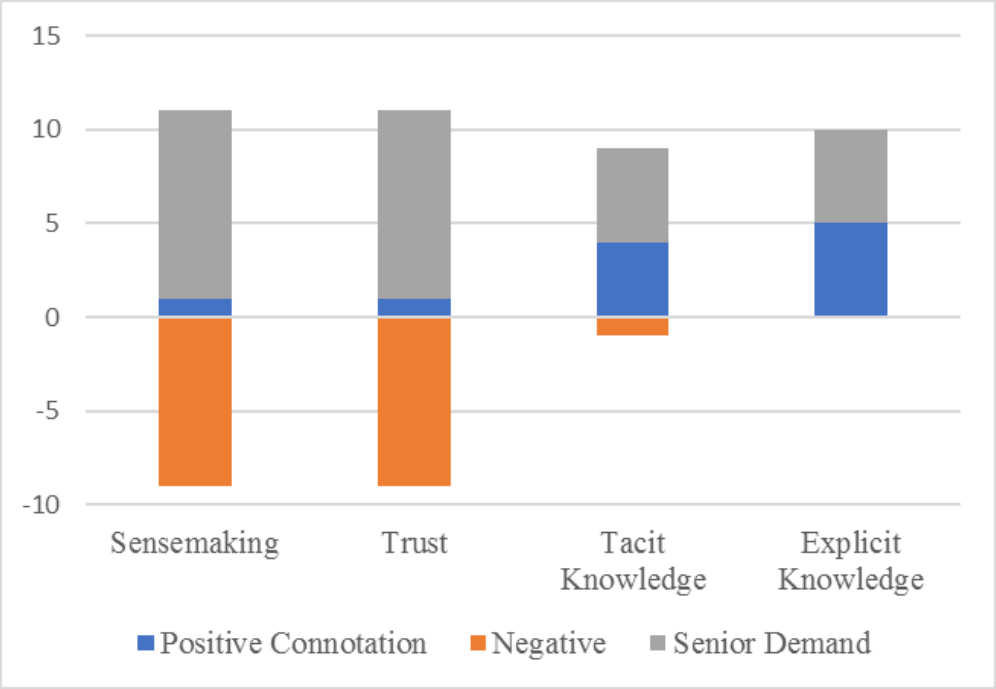

Figure 9. Subject A's Decomposed Nousmaking Categories

Sensemaking within Subject A's interview had around 10 traits tied with these categories, nine of which are negatively attributed to the model. At one point, the subject referred to "whack-a-mole" when controlling the rise of rumors, as the program manager needed to ensure that a rumor does not turn to fact for the program. Other comments, such as "It's our job" or "I don't control the amount of testing to be completed," indicate, within the context of the interview, sensemaking.

Trust had the highest occurrence within Subject A's interview, similar to the nousmaking model's history, only this time, a majority of the responses had a negative connotation. By breaking down the influences on a subject's decision-making, we can understand how the program manager forms their reality and we can potentially find ways to gain efficiencies in the process. This brings about our first theory:

Theory 1: Program managers could use their time to increase decision-velocity if trust in their decision-making was increased.

To determine the validity of this theory, we analyze the subject's current decision-making model and then propose an updated model that would increase decision-velocity.

2. Decision-Making Model

Subject A described the process that is necessary to distribute information that requires a decision. This process is presented in Figure 10.

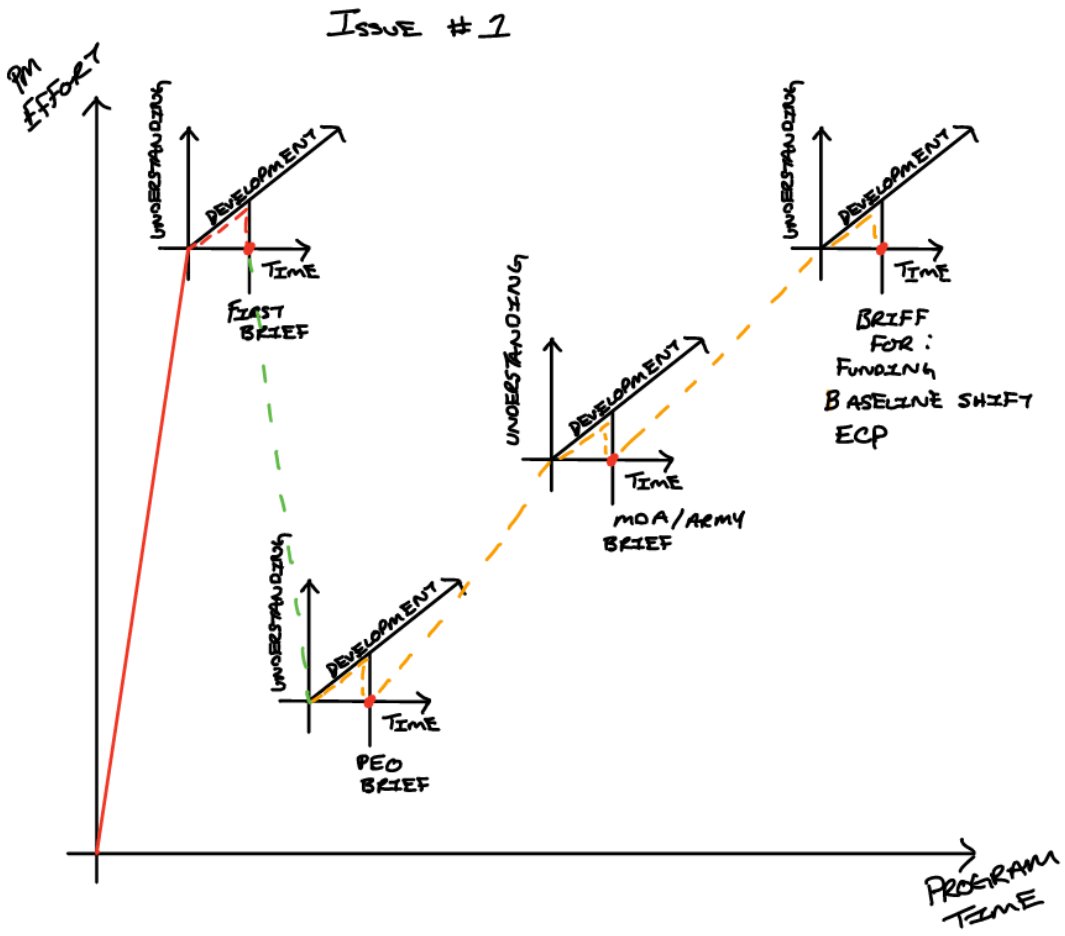

Figure 10. Subject A's Decision Preparation Model

In this chart, we see that decisions require a large amount of effort on the part of the program manager to gain understanding and then to develop the situation to a point where a brief is given to the next higher level. This initial time and effort are unavoidable for the program manager, but the subsequent iterations of this process are time consuming and redundant. Notice that as the level of the briefing escalated, it required increased effort on behalf of the program manager, while also increasing the program's timeline.

It stands to reason that one way to reduce effort and the program timeline is to decrease the quantity of briefs that need to happen prior to a decision. This could be accomplished by empowering the frontline leaders of organizations to make the decisions that best support the program. No one is better equipped to make such a decision than that of the program manager. Figure 10 depicts who has the most time working on this problem and who has the most information about it.

By increasing trust and pushing decision-making authority down to the program manager, we are able to reduce the time spent per issue, increasing overall decision-velocity. The updated chart in Figure 11 is what it could look like if bureaucracy were decreased and decisions held at the program manager's level.

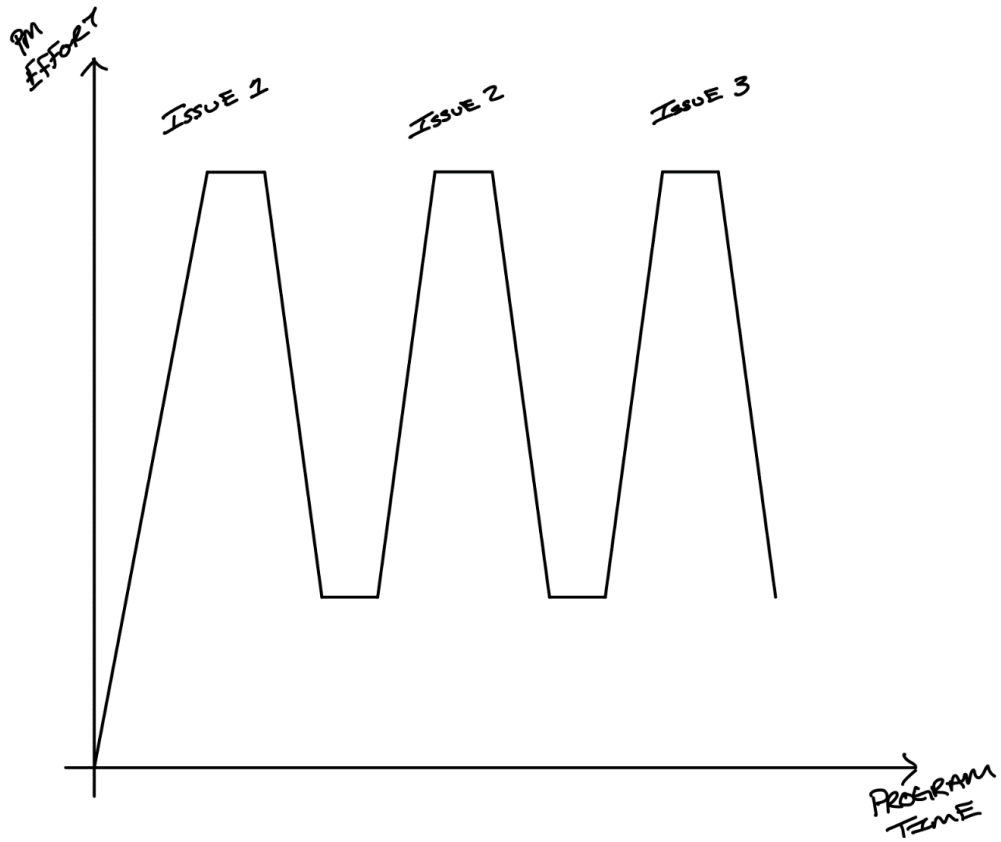

Figure 11. Tailored Decision Preparation Model

Figure 11 shows a clear gain in efficiency. This efficiency is associated with the overall program timeline. The leader can now handle exponentially more issues within the same amount of time as one issue in Figure 10.

3. Model Analysis

Both Figures 10 and 11 show that the quantity of efforts made by the leader of an acquisition program is extremely high. The interesting thing is that once the initial brief is complete, the effort drops significantly, but then ramps up again in preparation for the follow-on brief. This cycle continues until the effort matches back with the initial amount of effort, with a significant amount of time passing with no more understanding of the issue than what was already achieved at the first briefing. We believe this is due to the focus being more on the message and how to present the data than on understanding the solution to the problem at hand.

Conversely, Figure 11 shows leadership dealing with multiple issues within the same time span as Figure 10. This is primarily due to the lack of follow on briefings for each decision. Note that the effort on behalf of the program manager is approximately the same amount as Figure 10, but efficiency has been gained with the empowerment of such leaders. Now program managers can solve more issues and give attention to things that will improve the overall program.

4. Summary

It appears that much of Subject A's time and decisions within the program office are out of the control of the very person responsible for its success, as represented by Subject A's responses:

> As a program manager, this is not your decision. The biggest thing I'm trying to do is instill in the team now that this is not . . . the program. This is not PEO. This is the Army's program, and so it's an Army decision. . . . You can't feel like this is on us because . . . as program managers [we] own a smaller piece of the decision and process as anybody. We're just trying to herd the cats to make an informed decision.

This became evident within the speech pattern of our subject, who indicated that it was a common theme within the profession. This is reinforced by the fact that a program

office is created when the leader arrives, and he or she is often bound by decisions made in the past. The indication of our subject that program managers control very little of what happens within the program office is clearly the reality as Subject A sees it. The feeling of lack of control and an inability to affect critical decisions only adds to the delay of timely actionable tasks by leaders, as exhibited in the interview:

> The decisions that I personally make are not that big. It is me influencing other people to make informed decisions. That's really what this job's all about, because I'm not the milestone decision authority. I make resourcing decisions at my level.

The critical factor of efficiency associated with the program manager's most valuable recourse was also a focal point throughout the interview. The separation between "we" team/ownership statements, and "we" in the proverbial sense was worth noting the 2/1 ratio, with a majority of items or discussions seeming out of the hand of the program manager. This appears to be a systemic problem within this professional workforce and must be addressed if we desire any meaningful change.

B. SUBJECT B

The second individual we chose to interview was the program manager of an ACAT 1 program. This person is referred to as Subject B.

1. Background and Vignettes

Subject B had previous experience within the office and was familiar with many of the people and processes of the program. Subject B took us through a major acquisition event that would eventually encounter upheavals as senior decision-makers changed the conditions of the event.

> I can speculate, but I know there were not enough spares to support a deployment. The spares were procured to support a peacetime optempo. I don't know where that was communicated, or if it wasn't or heard or what, but it was a new problem set for me when you got the log folks finally got a guy in going, "You don't have enough." So, obviously that's something where you got to go, one, you can't deploy them; or, two, we got to change first unit equipment as they're halfway through fielding. Chief of Staff of the Army-level type decisions. I think the first thing is just to get the data

> and find out if it is fixable. And I think—what we ultimately did, and we did a good job with it.

This major shift in the condition in which the events occurred made the initial baseline of the plan no longer appropriate. This necessitated a change to the military unit that was scheduled to participate in the event. This change could only occur after Subject B had taken in the new information of the condition change, identified it as a problem, identified data-based solutions and the associated risks, and presented it to the stakeholders and decision-makers. Problems arose when multiple stakeholders were briefed and one decision-maker was willing to accept the risk while another was not:

> We went to [Forces Command] FORSCOM first with this issue instead of the Department of the Army. FORSCOM was, okay, we'll just switch up real easy and not understanding the big picture of the Department of the Army and didn't think—The Department of the Army went high-side once they kind of found out we'd coordinated with FORSCOM, and we're going to switch first unit equipment and store aircraft, and it was just going to be a—just a big nut roll.

This created a backlash that created multiple briefings to the unsatisfied decision-maker, but ultimately led to the same end result.

Subject B next spoke of the 2018 National Defense Strategy, emphasizing the strategy's drive to prioritize the speed of delivery as well as continuous adaptation and frequent modular upgrades. Subject B described how this creates a conflict of interests in which the Acquisition Corps stresses the speed of delivery, but the concept of frequent modular upgrades creates a burden on the end users, as they will have multiple versions in various states of proven and unproven reliability. In a military that prides itself on its modularity and interchangeability, frequent modular upgrades can create a state of turbulence for staffing, training, and logistics.

Again, we applied the categories of nousmaking to the interview in order to gain insight into how the subject makes decisions or sees them being made. The breakdown of the nousmaking categories is shown in Figure 12.

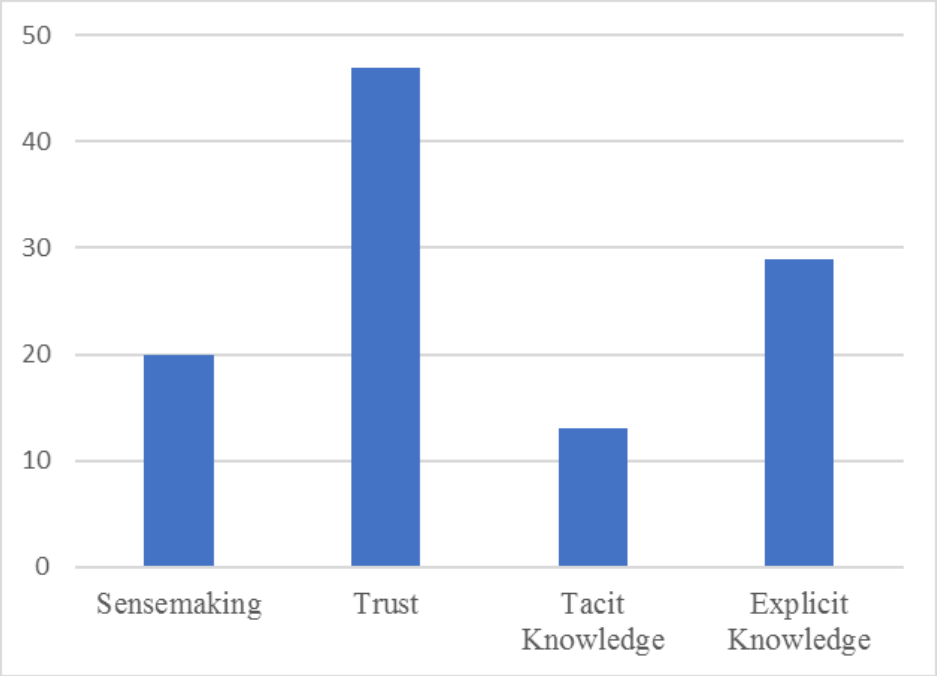

Figure 12. Subject B's Nousmaking Categories

Subject A's nousmaking categories were heavily favored towards trust, then explicit knowledge. Once more, we deconstructed the responses into positive or negative connotations, and whether the response eluded to a senior's request for information. This decomposition is shown in Figure 13.

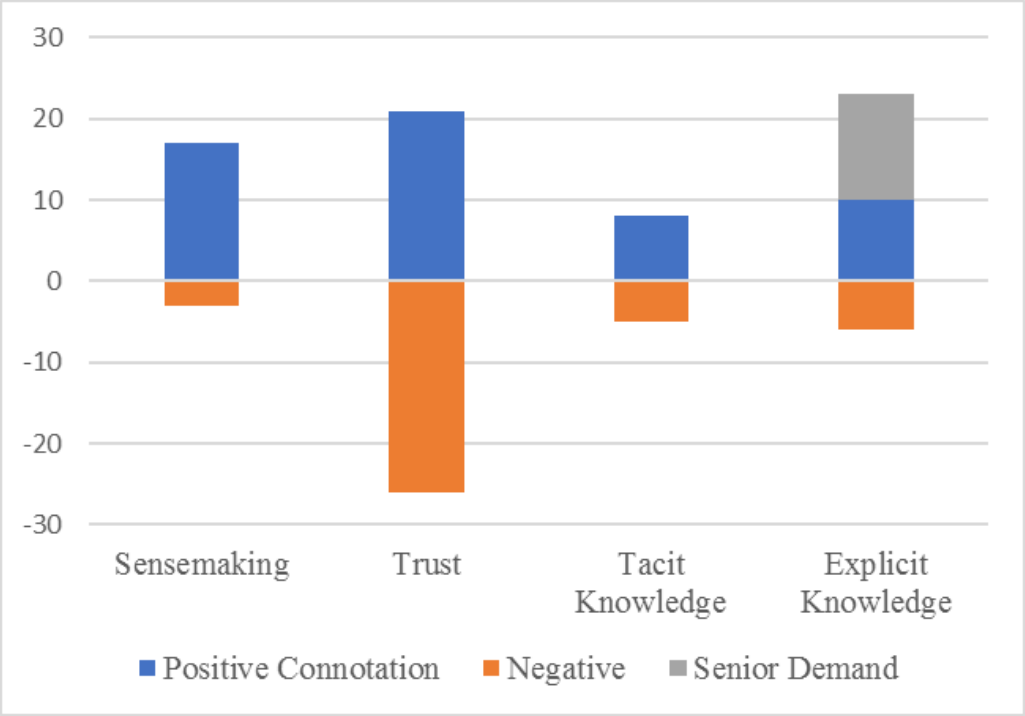

Figure 13. Subject B's Decomposed Nousmaking Categories

Subject B's heavy leaning toward trust brings about a different meaning when over half of the responses were negatively based. Subject B also expressed that his superiors primarily used him as a conduit of explicit knowledge for them to utilize in their own nousmaking.

2. Decision-Making Model

Through these vignettes, we were able to capture the decision-making model Subject B utilized. A visualization of this model is shown in Figure 14.

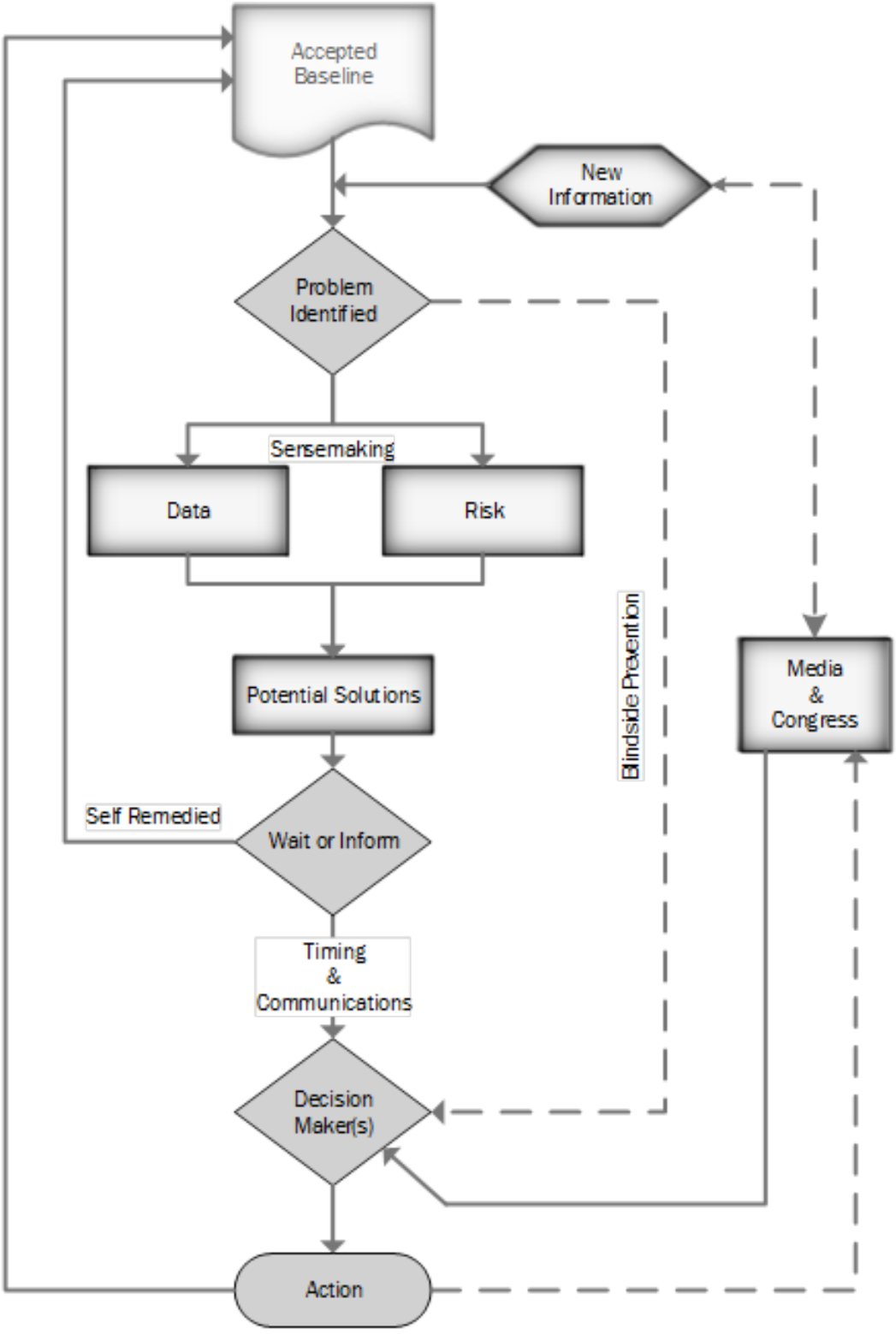

Figure 14. Subject B's Decision-Making Model

The overall theme of the model is reactionary, with an accepted baseline that is only modified with a stimulus of new information. This information could come in the form of production data, test results, shifting requirements, invalidated assumptions, or even perception issues attributed to misinterpreted information by the media or Congress. New information is to be expected in the management of a program, and it would be unexpected for it to all be good news. If the new information is identified as creating a problem, Subject B must begin the process of sensemaking by gathering the data and determining the risk associated with the potential solutions. Subject B stressed the importance of collaboration in the sensemaking process, asking the team, "What do you think?"

Prior to Subject B delving into a problem, they have the option to "prevent the blindside," as they referred to it. This ensures that senior decision-makers are not surprised by later questions, because as Subject B discussed, it is considered a failure to say, "I don't know."

> A lot of my choices of a problem is when to alert and inform and how to stratcom [strategic communications] that. We have some stuff going on now, and it's like, . . . "Hey, I just wish you would have told me first." It's like, "Yeah, but I just told you first and you told my boss and my boss doesn't know yet." . . . We're all leading to prevent the blindside. I think I'm doing a little bit different with my guys and going, "Hey, bad news might not get better with time, but it might."
>
> No one wants to be blindsided; no one wants to say, "I don't know, I'll get back to you." So, the churn of "I need to prep—I need to prep this; I need to prep that."

Deciding whether to inform the leader to "prevent the blindside" or to keep a problem in-house was one of the main decision points that Subject B felt they made in their professional role. The decision to inform or not depended on the personalities of the leader that Subject B would have to inform.

> Currently, that's one of the things I think I struggle with the most is . . . when you inform. When do I put the monkey on my boss's back? They say, "Hey. Don't put the monkey on my back, but I don't want to be blindsided either. When do you let me know?" And I think part of the anxiousness is, "Hey. I think I got this. I don't know if you're going to be able to help, but now I'm just preventing a blindside."

If the decision-maker was interested in the "bottom line up front," informing them of the latest problem would be a simple matter; however, if the decision-maker was a data-driven deep diver, it would force Subject B to answer, "I don't know," and be perceived in a negative light since there had been insufficient time to conduct sensemaking.

> Everybody wants the bottom line up front. But . . . they want the details. "Well, we need to know the forensics on that. What you're showing me here is just—I need another detail." And you're like they're all talk big. And . . . for senior leaders, just give them the high points. And I just don't think it's like that anymore.

With Subject A and Subject B referencing similar trust issues in the organization's decision-making and with indications of what may be causing this issue, our second theory is uncovered:

Theory 2: A culture of zero-defects erodes trust, stifles speed of communication, and slows decision-velocity.

This theory builds on Theory 1, in which trust is an enabler of decision-velocity, and adds in a zero-defect culture as a source of distrust. Once the decision to inform or not is completed, the next step is to gather additional data to conduct sensemaking and identify potential solutions and their associated risks. Subject B's next decision point is to inform the decision-maker of the situation or potentially give the problem more time to possibly remedy itself. This is a matter of judgment, as delaying informing a decision-maker increases the potential for a blindside, but if Subject B has built a level of trust with the decision-maker, they may be confident that it is prudent to wait and develop the situation prior to informing the decision-maker.

Once the decision to inform is made, Subject B stressed the importance of timing and what the message says. It is important to time the information with the business cycle.

> I worry also about the assignments that come at night because of something that was important during the day. So, I spend a lot of time on thinking through when the best time to send something is, if you can. If you got a couple days, let's do this Tuesday. Let's get back from the weekend. When's the worst? Friday.

If bad information comes out on a Friday, and a data-driven decision-maker requests more information, the government civilians and defense contractors who are needed to get the data are likely not available until Monday, leaving 48 hours of unresolved problem in the decision-maker's lap. The key to a timely delivery is to deliver both when the data is available and solutions are actionable.

Subject B concluded the interview by describing the program's overall climate and visibility:

> We call it the optics now. The program, as General [ ] says, is radioactive, hypersensitive, so all of our decision-making is geared on how [the user is] going to perceive this. How are they going to perceive it wrong?

Another superior's demand that Subject B "sign the schedule" and "guarantee" the schedule further reinforced the pressure on the program.

> It gets back to commitments to the users, and General [ ] [is] big on signing, and you're signing your schedule and "Okay, I need you to guarantee it." And I didn't say it then, but we'll go back and look at this, but it's hard—guarantee's a strong word, right? I can guarantee something I could control. . . . I hope I'm not just one of those acquisition guys who's all, "Yeah. We'll get it done." And then at the end, we need six more months.

3. Model Analysis

Much of the subject's decision points focused on the anticipated reaction of senior leaders and whether they demanded more data or trusted the subordinate and supported their decision-making. The data-craving leader may have grown out of the illusion of the information age's ability to provide perfect information, and this could be further compounded by the zero-defect mentality of the lean military of the 1990s. Considering many senior decision-makers with over 25 years of service will have survived (and likely excelled) in the zero-defect culture of the 1990s, it is understandable that they may carry on that tradition today. Through the fear of being caught without the answer, senior decision-makers have been in a constant preparation mode, requiring a full brief with a data deep-dive on every aspect of a program.

Based on the speed at which new information flows through multiple channels for others to scrutinize, it should almost be expected that someone would know more than any

individual would. The idea that "I don't know" should be considered a failure could be attributed to our previous industrial age–based decision-making model, where a single, top-level individual carries the weight of an entire organization.

The importance of messaging is not a new concept, as the military has been employing the concept of strategic communications, in which organizations focus on what words and actions are trying to convey, particularly to the nation or the enemy. By adding in the concept of framing, we can better control how a message is perceived by the receiver.

This concept of zero-defect grew out of a drawdown military culture that feared any mistake would result in denial of promotion and separation (Kissel, 1999). In the acquisition community, we must reach into the civilian sector to extract the greatest performance from unproven technology at the lowest possible price. Drawing an analogy from the various forms of contracts available to federal acquisitions, when you ask a contractor to guarantee something (such as in a firm-fixed price contract), they assume all of the risk associated with going over the baseline, and to address that risk, they will inflate the price in order to remain within budget (Lowden & Thornton, 2015). A situation that has high uncertainty is not appropriate for a firm-fixed price contract, as the inflation needed to address the uncertainty will create waste and inefficiencies. Additionally, the pressure of a guarantee could be a redirection of accountability, as Subject B spoke of how the program is dealing with reliability and quality issues in the product delivered by the contractor.

If the trend of requiring program managers to sign their schedules continues, program baselines will likely become inflated. This will be compounded when the charter changes every three years and the incoming program managers reassess the baseline, as they may be trained to be risk-averse. After their assessment, a re-baselining may be necessary prior to signing, which may force the entire organization to face Congress every three years for every program. This schedule inflation and added bureaucracy does not align with the National Defense Strategy drive to "prioritize speed of delivery" (Mattis, 2018)

A large correction in schedule could have an added benefit of avoiding the potential for a perceived loss. By growing the schedule early, it is less likely for the program to fall behind schedule in the end, and the program could potentially make up time to end on a positive note. One way the acquisition enterprise could encourage this is to increase the annual funding rollover limits that would allow funds to be saved for later program expenses and not stress the program to deliver simply because the money is available.

By juxtaposing the time period of senior leader development, the time period of the information age, and the zero-defect culture created by the post-Desert Storm drawdown, we are able to propose our final theory:

Theory 3: The information age has enabled senior decision-makers to receive more data and explicit knowledge than ever before, enabling them to hold decisions at a higher level, but reducing overall decision-velocity.

The fallacy of data-driven decision-makers is that their desire to remain informed may in fact make them less informed. By criticizing early reports that do not have enough information, they may be left in the dark when subordinates attempt to wait it out and maintain the risk at their level. This breakdown in communication could stem from a lack of trust in subordinates.

The information age's flood of information has created a situation in which acquisition managers and decision-makers are constantly facing the threat of negative reports based on misinterpreted data. Because these reports relate to a government organization, they must each be disproven to maintain a program's image in the public eye. The difficulty becomes overwriting past learning when System 1 of our brain makes a Type I error and takes everything they see as truth.

4. Summary

Subject B pictured the program manager's professional role as less of a decision-maker and more of an individual who managed the message of the program. By identifying the problem and understanding the senior leaders they were working under, they were able to time their actions and craft the strategic communications needed to enable action at the

highest levels. This process varied based on the relationship and amount of trust the senior leaders had in the program manager. The overall tone was that distrusting senior leaders did not delegate trust and were more likely to probe the problem for more explicit knowledge until the program manager exhausted all available information. This stifled early communications and delayed the analysis of the problem.

C. SUBJECT COMPARISON

By normalizing and combining the subjects' responses, we can establish how each nousmaking category's percentage contributed to their overall nousmaking model. The combined data is shown in Figure 15 and the decomposed data is shown in Figure 16.

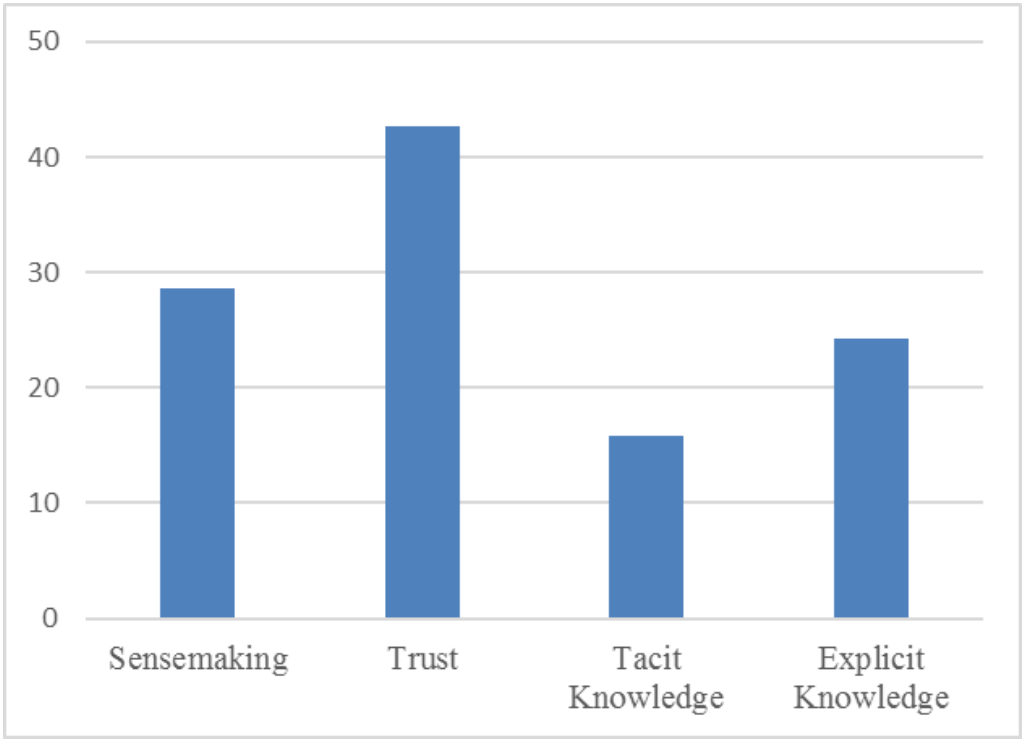

Figure 15. Aggregate Nousmaking Categories

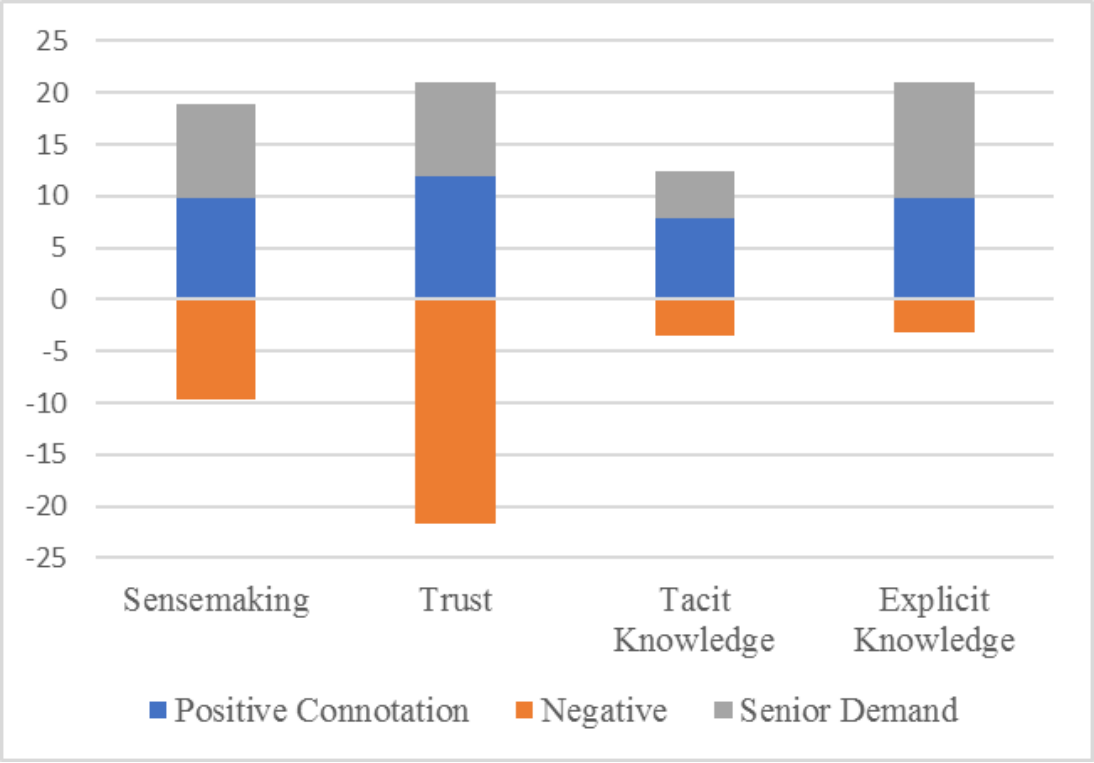

Figure 16. Aggregate Nousmaking Categories Decomposed

Trust's high level of contribution (over 40%) to nousmaking stresses the importance of trust in accurate and timely decision-making. Unfortunately, within the interview of our subjects, nearly half of the trust responses had a negative connotation, meaning that while the subjects felt it was important, it was not being properly executed. In our conclusion, we recommend ways forward to correct this imbalance.

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IV. CONCLUSION AND RECOMMENDATIONS

Our two subjects delved into the time they spent on preparing for decisions as well as on the effort necessary to craft information for each specific decision-maker. Both subjects operated in an environment where the critical resource of time was being expended to feed decision-makers more data.

A. CONCLUSION

Data has been referred to like wine, in that it gets better with age, as more insights can be drawn the longer it is analyzed (Dykes, 2017). Recently, however, the information age has given birth to the concept of big data, in which massive amounts of data are available for users to interpret. Big data has grown the quantity of data that is perishable, similar to the data that military commanders utilize in tactical operations. The three tenants of big data are variety, volume, and velocity. In our interviews, our subjects recounted senior leaders' drives for volume and variety in the data they consumed, but they did not transfer the data's velocity into decision velocity. Amazon CEO Jeff Bezos (2017) stresses the importance of rapid decision-making followed by rapid adjustment:

> Most decisions should probably be made with somewhere around 70% of the information you wish you had. If you wait for 90%, in most cases, you're probably being slow. Plus, either way, you need to be good at quickly recognizing and correcting bad decisions. If you're good at course correcting, being wrong may be less costly than you think, whereas being slow is going to be expensive for sure. (p. 3)

The pictures painted by our subjects suggest that this is not the case within the DoD. It is true that modern data can still age like wine, but senior leaders must trust lower level decision-makers and empower them with the ability to differentiate between what needs further analysis and what is perishable and requires rapid action now.

Revolutions in military affairs have been arriving at accelerating rates. From gunpowder taking centuries for full adoption, to steam engines, telegraphs, and railroads taking a single century, and to radio, flight, and the internal combustion engine taking only decades, it is expected that future revolutions will continue to come faster and faster

(Singer, 2009). As the revolutions come quicker, decision-velocity will become ever more important in the DoD and has been spelled out in the 2018 National Defense Strategy:

> *Deliver Performance at the speed of relevance*. Success no longer goes to the country that develops a new technology first, but rather to the one that better integrates it and adapts its way of fighting. Current processes are not responsive to need; the Department is over-optimized for exceptional performance at the expense of providing timely decisions, policies, and capabilities to the warfighter. Our response will be to prioritize speed of delivery, continuous adaptation, and frequent modular upgrades. We must not accept cumbersome approval chains, wasteful applications of resources in uncompetitive space, or overly risk-averse thinking that impedes change. Delivering performance means we will shed outdated management practices and structures while integrating insights from business innovation. (Mattis, 2018, p. 10)

> *Organize for innovation.* The Department's management structure and processes are not written in stone, they are a means to an end—empowering the warfighter with the knowledge, equipment and support systems to fight and win. Department leaders will adapt their organizational structures to best support the Joint Force**.** If current structures hinder substantial increases in lethality or performance, it is expected that Service Secretaries and Agency heads will consolidate, eliminate, or restructure as needed. The Department's leadership is committed to changes in authorities, granting of waivers, and securing external support for streamlining processes and organizations. (Mattis, 2018, p. 10)

In order for the acquisition community to continue to grow, we must empower and develop leaders to be more entrepreneurial within the DoD. This idea is neither new nor is it only speaking to creative ideas. This person would have the ability to create and develop the right team for the job. "Experienced professionals in the entrepreneurial arena, whether they are bankers, lawyers, venture capitalists, or other investors have always agreed with successful entrepreneurs that finding and leading the right people is the key to creating an enduring venture" (Sarasvathy, 2008. p. 8). One of the most powerful tools that a leader has is the ability to establish and utilize the right people for the job at hand, and that is a critical ability that is lacking within the DoD.

The modern acquisition decision-making models can only improve by empowering the right people and placing them closer to the operation to make quicker decisions. Program managers already bear the responsibility and accountability of the systems they

manage, but they are not granted the authority that should come with responsibility and accountability. Senior leaders have excelled under the past culture of zero-defect and industrial-based, top-focused decision-making models, and they have continued that mindset in a modern world that must accept some risks and rapidly adapt changes. Leadership regularly speak of "thinking outside the box," which, in the world of acquisition, is the Federal Acquisition Regulation (FAR). Unfortunately, the current system is tailored to reward those who remain in the box. As the DoD has a top-down emphasis on improving structures and increasing speed, now is the time to reinvent the acquisition decision-making model and empower program managers to make the decisions the programs need to deliver the capabilities the warfighters require.

B. RECOMMENDATIONS FOR FURTHER STUDY

These findings were developed based on the professional opinions of two program managers. More interviews should be conducted to determine if this trend is localized or endemic. Given the current backing of reform from the National Defense Strategy, a DoD-wide program manager analysis of decisions should be undertaken, determining correlation and causality in order to determine if a decision had any effect on program outcome. The next phase would be to determine what lead to that decision and if the decision-making model needs to be captured as a best practice or a lesson learned.

With the momentum from the National Defense Strategy, the DoD acquisition process needs to be evaluated to determine where risk can be accepted, or at a minimum to identify procedures that allow more risk to be accepted in various forums. This could be accomplished by developing additional "doors" for program managers to exit the prescribed FAR. This could be through the Other Transaction Authority contract vehicles, but a hybrid model may better be applied to establish programs of record.

Additional research into techniques to transform the military industrial complex out of the industrial age and into the information age could also be conducted. Information can be easily reproduced, while military forces cannot, so perhaps the military cannot evolve into a pure information age force, as we must still maintain "boots on the ground."

C. FINAL THOUGHTS

In 1996, during the adolescent years of the information age, Al Gore, "the first political leader to recognize the importance of the internet" (Kahn & Cerf, 2000, para 1), spoke of the power of distributed processing:

> Distributed intelligence offers a pretty coherent explanation for why democracy triumphed over governments that depended on all-powerful central processing units. And it helps explain why American businesses are pushing power, responsibility, and information away from the center—and out to the salespeople, engineers, and suppliers who know the product best. (Gore, 1996)

Gore may have been speaking of the physical computer processor, but it is a striking analogy to the distributed decision-making model our nation needs today.

LIST OF REFERENCES

Ancona, D. (n.d). *Sensemaking: Framing and acting in the unknown*. Retrieved October 17, 2018, from https://www.sagepub.com/sites/default/files/upm-binaries/42924_1.pdf

Bezos, J. (2017, April 12). Jeff Bezos 2017 annual shareholder letter. Retrieved from http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NjY2MjA1fENoaWxkSUQ9Mzc0MDUyfFR5cGU9MQ==&t=1

Boston University. (2017, November 16). Printing press, digital age, and social movements. Retrieved from https://sites.bu.edu/cmcs/2017/11/16/printing-press-digital-age-and-social-movements/

Combat Aircraft. (2012, May 3). Final F-22 delivered. Retrieved from https://combataircraft.keypublishing.com/2012/05/03/final-f-22-delivered/

Cowings, J. S. (2012). Strategic leadership and decision-making. Retrieved from http://www.au.af.mil/au/awc/awcgate/ndu/strat-ldr-dm/cont.html

Defense Acquisition University (DAU). (n.d.). Program of record. Retrieved October 3, 2018, from https://www.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=2f2b8d1e-8822-4f88-9859-916ad81b597e

Defense Acquisition University (DAU). (2017, December 05). *Defense acquisition guidebook*. Retrieved from https://www.dau.mil/tools/dag

Defense Acquisition University (DAU). (2018, January 31). Defense acquisition life cycle wall chart (Ver. 1.2). Retrieved from https://www.dau.mil/tools/t/Department-of-Defense-Acquisition-Life-Cycle-Chart

Department of the Army (DoA). (2011). *Army tactical standard operating procedures* (ATP 3–90.90). Retrieved from https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/atp3_90x90.pdf

Department of the Army (DoA). (2012). *The operations process* (ADRP 5–0). Retrieved from https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/adrp5_0.pdf

Department of the Army (DoA). (2015a). *Army aviation* (FM-3-04). Retrieved from https://fas.org/irp/doddir/army/fm3-04.pdf

Department of the Army (DoA). (2015b). *Evaluation reporting system* (AR 623–3). Retrieved from https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r623_3.pdf

Department of the Army (DoA). (2017). *Command post organizations and operations* (ATP 6–0.5). Retrieved from https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ATP%206-0_5%20(final).pdf

Department of Defense (DoD). (2008). *Principles of strategic communication.* Retrieved from http://www.au.af.mil/info-ops/documents/principles_of_sc.pdf

Desjardins, J. (2017, February 8). How many millions of lines of code does it take? Retrieved from http://www.visualcapitalist.com/millions-lines-of-code/

Duke, A. (2018). *Thinking in bets: Making smarter decisions when you don't have all the facts.* New York, NY: Portfolio.

Dykes, B. (2017, June 2017). Big data: Forget volume and variety, focus on velocity. Retrieved from https://www.forbes.com/sites/brentdykes/2017/06/28/big-data-forget-volume-and-variety-focus-on-velocity/#5835654b6f7d

Fallows, J. (2002, June). Uncle Sam buys an airplane. *The Atlantic*. Retrieved from https://www.theatlantic.com/magazine/archive/2002/06/uncle-sam-buys-an-airplane/302509/

Federal Business Opportunities. (2018, October 3). Advanced pilot training (APT) family of systems (FoS) program, commonly referred to as "T-X." Retrieved from https://www.fbo.gov/index?s=opportunity&mode=form&id=d269f42d1e71393420a00779e7d11b5d&tab=core&_cview=1

Gore, A. (1996, February 14). The technology challenge: How can America spark private innovation? Retrieved from https://homes.cs.washington.edu/~lazowska/faculty.lecture/innovation/gore.html

Government Accountability Office (GAO). (n.d.). Reports and testimonies—Browse by topic. Retrieved October, 16, 2018, from https://www.gao.gov/browse/topic/National_Defense/Defense_procurement/

Government Accountability Office (GAO). (2018, October 2). About GAO reports. Retrieved from https://www.gao.gov/about/products/about-gao-reports.html

GovTrack. (n.d.). Members of Congress. Retrieved October 3, 2018, from https://www.govtrack.us/congress/members

Hall, J. B. (2017, March). *Department of Defense developmental test and evaluation FY 2016 annual report.* Washington, DC: Deputy Assistant Secretary of Defense. Retrieved from https://www.acq.osd.mil/dte-trmc/docs/FY2016_DTE_AnnualReport.pdf

Hall, T. (2013, February 19). A cultural decide: Differences in decision-making between Japan and the United States. Retrieved from https://www.cuinsight.com/a-cultural-decide-differences-in-decision-making-between-japan-and-the-united-states.html

Hilbert, M. (2011, April 1). World's information capacity PPTS. Retrieved from http://www.martinhilbert.net/WorldInfoCapacityPPT.html/

Information age. (n.d.). In *American Heritage Dictionary*. Retrieved September 26, 2018, from https://www.thefreedictionary.com/information+age

Jones, R. (2017, December 3). Why do programs fail? An analysis of defense program manager decision making in complex and chaotic program environments. Retrieved from https://my.nps.edu/documents/105938399/110512600/NPS-AM-18-020.pdf/

Kahn, R., & Cerf, V. (2000, 29 September). Al Gore and the internet. Retrieved from http://amsterdam.nettime.org/Lists-Archives/nettime-l-0009/msg00311.html

Kahneman, D. (2011). *Thinking, fast and slow.* New York, NY: Farrar, Straus, and Giroux.

Kendall, F. (2015). *Performance of the Defense Acquisition System, 2015 Annual Report,* Washington, DC: Office of the Under Secretary of Defense, Acquisition, Technology, and Logistics (OUSD[AT&L]). Retrieved from https://admin.govexec.com/media/gbc/docs/pdfs_edit/performance-of-defense-acquisition-system-2015.pdf

Kissel, R. (1999). *The hidden cost of down-sizing: A zero defects and risk avoidance mentality.* Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a525755.pdf

Lowden, G., & Thornton, J. (2015, May 11). *The special challenges of project management under fixed-price contracts*. Paper presented at PMI Global Congress 2015—EMEA, London, England. Newtown Square, PA: Project Management Institute.

Mattis, J. (2018). *National Defense Strategy.* Washington, DC: Secretary of Defense. Retrieved from https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf

National Enquirer Staff. (2016, October 3). 90 years of the National Enquirer! Find out how one magazine changed modern journalism. Retrieved from https://www.nationalenquirer.com/celebrity/national-enquirer-90th-anniversary-panel/

Prentice, R. (n.d.). Conformity bias. Retrieved from https://ethicsunwrapped.utexas.edu/video/conformity-bias

Record, J. (1997). *The information age: An anthology on its impact and consequences.* Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/a461496.pdf

Ropeik, D. (2014, December 1). How the information age makes it harder to make informed choices about risk (or anything else). Retrieved from https://bigthink.com/risk-reason-and-reality/how-the-information-age-makes-it-harder-to-make-informed-choices-about-risk-or-anything

Ryan, K. (2004, June 21). Shocking CIA leak reveals Dick Cheney is a robot. *Weekly World News*. Retrieved from https://books.google.com/books?id=z_MDAAAAMBAJ&lpg=PA2&as_pt=MAGAZINES&pg=PA2#v=onepage&q&f=false

Sarasvathy, S. (2008, October 21). *What makes entrepreneurs entrepreneurial?* Retrieved from https://www.effectuation.org/sites/default/files/documents/what-makes-entrepreneurs-entrepreneurial-sarasvathy.pdf

Singer, P.W. (2009, December 29). *Wired for war: The robotics revolution and conflict in the 21st century.* New York, NY: Penguin.

Straus, J. R., & Glassman, M. E. (2016). *Social media in Congress: The impact of electronic media on member communications* (CRS Report R44509). Retrieved from https://fas.org/sgp/crs/misc/R44509.pdf

U. S. Const. art. 1, § 8. Retrieved from https://www.usconstitution.net/xconst_A1Sec8.html

Vosoughi, S., Rou, D., & Aral, S. (2018, March 9). The spread of true and false news online. Retrieved from http://science.sciencemag.org/content/359/6380/1146

Weick, K. E. (1995). *Sensemaking in organizations*. Thousand Oaks, CA: Sage.

World Bank. (2018, October 3). Military expenditure (% of GDP). Retrieved from https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=US

Wright-Brothers. (n.d). Signal corps specification no. 486. Retrieved November 230, 2018, from http://www.wright-brothers.org/History_Wing/Wright_Story/Showing_the_World/Back_in_Air/Signal_Corps_Spec.htm

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