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IMPLEMENTATION OF DIGITALIZATION TO THE DECISION-SUPPORT AND DECISION-MAKING PROCESS

by

Michael W. Astrino and Adrian L. Lopez

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Thesis Advisor: Anthony M. Canan
Second Reader: Glenn R. Cook

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One of the most difficult aspects of being a leader today is the burden of making a formulated decision in a complex environment. Everything we do in professional environments is centered around making a decision or supporting the decision maker. Information and raw data are consistently being processed and briefed to decision makers all in expectations of clearing out the ambiguity of the issues. The data and information that are being processed come in all types of mediums: word of mouth, written on paper, saved on individual computers, or stored in large data centers. For the discussion of the thesis, it is not just looking into the simplistic answer of moving data from written paper to computers. Instead, this thesis explores what systems and programs military organizations have available to them to assist in the decision support and decision-making process, and whether these organizations and their members are using these assets to their advantage.

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IMPLEMENTATION OF DIGITALIZATION TO THE DECISION-SUPPORT AND DECISION-MAKING PROCESS

Michael W. Astrino
Captain, United States Marine Corps
BS, Pennsylvania State University, 2017

Adrian L. Lopez
Major, United States Marine Corps
BS, University of Texas, Tyler, 2010

Submitted in partial fulfillment of the
requirements for the degree of

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June 2023

Approved by: Anthony M. Canan
Advisor

Glenn R. Cook
Second Reader

Alex Bordetsky
Chair, Department of Information Sciences

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ABSTRACT

One of the most difficult aspects of being a leader today is the burden of making a formulated decision in a complex environment. Everything we do in professional environments is centered around making a decision or supporting the decision maker. Information and raw data are consistently being processed and briefed to decision makers all in expectations of clearing out the ambiguity of the issues. The data and information that are being processed come in all types of mediums: word of mouth, written on paper, saved on individual computers, or stored in large data centers. For the discussion of the thesis, it is not just looking into the simplistic answer of moving data from written paper to computers. Instead, this thesis explores what systems and programs military organizations have available to them to assist in the decision support and decision-making process, and whether these organizations and their members are using these assets to their advantage.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR	area of responsibility
CCLEB	Commandant's Career Level Education Board
CFT	Combat Fitness Test, USMC
CJTF	Combined Joint Task Force
CEO	Chief Executive Officer
COA	course of action
CPIB	Commandant's Professional Intermediate Board
CPTR	Combat Physical Training Representative, USMC
DBMS	database management system
DEOS	Defense Enterprise Office Solutions
DOD	Department of Defense
DM	decision making
DSS	decision support system
DTMS	digital training management system
FFI	Force Fitness Instructor
GEARS	Global Electronic Approval Routing System
LSE	Large Scale Exercise
MBMS	Model Based Management System
MCTIMS	Marine Corps Information Management System
MCWP	Marine Corps War Fighting Publication
MOS	Military Occupation Specialty
NAVMC	Navy and Marine Corps [Form]
NPS	Naval Postgraduate School
NWC	Naval War College
O3	Officer Grade Three
O5	Officer Grade Five
O365	Microsoft Office 365
OIR	Operation Inherent Resolve
OODA	observe, orient, decide, act
PFT	Physical Fitness Test, USMC

JP	Joint Publication
SaaS	software as a service
SNCO	Staff Non-Commissioned Officer
SOCOM	Special Operations Command
SOF	Special Operation Force(s)
JLOC	Joint Logistics Operations Center
USMC	United States Marine Corps
VTC	Visual Telecommunications

EXECUTIVE SUMMARY

All organization actions are a result of a decision that was made. Our thesis focused in on how military organizations utilize digitization and digitalization technologies in decision support systems (DSS) to support decision making (DM) processes to make them more effective decision makers on the battlefield.

In our thesis, we trace back to the history and theories behind human decision making. We combined multiple factors and ideas from numerous sources and research to operationally define the variables we saw that contribute the most to DM, which are: trust, heuristics, and knowledge. Once our study identified factors that influence DM we studied how DSS and technologies have historically assisted humans in the DM processes. Upon establishing a baseline understanding of DSS and DM we had to understand the foundational concepts of what digitization and digitalization are and what makes these concepts unique from one another.

As we progressed in our study and conducted surveys with United States military personnel and civilian support staff, we came to a realization: A majority of the personnel we surveyed—to include ourselves—had a misunderstanding of what digitization and digitalization really are. Our study and research identified that, from the beginning, we were asking the wrong questions. We had assumed that U.S. military organizations were utilizing more digitalized DSS technologies in the DM process than actually proved to be the case. As a reader goes through this study, our progressive understanding of what digitization and digitalization are and how those concepts fit into DSS technologies and DM processes is revealed.

Our study concludes with the realization that many of the DSS technologies that we utilize to support the DM process in the military are not digitalized after all. Many of the DSS technologies that the military uses today are digitized processes; essentially electronic rather than paper-based media, all of which still require human interaction to have any relevance in the DM process. While digitized processes do have benefits, achieving digitalization is still a far reach for the DSS technologies available at present.

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I. INTRODUCTION

Organizations are making decisions every day that affect the people within the organization as well as the lives of so many others. Within military organizations, decisions must be made in complex and chaotic environments. In such environments, often there are only fragments of data available that must be piecemealed together. Before the technological age, data and information were passed along the battlefield through various methods, some of which consisted of couriers who passed information through visual signals, handwritten messages, or by voice. Today's military organizations transfer data through multiple types of mediums to include voice, video, chat, and email to name a few. The large quantities of data serve a purpose, which is to assist humans in decision support (DSS) and decision making (DM) processes.

With terabytes of information being passed in and through military organizations, the data still needs to be processed so that it can be utilized for DS and DM processes. The method that we most commonly use today is what is known as a digitized process, which means information is gathered and inputted into a computer. Digitizing information can be done in multiple ways to include manually inputting information into the computer, scanning documents, or filling in information on an online form. Once digitized, the information still needs to be processed for the data to be useful. The processing of the data for DS and DM can be time consuming and fallible to human error. In a digitalization process, information is inputted into databases. From there, the data is processed and analyzed by computers from which humans can query the data to assist in DS and DM processes.

Given that miliary organizations must make decisions that affect the lives of millions of people, it is important to understand what technological processes military leaders and support staff are using to assist them in the DS and DM process.

A. PROBLEM DESCRIPTION

The problem is that military organizations may not be integrating available digitalization tools to assist in the DSS and DM process. This is a problem because

although these technologies exist, military organizations might not be taking advantage of tools that can not only assist, but also greatly augment DSS and DM processes. This underutilization can put military organizations into a disadvantage against other adversaries that are utilizing digitalization processes.

B. PURPOSE OF THE THESIS

The purpose of this research is to examine if various U.S. military organizations are using digitization or digitalization processes to assist in DSS and DM processes. This is important because the U.S. military has initiatives and strategies such as the DOD Modernization Strategy, which places a focus on providing the warfighter with the most up to date technologies available to help fight and win our nations wars. This thesis is focused on understanding where the military currently stands in this process and if the military is using all the tools available to help make better decisions.

C. POTENTIAL VALUE

The value that this research will provide to military organizations is an improved perspective for military leaders on where to focus efforts when it comes to implementing digitization and digitalization into DSS and DM processes. Additionally, this study will examine if the humans we surveyed and are working in different facets within the DOD are aligned with current efforts and initiatives that are being met in the *DOD Modernization Strategy.*

D. EXPECTED OUTCOMES

Through the conduct of this study, it is expected to learn what the implementation of digitization and digitalization of DSS and DM tools looks like in today's military organization. To gain a better understanding of what digitization and digital modernization mean to current service members, and whether service members see these modernization tools as a positive or negative for their organization.

II. LITERATURE REVIEW

A. DECISIONS

Humans make decisions, from deciding what to wear and eat or policy makers deciding on the future of a State and everything in between a decision must be made. Pitz emphasized "decisions occur as responses to uncertainty; the initial statement of a problem leaves many questions unanswered, and a person's subsequent behavior is a reflection of efforts to remove or cope with the uncertainty*"* (Pitz, 1984, p. 148). To further understand why humans make decisions, it is important to learn the history decisions. In early civilizations it was believed that higher powers, priest, and oracles were the ones in charge of deciding for the general population (Buchanan, 2006). In the ninth century with the further advances in mathematics and science humans began to realize that occurrence/ incidents did not happen because of external higher powers, occurrences could now be explained by math and sciences. This advent of knowledge pulled the deciding power away from priest and oracles and resulted in the foundational groundwork for humans to make their own choices.

North's discussion in *A Tutorial Introduction to Decision Theory* is an interesting analysis of why he assumes a decision must be made, his studies are centered around a notion that decisions are a *cause* and the end result is an *effect* (North, 1968). North also argues that "decision theory provides a rational framework for choosing between alternative courses of action when the consequences resulting from this choice are imperfectly known" (North, 1968, p. 200). North's analysis of *decision theory* is not as binary as he would leave a reader to believe, his studies allude to that reader that humans make decisions because they know the potential outcome. Alternatively, humans sometimes make decisions because they do in fact know specifically the outcome. Sage identifies four types of decision that humans can encounter. These four types are:

1. Strategic Planning Decisions: decisions related to choosing highest-level policies and objectives, and associated resource allocations.
2. Management Control Decisions: decisions made for the purpose of assuring effectiveness in the acquisition and use of resources.

3. Operational Control Decisions: decisions made for the purpose of assuring effectiveness in the performance of operations.
4. Operational Performance Decisions: day-to-day decisions made while performing operations. (Sage, 1991, p. 2)

When an individual is trying to categorize their decisions to these decision types, our studies have determined that these types of are subjective/relative to the individual decision maker.

All decisions involve a choice, and this has been the case since ancient times. Even during the times when decisions dictated by an outside source, an individual seeking guidance still had *choice* to adhere to the decision that was made or not execute as directed (Buchanan, 2006). In North's discussion of *decision theory*, even though there is not a consensus on how decisions are made because *results are imperfectly known*, it is still identified that the foundation of the decision is based around a choice (North, 1968). Examining the history, theory, and types of decisions the constant theme that is seen throughout the research is that a choice must be made.

1. Factors That Affect Decisions

Holcomb identifies several key factors in decision-making, such as sensemaking, trust, tacit knowledge, explicit knowledge (Holcomb, 2018). In addition to these factors, Gigerenzer's argued that logic, probability, and heuristics are also key factors in decision making (Gigerenzer, 2008). Among these seven factors this study identified three key factors that played a noteworthy role in decisions as shown in Figure 1. These three factors are: trust, knowledge, and heuristics. When analyzing these three factors that affect decision making, it is important to note that these three factors do not flow in one direction and stop, these factors are free flowing and situational dependent. There might be times where trust is the most important factor and another situation where heuristics is central; every situation is different.

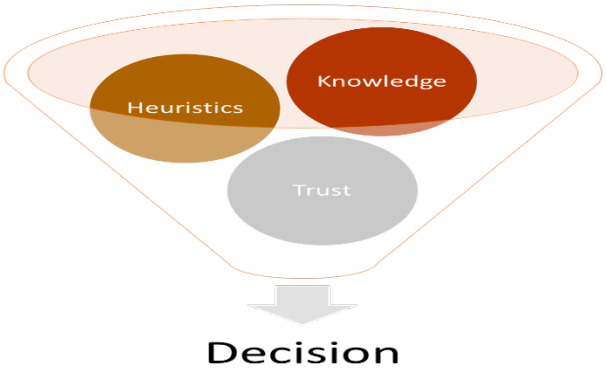


Figure 1. Factors that affect decisions.

a. Trust

Trust is an intangible concept that humans consciously or unconsciously use every day to guide their decisions. Trust is defined as "an assured reliance on the character, ability, strength, or truth of someone or something in which confidence is placed" ("Trust," 2022). The definition within itself leaves much to interpretation to the one entrusting someone or something to help guide their decision. There is a *grey area* based on what someone would distinguish as *assured reliance.* Allen and Wilson's investigated the relationship of managers and subordinates in an organization and how trust plays a pivotal role in the exchange of information in *Vertical Trust/Mistrust During Information Strategy*. The study identifies five key concepts of trust that are looked for in someone/something in the exchanging of information: competence/coherence, openness, benevolent, and reliability with integrity (Allen & Wilson, 2003, p. 234). The premise that on which they based their argument while identifying the concepts is reliability, otherwise referred to as assured reliance. Basically, is the source *trustworth*y? In Holcomb's study it is identified that among all the variables that he observed [decision-making, such as sensemaking, trust, tacit knowledge, explicit knowledge], trust was the most important variable that increased the overall decision velocity; when a manager trusts their subordinates they could push decision making authority down, therefore decreasing the time it take to make a decision (Holcomb, 2020).

b. Knowledge

There are two main knowledge categories: *tacit and explicit.* The American Psychological Association defines tacit knowledge as; "knowledge that is informally acquired rather than *explicitly* taught and allows a person to succeed in certain environments and pursuits" (Merriam-Webster, 2022) knowledge learned from personal experiences. Explicit knowledge is knowledge that can be expressed in words, numbers, and symbols and stored in books, computers, etc. (Merriam-Webster, 2022) knowledge that is learned or taught.

Manuel Becerra et al. analyzed the linkage between trust and knowledge, citing *the transfer of knowledge in alliances entail risk to partners, whose willingness to accept it presumably relies on the trustworthiness that they perceived in their partners* (Becerra et al., 2008, p. 691). His study identifies a crucial bond that must form between knowledge and trust. For a DM to begin making a formative decision they must have trust in the knowledge they receive. This also presents the variable of *risk*, Becerra's study examines the potential risk that is involved with accepting knowledge, a receiver of knowledge gives trust to the giver the knowledge. When the receiver accepts that knowledge, they assume the risk of that knowledge being correct, hence the trust that is formed between the giver and receiver of knowledge (Becerra et al., 2008).

In Markus's study of *Theory and Knowledge Reuse* she observed that the purpose of knowledge in an organization is useful when they needed to recall a reason that decision was made or when a decision needed to be revisited (Markus, 2001, p. 64). In this situation not only would explicit knowledge be beneficial (e.g., looking at previous after-action reports or accessing data bases). The addition of questioning of humans that were a part of the process would provide helpful insight into the undocumented variables that were involved in that decision making process. In these discussions the interviewee would be able to observe the temperament of the people and environment.

c. Heuristics

Hoffrage eloquently described heuristics *as "*useful shortcut [s], and approximation, or a rule of thumb for searching through space for a possible solution"

(Hoffrage & Reimer, 2004, p. 439). Heuristics differs with tacit knowledge in the sense that tacit knowledge builds off of human heuristics. Heuristics helps a decision maker make a logical pattern in their thought processes. These patterns at first are a jumbled Lego set that is unrecognizable, but as they move through various situations, contexts, and experiences the individual pieces begin to become a recognizable object. With more experience, a human will begin to realize that they can use these situations, contexts, and experiences to better help them decide.

2. Mental Models

In the earlier Lego analogy, Lego pieces compared to thought processes, an eloquent corresponding definition of that example would be *mental models*. Jones et al. defined a mental model as a *cognitive representation of external reality* (Jones et al., 2011a or 2011 b, p. 46); simplistically put it is a human's personal interpretation of how things work. Mental models are the tools that humans use to process information concerning all aspects of life. Mental models also assist in helping travers through the unknown as Jones pointed out:

> When a person explains a domain with which they are unfamiliar, they tend to draw on a familiar domain, which they perceive as similar. This involves tapping into an existing mental model and importing its relational structure to another domain. (Jones, 2011, p. 46)

Mental models are a crucial element when making any decision; the problem occurs when the "decider" must arrange the complex patterns of information process the information and update the existing mental representation or adapt/develop a new one to understand what decision needs to be made (Pitz, 1984, p. 147). As discussed in the factors that affect decision making, there is no set standard to determine how a mental model is created within someone's mind because of the following two reasons. First, "mental models and proposition representation can be distinguished on a number of criteria" Johnson-Laird, 1980, p. 98); Second, the set criteria differ from person to person. "In building the mental model there are plenty of issues left uncertain by the problem statement, uncertainties that must either be resolved or represented in the model in some way*"* (Pitz, 1984, p. 147).

3. Technology in Decision Making

Technology integration into the decision-making process is a dual-edged sword; in once sense "technologies can support more flexible strategic decision-making processes*"* (Andersen, 2001, p. 102). In the other hand, they can burden the decision-making process with an influx of information, which could delay the decision-making process or even a non-acceptance of technological tools by an organization focused in assisting in the decision-making process (Chakraborty, 2008).

Chakraborty's analysis of integration on technologies into decision making cognitive styles [mental models] will dictate the perceived usefulness of technologies into organizational processes (Chakraborty, 2008, p. 232). Whereas in Markus's study she observed "only [in] explicit knowledge is the province of information technology, including the communication systems by which people informally share their observations and the more formal repositories in which structured knowledge is stored for later reuse." (Markus, 2001, p. 58).

At the confluence of these two studies, it can be concluded that technology in decision making can be useful if the user perceives it as *useful*. A key variable that is identified that will help a user decided if technology is *useful* in decision making is the explicit knowledge that is given to learn the technology. If users are not provided adequate explanation via training on how to use new technologies, it can result on them having a negative perception of the new technologies that are adapted.

B. DIGITIZATION AND DIGITALIZATION

The terms digitization and digitalization are often used interchangeably; however, the terms have different meanings. Samoilenko (2022) made a clear distinction between these two terms. Samoilenko (2022, p. 1) defined digitization as "the process of using digital information technologies to convert analog data into its digital counterpart*."* This aligns with the Information Technology Glossary from Gartner.com, which defines digitization as *"*the process of changing from analog to digital form, also known as digital enablement. Said another way, digitization takes an analog process and changes it to a digital form without any different-in-kind changes to the process itself (Gartner Inc., n.d.)*."*

Similar definitions highlight that the definition of digitization is generally agreed upon. This is emphasized by the fact that Bloomberg (2018) referred to digitization as the term that is straightforward in comparison to digitalization. The takeaway from these definitions is that digitization is simply an action. The methods for accomplishing tasks are not necessarily improved upon through digitization alone.

The benefit of performing digitization is that once a physical copy is converted to digital form, it can be easily disseminated to a large audience and collaborated upon in a software package such as Microsoft Office 365. Unfortunately, the digitization process can sometimes lead to cumbersome processes that do not provide any benefits to the organization. For example, the directed study approval process at the Naval Postgraduate School used to require email correspondence between the student, instructor, academic associate, program officer, and the department chair. In the case of an overloaded schedule, the Vice Provost or Provost would also be in this approval chain. This required routing of the document and a digital signature from all parties to finally gain approval for a directed study. This process has since improved to an automated workflow that eliminates a chain of emails, but the process is still digitized. The point is that while digitization can improve certain tasks, digitalization has much greater potential in delivering value to the entire organization.

Samoilenko (2022, p. 2) described digitalization on the other hand, as using digitization "to improve the existing state of affairs in business and to change, or create new, business models and streams of revenue, then we get digitalization." For this research, the significant part of this definition is the improvement of an existing state to positively alter business models. In other words, digitalization changes old processes and creates new processes that are more efficient and effective. Processes are connected and made simpler. The portion about creating new streams of revenue would not be applicable in the context of this research. For example, the submission of Physical Fitness Test scores (PFT) and Combat Fitness Test scores (CFT) are digitized processes in the Marine Corps. A force fitness instructor (FFI) or command physical training representative (CPTR) will monitor the test and fill in NAVMC 11622 manually. The NAVMC will then be uploaded into the Marine Corps Training Information Management System (MCTIMS). From there, another

individual will approve the document and it will populate in other systems such as a Marine's Master Brief Sheet and Marine Online. A digitalized process would be recording the scores digitally from the beginning, and then submitting for automatic population into all systems tied to the individual Marine.

To show the similarity between Samoilenko's definition with the Information Technology glossary used previously, Gartner.com defined digitalization as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business." However, Bloomberg's (2018) characterization of the term digitalization is both ambiguous and confusing. This is because its interpretation is different by many. For example, Brennen and Kreiss (2016) defined digitalization as "the way many domains of social life are restructured around digital communication and media infrastructures." This social perspective is important to this thesis because a digitalization tool such as Microsoft Office 365 will change the way people communicate, interact, and ultimately ameliorate task accomplishment.

To further conceptualize the notion of digitalization in an organization, it is essential to review the possible effects of digitalization in an organization. A common theme in the literature is that digitalization effects can be within three key dimensions. Parviainen et al. (2017) and Sehlin et al. (2019) both stated that digitalization impacts come from the areas of internal efficiency, external opportunities, and disruptive change. Typically, internal efficiency refers to better business process efficiency and a better real time view on operations due to data integration enabled by digitalization (Parviainen, 2017). In the context of this research, internal efficiency means that improved internal efficiency enabled by digitalization can speed up the decision-support and decision-making process; in part, makes digitalization especially useful in a time sensitive environment. In addition, data integration enabled by digitalization can lead to a more effective decision-support and decision-making process because a more comprehensive and time sensitive picture of the current situation can be provided to key decision-makers and their staff.

Parviainen (2017) described external opportunities mostly as new and improved ways of servicing the customer, but another part of the description was the potential for

new ways of doing business. This aligns with Samoilenko's definition for digitalization and the definition from Gartner.com. Although "new ways of doing business" is a general statement, it is relevant to the arguments in this research. This is because "new ways of doing business" are enabled by digitalization tools that can provide improved methods of supporting decision-making.

Finally, disruptive changes refer to changes in a company's operating environment due to the implementation of digitalization (Parviainen, 2017). For example, manual tasks can become automated and people within the organization will be employed differently than they were previously. People must adapt to changes that digitalization and digital technologies bring into the organizations. For example, in the context of the Department of Defense (DOD), this can be an outcome when users transition to the use of Microsoft 365 and its applications for the decision-support and decision-making process.

Lastly, it is important to mention some of the pitfalls that would limit the previously discussed positive impacts of digitalization. Samoilenko (2022) stated that integration failure due to technological complexity, a failure of human capability, and a failure to invest in complementary areas could all be reasons why an organization does not get full value out of digitalization initiatives. Microsoft 365 has already begun to be integrated into military organizations, so potential failure in the DOD can be as follows. Human capability can be an issue if users lack knowledge and do not receive training for the intended use of Microsoft 365 applications that are designed for decision support. It was not made clear what Samoilenko was referring to in terms of complementary areas; however, Samoilenko (2022) states that organizational change must occur concomitantly with digitalization. Therefore, it is reasonable to identify the two complementary areas by using a framework called the Information Systems (IS) Strategy Triangle (Pearlson & Sanders, 2009). The two complementary areas then become business strategy and organizational strategy. The IS Strategy Triangle framework shown in Figure 2 states that a firm's business strategy, which is the plan for where the firm wants to go and how that will be achieved, must drive organizational and information strategy (Pearlson & Sanders, 2009). Organizational strategy deals with organizational design and work processes, and information strategy is an organization's plan for how it provides information services (Pearlson & Sanders,

2009). Microsoft 365 implementation is a change in information strategy. That change should stem from a change in business strategy, and organizational strategy must also change to account for a change in information strategy. If this does not occur, it presents a risk of failure in digitalization initiatives tied to Microsoft 365. This is because the business strategy, organizational strategy, and information strategy will potentially be out of alignment. Alignment in this case means that technology enables, supports, and does not constrain a company's current and emerging business strategy (Hoque et al., 2005).

Figure 2. IS Strategy Triangle. Source: Pearlson and Sanders (2009).

1. Mental Models in the Context of Digitalization

Senge (2006) described mental models as "deeply held internal images of how the world works." They are important because mental models can limit a person to think or act in ways that are familiar (Senge, 2006). Mental models of the people in an organization with respect to technology may support or hinder digitalization implementation depending on their mental models of digital technologies.

As stated previously, the construction of mental models is unique and personal (Jones, 2011). Mental models are also probabilistic in nature, and this was made clear when Johnson-Laird (1980) mentioned that mental models can be created based on numerous criteria. While numerous criteria can influence a person's mental model, two specific criteria have the most influence on a person's mental model in the context of digitalization. The first criterion is an individual's belief of their own level of proficiency regarding the

use of digital technologies. The second one, a major influencer, is an individual's prior digital technology experience.

The first claim about individual proficiency beliefs was supported by Peiffer et al. (2020) in the discussion of competence beliefs. The argument is that subjective competence beliefs, which refer to perceptions of one's own performance, competence, and ability, can have influence in a digital systems context (Peiffer et al., 2020). Digital systems in this example refer to digital information and communication technologies (ICT). Peiffer et al. (2020) expanded further by stating that an individual's competence beliefs affect their own stress level and level of trust in technology use. The second claim about prior experience being a major factor is supported by Olesen (2014, p. 3): "user resistance has its base in a user's prior interactions with technology. The term 'resistance' does not imply as being good or bad, but rather describes user adjustment to new technology." This means that a user's prior experience and history with technology is what influences the level of resistance. Thus far articulated claims in this research are also supported by Jones et al. (2011), who argue that mental models are created through unique life experiences and perceptions. Consequently, as it is augmented by Senge's (2006) discussion on mental models, an individual's internal images and familiarity with technology, which is heavily influenced by competence beliefs and experience regarding technology use, will influence the likelihood of the embracement of digitalization initiatives.

Mental models, shaped by perceived competence and prior experience, will play a role in the success or failure of the DOD's Microsoft 365 digitalization initiative. Members within an organization with optimistic mental models on digital technologies will be more open to the intended use of Microsoft 365 than members within an organization who largely exhibit pessimistic mental models towards digital technologies.

2. Digitization and Digitalization in Military Organizations

MCDP 1 *Warfighting* stated that uncertainty is present in all actions in war (DOD, 2018). The publication expanded on this further and stated that incomplete, inaccurate, and contradictory information will be present in all actions in war (DOD, 2018). Furthermore, the publication also stated that consistently making faster decisions than the adversary in

war creates a substantial and often decisive advantage (DOD, 2018). Digitalization initiatives such as the implementation of Microsoft Office 365 and its applications can be an asset to a commander and his/her staff in the DS and DM processes because using these advanced tools can reduce uncertainty, and decisions can be made with the support of more complete, accurate, and timely information. In return, increased decision speed becomes attainable.

The stated benefits were evident in a review of the prior literature. For example, Öhman et al. (2016) stated that one change brought by digitalization is that it will improve situational awareness while simultaneously reducing the complexity of tactical decisions, which augment decision-making processes. This is the expected outcome because as more information becomes available, the complexity of tactical decisions is reduced by decision-support systems that make decision-making more effective (Dargam et al., 1991). Greater situational awareness and reduced complexity in tactical decisions hence become possible through digital decision-support tools, which translates to greater speed in decision-making relative to the adversary. Although more information does not always equate to a better decision, DSSs enable the effective use of more information.

LeFace (2001) stated that digitization reduces complexity and uncertainty on the battlefield because it enables linking of information nodes throughout the battlespace. Information nodes can be systems and "knowledgeable" units, or units that can make sense of data. What this means is that digitalization enables information sharing, which can speed up the DS and DM process. This also means that digitalization enables tactical units to make sense of large amounts of data, which, in part, will reduce uncertainty and lead to better decision-making.

C. DECISION-SUPPORT SYSTEMS (DSS) AND DECISION-MAKING (DM)

1. General Discussion on DSS

A DSS can be defined in numerous ways, but each definition generally conveys the same idea. For example, Shim et al. (2002) defined DSS's as "computer technology solutions that can be used to support complex decision making and problem solving." Sage (1991) defined DSS's as "a system that supports technological and managerial decision

making by assisting in the organization of knowledge about ill-structured, semistructured or unstructured issues." Another definition by Burstein and W. Holsapple (2008) stated "Decision support systems are technologies that help get the right knowledge to the right decision makers at the right times in the right representations at the right costs." The common theme in the literature is that DSS is a digital technology that assists, supports, or augments a decision-maker in various decision processes.

It was evident in the literature that DSS's are broken down into three separate components. For example, Sage (1991), Mikolajuk and Yeh (2002), and Janakiraman and Sarukesi (2009) all discussed that a DSS comprises of the data-base management system (DBMS), model-base management system (MBMS), and dialog generation and management system (DGMS).

Janakiraman and Sarukesi (2009) stated that a DBMS manages data needed for the decision-making process, and a DBMS gives users the ability to delete, modify, or query that data as necessary. Additionally, Sage (1991) stated DSS's often support multiple decision-makers with DBMSs for personal, local, or systemwide use. This is important in the context of the DOD because it is such a large organization with decision-makers at various echelons.

A MBMS manages and stores models that are required for decision-making analysis (Turban et al., 2004). A MBMS enables complex analysis and interpretation in the DSS (Sage, 1991).

A DGMS is the user interface component, and it is how the user communicates with the DSS (Hasan et al., 2017). Sage (1991) mentioned that a DGMS should be user friendly. A user friendly DSS is important because it will minimize training time for a DSS; also allows users to access specific data or information quickly so that the decision-support and decision-making processes become as efficient as possible.

These components are relevant because it shows that Microsoft 365 is not a DSS by itself. It does not include an organic DBMS or MBMS. This would be impossible because these components of the DSS need to be tailored to the specific needs of the user.

However, it also shows that specific applications within Microsoft 365, such as Microsoft Power BI, would be considered a DSS because it meets all the mentioned criteria.

2. DSS Applicability to Military Organizations

DSSs can be an asset to decision-makers in any military organization. The benefits of ensuing using DSS and the benefits of the implementation of digitalization for DOD are complementary. An appropriate DSS has the potential to speed up the decision cycle so that DOD decision-makers can out-pace adversaries' decision cycle. In part, the decisions will be made with more situational awareness and less uncertainty. This premise was supported by Tolk and Kunde (2000). They stated that a DSS enables information superiority, which results in the ability to decide and act faster than any adversary. Ben-Bassat and Freedy (1982) also supported this claim. They argued that a DSS can provide a commander with a clearer picture of the battlefield to support decision-making and future planning. However, at this time the DOD does not possess what would be considered a DSS. Microsoft O365 as it stands now is not a DSS because it does not include the DBMS or MBMS. Microsoft O365 is not going to give a commander and staff the benefits discussed in the context of combat. In military organizations across the DOD, Microsoft O365 is merely a tool that can digitize and generate task flows for routine activities in a garrison environment. For example, at NPS, O365 is used as a communication tool in the form of text and video calls, as well as a place to share and edit documents. These use cases could also apply to any military unit in garrison. It is great for holding meetings when personnel are dispersed, or simply routing documents in a more efficient manner.

If the DOD does pursue a DSS in the future, there are risks associated with adopting such a technology. Susnea (2012) discussed issues related to the adoption of new DSS's in military organizations. These issues include acquisition issues related to cost constraints, time constraints, training, security, and human error (Susnea, 2012).

Acquisition issues are among the many concerns related to any new system adoption. Azizian et al. (2011) discussed how defense acquisition programs have a historical track record of cost overruns, schedule delays, and poor technical performance.

The acquisition of DSSs suffers the same risks as any other new system due to the complexities of the defense acquisition process.

Training the personnel within an organization, to include military organizations, is another challenge. This is a possible issue because it takes time and resources to instruct personnel on how to use a new system as intended. This undertaking is even more difficult in large organizations such as the DOD. The Technology Acceptance Model (TAM) introduced by Davis (1989) can be used to understand how the implementation of a DSS can be done successfully. The theory indicates that among many variables, perceived usefulness and perceived ease of use are the two most influential when it comes to the acceptance or rejection of new technology. Perceived usefulness is the perceived degree to which the new technology will help one perform their job better. Perceived ease of use refers to the perceived level of difficulty to use a new technology. The level of difficulty must not outweigh the benefits for acceptance to occur. The DOD will need to design an implementation plan of a new DSS that heavily accounts for these two variables.

As for security, the DOD must ensure that DSS's are secure from adversaries and the data is protected. Microsoft 365 has a long list of third-party applications that can be used as a DSS, but these applications are not thoroughly vetted, revealing a potential security gap in current digital DSS tools.

3. General Discussion on DM

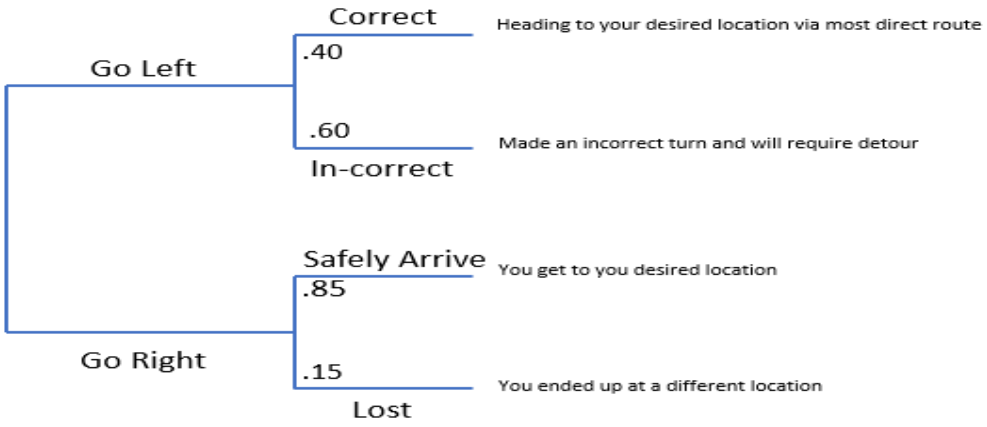
There are multiple definitions, theories, and/or interpretations of decision making (DM). In Reid Hastie's *Rational Choice in an Uncertain* World, he defined DM as a *way to reach a desired goal or to avoid an unpleasant outcome* (Hastie, 2010, p. 23). A common theme that can be seen in his study is that DM is a methodology that humans employ to reach/achieve a desired outcome. In identifying definition and reason behind DM, Hastie's analysis recognized three variables that encompass DM:

1. There is more than one possible course of action.

2. The decision maker can form expectations concerning future events and outcomes following from each course of action.

3. The consequences associated with the possible outcomes can be assessed on an evaluative continuum determined by current goals and personal values (Hastie, 2010, p. 24).

In the DM process it is important to analyze the idea of choosing a course of action (COA). One salient decision-making theory considers it a mathematical equation in which a decision maker "apply [ies] the principal of scientific decision theory to choose the best course of action." (Hastie, 2010, p. 27). The use of decision trees and probability is a mathematical way to help guide our decision-making process. Using a scale of 0.00 (highly unlikely) to 1.00 (highly probably) a decision maker can assign statistical values to a COA to limit uncertainty and achieve a desired outcome. Figure 3 shows a sample decision tree for choosing a COA. As shown in Figure 3, a user has a higher probability to get to their desired location if they decide to go "right" versus going "left." Although, this mathematical concept to decision making is helpful, assigning statistical values to COAs is not a fail proof system, *Choosing wisely is a learned skill, which, like any other skill, can be improve with experience* (Hastie 2010, p. 2). The decision tree method would fall into the category of *knowledge*, but a decision maker would also have to include *trust* and *heuristics,* which are not easily quantifiable. This is noted in Steffen Hoßfeld study *Optimization on Decision Making Driven by Digitalization*, when he noted that *on the other hand, a strong emotional influence on decision making is obvious, because human beings do not follow strict rational rules (*Hoßfeld, 2017, p. 120).



This simple decision tree example shows the probability of getting to a desired location safely based on if someone makes a left or a right.

Figure 3. Sample decision tree

Another theory of looking at DM with less of a mathematical analysis is observing it from a cost to benefit ratio. As noted in *Risk and Decision Making in Military Operations, the ideal decision-making situation, the decision-maker seeks the most objective cost-benefit analysis available* (Bernhart, 2020, p. 8). Unlike the decision tree methodology to DM, cost benefit analysis concentrates more on a decision-making model that gauges the benefits of one decision over another. Using a DM method that utilizes cost to benefit analysis requires the decision maker to utilize much of their previous knowledge and heuristics to come to a COA they would want to move forward with. Based on our research cost to benefit analysis best utilized when accompanied with other DM methodologies. Hastie's research also identified a conundrum known as *honoring sunk cost*, it is a theory that if someone approaches a decision from a cost to benefit perspective, there is a potential situation where the decision maker will stick with the sub- optimal COA because following through with current COA is more beneficial (Hastie, 2010).

Another way to approach DM is to cater the decision process to the individual's cognitive style. Scott and Bruce's observations in *Decision-Making Style: The Development and Assessment of a New Measure* identify that their test subjects used different types of DM Styles, which encompasses multiple types of DM methodologies; these observations were more representative of their individual cognitive cycles, which their subjects used while making important decisions (Scott & Bruce 1995, p. 829).

> Four decision [making] styles were identified from prior theorizing and empirical research and defined in behavioral terms:
>
> (a) rational decision-making style is characterized by a thorough search for and logical evaluation of alternatives,
>
> (b) intuitive decision-making style is characterized by a reliance on hunches and feelings,
>
> (c) dependents decision-making style is characterized by a search for advice and direction from others, and
>
> (d) avoidant decision-making style is characterized by attempts to avoid decision making. (Scott & Bruce 1995, p. 820)

Instituting the appropriate DM styles with the applicable DM methodologies harnesses a more naturalistic environment for the decision maker so they can create a propensity-based process to perceive and respond to decision-making tasks (Scott & Bruce 1995, p. 818). As noted in all of the studies, not one singular methodology and/or theory of DM is going to guarantee a decision maker choosing the right course of action, as noted by Hastie decision making/choosing a skill that is learned through practice and experience (Hastie, 2010).

4. DM applicability to Military Organizations

In the context of this research, decision making in the military for this discussion will be broken into two ideas. The first is a group approach to decision making, which is bounded by Joint Publication 5-0. The second is an individual approach to decision making, which has a foundational basis set in Colonel John Boyd's (Air Force); Observe, Orient, Decide and Act (OODA) Loop model (Brown, 2018).

a. Joint Planning and Creating a Shared Understanding

The quintessential document that the DOD uses to guide decision making is known as Joint Publication 5-0, Joint Planning (Joint Chiefs of Staff, n.d.). This document sets the foundational groundwork to guide planners in a "deliberate process of determining how to implement strategic guidance: how (the ways) to use military capabilities (the means) in time and space to achieve objectives (the ends) within an acceptable level of risk" (Joint Chiefs of Staff, n.d., p. xi), culminating in providing options for a decision maker to choose from.

Each military service has their specific planning process. Sservice-specific planning processes mostly follow the same joint five step process: mission analysis, situation and COA development, COA analysis, COA comparison, and COA selection. This creates a *universal planning language* across all departments of the military, this *universal planning language* becomes especially helpful when the military conducts joint planning conferences (Figure 4).

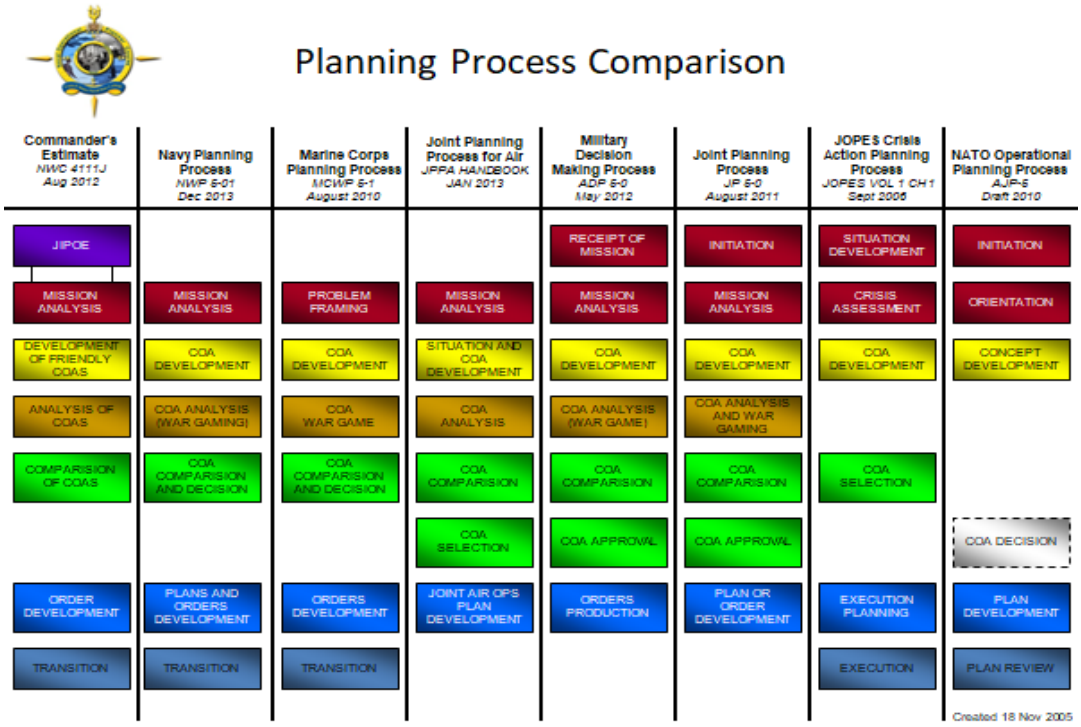


Figure 4. Naval War College comparison of service planning processes, Source: Naval War College (n.d.).

A decision-making process is a culminating event of planning, it is the catalyst that keep the military operational. The military during planning conferences go through what this study has identified as a *decision-making cycle*: planners (decision support), commanders (decision makers), everyone else (supporting/executing a decision), repeat [this cycle will be further explained in *Decision Execution Cycle*]. The planning process is what the military commonly refers to as a "common language" that can be understood by all services; this give the military the freedom is integrate planners from all services of the DOD and they will all have a common reference point on how to approach planning and presenting options do the commander to decide (Joint Chiefs of Staff, n.d.).

b. OODA Loop and the Individual Decision Maker

Col John Boyd's Observe Orient Decide and Act (OODA) loop (Figure 5) came to fruition when he identified a key factor that would make fighter pilot more successful in a dogfight, *tempo*. One key variable that could dictate *tempo* in a dogfight is the speed of

the decision-making cycle of the pilot; the pilot who has the quicker decision-making cycle sets the *tempo* then in turn has the higher probability of success in the fight (Wikipedia, 2022)

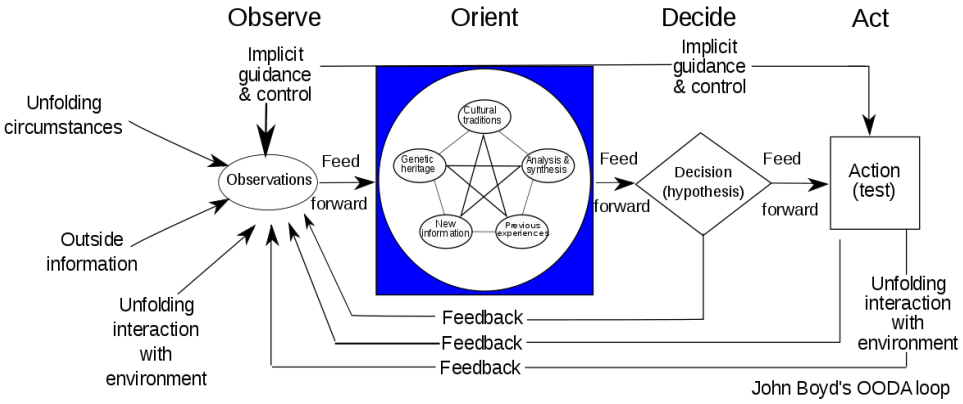


Figure 5. Detailed OODA Loop. Adapted from Wikipedia contributors (2023)

The Marine Corps found the applicability of the OODA loop and how it can be applied to their style of warfare known as maneuver warfare, which was "focused on attacking an adversary's mental and moral cohesion, with the goal of disrupting their ability to think and respond effectively to those friendly activities directed against them" (Brown 2018, p. xxv). This remains relevant today with the Marine Corps Warfighting Publication (MCWP) 3–01, Offensive and Defensive Tactics noting that one of the successful tenants in offensive operations is, overwhelm the ability of enemy decision makers to observe, orient, decide, and act (MAGTF Ground Operations, 2018, p. 3-1).

5. Decision to Execution Cycle

Our study has identified that DSS's are those *technologies* that assist a decision-maker in the process of arriving at a decision, and a DM as a "way to reach a desired goal or to avoid an unpleasant outcome" (Hastie, 2010, p. 23). The result of the decision is what in the military is called execution, which defined is to do fully or to do what is provided or required (Merriam-Webster, 2022). Figure 6 shows a graphical depiction of the DSS and DM cycle. The main differentiation between our cycle shown in Figure 6 and Col John Boyd's OODA loop is that DSS not only includes technologies but identifies technologies

as a necessity in the DM cycle. The identified the *execution phase* in Figure 6 as a continuation of the DM cycle; in the supporting decision phase there is feedback "mechanisms in which, broadly speaking, a system's output affects the input into that same system and thus the system's subsequent output" (Gadinger 2016, p. 254)]/communication from the decision-support phase to gain knowledge, heuristics, and trust to further support the DM process in the future.

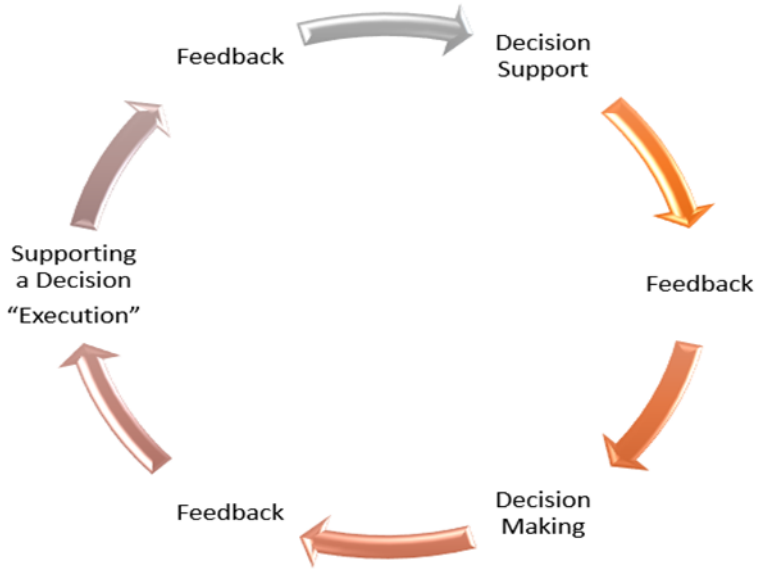


Figure 6. Decision-support cycle

Decision-Support Cycle:

Begins with a DSS, as discussed this can be in a form of technologies, humans, etc. (Gadinger, 2016)

Feedback/communication from the DSS to the DM; in military organization this is call *Commanders Guidance/touchpoints.*

Once there is an establish set of choices to be made, the process moves to the decision-maker who will choose a COA.

Once a COA has been decided by the decision maker there will be feedback from the supporting decision phase back the DM phase, this gives the DM an opportunity to make adjust as needed.

Once a decision is in supporting a decision phase the cycle repeats and adjusts as needed, if no adjustments are needed to the current decision they cycle continues for another decision.

D. MICROSOFT AND THE DEPARTMENT OF DEFENSE

The DOD has a modernization strategy that is focused on: cyber, C3 (command, control, and communications modernization), artificial intelligence, and cloud (service, applications, etc.) (Department of Defense. 2018). Within the cloud focus area lies "DEOS (Defense Enterprise Office Solution) [a] BPA (Blank Purchase Agreement) [that] is a 10-year contract designed to provide a comprehensive set of capabilities focused upon collaboration and cloud (Figure 7). BPA is DOD's preferred contracting vehicle for all Microsoft Office 365 Collaboration and Cloud capabilities through both license and service support requirements" (DISA, 2022)

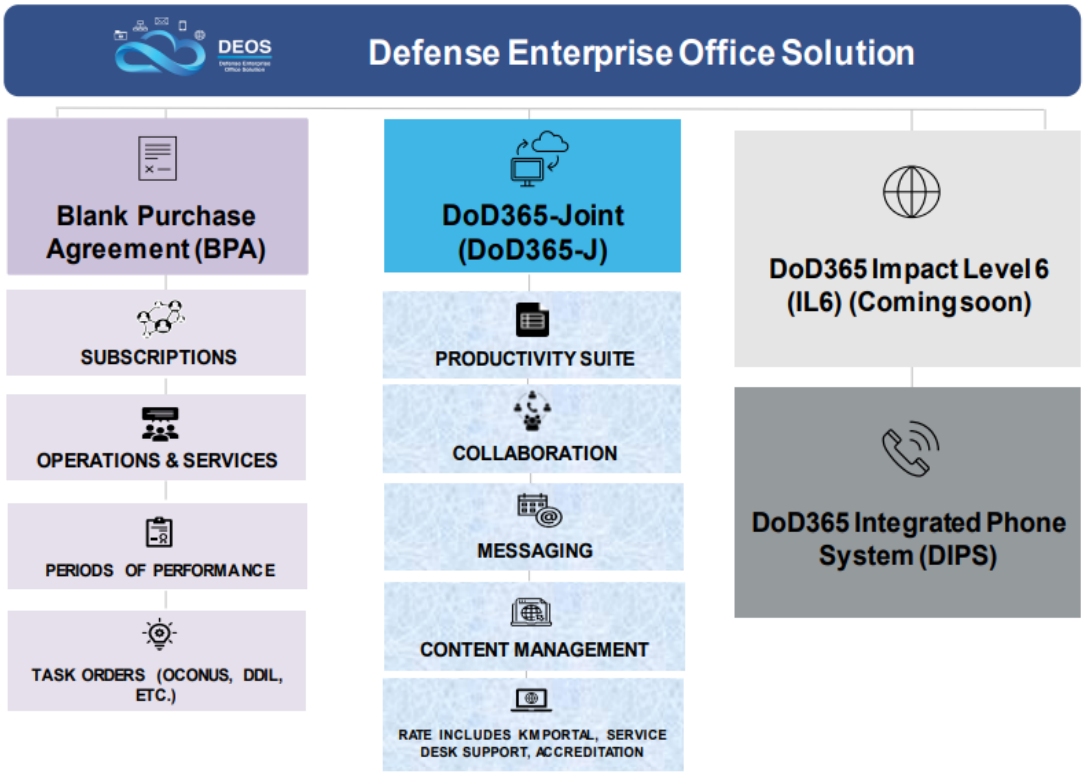


Figure 7. DEOS offerings to the DOD. Source: DISA (2022).

DEOS is a Software as a Service (SaaS) contract worth approximately eight billion dollars focused on offering the DOD's 3.2 million users' cloud-based collaborative environment, which is set to include services such as email, calendars, presentations, conferencing, etc. (Defense.gov, 2022). Most of these products/services will provide users a digitized environment; if this environment is used effectively and efficiently, it can support DOD users as the DSS in DM processes. Based on the length of this contract our study decided to only discuss the Microsoft Office 365 ecosystem for DSS technologies in military organization.

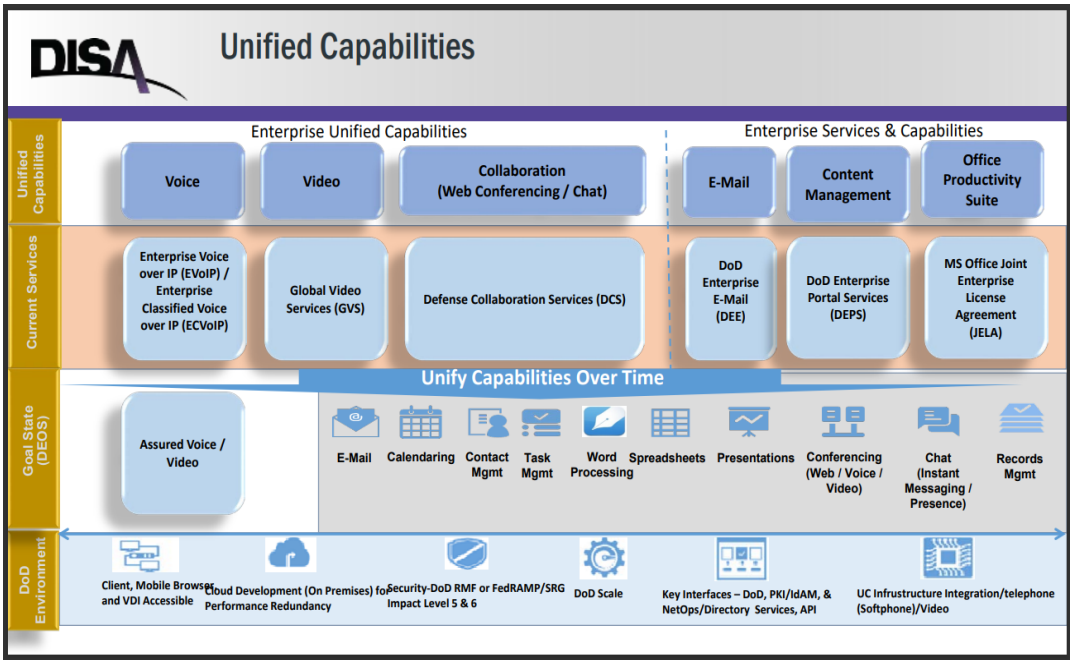


Figure 8. DISA unified capabilities. Source: Carpenter (2017, p. 8).

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III. METHODOLOGIES

A. DESIGN OF THE STUDY

1. Qualitative Analysis

The purpose and structure around the survey questions were not aimed at trying to find a quantitative value of how many decisions are made using digitization/digitalization tools or how much time is saved; the survey was focused on the individual perspectives of digitalization and how it is implemented in the DSS and DM processes.

The focus of our survey is to analyze the participants' understanding of digitization/ digitalization, and how they think it is being implemented into their organizations. Individuals' perspective are the important part of this study; the people interviewed for this study come from all different parts of the DOD, and it is assumed that all participants' perspectives of digitization/digitalization tools in DSS and DM are different.

This study aims to provide a better understanding of how the DOD as an organization is using digitization and digitalization for decision support and DM in everyday operations. This will be accomplished through gaining a better understanding of different perspectives across the DOD, such as how people currently see these technologies being utilized and implemented. We foresee a strong possibility for future recommendations and calls for further studies into this subject matter.

2. Participant Demographics

Given the study was based on implementation of digitalization to the DSS and DM process in a military organization, a majority of the survey's participants are currently serving on active duty. Figure 9 shows the array or participants we surveyed, there was an emphasis on surveying members of different branches of the military to see how their organizations are utilizing these technologies and examine both the similarities and differences. However, the study was not limited to only active-duty uniform service members. The study was also extended to non-uniform support personnel who work within the military construct.

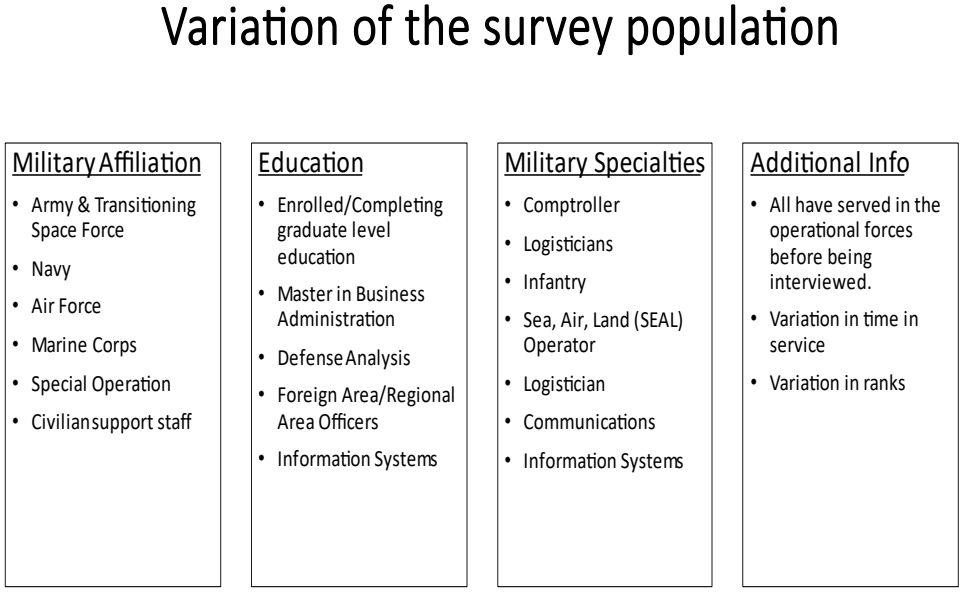

Figure 9. Survey population

3. Comparative Analysis

Another aspect of this study is to analyze the relationship between training and implementation, as well as if there is an alignment or miss-alignment between the two. This aspect plays a critical role in how an organization implementing digitized/digitization DSS and DM tools within an organization. All the survey participants are within the military rank structure of O3 through O5 (selected), which are ranks typically assigned to management positions. The goal of this selection was to compare how these managers view digitized/digitization DSS and DM tools, what training they have undergone, and if they are using these tools as intended. In doing so, an understanding of the various perspectives at the management level is obtained. This is important to know because their perspectives could influence others in various ways.

4. Limitations of Research Methods

It is important to note that limitations are present in the research methods. Our survey and the results that follow cannot possibly present the complete picture, and this is due to numerous factors. First limitation is the limited sample size. Although the intention was interview both civilians and active-duty service members from all military branches

to include as much diversity as possible, due to the time constraint the number of people interviewed needed to be limited. As a result, the diversity of the service member from all different military occupational specialties within each branch became limited. The occupational specialty of the service member may have a large influence on their perspective of digitization and digitalization in the DS and DM process. Lastly, as stated previously, we will only interview service members in the O3 to O5 (select) range based upon availability. There would be value added to this study with the perspective of senior officers and SNCO's.

B. EXECUTION OF THE SURVEY

1. Conduct of Survey

The conduct of the survey consists of one-on-one interviews with participants. These one-on-one interviews were either be in-person or virtual via a video call on the Microsoft Teams application. One-on-one, face-to-face interviews were beneficial to this qualitative study because in individual interviews, the perceptions, understandings, and experiences of the interviewee are present, which was beneficial for thorough data collection (Frances et al., 2009). Capturing the participants' understanding and perceptions based on their prior experiences is important for analysis and results.

2. Interview Questions

Below is a list of our interview questions. Responses to all these questions will be recorded and analyzed to gauge the understanding and use of digitalized DSS and DM tools in military organizations.

1. What is the difference in your organization between digitization and digitalization?

2. Does your organization make any distinction between digitalized decision support and digitalized decision-making tools and has your organization noted any improvements to processes?

3. Do digitized tools assist your organization in making more informed decisions?

4. What training resources does your organization offer to assist in the use of decision-support and digitalized decision-making tools.

5. What are the advantages and disadvantages your organization has noted of utilizing analog decision-support and decision-making vice digitalization, for example Instant chat vs. email?

IV. ANALYSIS

A. INTRODUCTION

In review of the interviews, we noticed themes when analyzing the data. These themes were not injected by the study or the interview questions; they naturally began to arise based on the interviews and an array of factors to include their own personal heuristics, knowledge, trust, and mental models. All variables that our research has identified as factors that influence decision making. The most common themes that we noticed within the analysis were: benefits the interviewees see in digitization and digitalization processes, how organizations are utilizing DS and DM tools like O365, multiple system are required to get information, organizations are not on the same strategy, training, and dangers of solely depending on digitization and digitalization tools.

B. BENEFITS

This section consists of an overview of the perceived benefits of digitalized DS and DM tools stated by participants during the survey. Despite the diversity in service branch and MOS's, the same benefits were repeatedly brought up, just in different contexts. The first of those benefits is increased speed in everyday operations. The second major benefit was increased organization and availability of data or information. The examples discussed referred to digitization vice digitalization because data, information, and communications were put from analogue to digital form.

In terms of increased speed, one example came from one of the participants with an Army SOF background. He discussed how digital tools improved communications when geographical dispersion and time zone differences were factors that had to be dealt with. Another example was from an Air Force service member with a maintenance background, he discussed that a lot of processes maintenance personnel conduct are via an analog method e.g., paper files that have to be transferred manually. This service member mentioned the time drain that this causes, and that digitization or digitalization could speed up current processes and alleviate this issue. That point segues nicely into the last point made by a civilian working in a military construct, who talked about how digitized,

automated processes have saved time and streamlined work. This interviewee talked about a report that was usually created by human action that was taking up to two weeks, but with digitization streamlining the process this action now takes at most one business day.

The second benefit of digitization and digitalization tools for DS and DM was the organization and availability of data they provide. As an example, a Navy SOF service member explicitly stated that there is better organization for data in reference to O365. He discussed that rather than going through the cumbersome process of searching through email chains, communication platforms such as O365 allowed him to group information and access it quickly when needed. Another example is from the same civilian who works in the military construct. She discussed how in the institutional research that she conducts, it involves pulling data from databases, merging the data, transforming it, and lastly analyzing the data. This is a great example of how useful databases in digital DSS's can be for organizing and accessing useful data to improve decision-making. Lastly, a Marine financial management officer discussed how digitization allows for quick access to data, which assists senior leaders in decision-making. He brought up that if a senior leader needs to know how much the unit is spending on a particular item, digitization enables a quick look up because of the organization and availability of data when it is digitized vice a looking for data in an analogue method.

We agreed with the points made by the participants in the interview when discussing perceived benefits of digitization or digitalization in DS and DM. In fact, it was easy to apply these themes to our own past real-world experiences. For example, the benefits discussed were evident in one deployment experience at Combined Joint Task Force – Operation Inherent Resolve (CJTF – OIR). CJTF-OIR was headquartered in Camp Arifjan, Kuwait, but it had the responsibility of coordinating with and supporting units dispersed throughout Iraq and Syria. Digitization allowed for headquarters to conduct its mission by improving the speed of communications, data, and information sharing throughout the AOR. Digitized data was accessible and organized, so it could be provided to senior leaders who ultimately had to make critical decisions. This was before the DEOS contract and O365 were fully implemented, so we foresee that the benefits would be amplified in such an environment with the use of O365.

To conclude, it is evident that the benefits gained for DS and DM from digitization and digitalization apply to various contexts. Speed of operations, data organization, and availability are the key benefits to DS and DM that are facilitated by digitization and digitalization, which is valuable to any decision-maker.

C. HOW ORGANIZATIONS ARE CURRENTLY USING OFFICE 365

As shown Figure 8 the DEOS contract is centered around being the singular collaboration tool to be used by the DOD. In addition, video/voice communications, text, and email DEOS is also offers cloud-based capabilities enabling users to work on Microsoft-based products with other users in real time regardless of geographical location. There currently is no one DOD policy that dictates how service members and civilian employees are supposed to use this capability, this resulted in a variation of methods of execution based on organization, unit, personal preference, etc.

The common use of O365 by the ones interviewees is communication tool. Interviewees found the effectiveness of being able to use one application that enables talk, massage, video chats. From previous experiences there has been confusion and miss communication based on what platform was to be used for communication during large scale exercises (LSE), which encompassed multiple countries, service, and geographical locations. These LSEs had multiple video teleconferencing systems and meeting throughout the day that had to be deconflicted by a document called the *Battle Rhythm*, this document contained the meeting, times, and VTC system, etc. One issue that was commonly experienced was that spatially distributed units sometimes would have limited VTC systems to participate in meeting. By using O365, more humans are now capable of participation in these *Battle Rhythm* events—which provides them with more information, resulting in users being able to make more informed decision than previously.

Another use of O365 that was commonly observed in the interviewees was the collaboration feature that is offed on O365 applications such as Word, Excel, PowerPoint, and Calendar. This feature offered users the opportunity to work on a document with other humans in real time regardless of geographical location. Previously before the method for collaboration was either have one human work on it and email mail their "version" to

another human to make their edits or if a unit was lucky enough to the SharePortal capability, users then could *hang* a document on the application that then could be accessed and edited by one user at a time. With cloud enable collaboration features users can now disperse information and ideas faster through a digitized DSS/DM tool. There were some noted issues with the cloud-based collaboration tool and that was the issue of compatibility. One user had noticed that the collaboration feature for the applications: Word, Excel, PowerPoint, and Calendar only work if the originator of the document uploaded a version of the document that was save on the latest format of that application e.g., a PowerPoint a file would have to be saved under the newest file version *.pptx vice the previous file version *.ppt to be compatible on the collaborative cloud-based system. This note accentuated another observation, when humans do not understand what is happening with technology; their mental model could revert them back to what they know and are comfortable with and reject the new technology, a technology that many interviewed saw as an enabler to the DSS and DM processes.

One of the key takeaways that was taken from all the interviews in regarding O365 current usage was that all users were using the features and capabilities of the system in digitized functionality to assist in DSS and DM. None of the in O365 applications were linked to each other or databases in a way that it could output the data into useful information. Some of the interviewees indicated that they assumed since they were on O365, which was a collaborative cloud-based system and the information on that system was being used to brief and make decision that they were utilizing a digitalized DSS and/ or DM tool it was a digitalized tool. Although, according to our research and compared to what was discussed from the interviewees, all that was happening was humans inputting data into O365, from there humans were processing their data and other data that was on the system and compiling the information to be used in DSS and DM processes. One interviewee did note that the capability to use O365 as a digitalized DSS and DM tool is within the possibility, but it would require highly technical humans who are familiar with Microsoft ecosystem products like PowerBI to create workflows and analytic tools that process data. Another interviewee also noted the technical expertise to create and execute

the more complex analytic tools like PowerBI would require technical experts with backgrounds in data engineering and computer sciences.

D. MULTIPLE PROGRAMS, SYSTEMS, AND DATABASES ARE REQUIRED FOR DSS AND DM

A consistent among those that were interviewed was that each of their individual organizations were using a: program, system, and/or "database" [some of the interviewees alluded to Excel or equivalent O365 products as a database], which they in turn used to assist them in the DSS and DM processes. Many of the interviews expressed frustrations that there were multiple systems and platforms that performed similar actions, but different enough that they were required to use two systems. One interviewee noted multiple voice/ texting platforms that were required to talk in their organization, some used for secure facilities, others for unclassified environments and others used for both. With this organization choosing multiple platforms it would make it difficult for that organization to digitalize the data produced in those texts and conversations and be processed and analyzed by DSS and DM tools to assist a decision maker.

An Army officer discussed Digital Training Management System (DTMS), a digitized tool that the Army is using to convert their paper military records into a digitized version. The Army officers did acknowledge that DTMS is a digitized DSS and DM tool meaning humans are still required to go into the system and analyze the data. In another interview conducted with a Marine Corps officer, they discussed the process for inputting Physical Fitness Test (PFT) and Combat Fitness Test (CFT) scores into a Marine Corps systems called Marine Corps Information Management System (MCTIMS). While the whole system and process is still very much digitized, it does have digitalization aspects e.g., once a Marine manually inputs the score into the system, that score automatically assigned a class, that score and class is then automatically inputted into the Marines service record and Master Brief Sheet (MBS), that score can now be viewed at a promotion board where a decision will be made to promote them or not.

Another issue that was elicited by the surveys is that the misunderstanding of digitization and digitalization and the requirements to achieve digitalization DSS and DM

tools. As alluded to earlier, some of the interviewees assumed that O365 was a digitalized DSS and DM tool, which of this study O365 tools falls into a digitized DSS and DM tool. Many of the applications and systems that were brought up in the interviews consisted of systems utilizing isolated databases that typically only spoke with their specific functional area or organization. Many of the applications and systems are not designed to pull information from multiple data bases; majority of the interviewees were the once responsible party of consolidating the information from multiple sources and consolidating them into a centralized data base, which in most cases is done by O365. Once the information is consolidated analytic software like PowerBI is not used to process the data, individual subjective analysis is conducted by staff members and outputted to Excel work pages; then compiled as a PowerPoint presentation to be briefed to decision makers.

We also observed a loyalty to some of the legacy systems resulting in an adversity to use some of the collaboration functionality in O365 to assist in DSS and DM. One of the interviewees alluded to a, "rigidity in the process…there's not enough money or inertia in the system to change anything at the moment." This statement elicits this interviewee's mental model about a logistical system that is used in their organization. The system that this interviewee used was to track aircraft maintenance and parts. The information outputted by these systems remained on the application until transferred by another user to be processed or analyzed. This interviewee felt as though this is the most efficient way to do this process and did not think that digitalized DSS and DM processes would assist in any way.

Overall, most interviewees are aware and frustrated that there are multiple systems and applications that do mostly the same thing but with different nuances. Additionally, most of the ones that were interviewed did not have a good understanding of the differences between digitization and digitalization and what requirements are needed to qualify a process a digitalized DSS and DM tool. Combining what we learned from the interviews and from our own personal experiences working with these systems and applications in our own specific functional areas and organizations we concluded that due to the fact that organizations are using multiple programs, and data bases to store their data, many

organizations are using digitized DSS and DM tools and cannot achieve digitalization until the all the data can centralized and processed by a centralized application.

E. GETTING EVERYONE ON THE SAME PAGE

Going interviews, one realization that occurred was that everyone uses digitization or digitalization in DS and DM differently. There is a wide degree of variance with no actual standardization in place. To preface this section with a viewpoint from an Army officer, who talked about how the Army is all over the place in terms of digitation and digitalization. This section provides evidence to this realization with specific examples from participants in our survey as they described how they've seen digital tools used for DS and DM in their respective lines of work. Ultimately, is makes sense to have a certain degree of differences in the use of digital tools for DS and DM across the DOD. However, a certain level of standardization must also be in place to ensure that the DOD can reap the benefits of digitalization for DS and DM.

The first points to bring up on this subject came from the Army and Navy SOF personnel who participated in our survey. One point was that from their experiences, the use of digital processes was completely dependent on the commander of the unit. One commander was old school and wanted everything printed out, and then the next commander preferred processes to be digital. Under the second commander, Microsoft Teams was used heavily to aid in unit processes and decision-making. Based on the researchers' experiences this is true not just in the SOF community, but in many units across the DOD. Leadership will often dictate the extent of how much these tools are used, and with leadership changeover occurring frequently in military organizations, changes to the use of digital tools will also occur. This will lead to inconsistent work processes and inefficiencies because frequent changes will occur with no standardization in place.

The second point from the SOF personnel who did our survey was that there is a challenge to get people within a unit or a military organization to adopt digital technologies. Specifically, it was mentioned that an individual's decision whether to use digital technologies is often personality dependent. For these technologies to become the standard, individuals and sub-groups in military organizations need to see the value these tools provide. This related back to the first point because if commanders see the value, they can

ensure widespread implementation throughout their unit. Although it starts with the commander, personnel at all levels in a military unit that use may use digital tools must see the value in them for it to become the standard.

A final example made by an Army SOF service member that shows a lack of "being on the same page," was an example about the routing of operational paperwork for DS. The "big Army" uses a system called Global Electronic Approval Routing System (GEARS) for automated document routing and tracking. This service member's unit was a part of SOCOM, and SOCOM uses different systems and methodologies. The "big Army" wanted SOF units to start using the GEARS system, but in the case of this service member, it was not useful and did not align with specific needs. This example clearly demonstrates the vast differences among use of digitization for DS. To ensure that everyone used the GEARS system, it would have to be written in policy that all units within the Army would be required to use the system. Written policy is the only way to formally standardize the use of systems in military organizations.

When discussing O365 specifically, as participants discussed how their units used this tool, it was clear that there were differences once again. One Air Force service member discussed that his past unit only used Microsoft Teams to build calendars, schedule meetings, and take meeting notes. In our own experience, we have seen it used for all those tasks, but we have also seen it being used as a communication and collaboration tool as well. One similarity in our own experiences and after hearing the experiences of participants, we are digitizing through software like Microsoft Teams, and not digitalizing for DS and DM.

Digitizing rather than digitalizing for DS and DM may be the extent to which we can "get on the same page" in military organizations currently. An Army service member pointed out that using the Power BI for analytics in Microsoft Teams, which would be a form of digitalization, would be difficult to standardize. This demonstrates that military organizations are capable of digitization but are not ready for digitalization. Using Microsoft 365 for digitization is straightforward, whereas using it for digitalization with tools such as Power BI would take extensive knowledge and training. The takeaway is that military organization should only standardize to a point where service members can use

digital tools for DS and DM. This was supported by a participant who is a DOD civilian employee, the interviewee stated that the people do not want to work outside their comfort zones. As a result, adoption will be incredibly difficult if people are asked to digitalize without the understanding what those entails.

In conclusion, "getting on the same page" for digitization and digitalization in support of DS and DM is not an easy task. Military organizations across the DOD currently use provided digital tools differently, or not at all. It is a common theme that has been observed throughout the interviews that the value of digital tools warrants policy to be written that standardizes the use of digitization for DS and DM. At this current point in time, we are only equipped to digitize, but the end goal should be digitalization for DS and DM across all military organizations in the DOD. This is because digitalization will lead to more efficient processes that will support DS and DM more effectively.

F. TRAINING

The majority of the interviewees in this study noted that they have not received any training for the new application provided on the DEOS contract: Teams, PowerPoint, Excel, Word, etc., many of the interviewees noted that the Microsoft ecosystem was familiar and "easy to use… [usage was] ad hoc." While the familiarity in the applications is seen as a good variable among the humans interviewed, another perspective this can be seen as a disadvantage. With the O365 suite of applications, while they might look the same as previous versions there are more capabilities provided than before. As noted in *how organizations are using O365*, one of the interviewees noted an issue with saving files being saved in the previous format of *.ppt vice *.pptx, which resulted in the loss of compatibility when trying to work on the file with other humans online. This small but important detail that is required to have collaborative online capabilities with the file. One interviewee that noted that, "I think there was training, but nobody ever goes to it," this is the same interviewee that noted that *O365 seemed user friendly* but acknowledges that their organization is not using O365 to its full capability.

Another topic we observed in the interviews was the disparity of training among people within the same organization. Some of the interviewees noted in their organization

they had “that one person”; this refers to that individual within in an organization that is trained on the capabilities of an application and has the knowledge and training to use that application to its full extent. While this is a positive in the short term, “that one person” usually does not stay in that organization for an extended amount of time. Based on experiences “that one person” eventually becomes the critical link in the process. The organization will tend to lean on that person more than before, and once that individual leaves so does that capability. Typically, organization will try to lean on the individual to try and teach others how to use application, but more times than not the people they are teaching do not have the background and training to fully understand what they are doing.

The interviewees that were knowledgeable of digitization and digitalization and have had appropriate training on DEOS recognized their organizations did not have adequate training to utilize the applications. A minority of the interviewees ae cognizant of understood the need for appropriate training and have had the training and education. The interviewees in this category understood that many of the people they worked with do not understand the capabilities of the applications that their organization provides them. One noted that there was a big push in their organization to do *data analytics,* but no one knew how nor the organization fully understood the full capabilities of data analytics. One interviewee noted that they were even going as far to code in application to help their organization improve data processes; and while their efforts did help, the organization often reverted back to older processes.

The main emerging theme concerning the training from the interviews is that military organizations are not investing in training for the applications they are fielding. There are more capabilities that are currently in the hands of DOD service members and civilians that can assist them in the DSS and DM processes, although based on the interviewed sample size, the knowledge of how to use it to their advantage is not there.

G. RISK OF DEPENDING ON DIGITAL TECHNOLOGIES FOR DSS AND DM

The last theme that emerged throughout the survey interviews dealt with the risk of depending on digital technologies for DS and DM. While digital technologies provide

many benefits and can improve the DS and DM process, our studied highlighted some potential negative aspects of this technology that users should keep in mind.

The first risk of using digital technologies for DS and DM was invalid or inaccurate data as an input into the system. One Air Force service member stated that the most difficult aspect of using digital technologies was not knowing whether the data was valid. Another Air Force service indicated how the databases that are used at his last unit were described as "garbage in, garbage out," which meant that invalid data was being inputted into the system, which then outputted bad information and negatively affected the DS and DM process.

Another potential risk that was brought up was from the Navy SOF service member. Speaking in a tactical context, he spoke about how it is possible to get sucked into devices. This was an important point because an overreliance on digital technologies can come with consequences. For example, if one becomes overly dependent on these tools, and access is lost for any reason, he or she may not be prepared to make informed decisions going forward.

An Army SOF service member brought up a good point that shows a potential flaw in digitization and digital tools for decision support. His point was that for SOF, they are partner-based, but the use of different networks resulted in stove-piped data and something as simple as paperwork correspondence has become difficult to complete. This service member mentioned that due to this situation, analogue methods are often used while communicating and working with military organizations from countries such as Indonesia. From the researchers' perspectives this can be a major issue, and there is not an immediate solution. Working with partner forces poses unique challenges because separate networks are often necessary due to classification levels of data and information. Ultimately, this issue is a data accessibility issue.

In conclusion, the greatest risk factors to the use of digital technologies for DS and DM are invalid data, developing an overreliance on the technology, and stove-piped data that cannot be accessed by the personnel who need that data in the DS and DM process. Users need to be aware of these potential pitfalls when using digital technologies for the

DS and DM process, otherwise they may experience these risks and the DS and DM process will be negatively affected.

V. CONCLUSION

A. SUMMARY

Due to the broad spectrum of interviewees the results of this study elicited various conclusions. For example, SOF had a much different perspective than someone who worked in the communications field and vice versa. However, in this analysis it has been noticed that common themes exist among responses. The responses can be categorized in six common themes. This included benefits, how organizations are utilizing DS and DM tools (O365), multiple system requirements, organizations not on the same strategy, training, and dangers. These target areas contained similarities among participants, but in the context of their own individual backgrounds. These subsections are not cleanly compartmentalized, as each of them feeds into the others. For example, interviewees could not talk about the benefits without leaning into some of the dangers that for some interviews linked into training.

There were also a lot of similarities within the sample size as noted in Figure 9, such as all humans interviewed being military officers or civilian equivalent going through or having completed graduate level education. This brings another interesting aspect to the analysis: the polarizing views on digitization and digitalization in support of DS and DM. For the interviewees who did not have a technology-based background either in daily work or graduate level studies, we found it difficult to explain to them the differences between digitization and digitalization and the requirements to use a technology like digitalization in the DSS and DM processes.

Lastly, over the course of the three-month period where we interviewed multiple service members and civilian support staff across the DOD, many of the interviews validated our epistemic assumptions around the usage of digitized and digitalization tools in the DS and DM processes. Although, there were just as many surprising revelations in the interviews such as different variables, situations, and so on that was never considered. This study did uncover findings that provides an insight in various mental models into how military organization are using technologies to assist/support the DS and DM processes.

B. EFFECTS THE RESEARCH AND INTERVIEWS HAD ON THE STUDY

Starting with literature review; it has been realized that digitalization processes were in all actuality digitization processes. For example, the interviewees were not clear on the distinction between digitization and digitalization either. At the end of the study, it has been realized that most of the technological processes that are mentioned in this study are all forms of digitization tools that are used to assist the DSS and DM processes. Humans are processing data that is also produced by humans. Some might view this as a good thing, but as discussed in the literature review, there is human subjectivity that occurs during data processing. Therefore, when the data is used in the DSS and DM process, the human subjectivity ultimately factors into the decision (knowledge, heuristics, and trust). If the DOD can reach a point where digitalization tools are able to be more widely implemented, one of the benefits that will occur is that DSS and DM tools will not be influenced by human subjectivity. This is a benefit because it ensures that DSS and DM tools can function as intended without the influence of human biases.

The study transitioned from trying to learn and understand how military organizations use digitization and digitalization tools in DS and DM. It evolved into how military organizations use digitization tools in DS and DM, as well as the level of understanding of how digitalization can help them in the DS and DM process. Once the study revealed that military organizations were not using digitalization processes, it came to light that a majority of the interviewees just did not know the difference and that there was not the expertise available within their organization to implement digitalization tools.

Another variable observed was education and training with an emphasis on education. The military is now placing a greater emphasis on education. To illustrate this point. The Marine Corps recently appointed a three-star general over training and education command and published a Marine Corps 2030 strategy to increase education within the organization. Our study showed that a high level of technical expertise as well as commitment from the service will be required to get there. These are great strides in the right direction, but it may not be enough to get the Marine Corps to the point where it can implement digitalization for DS and DM.

It was discussed in one of the interviews that there was no training involved with the DEOS rollout of O365. Many of the interviewees noted that the O365 ecosystem was familiar so they felt that there was no training required. Assumably that would mean they are continuing to use it the same way and not implementing some of the new features within O365 like PowerBI that does have the capability to digitalize some processes. Their mental model of how to utilize O365 almost inhibits the progression of instituting digitalized processes into their everyday work life. If new processes are not enforced by policy, it is likely that the military organization will continue with the processes that its members have become accustomed to.

C. RECOMMENDATIONS

1. Unified Approach to Digitalization

Policy and strategy are what drive military organizations. It gives the organization a direction and a desired end state. In other words, it defines what success looks like. There are strategies and policies such as the DOD Modernization Strategy and the DOD Cloud Strategy that outline large overarching objectives that the DOD wants to achieve (Department of Defense, 2019; Department of Defense, 2018). However, the current policy in place lacks enough guidance to keep all branches of service within the organization aligned. Alignment in this case means that compatibility exists, which facilitates information exchange throughout the DOD. As noted in the interviews, the approach to digitization tools varied from unit to unit and organization to organization. If the DOD is to ever achieve a point where they are utilizing digitalization tools in DS and DM, it would require a policy and strategy that is applicable throughout the entire organization. Applications, systems, and databases would all have to work in unison with each other, and all organization members would require proper education on how to utilize the modern tools. This is not a feat that can be achieved within a unit. This would have to come from policy makers and enforced throughout the organization.

2. Training

Military organizations need to invest more in training for the applications that they provide to their service members and government employees. Most of the people that were

interviewed continue to use the applications provided the same way that they have always used them, but the issue is that the applications are changing. Newer capabilities are in the applications that everyone is using, but people are not aware because they have not been trained. Furthermore, continue to use the applications that they are familiar with. The best example is how military organizations continue to use Excel as a database tool, inputting various forms of data in Excel cells with no unified format. In reality, Excel is not meant to be a database tool and could be used more effectively for DS. Another side effect of that is that more times than not, the data cannot be compiled and connected from one organization to another. Standardized training for applications that are released for use in the DOD would eventually assist efforts when the DOD gets to the point where data analytics can be used to assist in digitalized DSS and DM processes.

D. AREAS FOR FUTURE RESEARCH

1. Security Requirements for Fully Digitalized Processes

This study did not go explicate the security requirements that are needed to fully digitalize DSS and DM processes within a military organization. It was noted within this study that to go digitalized, a system and application would have to access multiple databases to process and analyze a large amount of data to provide an output. In most cases, more data utilized means that there is a more informed output. Security of the data at rest and in use must be a priority when dealing with information used for DS and DM in the military organization.

2. Cost-Benefit Analysis for Digitalized Processes

As discussed in the study, many of the interviewees are not trained or do not have the educational background to make the transition to digitalized DSS and DM processes. This leads to the question does the U.S. military have the resources to get us there and is it worth it? Getting the military to digitalized processes would first require humans with deeper understanding, which means more education and personnel with professional backgrounds in this field of study would be required. That would not only require recruiting humans with different talents, but harnessing their talents and knowledge with more education, all of which takes time and money away from other initiatives the DOD is

currently working on. Furthermore, the cost of infrastructure going from mostly digitized processes to the use of digitalization tools would need to be examined.

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LIST OF REFERENCES

Allen, D., & Wilson, T. (2003). Vertical trust/mistrust during information strategy formation. *International Journal of Information Management*, *23*(3), 223–237. https://doi.org/10.1016/S0268-4012(03)00026-4

Andersen, T. J. (2001). Information technology, strategic decision-making approaches and organizational performance in different industrial settings. *The Journal of Strategic Information Systems*, *10*(2), 101–119. https://doi.org/10.1016/S0963-8687(01)00043-9

Becerra, M., Lunnan, R., & Huemer, L. (2008). Trustworthiness, risk, and the transfer of tacit and explicit knowledge between alliance partners. *Journal of Management Studies*, *45*(4), 691–713. https://doi.org/10.1111/j.1467-6486.2008.00766.x

Ben-Bassat, M., & Freedy, A. (1982). Knowledge requirements and management in expert decision support systems for (military) situation assessment. *IEEE Transactions on Systems, Man, and Cybernetics*, *12*(4), 479–490. https://doi.org/10.1109/TSMC.1982.4308852

Bloomberg, J. (2018, April 29). Digitization, digitalization, and digital transformation: confuse them at your peril. *Forbes.* https://www.forbes.com/sites/jasonbloomberg/2018/04/29/digitization-digitalization-and-digital-transformation-confuse-them-at-your-peril/#78e677fd2f2c

Brennen, J. S., & Kreiss, D. (2016). Digitalization. In *The International Encyclopedia of Communication Theory and Philosophy* (pp. 1–11). John Wiley & Sons. https://doi.org/10.1002/9781118766804.wbiect111

Brown, I. T. (2018). *A new conception of war: John Boyd, the U.S. Marines, and maneuver warfare* (First edition). Marine Corps University Press.

Brown, T. (2004). *The value of enterprise architecture*. cioindex.com. Retrieved November 1, 2022, from https://cioindex.com/wp-content/uploads/nm/articlefiles/61096-value_of_ea.pdf Buchanan, L., & O'Connell, A. (2006, January 1). A brief history of decision making. *Harvard Business Review*. https://hbr.org/2006/01/a-brief-history-of-decision-making

Burstein, F., & Holsapple, C. (2008). *Handbook on decision support systems 1*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-48713-5

Carpenter, T. (n.d.). Forecast to industry 2017 services development directorate [Slide show]. https://disa.mil/

Chakraborty, I., Hu, P. J.-H., & Cui, D. (2008). Examining the effects of cognitive style in individuals' technology use decision making. *Decision Support Systems*, *45*(2), 228–241. https://doi.org/10.1016/j.dss.2007.02.003

Dargam, F. C. C., Lopes Passos, E. P., & Rocha Pantoja, F. D. (1991). Decision support systems for military applications. *European Journal of Operational Research*, *55*(3), 403–408. https://doi.org/10.1016/0377-2217(91)90209-E

Defense Information Systems Agency. (2019). Defense Enterprise Office Solution (DEOS) [Fact sheet]. https://www.disa.mil/-/media/Files/DISA/Fact-Sheets/Defense-Enterprise-Office-Solution-DEOS-Nov2018

Department of Defense. (2018, December). DOD cloud strategy. https://media.defense.gov/ 2019/Feb/04/2002085866/-1/-1/1/DOD-CLOUD-STRATEGY.PDF

Department of Defense. (2019, July 12). DOD digital modernization strategy. https://media.defense.gov/2019/Jul/12/2002156622/-1/-1/1/DOD-DIGITAL-MODERNIZATION-STRATEGY-2019.PDF

Frances, R., Coughlan, M., & Cronin, P. (2009). Interviewing in qualitative research. *International Journal of Therapy and Rehabilitation*, *16*, 309–314. https://doi.org/10.12968/ijtr.2009.16.6.42433

Gadinger, F., & Peters, D. (2016). Feedback loops in a world of complexity: A cybernetic approach at the interface of foreign policy analysis and international relations theory. *Cambridge Review of International Affairs*, *29*(1), 251–269. https://doi.org/10.1080/09557571.2013.872599

Hasan, M. S., Ebrahim, Z., Mahmood, W. H. W., & Rahman, M. N. A. (2017). Decision Support System Classification and its Application in Manufacturing Sector: A Review. *Jurnal Teknologi*, *79*(1), Article 1. https://doi.org/10.11113/jt.v79.7689

Holcomb, J. N., & Rumfelt, C. A. (2018). *Building the decision-making environment in the information age: An analysis of defense program manager decision-making in complex and chaotic program environments*. Naval Postgraduate School. https://apps.dtic.mil/sti/citations/AD1069596

Hoque, F., Sambamurthy, V., Zmud, R. W., Trainer, T., & Wilson, C. (2005). *Winning the 3-legged race: When business and technology run together* (1st edition). FT Press.

Hoßfeld, S. (2017). Optimization on decision making driven by digitalization. *Economics World*, *5*(2). https://doi.org/10.17265/2328-7144/2017.02.004

Joint Chiefs of Staff. (n.d.). Joint Chiefs of Staff > Doctrine > Joint Doctrine Pubs > 5–0 Planning Series. https://www.jcs.mil/Doctrine/Joint-Doctrine-Pubs/5-0-Planning-Series/

Jones, N. A., Ross, H., Lynam, T., Perez, P., & Leitch, A. (2011a). Mental Models: An interdisciplinary synthesis of theory and methods. *Ecology and Society*, *16*(1), art46. https://doi.org/10.5751/ES-03802-160146

LaFace, J. L. (2001). *Digitization and the commander: Planning and executing military operations*. Army Command and General Staff Coll Fort Leavenworth KS School of Advanced Military Studies. https://apps.dtic.mil/sti/citations/ADA388509

MAGTF Ground Operations. (2018). Marine Corps Warfighting Publication (MCWP), 3–01, PCN 143 000111 00. https://www.marines.mil/portals/1/Publications/MCWP%203-10.pdf?ver=2018-09-20-112713-937

Markus, M. L. (2001). Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success. *Journal of Management Information Systems, 18*(1), 57–93. https://doi.org/10.1080/07421222.2001.11045671

Merriam-Webster. (n.d.). Executing. Retrieved October 19, 2022, from https://www.merriam-webster.com/dictionary/executing

Merriam-Webster. (n.d.). Explicit. Retrieved October 19, 2022, from https://www.merriam-webster.com/dictionary/explicit

Merriam-Webster. (n.d.). Tacit. Retrieved October 19, 2022, from https://www.merriam-webster.com/dictionary/tacit

Merriam-Webster. (n.d.). Trust. Retrieved October 6, 2022, from https://www.merriam-webster.com/dictionary/trust

Mikolajuk, Z., & Yeh, A. G.-O. (2000). Sustainable Development and Decision Support Systems. In G. E. Kersten, Z. Mikolajuk, & A. G.-O. Yeh (Eds.), *Decision support systems for sustainable development: A resource book of methods and applications* (pp. 13–27). Springer U.S. https://doi.org/10.1007/0-306-47542-1_2

Naval War College. (n.d.). JPP intro slides [Slide show]. https://cle.nps.edu/. https://cle.nps.edu/portal/site/535db492-31e3-4983-b34b-1935dd99c2fe

North, D. W. (1968). A tutorial introduction to decision theory. *IEEE Transactions on Systems Science and Cybernetics*, *4*(3), 200–210. https://doi.org/10.1109/TSSC.1968.300114

Öhman, M., Rodriguez, T., Nykänen, J., & Dou, J. (2016). *Digitalization reshaping conflicts—The ordinary citizen as the new peacekeeper.* Aalto University's Multidisciplinary Institute of Digitalisation and Energy (MIDE) (pp. 159–201).

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: How to benefit from digitalization in practice. *International Journal of Information Systems and Project Management*, *5*(1), Article 1. https://doi.org/10.12821/ijispm050104

Peiffer, H., Schmidt, I., Ellwart, T., & Ulfert, A.-S. (2020). Digital competences in the workplace: Theory, terminology, and training. In E. Wuttke, J. Seifried, & H. Niegemann (Eds.), *Vocational education and training in the age of digitization* (1st ed., pp. 157–182). Verlag Barbara Budrich. https://doi.org/10.2307/j.ctv18dvv1c.11

Pitz, G. (1984). Judgment and decision: Theory and application. *Annual Review of Psychology, 35*(1), 139–163. https://doi.org/10.1146/annurev.psych.35.1.139

Sage, A. P. (1991). *Decision support systems engineering*. John Wiley & Sons.

Samoilenko, S. V. (2022). *Digitalization: Contexts, roles, and outcomes*. Routledge. https://doi.org/10.1201/9781003304906

Sarukesi, J. &. (2009). *Decision support systems* (1st edition). Phi.

Scott, S. G., & Bruce, R. A. (1995). Decision-making style: The development and assessment of a new measure. *Educational and Psychological Measurement, 55*(5), 818–831. https://doi.org/10.1177/0013164495055005017

Sehlin, D., Truedsson, M., & Cronemyr, P. (2019). A conceptual cooperative model designed for processes, digitalisation and innovation. *International Journal of Quality and Service Sciences*, *11*(4), 504–522. https://doi.org/10.1108/IJQSS-02-2019-0028

Shim, J. P., Warkentin, M., Courtney, J. F., Power, D. J., Sharda, R., & Carlsson, C. (2002). Past, present, and future of decision support technology. *Decision Support Systems*, *33*(2), 111–126. https://doi.org/10.1016/S0167-9236(01)00139-7

Susnea, E. (2012). Decision support systems in military actions: Necessity, possibilities and constraints. *Journal of Defense Resources Management*, *3*(2), 131–140.

Tolk, A., & Kunde, D. (2010). *Decision support systems—Technical prerequisites and military requirements* (arXiv:1011.5661). arXiv. https://doi.org/10.48550/arXiv.1011.5661

Turban, E., Aronson, J. E., Liang, T.-P., & McCarthy, R. V. (2004). *Decision support systems and intelligent systems* (7th edition). Prentice Hall.

U.S. Department of Defense. (n.d.).*DOD/GSA Seeks Industry Feedback on Cloud Computing.* Retrieved October 24, 2022, from https://www.defense.gov/News/News-Stories/Article/Article/1672836/dodgsa-seeks-industry-feedback-on-cloud-computing/https%3A%2F%2Fwww.defense.gov%2FNews%2FNews-Stories%2FArticle%2FArticle%2F1672836%2Fdodgsa-seeks-industry-feedback-on-cloud-computing%2F

Wikipedia contributors. (2023). OODA loop. Wikipedia. https://en.wikipedia.org/wiki/OODA_loop

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