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EASY DECISIONS MADE HARD:
INTUITIVE DECISION MAKING IN AN INFORMATION RICH ENVIRONMENT

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ABSTRACT

The advance of technology in the United States military has created a mountain of data and information for Operational Commanders to process and make decisions. This volume of information has slowed the commander's ability to make decisions. This paper will examine command and control to define the construct the commander works within. Intuitive decision-making is described and three methodologies are chosen: efficiency thoroughness trade off, recognition-primed decision-making, and thin slicing. Technology specific to the United States military will be examined to describe the amount of information to which commanders are exposed. These topics frame the analysis that shows the fusion of data into information for a commander's decision-making. The current planning of the United States military is process driven and thrives with immense amounts of information driving analytic decision-making. The analysis further showed that these decision-making models can be used in the face of this to increase the tempo of that planning and execution. Technology will continue to improve, battlefields will continue to be complex, and commanders will continue to be overloaded with information. The key to reversing this trend lies in the decision-making the commanders already know, intuitive decision-making can help them make sense of all the information but more importantly it will make them time, a luxury on the battlefield.

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"Finally, our commanders must foster a climate within their units that is supportive of intuitive skill development. Doing these things will cultivate "coup d'oeuil" and guarantee our success on the 21st century battlefield."

General Charles Krulak, Commandant of the Marine Corps, 1999

INTRODUCTION

Military leaders throughout history have been judged on a number of different criteria for their effectiveness and success. The most obvious of these is whether or not they made good decisions. The art of military leadership has been said to be both Art and Science. With that thought in mind, the decision making process these leaders use becomes paramount to continued evolution in military leadership. This factor in unison with leaps in technological capabilities has made the issue even more contentious. The modern battlefield operation center has transformed from paper maps to a multitude of computers and monitors. This paper will propose that technology will slow the decision-making process and can only be overcome by the use of intuitive decision-making.

Command and control is the first topic to be examined. The terms are specifically defined with United States Joint Doctrine and North Atlantic Treaty Organization definitions to clarify key terms. The first term is command. Next, the term control is defined. Finally, the term command and control is defined for clarity. A solid understanding in a narrow scope is necessary to establish the foundation of these concepts for later discussion.

The next topic to be discussed is decision-making models applicable to military operations. Three intuitive decision-making models were chosen for use in this work. First, the efficiency thoroughness trade off decision-making model will be discussed. The

next model to be discussed is recognition-primed decision-making. Finally, a concept of thin slicing for decision-making will be discussed. These three models will form the models used to analyze decision-making in the military environment at the operational level.

Following the decision-making models, a discussion of technology and its affect on military operations will be proposed. The discussion on technology will be broken into three main elements. The first element is data links in the military environment. Next, intelligence, surveillance, and reconnaissance will be examined. Finally, real time battle tracking will be examined for its implications on the operational environment. The implications of technology will lay the final piece of foundation for the analysis of operational command and decision-making.

Command and control, decision-making models, and technology will be used to analyze decision-making on the modern battlefield conducted by the operational commander. The first aspect of the analysis will focus on joint operations. Next, planning and execution will be examined for its use of the proposed decision-making models. The last segment of analysis is the future of operational decision-making and the modern environment. The analysis of operational command and decision-making focuses on key aspects to overcome information overload and complexity to maintain operational tempo.

CHAPTER 1 — COMMAND AND CONTROL

INTRODUCTION

Command and control is the topic of extensive writing. These terms are often misunderstood and misused. In order to try and reduce the misunderstanding, this paper will describe command, control, as well as command and control. There are many definitions and use of the terms in both current and historical literature. This paper will narrow the scope of definitions to United States Joint Forces doctrine definition and the North Atlantic Treaty Organization definition.

The literature used for this focused around doctrine and the interpretation of doctrine by different authors. United States Joint Doctrine from 2012 is the focus of the chapter on command and control. This doctrine having been approved by the Chairman of the Joint Chiefs of Staff is the guiding principle of the United States military forces. The definitions examined in this chapter have not changed in the Joint Publication since 2001. The North Atlantic Treaty Organization (NATO) also as a dictionary of military terms which, while may not be the guiding principle of all NATO country's militaries, treaty bound nations must operate under these definitions while conducting NATO military operations. This coupled with the fact that the NATO definitions will be shown to be virtually synonymous with the United States Joint doctrine. Recent literature, by David Alberts and Richard Hayes, as well as Ross Pigeau and Carroll McCann provide alternative views on command, control, and command and control. These viewpoints will be used in this chapter and in the analysis in chapter 4.

Doctrine is defined as "the fundamentals by which military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application."[1] Current United States Military doctrine is an evolving process using lessons learned in an iterative approach to maintain relevancy of the doctrinal publications.[2] The revisions of all the United States Joint Publications are on a 4-5 year revision cycle with interim changes being published as necessary.[3] In the classic sense of warfare as being both art and science, doctrine is the science of the established, accepted principles. The application of those principles is the art of conducting military operations.

COMMAND

Command is a term that is used often and in a wide range of contexts. The United States Joint Publication 1-02, Military Definition and Terms, defines it as "The authority that a commander in the armed forces lawfully exercises over subordinates by virtue of rank or assignment.[4] The definition goes on to cover all aspects relevant to what military professionals consider when being designated a commander. These details include: "authority and responsibility for effectively using available resources … the employment, organizing, directing, coordinating, and controlling military forces for the [mission]

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[1] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), 95.
[2] Joint Staff. *Joint Publication 1: Department of Defense Doctrine for the Armed Forces of the United States.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), VI-9.
[3] Ibid, GL-15.
[4] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), 49.

accomplishment… also includes responsibility for health, welfare, morale, and discipline of assigned personnel."[5]

This covers the scope of what the United States military forces expect and require from leaders to which command has been bestowed. The North Atlantic Treaty Organization (NATO) Glossary of Acronyms and Terms, AAP-6 (2008), defines command as "The authority vested in an individual of the armed forces for the direction, coordination, and control of military forces."[6] The NATO definition does not delineate the specifics of responsibility of the commander, but this difference does not differ from Joint Publication 1-02 definition. These definitions broadly differ with Ross Pigeau and Carol McCann's contention that command is simply, "the creative expression of human will to accomplish the mission."[7] This on its surface does not provide any connection to the United States definition of command. However, there is a common thread in the deeper elements of Pigeau and McCann's definition. They go on to identify three "critical components of competency, authority, and responsibility."[8] These components are contained within the United States and NATO definitions, either implicitly or explicitly. The United States and NATO definitions explicitly state "authority" and "responsible" in the definition. The concept of competency is implicit in that the screening and vetting process of the respective United States military service has accurately evaluated a commander's competency before selection to command. The definition of command is easily stated by each publication and forms the basis for later discussions.

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[5] Ibid.
[6] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6)*, (STANAG 3680, 2013), 2-C-9.
[7] Ross Pigeau and Carol McCann. "Clarifying the Concepts of Command and Control.", last accessed 20 April 2013, http://www.dodccrp.org/events/1999_CCRTS/pdf_files/track_3/019mccan.pdf., 5.
[8] Ross Pigeau and Carol McCann. "Clarifying the Concepts of Command and Control.", last accessed 20 April 2013, http://www.dodccrp.org/events/1999_CCRTS/pdf_files/track_3/019mccan.pdf., 6.

CONTROL

One of the common terms in the definitions from the United States Joint Publication 1-02 and NATO AAP-6 is that the commander is responsible for control of his forces. United States Joint Publication 1-02 defines control as "authority that may be less than full command exercised by a commander over part of the activities of subordinate or other organizations."[9] The NATO Glossary of Acronyms and Terms goes further than Joint Publication 1-02 by delineating control as "that authority exercised by a commander over part of the activities of subordinate... other organizations not normally under his command, which encompasses the responsibility for implementing orders or directives. All or part… may be transferred or delegated."[10] David Alberts asserts control is "subsumed" in the United States Joint definition of control.[11] Ross Pigeau and Carroll McCann assert that control is "the structure and process by the Command to manage risk."[12] The structure can be the architecture, personnel, or systems in place to manage risk. In this manner both Alberts and Pigeau / McCann agree that the accepted definition of the United States and NATO includes many elements of control. However, it can be said that defining authority of a commander exercised over subordinates or those not

[9] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), 61.
[10] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6)*, (STANAG 3680, 2013), 2-C-14.
[11] David S. Alberts and Richard E. Hayes. *Power to the Edge: Command and Control in the Information Age.* (2005), last accessed 20 April 2013, http://www.dodccrp.org/files/Alberts_Power.pdf, 14.
[12] Ross Pigeau and Carol McCann. "Clarifying the Concepts of Command and Control.", last accessed 20 April 2013, http://www.dodccrp.org/events/1999_CCRTS/pdf_files/track_3/019mccan.pdf., 4.

normally under command is the structure and process of managing risk by reducing uncertainty with in the chain of command. This further increases the need for the term

Operational Command and with it the term Operational Control.

The terms Operational Command and Operational Control are used across the gambit of literature from historical to doctrinal. Doctrinal literature will continue to be the source to distinguish these terms for discussion. Operational Command is a term used by NATO and many other countries that subscribe to NATO doctrine. Operational Command is defined as "the authority granted to a commander to assign missions or tasks to subordinate commanders, to deploy units, to reassign forces, and to retain or delegate operational and/or tactical control as the commander deems necessary."[13] This concept bridges the gap between the NATO and United States Joint Publication 1-02 definition of command. The United States Joint Publication definition encompasses the authority to employ, task, and delegate to forces assigned to that commander by the force generators. Operational Control is common to both NATO and United States Joint Doctrine. NATO defines Operational Control as "the authority delegated to a commander to direct forces assigned so that the commander may accomplish specific missions or tasks… It does not include authority to assign separate employment of components of the units concerned. Neither does it, of itself, include administrative or logistic control."[14] Whereas the United States Joint Doctrine defines Operational Control as:

> "Command authority that may be exercised by commanders at any echelon at or below the level of combatant command. Operational control

[13] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6),* (STANAG 3680, 2013), 2-O-3.
[14] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6),* (STANAG 3680, 2013), 2-O-3.

> is inherent in combatant command (command authority) and may be delegated within the command. Operational control is the authority to perform those functions of command over subordinate forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction necessary to accomplish the mission….Operational control normally provides full authority to organize commands and forces and to employ those forces… it does not, in and of itself, include authoritative direction for logistics or matters of administration, discipline, internal organization, or unit training."[15]

Both of these definitions clearly describe that supporting units are assigned under Operational Control for tasks or missions but does not automatically require the supported commander to provide any training or support, other than the operational support required to complete the assigned mission.

COMMAND AND CONTROL

United States Joint Publication 1-02 defines command and control as "the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission."[16] This concept is often confused with command and control system. The equipment, architecture, and personnel that allow the commander control of his forces comprise the command and control system.[17] The NATO definition also focuses on equipment, personnel, and architecture to allow a commander to control his forces for the assigned mission.[18] So the important

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[15] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), 211.
[16] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), 49.
[17] Ibid.
[18] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6),* (STANAG 3680, 2013), 2-C-9.

differentiation to make is the system allows command and control, separate terms, to occur. Pigeau and McCann would argue command and control is "[t]he establishment of common intent to achieve coordinated action."[19] Alberts and Hayes describe command and control, first as a combination of the separate terms of command and control, and as an approach that is comprised of three key elements: "allocation of decision rights; patterns of interaction among the actors; and distribution of information."[20] While these definitions are very different than the United States Joint or NATO definitions, all of these are implicit in the United States and NATO definition if the commander executes his assigned duties. It is important to ensure that command and control is not misused to alleviate any confusion.

CONCLUSION

The use of terms when discussing military operations becomes key to the deeper understanding of what is being discussed. Command, the authority to direct and employ troops, has to be clear and well described in any operation. This may include limits to the extent of the command with the distinction of Operational Command. Control then has been established to be the level of the control of the supporting units. Operational Control can also define the level of control the commander is authorized. Then the term command and control is the exercise of those two elements on the assigned units. Command and control cannot be confused with command and control systems. Using these two terms

[19] Ross Pigeau and Carol McCann. "Clarifying the Concepts of Command and Control.", last accessed 20 April 2013, http://www.dodccrp.org/events/1999_CCRTS/pdf_files/track_3/019mccan.pdf., 2.
[20] David S. Alberts and Richard E. Hayes. *Understanding Command and Control.* (2006), last accessed 20 April 2013, http://www.dodccrp.org/files/Alberts_UC2.pdf, 74-75.

interchangeably can add confusion to an already complex and nuanced set of terms.

The decision to narrow the scope of how these terms are defined comes with some strengths and weaknesses. The decision to use the United States Department of Defense Joint publication definition as well as the North Atlantic Treaty Organization definitions of these terms is a represents most 1st world western militaries. While this may seem to exclude other possible viewpoints, these two definitions include or are used by 6 of the top ten militaries in the world as NATO countries or allies of the United States.[21] Another strength is that the two definitions are very similar so there should be no confusion with any of the terms when used. A weakness may lie in the fact that there are other terms such as command and control protection and command control warfare.[22] These terms are further breakdowns of command and control systems that are not made by the United States Department of Defense Joint Publication 1-02. Since these distinctions are not defined and not salient to the discussion of this work, they will not be used for the analysis.

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[21] Stockholm International Peace Research Institute. "The 15 countries with the highest military expenditure in 2012.",last accessed 20 April 2013, http://www.sipri.org/research/armaments/milex/Top%2015%20table%202012.pdf, Table 3.3.

[22] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6)*, (STANAG 3680, 2013), 2-C-9.

CHAPTER 2— DECISION-MAKING

INTRODUCTION

Decision-making in military operations is one of great interest and importance throughout history. Recently, the psychology of decision-making has become one of great study. Whether in business, healthcare, emergency services, or military operations, decision-making has been modeled in many different ways. In the broadest of terms there are two major definitions of decision-making in the military context. The two primary types of decision-making are analytic and intuitive. While the field of these two types of decision-making is broad, this paper will use three intuitive decision-making models. Three methods used in this work are efficiency thoroughness trade off, recognition-primed decision-making, and Malcolm Gladwell's thin slicing.

The literature on decision-making encompasses nearly every endeavor in the human function. This work focuses on intuitive decision-making as one of the primary methods used by commanders in the United States military. Intuitive decision-making has recently the subject of a great deal of research. Glockner and Witteman in 2009 provide insight on intuitive decision-making and some of the previous models associated with the field.[23] Naturalistic decision-making and its use in the military context have been extensively researched. In 2001, Lipshitz and Klein examine the five main areas of naturalistic decision-making in their work "Taking Stock of Naturalistic Decision-

[23] Andreas Glockner and Cilia Witteman. "Beyond Dual-Process Models: A Categorisation of Processes Underlying Intuitive Judgement and Decision Making." *Thinking and Reasoning* 16, no. 1 (2010), 2-6.

Making. “Natter, Ockerman, and Baumgart’s work on “Command and Control Assessment Tool and Metrics” research the mental constructs and decision-making in command and control.

Gary Klein and David Klinger first identified Recognition-primed decision-making. There original research was on fire-ground commanders and the process they used for decision-making on the scene of fires.[24] Other researchers on the subject include Salmon et. al. in their work on decisions when using digitized mission support systems in a military context. [25] Mica R Endsley is one of the most prolific researchers on naturalistic decision-making and situational awareness authoring over 200 articles in her career. Finally, Malcolm Gladwell’s book “Blink” will serve as the source for the discussion of thin slicing. Preeminent authors on Command and Control also use the idea of intuitive decision-making. David Alberts and Richard Hayes discuss this decision-making process in their works *Power to the Edge* and *Understanding Command and Control.* These works and more on the subject will be used to describe the decision-making process.

INTUITIVE DECISION MAKING

It is useful to examine intuitive decision-making generally before describing the there models to be used. In the military context, decision-making is taught early and

[24] Gary A. Klein. "A recognition-primed decision (RPD) model of rapid decision making." *Decision making in action: Models and methods* 5, no. 4 (1993), 139.
[25] Paul M. Salmon, Neville Stanton, Guy Walker, and Laura Rafferty. "Decisions, Decisions ... and Even More Decisions: Evaluation of a Digitized Mission Support System in the Land Warfare Domain." International Journal of Human-Computer Interaction 26, no. 2/3 ,Feb/Mar2010, (2010), 206.

continuously throughout a military leaders career. The Chairman of the Joint Chiefs of Staff Instruction 1800.01D, the Officer Professional Military Education Program, outlines the joint officer education program. Education of military officers is a continuous process of "training, experience, education, and self-improvement."[26] All these aspects of professional military education build a foundation for leaders to gain a significant base of experiences and training to draw from in intuitive decision-making.

Glockner and Witteman identified four types of intuition. They are not exclusive from one another and a brief description aid in the use of the three intuitive models to be discussed. The four categories of intuition are posited as associative intuition— "activation of the previously successful behavioral option", matching intuition— comparison of learned images or schemas with those that have been learned, accumulative intuition—automatic accumulation of evidence and based on the overall importance of the decision, a decision is made when the acquired information reaches a certain threshold, and constructive intuition— combination of matching and accumulative intuition, the information is both past and present.[27] The result of that information is that the information "enters the awareness" of the decision maker.[28] The four categories of intuition describe the theory behind intuitive decision-making. These ideas on intuitive decision making agree with Erik Hollnagel's efficiency thoroughness trade off model. Recognition-primed decision-making model agrees with associative and matching intuition and relies on accumulative and constructive intuition for higher-level decision-

[26] Joint Staff. "OFFICER PROFESSIONAL MILITARY EDUCATION POLICY (OPMEP)," (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2012), CJCSI 1800.01D, last accessed 20 April 2013, http://www.dtic.mil/cjcs_directives/cdata/unlimit/1800_01.pdf, A-1.
[27] Andreas Glockner and Cilia Witteman. "Beyond Dual-Process Models: A Categorisation of Processes Underlying Intuitive Judgement and Decision Making." *Thinking and Reasoning* 16, no. 1 (2010), 8.
[28] Ibid., 8-9.

making. Gladwell's thin slicing while doesn't disagree with the four categories, Gladwell's intuitive decision-making relies on instantaneous natural decision response, rather than Glockner and Witteman's categories.

EFFICIENCY THOROUGHNESS TRADE OFF

Erik Hollnagel wrote an explanation of his efficiency thoroughness trade off in his book The ETTO Principle: Efficiency Thoroughness Trade Off in 2009. Put simply, his contention is that in decision-making is a balance between efficiency in time and completeness in the information available.[29] ETTO looks to strike a balance between quick and possibly wrong, or thorough and decisions that are possibly too late.[30] While this concept was originated for risk management the extension to decision-making is seamless. The analysis of in United States Navy aviation involves a five-step process of risk management. "Identify the hazard, assess the hazard, make risk decisions, implement controls, and supervise"[31] build the foundations for risk management at the organizational level. The connection of ETTO and risk management then lies in the decision-making conducted during the process. This style of decision-making also closely resembles the decision-making in military operations. Risk is evaluated concurrently across decisions involving "ends, ways, and means" which are the heart of operational planning and

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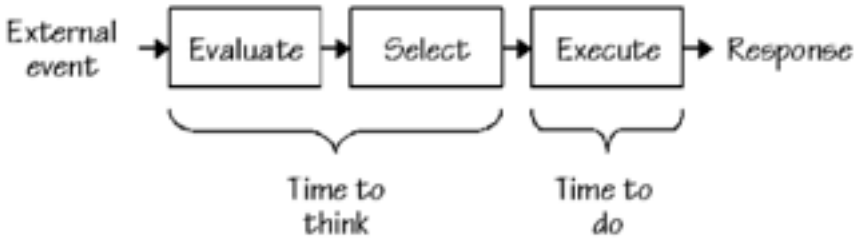
[29] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009). Chapter 1,The ETTO Principle.
[30] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009). A need for simple explanations.
[31] Chief of Naval Operations. "Operational Risk Management.", 2010, OPNAV 3500.39C, last accessed 20 April 2013, http://doni.daps.dla.mil/Directives/03000%20Naval%20Operations%20and%20Readiness/03-500%20Training%20and%20Readiness%20Services/3500.39C.pdf, Encl. 1, 5.

command.[32]

Decision-making evaluated by Hollnagel is best described in a series of graphical depictions. The process of decision-making is open to debate as to the actual steps in the process. The basic definition of decision in operational context is defined by the United States Department of Defense in Joint Publication 1-02 as "a clear and concise statement of the line of action intended to be followed by the commander as the one most favorable to the successful accomplishment of the assigned mission."[33] Hollnagel proposes two similar processes depicted in different manners. First as seen here in Figure 1.1 is the idea of sequential events requiring a decision.

Figure 2.1 Sequential ETTO[34]

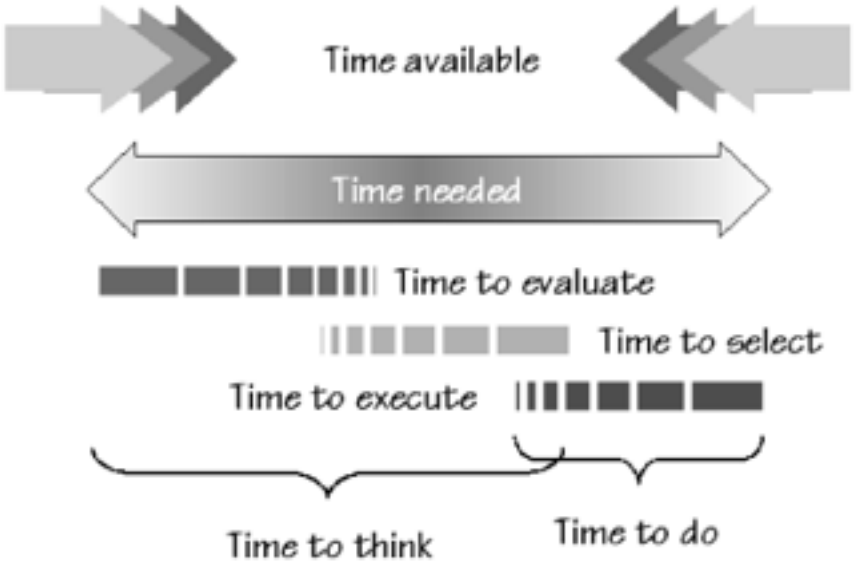


This model puts no emphasis on the amount of time for the decision. It also does not involve the permutation that time is dependent on the external event or that the response is dependent and may change based on either the "time to think" or "time to do" step of

[32] Joint Staff. *Joint Publication 3-0: Department of Defense Operations.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013), II-4.
[33] Joint Staff. *Joint Publication 1-02: Department of Defense Dictionary of Military Terms.* (Washington, DC: Department of Defense, Joint Chiefs of Staff, 2013),
[34] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009), Figure 2.1

the process. A different representation by Hollnagel is a temporal representation of decision-making.

Figure 2.2 Temporal ETTO[35]



This idea of decision-making Hollnagel describes the "solution" to be "to reduce the time for either for evaluation, for selection, or for execution, so that the time required does not exceed the time available."[36] Time is always a critical factor in operational decision-making and a key component that must be dealt with for the decision-making to be productive. A more succinct view of the ETTO concept by Hollnagel as a "strategy" is seen in Table 2.1[37]

	Situation as assumed (positive outcome)	Situation not as assumed (adverse outcome)
Trade-off thoroughness for effectiveness	Relief: Success, even though efforts were saved.	Regrets: Failure, should have been thorough.
Trade-off effectiveness for thoroughness	Vindication: Success, wise use of effort.	Misgivings: Failure, and effort spent in vain.

[35] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009), ebook, figure 2.2.
[36] Ibid, Time to think time to do.
[37] Ibid, table 3.3.

This table shows the quadrant view of tradeoff and result based on what Hollnagel describes as “positive” or “adverse” outcomes. This simplistic view of the limits of the scale between efficient and thorough frames the scope of outcomes for any decision and will be applied later in this paper to apply to Operational decision-making.

RECOGNITION PRIMED DECISION MAKING

Naturalistic decision-making is a strategy that takes available information and allows users to quickly make a decision that presents a high probability of success. Using situational awareness and cognitive assessment to intuit a decision and test its plausibility, naturalistic decision-making provides a method to make quick, intuitive decisions.38 Research on this model became more applicable due to the methods used to study the model. Initial research focused on strategies used by people rather than designing experiments to measure responses.[39] As this model continued to evolve, a Recognition-Primed Decision model of rapid decision-making developed. This model is based on similar situations experienced and use of that history to make current decisions.[40] A key component to naturalistic decision-making is situational awareness.

Situational Awareness

[38] Gary A. Klein. "A recognition-primed decision (RPD) model of rapid decision making." *Decision making in action: Models and methods* 5, no. 4 (1993), 138.
[39] Gary Klein. "Naturalistic Decision Making." *Human Factors* 50, no. 3 (2008), 456.
[40] Gary A. Klein. "A recognition-primed decision (RPD) model of rapid decision making." *Decision making in action: Models and methods* 5, no. 4 (1993), 140

Situational awareness can be defined in as many ways as there are fields that to which it is applicable. The most widely accepted version of situation awareness is "the perception of elements in the environment within a volume of time and space (level 1), the comprehension of their meaning (Level 2), and the projection of their status in the near future (level 3)."[41] Situation awareness began in the aviation community but has grown to be the focus of many different domains. In the context of military operations and command and control, situational awareness can be further divided to include situation understanding. This subdivision of Endsley's definition of situational awareness corresponds to Level 1 situational awareness, situational understanding corresponds to Level 2 situational awareness, and Level 3 situational awareness corresponds to

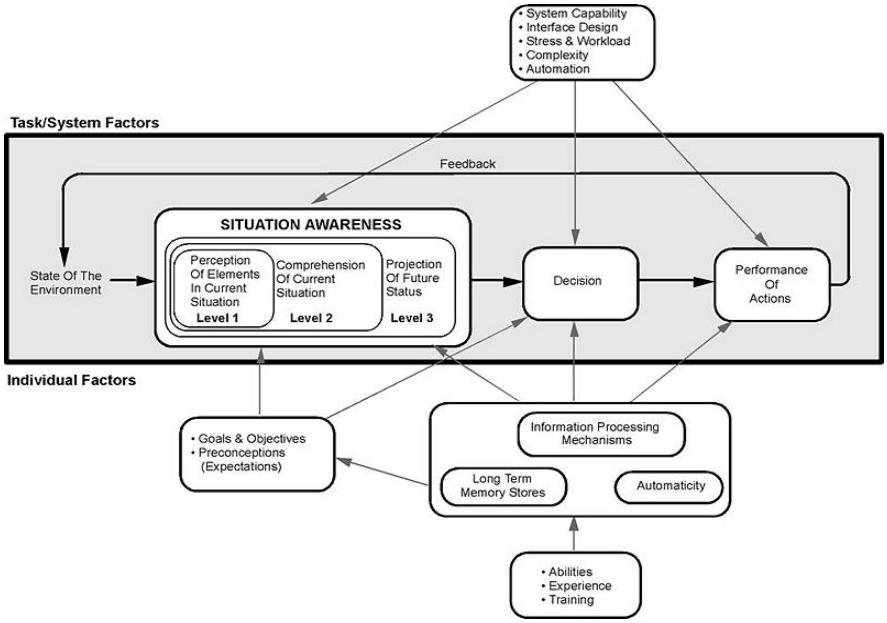


Figure 2.3[42]

[41] Mica Endlsey. "Automation and Situation Awareness." in *Automation and Human Performance: Theory and Application.* ed. R. Parasuraman and M. Mouloua, 163-181, (Mahwah, NJ: Lawrence Eribaum, 1996), 1
64.

[42] Endsley, Mica. "Toward a Theory a Theory of Situational Awareness in Dynamic Systems." *Human Factors: The Journal of the Human Factors and Ergonomics Society* 37, no. 1 (1995), 35.

situational assessment.[43] Endsley's model of situational awareness is depicted in Figure 2.3. As depicted the task/system factors are key components in decision-making in this model with regard to command and control. System capability, interface design, stress and workload, complexity, and automation are all items that will be discussed in Chapter 5 in the broad sense of what a commander needs at the operational level to conduct command and control.

Level 1 Situational Awareness

Mica Endsley describes Level 1 situational awareness as the perception phase. This stage is the process of perceiving the "status, attributes, and dynamics of relevant elements in the environment."[44] These attributes take many different forms based on the domain of operations. In its beginnings, the discussion of situational awareness was centered on aviation and a pilot's ability to be aware of his environment. "Mountains, aircraft, and warning lights" are examples of items pilots need to perceive from their environment while conducting flight operations.[45] This idea is extended to tactical troops in their perception of enemy, weather, terrain, etc., as well as the need to not be misinformed by the enemy's attempts to deceive the warfighter.[46] These micro level

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[43] Brad C. Dostal. "Enhancing Situational Understanding through the Employment of Unmanned Aerial Vehicles." Last accessed 20 April 2013, http://www.globalsecurity.org/military/library/report/call/call_01-18_ch6.htm.
[44] Kott, Alexander. *Battle of Cognition: The Future Information-Rich Warfare and the Mind of the Commander* . Westport, Conn.: Praeger Security International, (2008), 95.
[45] Mica Endlsey. "Toward a Theory of Situation Awareness in Dynamic Systems." *Human Factors: The Journal of Human Factors and Ergonomics Society* 32, (1995), 36.
[46] Kott, Alexander. *Battle of Cognition: The Future Information-Rich Warfare and the Mind of the Commander* . Westport, Conn.: Praeger Security International, (2008), 95

perceptions can easily be expanded to the operational level. At the macro level the operational commander and staff will need to perceive the aspects of the environment that apply at the operational level. So level 1 situational awareness is the true perception of reality at whatever level it is being applied.

Level 2 Situational Awareness

Level 2 situational awareness is the comprehension of the perceived environment. Comprehension of the environment involves the synthesis of the data received in level 1 situational awareness.[47] The data perceived at the operational level will be more holistic than at the lower level tactical commanders. Some examples of these are logistic requirements of tactical commanders, theater level medical transport and medical services, and unit readiness and capability. These are items that need to be comprehended at the operational level. Comprehension of the available level 1 data requires more experienced decision makers to enable the synthesis of the information.[48]

Level 3 Situational Awareness

Level 3 situational awareness is the projection of the acquired level 1 and level 2 situational awareness in to at least the short-term future.[49] The ability to take the synthesized information from Level 2 situational awareness and use that to perceive the

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[47] Ibid, 96.
[48] Mica Endlsey. "Toward a Theory of Situation Awareness in Dynamic Systems." *Human Factors: The Journal of Human Factors and Ergonomics Society* 32, (1995), 37
[49] Ibid, 37.

future state of the environment allows decision-makers to make decisions that drive the environment to a desired outcome. At the operational level some examples of level 3 situational awareness are ability to "sustain their forces, enemy course of action decisions, and time and ability to resupply units."[50] An important factor in operational command is to remain proactive in decision-making. The use of all available data, level 1 and level 2 situational awareness, to make decisions in a timely manner to maintain tempo is the practical use of level 3 situational awareness in military operations.

Recognition-Primed Decision

Naturalistic decision-making is a researched and documented model that has shown significant application to military operations. [51] The focus of naturalistic decision-making centers around "perception and recognition" and using that information to make a choice of an "appropriate response."[52] Subsequent research in the naturalistic decision making, yielded recognition-primed decision-making. This model describes how experienced decision-makers use previously formed patterns or information, apply that to current situations, and make quick decisions.[53] A key identifier of this method is users are able to come to decision without comparing course of action strengths and weaknesses.[54] Further study of the recognition-primed decision making model brings forward three variations of the model. The first of these variations is the where "skilled

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[50] Kott, Alexander. *Battle of Cognition: The Future Information-Rich Warfare and the Mind of the Commander* . Westport, Conn.: Praeger Security International, (2008), 101.
[51] Gary Klein. "Naturalistic Decision Making." *Human Factors* 50, no. 3 (2008), 457.
[52] Ibid, 457.
[53] Ibid.
[54] Walter Warwick, Stacey McIlwaine, Rob Hutton, and Patty McDermott. "Developing computational models of recognition-primed decision making." In *Proceedings of the tenth conference on Computer Generated Forces, Norfolk, VA* (2001), 2.

decision makers perceive situations as typical cases where certain types of actions are typically appropriate."[55] The second variation is story building. This methodology takes all the available information and pieces the information together to elicit a course of action based on a "built" story that connects the disconnected pieces of information.[56] A third variation of the model that emerged is termed progressive deepening. This variation, originally proposed by Adrian de Groot in 1965, involves a real-time simulation of the course of action for suitability and any undesirable outcomes.[57] These three variations of the recognition-primed decision-making give ample explanation to the methods observed in the decision makers studied.

The first variation of recognition-primed decisions uses their perception of a situation and experience to provide "prototypes or functional categories."[58] This methodology is the most basic style of recognition-primed decision making. A decision-maker perceives the environment based on the available information. This information is compared to experiential knowledge to guide a decision. Based on the experience of past events and the similarity of the current event, a decision is made that has a history of positive outcome. Basing current decisions on past experiences is the epitome of recognition-primed decision-making's first variation.

The second variation of recognition-primed decision-making is story building. This variation of recognition-primed decision-making allows the decision-maker to take

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[55] Lipshitz, Raanan, Gary Klein, Judith Orasanu, and Eduardo Salas. "Taking Stock of Naturalistic Decision Making " *Journal of Behavioral Decision Making* 14, no. 5 (2001; 2001), 336.
[56] Kaempf, George L., Klein, Gary, Thorsden, Marvin, and Wolf, Steve. "Decision Making in Complex Naval Command and Control Environments.", *Human Factors: The Journal of Human Factors and Ergonomics Society.* 38, (1996), 227-228.
[57] Gary A. Klein. "A recognition-primed decision (RPD) model of rapid decision making." *Decision making in action: Models and methods* 5, no. 4 (1993), p336.
[58] Lipshitz, Raanan, Gary Klein, Judith Orasanu, and Eduardo Salas. "Taking Stock of Naturalistic Decision Making " *Journal of Behavioral Decision Making* 14, no. 5 (2001; 2001), 336.

available fragmented information and piece it together to a mentally plausible "story" that explains the current situation, allowing a reasonable decision based on experience of similar "stories" already experienced.[59] George Kaempf examined this variation et. al. in 1996, in the study of decision making in complex naval environments. They examined 103 incidents of situational awareness in 14 incidents from the viewpoint of commanding officers through anti air warfare officers.[60] Story building accounted for 12 percent of the observed incidents.[61] In these cases the decision maker used mental construction to build a story that would explain the lack of information or conflicting pieces of data to explain the situation and then make a decision.[62] This is a clear example of variation 2, recognition-primed decision-making.

The third variation is progressive deepening. This variation is a "mental simulation" of a course of action to test the "effectiveness" of that course of action.[63] This is a process of evaluating the first course of action decided upon, if that is not feasible, then the next course of action. Another observed use of this variation is by master chess players. Master chess players would choose the first move that came to mind, then that move would be mentally evaluated for successive moves and success.[64] This was not observed to be a process of comparing courses of action but a process of evaluating single courses of action, first courses of action recognized, then moving to the next

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[59] Ibid.
[60] Kaempf, George L., Klein, Gary, Thorsden, Marvin, and Wolf, Steve. "Decision Making in Complex Naval Command and Control Environments.", *Human Factors: The Journal of Human Factors and Ergonomics Society.* 38, (1996), 225.
[61] Ibid, 226.
[62] Ibid.
[63] Nigel Harvey and Derek J. Koehler. *Blackwell Handbook of Judgment and Decision Making* Oxford, UK: Blackwell Publishing, (2004), 305.
[64] Gary Klein. "Naturalisti
c Decision Making." *Human Factors* 50, no. 3 (2008), 458.

course of action if the previous was not found to be feasible. These are examples of the third variation of recognition-primed decision-making.

The recognition-primed decision-making model developed by Mica Endsley portrays the three variations of recognition-primed decision-making model in figure 2.4. [65] The flow chart shows variation 1 if the initial situation is recognized. If not, the second

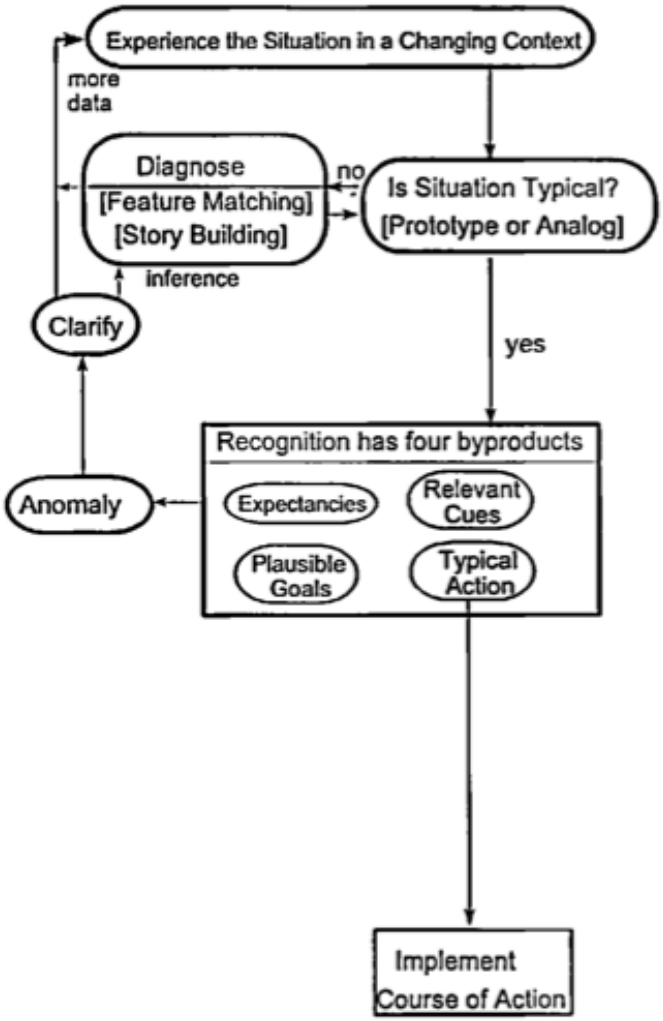

Figure 2.4 Endsley's Recognition Primed Decision-Making Model

[65] Kaempf, George L., Klein, Gary, Thorsden, Marvin, and Wolf, Steve. "Decision Making in Complex Naval Command and Control Environments.", *Human Factors: The Journal of Human Factors and Ergonomics Society.* 38, (1996), 228.

variation is the diagnose branch goes into variation 2. If that iteration is repeated then it is an example of variation 3. This is a simplistic view of the three variations of the recognition-primed decision-making model. All of these variations rely on the experience of the decision-maker to operate efficiently.

Another idea on intuitive decision-making is Malcolm Gladwell's concept of thin slicing. In military command and control the necessity to make decisions quickly and based on limited information can be the difference between success and failure. "Finding patterns and behaviors based on very narrow slices of experience" is what Gladwell calls thin slicing.[66] In military operations, this can be seen as the "ability to be in a situation and quickly make sense of the battlefield".[67] His idea suggests that by controlling the introduction environment of the information a user can immerse his subconscious in the situation and quickly come to a conclusion.[68] Confusion and complexity are rife on the battlefield and the need to make quick and correct decisions can literally be a matter of life or death.

An example used by Gladwell with military application was a discussion on the Millennium Challenge in 2002. The exercise was sponsored by the United States Joint Forces Command to test the integration of the "information revolution to improve the way [military planning and execution is conducted]."[69] The 250 million dollar exercise culminated in a blue team versus red team exercise. The blue team was commanded by a standing headquarters and used the most current and sophisticated planning and

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[66] Malcolm Gladwell, Malcolm. *Blink: The Power of Thinking without Thinking* . New York: Little, Brown and Co., (2005), 23.
[67] Ibid, 44.
[68] Ibid, 253.
[69] Department of Defense. "Special Briefing on Millennium Challenge 2002." Last accessed 20 April 2013, http://www.defense.gov/transcripts/transcript.aspx?transcriptid=3456.

execution tools.[70] General Paul Van Riper, United States Marine Corps (retired) commanded the opposing red team.[71] General Van Riper led his team by emphasizing tempo and proactive decision making from his staff. General Van Riper created the conditions for "complete spontaneity which allowed him and his team to act quicker and outpace the blue force leveraging over 20,000 losses after the first day of the exercise", merely by using initiative and innovation.[72] Ultimately, his decision to push decision-making to his subordinates and focus on improvisation allowed for "rapid cognition."[73] General Van Riper used his experience to make and guide decisions based on limited information and in rapid succession, he "thin-sliced" his decisions and allowed subordinate commanders to do the same.

Strengths and Weaknesses

As with any decision-making model, intuitive decision-making comes with its own strengths and weaknesses. First, military training is by its nature good training for intuitive decision-making. Repetition and exposure to different problem sets builds and experiential base from which a decision maker can draw. A staple of military training for leaders at all levels is scenario-based training. This type of training is "a promising one for the development of decision-making expertise in a specific domain."[74] This type of decision-making also has some weaknesses to be discussed. The first is the recognition-

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[70] [70] Malcolm Gladwell, Malcolm. *Blink: The Power of Thinking without Thinking* . New York: Little, Brown and Co., (2005), 107-111.
[71] Ibid.
[72] Ibid, 110-114.
[73] Ibid 119.
[74] Nigel Harvey and Derek J. Koehler. *Blackwell Handbook of Judgment and Decision Making* Oxford, UK: Blackwell Pub., (2004), 307.

primed decision-making "requires experienced decision makers" and requires realistic training to develop this experience.[75] Another shortfall is the absence of error detection ability. With this type of decision-making there exists "no analytic criteria that serve as a sign post for error."[76] Even with these weaknesses the overwhelming strength of this model is that it is not a method to teach, it is a method that is naturally used by decision makers. Klein asserts, "that [a recognition-based decision-making] process approach should be taught, since the [recognition-based decision-making] model is already a description of what people do."[77] This statement is true for all three discussed intuitive decision-making.

CONCLUSION

Intuitive decision-making is one that is easily adapted to military decision-making. Multiple militaries have adopted intuitive decision making into their doctrine. The United States Army, United States Navy, and the Swedish have all adopted intuitive decision-making into their doctrine.[78] The United States Marine Corps has been using intuitive decision-making since it adopted Col. Boyd's OODA loop cycle.[79] The United States Air Force is also investigating the benefits of intuitive decision-making in

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[75] Lipshitz, Raanan, Gary Klein, Judith Orasanu, and Eduardo Salas. "Taking Stock of Naturalistic Decision Making " *Journal of Behavioral Decision Making* 14, no. 5 (2001), 337.
[76] Ibid, 339.
[77] Gary A. Klein. "A recognition-primed decision (RPD) model of rapid decision making." *Decision making in action: Models and methods* 5, no. 4 (1993),146.
[78] Gary Klein. "Naturalistic Decision Making." *Human Factors* 50, no. 3 (2008), 458.
[79] Charles Krulak, "Cultivating Intuitive Decision Making", *Marine Corps Gazette,* last accessed 20 April 2013, http://www.au.af.mil/au/awc/awcgate/usmc/cultivating_intuitive_d-m.htm.

immersive training to increase decision-making ability and speed.[80] Whether it is efficiency thoroughness trade off, recognition-primed decision-making, or Gladwell's "thin slicing", intuitive decision-making is frequently used in the military setting and will be one of the foci used in Chapter 4.

[80] Robert Patterson, et. al., "Training Intuitive Decision Making in a Simulated Real-World Environment.", *Human Factors: The Journal of the human Factors and Ergonomics Society* (2012), 9-10.

CHAPTER 3— TECHNOLOGY

INTRODUCTION

Technology and technological advances have outpaced the realm any would have believed possible just 20 years ago. This evolution is no more evident anywhere than in the United States military. The discussion of technology to be discussed will cover three main areas that affect the operational leader. First, data links and their use on the battlefield will be discussed. Next, intelligence, reconnaissance, and surveillance are discussed. Finally, real time battle tracking and the commander's use will be discussed. These three aspects of technology have a significant effect on operational level command and control.

Military technology and its capabilities are only discussed in generalities in most literature to ensure security when used by military organizations. Therefore, the technology referred in this chapter is drawn from commercial technology applications and military technology information drawn from unclassified military manuals. The intent of the discussion is to highlight the general trend of technology in the three general areas. Joint Doctrine and strategic guidance are also used to highlight the trend of technology in the military and in military operations. Doctrinal publications from the component services as well as the Quadrennial Defense Review and research studies of technological capabilities and their application to military operations are used to provide a holistic view of technology and its advances. Specific systems were used on occasion but only to highlight a capability. In any free market industry, any time a system or

capability is offered there will soon be a different capability that claims to be better. Since, this would only be a distraction and unnecessary for a holistic viewpoint counter arguments on technology will not be discussed.

The evolution of the microchip and computing power has been the precursor to the growth of technology. George E Moore was in the forefront of the development of semiconductors. He proposed, in 1965, that the rate of growth of the density of semiconductors on a given chip would increase by a factor of 2 per year, known as Moore's Law.[81] Chris Mack pointed out that 50 years later Moore's Law was still applicable because it not only represented the growth of semiconductor density but was also a measure of the amount of interest into improvements.[82] Michio Kaku, renowned theoretical physicist, contends that Moore's Law will collapse in the next 10 years based on material and thermodynamic limits.[83] Whether the rapid growth continues or slow, the growth of computing technology continues and has a large impact on military operations.

DATA LINK

The use of data links in the United States military have had significant effect on operational level command and control. The discussion of data links will be handled in three steps. First, the current data links in operation in the United States military will be discussed. Next, one of the data links in use, Link 16, will be used to describe the basic

[81] R. R. Schaller. "Moore's Law: Past, Present and Future". Spectrum, IEEE. Vol. 34 1997, 54.
[82] C. A. Mack. "Fifty Years of Moore's Law". Semiconductor Manufacturing, IEEE Transactions on. Vol. 24 2011 205-206
[83] Matt Peckham, "The Collapse of Moore's Law: Physicist Says It's Already Happening," *Time*, May 1, 2012, last accessed 20 April 2013http://techland.time.com/2012/05/01/the-collapse-of-moores-law-physicist-says-its-already-happening/.

operating concepts of the data link. Finally, the network architecture of the data link will be discussed. The data link and its use by the United States military have had a significant effect on operational command and control.

There are several military data links that are currently in use in the United States military. They are commonly referred to as Tactical Digital Information Links (TADIL), these are approved communication links that allow machine-to-machine interface.[84] Theses data links are divided into several categories. The first category is that used by United States forces.[85] The next category is data links currently used by North Atlantic Treaty Organization militaries. These include: Link 1, Link 14, and finally Link 22[86]. Link 16 is the most widely used data link technology in NATO and in the United States military.[87] This discussion has illustrated the variety of data links used in the United States and North Atlantic Treaty Organization militaries.

Link 16 has already been described to be one of the most widely used data links; a discussion of its capabilities will provide the insight to its use to operational commanders. Link 16 has the capability of providing "near real-time" information exchange in a variety of methods.[88] These methods include fixed-format methods and free text messages.[89] These messages are translated to operational displays that display information that includes: surveillance information—track, track amplifying information, and positional references; electronic warfare—threat emitter information; mission

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[84] Federation of American Scientists. "Tactical Digital Information Links". Last Accessed 20 April 2013, http://www.fas.org/irp/program/disseminate/tadil.htm.
[85] Ibid.
[86] Ibid.
[87] Sturdy, James T. *Military data link integration application*. HONEYWELL INC ALBUQUERQUE NM DEFENSE AVIONICS SYSTEMS DIV, 2004, last accessed 20 April 2013, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA465745, 2.
[88] Air Land Sea Application Center (ALSA), *TADIL J*, N.P. (2000), last accessed 20 April 2013, http://www.globalsecurity.org/military/library/policy/army/fm/6-24-8/, 1-1.
[89] Ibid.

management / weapons coordination—engagement status weapons information; air control—track reporting information; fighter-to-fighter net—sensor target information and status from other aircraft in the data link; secure voice channels—secure digitized voice capability; navigation—relative position from other link participants; positive friendly identification—cryptographically secure location and identification of other link participants.[90] This information can be used to build situational awareness or communicate tactical information for all users in the network.

The information displayed is only useful to the operational commander if the network is robust enough to include an adequate portion of the operational command. The network can have a virtually unlimited number of participants allowing many users in aviation, maritime, and ground units providing immense information to all users.[91] The establishment of the network begins with assignment of the operating parameters to be used by the members. These parameters include the network parameters, user parameters, and frequency assignments and are designed by the Joint Interface Control Officer on the staff.[92] The introduction of Link 16 also provided a back compatibility with previous TADILs. This allowed the combination of TADIL C, TADIL A/B, and TADIL J to be combined into the same architecture for the creation of a common operating picture.[93] The use by unlimited number of users and the combination of previous TADILs provides the operational commander a robust network to conduct operations.

The use of data networks has greatly increased the capacity of information to be exchanged at the operational level. The different types of data links highlight the use of

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[90] Air Land Sea Application Center (ALSA), *TADIL J*, N.P. (2000), last accessed 20 April 2013, http://www.globalsecurity.org/military/library/policy/army/fm/6-24-8/, 1-2 to 1-8.
[91] Ibid, 1-8.
[92] Ibid, 24-26.
[93] Ibid, 28.

them by both United States and North Atlantic Treaty Organization forces. The description of Link 16 illustrated the wide variety of information exchange that can occur. Finally, the network architecture can allow virtually unlimited users in the information sharing. The use of data links greatly enhances the situational awareness of those who use it, however, it is also a likely source for information overload and slowed decision-making by commanders who rely on the information.

ISR

Intelligence, surveillance, and reconnaissance or ISR are widely used terms and a key component of military operations in recent times. The first step to understanding these terms is the definition of the individual terms. Next, defining the collective term of ISR and the use of this process and its applicability to the operational commander on the modern battlefield will be examined. ISR and its use are key enablers to operational commanders in both planning and execution of modern operations.

It is useful to define the terms individually and collectively to form a common language for their use later in this paper. Intelligence is defined in the United States Joint Publication 1-02 as "the product resulting from the collection, processing, integration, evaluation, analysis, and interpretation of available information concerning foreign nations, hostile or potentially hostile forces or elements…"[94] This intelligence can be gathered in many forms and is defined by the operational commander in planning in his

[94] Joint Staff, Joint Publication 2-0, Joint Intelligence, last accessed 20 April 2013, http://www.dtic.mil/doctrine/new_pubs/jp2_0.pdf, 141.

establishment of the area of intelligence responsibility.[95] Intelligence can take many forms in that area of operation. The subcategories of intelligence are the following: geospatial intelligence, human intelligence, signals intelligence, measurement and signature intelligence, open source intelligence, technical intelligence, and counter intelligence.[96] Information technologies are required to compile all these sources into a useable form that builds a commanders situational awareness of the enemy situation, this fusion process, guides the operational commander in decision-making.

Another term defined in Joint Publication 1-02 is surveillance. It is defined as "the systematic observation of aerospace, surface, or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means."[97] The types of surveillance available to a commander are as varied as the items to be observed. Some general types of sensors are radars, electro optical sensors, and multispectral sensors, all of which can be mounted on a variety of military equipment.[98] The information gained from sensors is then processed to become intelligence information.[99] Surveillance forms the collection of data and is a process in the intelligence process.

Reconnaissance is also defined in Joint Publication 1-02 as "A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or adversary, or to secure data concerning the

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[95] NATO. *Allied Administrative Publication 6: NATO Glossary of Terms and Definitions (English and French) (AAP-6),* (STANAG 3680, 2013), 2-A-17.
[96] Joint Staff, Joint Publication 2-0, Joint Intelligence, last accessed 20 April 2013, http://www.dtic.mil/doctrine/new_pubs/jp2_0.pdf, I-6.
[97] Joint Staff, Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, accessed 4/14/2013, 2013, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf, 279.
[98] Joint Staff, Joint Publication 2-0, Joint Intelligence, last accessed 20 April 2013, http://www.dtic.mil/doctrine/new_pubs/jp2_0.pdf, B-1 to B-4.
[99] Ibid, I-1.

meteorological, hydrographic, or geographic characteristics of a particular area."[100] Reconnaissance is the process of collection of data. It is a mission performed by various assets within the United States military. Some of these assets include specially trained personnel[101], aircraft specifically tasked to perform the function[102], and space based systems.[103] Reconnaissance is the action taken to gather data for use in intelligence operations.

These three terms individually have specific meaning in the context of military operations. The term ISR is a collective term that is defined as "an activity that synchronizes and integrates the planning and operation of sensors, assets, and processing, exploitation, and dissemination systems in direct support of current and future operations… an integrated intelligence and operations function."[104] The execution of ISR and the products gained from that function allow commanders gain situational awareness of the battle-space and make decisions towards the execution of the military mission. This collective use allows operational level planners to use these assets in a collective sense to transform data gained into information to be used as intelligence.

The terms used in intelligence gathering describe the process collecting and processing data to be useful information. The terms intelligence, surveillance, and reconnaissance have specific individual meanings in the military context. The collective definition of ISR is used to describe the entire process. The synthesis of the information gathered is then processed and fused to become intelligence for use by the operational

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[100] Joint Staff, Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, accessed 4/14/2013, 2013, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf, 240.
[101] Joint Staff, Joint Publication 2-0, Joint Intelligence, last accessed 20 April 2013, http://www.dtic.mil/doctrine/new_pubs/jp2_0.pdf, B-2.
[102] Ibid, II-5.
[103] Ibid, III-4.
[104] Joint Staff, Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, accessed 4/14/2013, 2013, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf, 143.

commander. This process has large volumes of data to be processed, cataloged, and combined to create an intelligence picture of the battlefield. This process requires extensive networks, computers, and information management on the modern battlefield for the functioning of ISR and for the commander to view the information and make decisions based on his observations.

REAL TIME BATTLE TRACKING

The process of battle tracking has been struggled with throughout history. The awareness of position, situation, and current capabilities is information key to a commander's decision-making ability. Technology has improved the ability of commanders to complete this complex task. The accomplishment of the task will be examined in three main areas. The first is the tracking of land forces. Next, the tracking of air forces will be discussed. Finally, the concept of common operational picture is introduced. The real time tracking of friendly and enemy forces enables a commander to have greater situational awareness of the battlefield from which to make decisions.

Ground forces are tracked in variety of methods that have evolved significantly with the technological improvements. The Army Battle Command System creates a architecture to enable multiple digital systems to interact to provide command and control as well as interoperability with other higher headquarter command and control systems.[105] A subsystem of the Army Battle Command System is Force XXI Battle Command Brigade-and-Below (FBCB2) is software that allows position, terrestrial or

[105] Global Security, Army Battle Command System, last accessed 20 April 2013, http://www.globalsecurity.org/military/systems/ground/abcs.htm.

satellite communications, and combat identification across the lower levels of command.[106] This system allows any equipped unit several elements of relevant information: "real-time situational awareness for commander, staff, and soldiers; shared common picture of the battle-space; graphical displays, with friendly and enemy unit locations; target identification.; integrated logistics support; communications/electronics interfaces with host platforms."[107] The use of this information allows a commander to view forces both friendly ground forces and enemy ground forces based on intelligence at multiple echelons on the battlefield.

The air forces of the commander are observed by various methods. The use of sensors in the form of radars, as previously discussed, give the commander information on the overall aircraft in the area of operations. The use of data link technology is the other key piece of information for the commander to visualize the air picture. The display of this data into a common display would allow the operational commander position and status as described in the use of the Link 16 technology. The fusion of sensor information and data link information can provide the commander a visualization of the air forces within the area of operation.

As early as 2000, the Consistent Networked Information Stream CNIS was a United States Naval program to manage information in Common Operational Picture and Common Tactical Systems.[108] Common Operational Picture is "a single identical display of relevant information shared by more than one command that facilitates collaborative

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[106] Global Security, Force XXI Battle Command, Brigade and Below, last accessed 20 April 2013, http://www.globalsecurity.org/military/systems/ground/fbcb2.htm.
[107] Ibid.
[108] Ranjeev Mittu and Frank Segaria. "Common Operational Picture (COP) and Common Tactical Picture (CTP) Management via a Consistent Networked Information Stream (CNIS)". Naval Research Lab Washington D.C., Last accessed 20 April 2013, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA461803, 1.

planning and assists all echelons to achieve situational awareness."[109] This information is said to have "long life spans serving war fighters... in terms of minutes, hours, days, and months."[110] Whereas, Common Tactical Picture has limited time and space relevance, in terms of "seconds and microseconds."[111]

The United States Air Force has the ability to interface and project a common operational picture and looking to widen the lens to material sustainment of deployed forces.[112] The reliance on and success is best described by Pyles et. al. of the Rand Corporation in the following statement from their commissioned study on Common Operational Picture:

"For the first time, ground and air commanders at multiple echelons had access to coordinated maps that depicted the disposition of forces, the primary targets, critical terrain features, impending weather conditions, etc. Dispersed service and joint command centers in the Middle East, Europe, and the continental United States (CONUS) could all see the same up-to-date images that depicted both the current state of the conflict and the near-term operational plans in varying levels of detail."[113]

With all the capability for a common operational picture, the volume of information available to an operational commander exceeds that of any time before. With the availability of that amount of information, overload becomes a very real possibility. There are two scenarios of overload to consider. The first is the physical overload of the network or the processing capability of the networked devices. The United States Navy was partnered with NATO during Kosovo in early attempts at interoperability. The

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[109] Joint Staff, Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms, accessed 4/14/2013, 2013, http://www.dtic.mil/doctrine/new_pubs/jp1_02.pdf, 52.
[110] Ranjeev Mittu and Frank Segaria. "Common Operational Picture (COP) and Common Tactical Picture (CTP) Management via a Consistent Networked Information Stream (CNIS)". Naval Research Lab Washington D.C., Last accessed 20 April 2013, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA461803, 1.
[111] Ibid
[112] Pyles, Raymond et.al.. *A Common Operating Picture for Air Force Materiel Sustainment: First Steps* . Santa Monica, CA: Rand Corp. (2008), 1-6.
[113] Ibid, 6.

network in place with all the new users and data providers was unable to manage the flow of information required by the NATO headquarters.[114] The improvement in computing and computer processing capability has not yet reached the capability to manage the amount of video being received from Unmanned Aerial Vehicles/Systems. Hershey et. al. reports that the increased bandwidth and ISR data overload actually slows process of gaining situational awareness, "increasing actionable timelines and reducing effectiveness."[115] A final example of system overload would be the institution of plans to "allow every soldier… to contribute his or her observations of battlefield activity to the intelligence network."[116] The planned increase of ISR data, data from tactical level units down to individual warfighters, and computers and networks that continue to struggle to maintain a positive flow of information will continue to reduce rather than increase a commanders capability to use this information in a useful manner.

The second aspect of overload is information overload on the human component in the system. Mica Endsley warns that a person's limited attention can quickly be exceeded in "complex" environments while performing "multiple" tasks.[117] Even with the computer and network capability, the massive amounts of data would currently overwhelm any commander. As mentioned earlier, the United States Central Command staff has more than 900 personnel, and if the hundreds of supporting staff at component supporting headquarters are added, the number of staff involved in an operational

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[114] Joseph M. Ladymon, "Network-Centric Warfare and its Function in the Realm of Interoperability," last accessed 20 April 2013, http://www.dau.mil/pubscats/PubsCats/AR%20Journal/arq2001/ladymon.pdf , 115.

[115] Paul Hershey, Mu-Cheng Wang, Chris Graham, Steve Davidson, Michael Sica, and Jason Dudash. "A policy-based approach to automated data reduction for intelligence, surveillance, and reconnaissance systems." *MILITARY COMMUNICATIONS CONFERENCE, 2012-MILCOM 2012*, pp. 1-6. IEEE, 2012. 1.

[116] Chris Strohm, "Army Intel Community Wrestles with Effects of Transformation," *Defense Information and Electronics Report,* August 17, 2001, pp. 8-9.

[117] Endsley, Mica R., "Toward a theory of situation awareness in dynamic systems," *Human Factors: The Journal of the Human Factors and Ergonomics Society* 37, no. 1 (1995), 41.

headquarters is quite large. Baddeley and Keggler proposed that the network capability can provide "reach-back" to support staff from anywhere in the world.[118] This reach-back increases the capability without increasing the size of the staff required.

Technology brings a huge capability to the United States Joint forces. But, there are some barriers to the effective use of the technology that still need to be cleared. The first of these barriers has been partially discussed in information overload. The ability to outperform the capabilities of human ability is present with almost all new technologies.[119] David Alberts highlights some more examples of items to be considered in network centric operations: "barriers exist, that shared information may not be equivalent to shared awareness, how shared information becomes shared awareness, the variables that effect that transfer, and finally how to overcome all these barriers and more."[120] Technology can greatly enhance and enable operational leaders in today's operations. It also has some pitfalls to be avoided. In 1997, the Joint Staff highlighted these pitfalls perfectly, "the purpose of technology is to equip the man…technology can[not] reduce warfare to simply manning the equipment. Warriors and leaders are at the heart of all operations."[121] Intelligence, surveillance, and reconnaissance and the applied use of these resources also enable greater situational awareness and economy on the battle-space. Real time battle tracking and the concepts of blue force awareness has increased tempo and reduced the risk of fratricide[122]. This evolution cannot over shadow

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[118] Adam Baddeley & Johnny Keggler, "Managing the Bits and Bytes." *Armada International* 28, no. 5 (Oct/Nov2004, 2004), 16.
[119] *Concept for Future Joint Operations: Expanding Joint Vision 2010*. Joint Warfighting Center, 1997, 22.
[120] Alberts, David S., John J. Garstka, Richard E. Hayes, and David A. Signori. *Understanding Information Age Warfare* (2001), 60.
[121] *Concept for Future Joint Operations: Expanding Joint Vision 2010*. Joint Warfighting Center, 1997, 22.
[122] Timothy L. Rider, "Blue Force Tracking to Expand Across Force." Army AL&T, (September-October 2004), 2-5.

the need to protect the ability to use these new technologies by protecting the equipment, network, and capability from allowing "information fratricide."[123]

CONCLUSION

The evolution of military operations in the 21st Century has relied heavily on technology and its advances. The advent and widespread use of data links has allowed a level of connectivity and automation that enables greater situational awareness and tempo. The examination of this issue contained several aspects. First, the tracking of friendly and enemy ground forces was discussed. Next, the tracking of air forces was discussed. Finally, the concept of common operational picture was discussed. Additionally, the information being provided to the operational commander and its effect on decision-making was discussed. All these factors describe real time battle tracking for the modern operational commander.

[123] *Concept for Future Joint Operations: Expanding Joint Vision 2010*. Joint Warfighting Center, 1997, 77.

CHAPTER 4— ANALYSIS

INTRODUCTION

The information above has established a foundation in decision-making, command and control, and technology in the United States military. The analysis of its affect on operational commanders will now be discussed. The first thing to be considered is joint operations. Another facet to be discussed is the training required to capitalize on technology its effect on decision-making. Next, the planning and execution of operations will be surveyed. Finally, ideas on the way ahead for operational commanders on the modern battlefield will be discussed. These facets of modern operational command will frame the analysis.

The challenges that face operational commanders on the modern battlefield are some of the same history has highlighted in retrospective analyses of successful and failed commanders. Other, more appropriate challenges are the product of a modern technological society and way of war. The United States military has a budget of 682 billion dollars comprises more than the next ten countries combined in military expenditures from 2012.[124] With the largest budget and massive amounts of technology operational commanders cannot process all the information available in a timely manner to be effective and efficient decision-makers.

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[124] Stockholm International Peace Research Institute. "The 15 countries with the highest military expenditure in 2012.",last accessed 20 April 2013, http://www.sipri.org/research/armaments/milex/Top%2015%20table%202012.pdf, Table 3.3.

JOINT OPERATIONS

Joint operations pose a number of challenges to the modern operational commanders. The first thing to be considered is the strategic guidance that drives the formation of the joint force and its capabilities. Next, an examination of the interdependence of the component forces in modern operations will be conducted. Finally, interoperability is a key enabler for the execution of joint operations. This will be evaluated by observing the effect of common operating pictures, the global information grid, and the media and political relationship with the operational commander. The concept of joint operations is evaluated to analyze the affect of technology on decision-making.

The United States military strategic guidance has been consistent in the past 6 years. The push for a smaller, more agile force coupled with a greater degree of uncertainty has finally forced the military to embrace the idea of true joint capability. In the 2006 Quadrennial Defense Review, the Secretary of Defense made clear his desire to have an "agile and expeditionary force" with technological advances that would allow United States forces to maintain the same capability with fewer platforms, fewer personnel, and more precision strike capability.[125] Then in 2010, the emphasis on information technology was listed as one foo the key elements to maintain the force's "agility, flexibility, responsiveness, and effectiveness."[126]

[125] Department of Defense, *Quadrennial Defense Review 2006*, Washington, D.C., 2006, last accessed 20 April 2013, http://www.defense.gov/qdr/report/report20060203.pdf, v.
[126] Department of Defense, *Quadrennial Defense Review 2010*, Washington, D.C., 2006, last accessed 20 April 2013, http://www.defense.gov/qdr/qdr%20as%20of%2029jan10%201600.PDF, 93-94.

The individual components of the United States forces can no longer depend on their independent ability to wage war.[127] For several years the Chairman of the Joint Chiefs of Staff has been guiding the forces to interoperability for greater degrees of Joint operations.[128] In Joint Vision 2010, the strategic guidance from the Joint Staff pushes the Joint concept to the point of no confusion in its idea of dominant maneuver. It is described as the "multidimensional application of information, engagement, and mobility capabilities to position and employ widely dispersed joint air, land, sea, and space forces to accomplish the assigned operational tasks."[129] Possibly chance, or an implied emphasis on information, led it to be first in the list of tools. This was even further solidified in Joint Vision 2020 when the statement was very clear:" The joint force of 2020 will use superior information and knowledge to achieve decision superiority, to support advanced command and control capabilities, and to reach the full potential of dominant maneuver…"[130] This is a clear message that the Joint Forces of the United States will continue its advance in information and technology as a capstone for the operational commander.

Joint operations require interoperability between the components of the joint force. The institution of a global information grid for the integration of all forms of data to be useful to the operational commander in a network-centric force where information is one of the newest and best weapons, but this concept will bring its own new "fog of war."[131] With the reliance on technology by operational commanders interoperability

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[127] Department of Defense, *Quadrennial Defense Review 2006,* Washington, D.C., 2006, last accessed 20 April 2013, http://www.defense.gov/qdr/report/report20060203.pdf, v-vii.
[128] Joint Staff, "Chairman od the Joint Chiefs of Staff Instruction 6610.01 – Tactical Data Link Standardization Implementation Plan," http://www.dtic.mil/cjcs_directives/cdata/unlimit/6610_01.pdf, 1.
[129] *Joint vision 2020*. US Government Printing Office, 2000, 9.
[130] Ibid, 10.
[131] Ibid, 9.

becomes crucial to mission success. Described as the "foundation of effective joint, multinational, and interagency operations", interoperability has continued to evolve and become more complex involving the required doctrine shifts, exercises, and technological improvement.[132]

The concept of common operating picture takes on a new face when it has to be the central hub for multiple input systems. On today's modern battlefield the discussion of technology is not if, but how much technology. This was made clear in a 2009 report on interoperability made the point clear from the operational command level, "We are no longer network enabled, we are network dependent."[133] This dependence on network connectivity has brought a new form of vulnerability of our network capabilities. These attacks "can take many forms from outright kinetic attacks on the physical hardware to clandestine information attacks on the data they contain... may be immediately evident…or less readily apparent."[134] Examples of kinetic threats can be kinetic fires from enemy forces, but these can also include other physical threats to hardware in the network. Other more sophisticated threats include: "electronic warfare jamming…Radio-frequency weapons, such as high-power microwave and wideband weapons, … and high-altitude EM pulse (HEMP) is already a battlefield-wide threat."[135]

A non-kinetic attack of the network is an even greater risk than its kinetic counterpart. The Global Information Grid is a United States government initiative to develop and maintain a "globally interconnected, end-to-end set of information

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[132] *Joint vision 2020*. US Government Printing Office, 2000, 15.
[133] February 13, 2009 MEMORANDUM TO THE CHAIRMAN, DEFENSE SCIENCE BOARD http://www.acq.osd.mil/dsb/reports/ADA498577.pdf, pg 1
[134] http://www.acq.osd.mil/dsb/reports/ADA498577.pdf, pg 61
[135] Robert Pfeffer, "Digital C4I Interoperability: The EM Protection Issue.", ARMY NUCLEAR AND CHEMICAL AGENCY FORT BELVOIR VA, 2000, last accessed 20 April 2013, http://www.dodccrp.org/events/5th_ICCRTS/papers/Track3/075.pdf , 2.

capabilities for collecting, processing, storing, disseminating, and managing information on demand to warfighters, policy makers, and support personnel."[136] Cyber attacks are a reality both on and off the battlefield with the Global Information Grid and have already occurred. A possible Russian infection of military networks was evident in Iraq and Afghanistan on unsecure and secure computer networks.[137] A less obvious non-kinetic threat to the network is weaknesses identified by a Carnegie Mellon report on "Systems of Systems Interoperability." It identified five items that could threaten the network or the larger Global Identification Grid: "complexity and combinatory: many problems and many players; interoperability: more than a technical problem; funding and control: not aligned; leadership, direction, and policy: not effective; and legacy: a persistent problem."[138] Non-kinetic attacks are a looming threat both in peace and combat that could deny or destroy an operational commanders network capability.

Operational commanders are forced to deal with aspects of their operation that lie well outside the confines of military operations. The globally connected media world rivals are exceeds the capability of the military Global Information Grid. The globalization of media accessibility, twenty-four hour news day, and political ramifications of decisions made by the operational commander leave commanders facing scrutiny and decisions usually reserved for the strategic level leaders. The Operational

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[136] National Security Agency, "Global Information Grid", last accessed 20 April 2013, http://www.nsa.gov/ia/programs/global_information_grid/index.shtml.

[137] Rebecca Grant, "The Cyber Menace: The world has yet to see all-out cyber-war, but it's getting closer.", *Air Force Magazine*, March 2009, 24.

[138] Edwin Morris, Linda Levine, Craig Meyers, Pat Place, and Dan Plakosh. *System of Systems Interoperability (SOSI): final report*. No. CMU/SEI-2004-TR-004. CARNEGIE-MELLON UNIV PITTSBURGH PA SOFTWARE ENGINEERING INST, 2004, last accessed 20 April 2013, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA455619, 27.

level by its very definition bridges the gap between strategic and tactical level decisions. Now, the decisions of the operational commander are immediately available to the media and therefore have the opportunity to become politically charged. Operational leaders must become proactive information effects planners and executors.[139] The skillful use of the media and the news cycle must be planned in a realistic manner by staffs and monitored with the same scrutiny as kinetic fires. This requires an operational leader to not only be a leader and planner, but also a savvy public relations and media planner.

This first type of media that an operational commander must be aware of is social media. The online domain can provide commanders with invaluable information, intelligence, and atmospherics within his area of responsibility, as well as reactions to operations from the local populace and the worldwide community at large.[140] This domain includes the internet, blogs, news sties, social networking sites, and more. The ability of a person to view video, pictures, and text on any connected device, such as computers, tablets, and smart phones, increases the reach of information to over 1.4 billion people according to some estimates.[141] The ability of close term successes and failures of an operational commander to be viewed in the public domain through media injects a real time political aspect to an operational leaders decision-making. Any decision made and its results are in the public forum soon after, this key fact keeps politicians keenly focused on the successes and failures of its military leaders. This

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[139] Dennis M. Murphy, *Fighting back: New media and military operations*. ARMY WAR COLL CARLISLE BARRACKS PA CENTER FOR STRATEGIC LEADERSHIP, 2008, last accessed 20 April 2013,http://www.carlisle.army.mil/DIME/documents/Fighting%20Back%20%28Murphy%29.pdf, 12.
[140] Thomas D. Mayfield III, *A commander's strategy for social media*. ARMY EUROPE AND SEVENTH ARMY APO NEW YORK 09403, 2011, last accessed 20 April 2013, http://www.ndu.edu/press/lib/images/jfq-60/JFQ60_79-84_Mayfield.pdf, 80-82.
[141] Heather Leonard, "There Will Soon Be One Smartphone for Every Five People in the World," *Business Insider*, last accessed 20 April 2013, http://www.businessinsider.com/15-billion-smartphones-in-the-world-22013-2.

coupled with the ability for direct contact with forward deployed operational commanders adds a distinct aspect of civil-military relations. This capability allows current military operations to be judged by the American citizens and subject to the scrutiny of the political landscape of Washington. All of these things add to the list of things an operational commander has to be concerned with. An already busy commander now has to make decisions more cognizant than ever in the context of political and media backlash.

TRAINING

Training becomes a critical factor in modern operations for the operational commander. The first thing to be considered in training is the traditional military view of decision-making cycle. Next, the Chairman of the Joint Chiefs of Staff's guidance on officer training is examined. Finally, a comparison of the proposed decision-making models with the current standard is completed. Training is a major factor to be considered in the effective use of technology and decision-making.

Colonel John Boyd proposed a decision-making model from 1950 of observe, orient, decide, and act (OODA) loop.[142] This model was adopted and has been used for many years as the relevant decision-making model for commanders. The concept of the model was for a commander to out pace the same decision-making cycle of the enemy. The relevance of the model can be questioned with the more recent studies of intuitive

[142] North American Marine Environmental Protection Agency, "A discourse on Winning and Losing," last accessed 20 April 2013, http://www.namepa.net/events5thAnniv/SUNY_Video.pdf.

decision-making. This traditional model proposed by Boyd has been used by the United States military as a standard in training decision-making in its leaders.

All the aspects that consume a commander's time make training of that commander even more critical. The United States military is firmly guided by the Chairman of the Joint Chiefs of Staff in the requirement for professional military education, both service specific and joint education. The professional military education is actually two regimes for preparation of an operational commander, education and training. Training is defined, by Webster's, as the "skill, knowledge, or experience gained by instruction, discipline, or drill."[143] Whereas education has a definition, in Webster's, unique to training that is "to develop mentally, morally, or aesthetically especially by instruction."[144] In the military context the nuance between the two is usually in the training of skills and the education of thought processes. If it takes "15 years to develop a Joint staff officer and 25 years to develop a Joint Task Force Commander,"[145] then the education of those officers has an significant influence on their decision-making. To prepare officers for intuitive decision-making requires a combination of education and training. The training regime allows for direct experiential knowledge to be acquired, while the education regime allows for historical and thought provoked knowledge to be acquired. Some would argue that "repetitive decision making drills be used at every level

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[143] "training," *Merriam-Webster.com*. 2011. last accessed 20 April 2013, http://www.merriam-webster.com.
[144] "education," *Merriam-Webster.com*. 2011. last accessed 20 April 2013, http://www.merriam-webster.com
[145] Henry H. Shelton, "Professional Education: The Key to Transformation." *Parameters* 31, no. 3 (2001), last accessed 20 April 2013, http://www.carlisle.army.mil/uSAWC/Parameters/Articles/01autumn/Shelton.htm.

of education."[146] Others view that training scenarios must be realistic experiences for implicit learning to occur.[147] Research is continuing on not only what to teach for intuitive decision-making, but also, how to teach intuitive decision-making.

A comparison of the OODA loop with the intuitive decision-making models previously discussed will address the relevance of the OODA loop model. Efficiency thoroughness trade off decision-making does not conflict with Boyd's OODA loop process. The decision to trade clarity and thoroughness for time is either the deletion or reduction of the orient stage of Boyd's OODA loop. The recognition- primed decision making model also fits Boyd's process. The observe portion of Boyd is the portion where recognition-primed decision makers would gain there level 1 and some level 2 situational awareness. Orient equates to the completion of level 2 and level 3 situational awareness. The variable of this comparison is the experience of the decision maker and the complexity of the issue. A large experiential base to choose from would allow the reduction of the orient phase to almost instantaneous for the operational commander.

The largest departure from Boyd's model would be with thin slicing. This method would have the operational commander moving directly from Boyd's orient to act. That proposition matches with Gladwell's idea of observing the situation and acting almost immediately based on the intuitive course of action chosen by the commander. This does not conflict with Boyd but in his analysis the orient and decide steps provide an important point of distinction in Boyd's method. The deletion of orient and decide also deletes two

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[146] Krulak, Charles C. "Cultivating Intuitive Decision-Making." *Marine Corps Gazette* 83 (1999), last accessed 20 April 2013, http://www.ndu.edu/hsr/20_october/doc/17_Krulak%20-%20Cultivating%20Intuitive%20Decisionmaking.pdf.

[147] Robert Patterson, "Training Intuitive Decision Making in a Simulated Real-World Environment.", *Human Factors: The Journal of the human Factors and Ergonomics Society* (2012), 2.

feedback loops to the observe stage.[148] These feedback loops allow for the reaction to a change in the original observation before a decision or action takes place. This component is absent Gladwell's thin slicing and by his account the very problem when professionals make decisions, over analyze for a decision that was known almost instantly.

Training is a key to development of effective decision-making in military leaders. The traditional view of Boyd's OODA was discussed. Next, the joint guidance on officer professional military education was described. Finally, Boyd's model was analyzed using the previously proposed decision-making models. The comparison of the traditional model with the proposed provides alternative decision-making strategies that could be used for an operational commander that is overwhelmed with information. This preserves Boyd's methodology but provides methods to maintain the pace of decision-making in complex and information overload situation. These aspects frame the need for effective training of military officer's to become effective operational commanders.

PLANNING

Planning is another element of operational command that should be evaluated. First, a discussion of the primary planning processes in the United States military is completed. Next, the process model of planning in the military is examined. Finally, a discussion of intuitive decision-making in the analytic process of military planning is evaluated. The planning process is one of utmost importance to the operational

[148] North American Marine Environmental Protection Agency, "A discourse on Winning and Losing," last accessed 20 April 2013, http://www.namepa.net/events5thAnniv/SUNY_Video.pdf.

commander and illustrates another facet of technology based information overload that has to be managed with decision-making strategies.

Planning is one of the main responsibilities of the operational commander. This may be planning in preparation of a tasked mission or it may be updating an already commenced mission. The United States military has a variety of planning processes. The United States Army uses the Military Decision Making Process[149], while the United States Marine Corps uses the Marine Corps Planning Process.[150] However, the operational commander uses the Joint Operations Planning Process.[151] The Joint Planning Process is "an orderly, analytical process, which consists of a set of logical steps to examine a mission; develop, analyze, and compare alternative COAs; select the best COA; and produce a plan or order."[152] During planning time is a critical factor for any commander.

With a large staff and limited time to accomplish the task, military planning has evolved to a process driven enterprise. In order to maintain control of the planning and ensure the desired outcome, commanders and staff gravitate to a defined process with time and product schedules. This idea would seem to negate the idea of intuitive decision-making for the more calculable analytic decision making process. Army publication FM 5-0 states that analytic decision making is preferred when time permits; it also warns that intuitive decision-making may not be appropriate for inexperienced

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[149] Federation of American Scientists, Army, U. S. "FM 5-0 The Operations Process." (2010), last accessed 20 April 2013, https://www.fas.org/irp/doddir/army/fm5-0.pdf, 1-4.
[150] US Marine Corps, "Marine Corps Warfighting Publication (MCWP) 5-1: Marine Corps Planning Process." *Marine Corps Logistics Base, Albany, GA* (2010), 1-1, last accessed 20 April 2013, https://www.mcu.usmc.mil/epme/SEPME%20Course%20Documents/MCWP%205-1.pdf, 1-1.
[151] Joint Publication 5-0, Joint Operation Planning, last accessed 20 April 2013, 2011, http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf , X.
[152] Ibid.

leaders, complex environments, or options with multiple courses of action.[153] "Conceptual planning" is the expected planning for Marine operations at the highest level.[154] The Joint Operation Planning Process requires "networked, parallel planning, across multiple echelons of planning."[155] This leads one to the conclusion that the Joint Operation Planning Process is analytic in design and execution of planning.

With an analytic process, intuitive decision-making by the commander may not seem appropriate. This brings out the need to separate the commander and staff responsibilities. The commander needs to provide his direction and approach to the staff, the art.[156] The commander's staff then develops the appropriate amount of detail for the commander to continue to make decisions, the science.[157] While this seems like a reasonable idea, it actually highlights one of the problems that plague the system of preparing commanders. A good staff officer then should be proficient at analytic decision-making. At the operational level, the staff officer's seniority shows an appropriate level of training in intuitive decision-making; the assumption is the officer is an accomplished tactical level planner. As discussed earlier, professional military education trains intermediate level officers in operational art and planning to fill positions on operational level staffs .[158] So if the formal training received prepares an analytic thinker, when does that officer receive training for the intuitive decision-making required

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[153] Federation of American Scientists, Army, U. S. "FM 5-0 The Operations Process." (2010), last accessed 20 April 2013, https://www.fas.org/irp/doddir/army/fm5-0.pdf, 1-6.
[154] US Marine Corps, "Marine Corps Warfighting Publication (MCWP) 5-1: Marine Corps Planning Process." *Marine Corps Logistics Base, Albany, GA* (2010), 1-1, last accessed 20 April 2013, https://www.mcu.usmc.mil/epme/SEPME%20Course%20Documents/MCWP%205-1.pdf, 1-2.
[155] Joint Publication 5-0, Joint Operation Planning, last accessed 20 April 2013, 2011, http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf , xi.
[156] Ibid, IV-1.
[157] Ibid, IV 1-IV 2.
[158] Joint Staff, "Officer Professional Military Education Policy : CJCSI 1800.01D" , last accessed 20 April 2013, 2011, http://www.dtic.mil/cjcs_directives/cdata/unlimit/1800_01.pdf, A-A-4.

of a commander. Senior level professional military education prepares officers for "strategic leadership and advisement" for working in strategic staff positions[159], this again results in no formal training in intuitive decision-making for higher-level commanders.

Time has already been identified as a luxury when dealing with operational planning. The staff works analytically to produce the appropriate level of detail to present the commander. The commander is then left with little time to digest massive amounts of information to make an informed decision. These decisions at the various advancing stages of the planning are required for the staff to continue their analytic work. It restates the earlier problem, a commander is required to use intuitive decision-making to keep the staff progressing, even in an analytic process driven process. The dilemma of conflicting decision-making styles in operational planning highlights the need for intuitive decision-making by the commander at the operational level. This requires appropriate training at intuitive decision-making to continue to hone that skill and evaluate a staff officer's ability at the process for future command potential.

Planning has been described now as an analytic process with intuitive decisions to be made. The commander's staff must use all available resources to gain information for their analytic process. Technology allows the staff to catalog real-time intelligence and information as well as historic information already cataloged. With the availability of internet and intranet capability, this information can be shared across echelons of the command, governmental departments, to most places in the world to produce an image that is limited only by the time available and the accuracy of the information available.

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[159] Joint Staff, "Officer Professional Military Education Policy : CJCSI 1800.01D" , last accessed 20 April 2013, 2011, http://www.dtic.mil/cjcs_directives/cdata/unlimit/1800_01.pdf, A-A-5.

With the information available to the staff, the commander is now tasked with making decisions. The commander is now able to use intuitive decision-making to provide the necessary decisions and guidance. The efficiency thoroughness trade off style would have the commander reduce the amount of time allowed to the staff to gather information and make a decision based on limited information gathered, in the reduced time. The conscious trade of time for certainty is a perfect example of the efficiency thoroughness trade off model[160]. If the commander takes the time to gain the appropriate gain situational awareness, potentially level 3 situational awareness, then the recognize the appropriate action, the planning tempo can be increased by 20 percent[161], this would be the commander using recognition-primed decision making. Based on the military education and training providing a large body of historical examples and tactical level expertise, the commander would have a large volume of models within cognition to recognize a similar situation and act based on that recognition. Finally, at any point during the process the commander could "go with his gut feeling" and make the intuitive leap, as Gladwell would say "take charge of the first two seconds" to make the decision.[162] This experience would most closely relate to the commander's expertise as a tactical commander. Even with the process driven analytics of the Joint Operational Planning Process, the commander still must rely on intuitive decision-making to continue the process.

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[160] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009), ebook, Time to think time to do.
[161] Ross, Karol G., Gary A. Klein, Peter Thunholm, John F. Schmitt, and Holly C. Baxter. "The recognition-primed decision model," ARMY COMBINED ARMS CENTER FORT LEAVENWORTH KS MILITARY REVIEW, 2004, 1.
[162] Malcolm Gladwell, *Blink: The Power of Thinking without Thinking* . (New York: Little, Brown and Co., 2005), 254.

Using intuitive decision-making to operate in a process driven operational planning environment has been contended to be effective for the operational commander. The types of planning processes were examined. Then, the analytics of the process driven planning was discussed. Finally, the proposed decision-making models were used to identify the need for intuitive decision-making in planning. The planning process is a domain within which the operational commander has to be proficient and effective.

EXECUTION

While planning is a primary domain for an operational commander to be proficient in, execution is when decision-making becomes essential. First, time implications of operational level decisions are examined. Next, the information desired to make decisions at the operational level is discussed. Finally, an evaluation of this decision-making is conducted. Operational commanders are required to make decisions in a time-constrained environment in modern operations.

During execution, time is short for decisions, even at the operational level. With the operational commander making decisions that may take weeks to put into action, every minute lost in decision is time wasted. The reaches of time and space at the operational level and the sheer amount of personnel, equipment, and supplies require decisions to be made in the most efficient manner possible. During execution the information available to the commander can be overwhelming.

A commander’s desire for situational awareness can drive his staff to require extraordinary amounts of information. Examples of this information could be friendly

and enemy troop levels, friendly and enemy equipment capabilities, and friendly and enemy supply reserves. This would be an example of the macro level situational awareness a commander might request. However, this information will be generalized and may not represent the actual situation on the battlefield. Technology now allows a great deal more detail and can provide the operational commander with a micro level view of the battlefield at his discretion. Data link capability with full integration of blue force tracking and enemy target locations could give the commander the ability to see real-time the span of his battlefield with friendly and enemy locations, as well as current engagements. This information coupled with the plethora of intelligence, surveillance, and reconnaissance assets relaying full motion video senor information, signals intelligence, and electronics intelligence at the time and place of the commander's choosing.

This micro view of the battlefield can lead to several things counter to timely decision-making. David Alberts, from his work in 1998, foresaw some of the problems that may arise with the staggering amounts of information available. He noted that command and control systems "will no longer be measured by the amount and speed with which information can be displayed."[163] A more accurate measurement will be related in "accuracy, integrity, ease of availability, and value for decision-making."[164] With the volume of information available, automation and filtering will be essential to effective use. The amount and type of filtering will have to be selectable based upon the

[163] Alberts, David Stephen, John J. Garstka, Richard E. Hayes, and David T. Signori. "The unintended consequences of information age technologies." (1996), last accessed 20 April 2013, http://www.dodccrp.org/files/Alberts_Unintended.pdf?iframe=true&width=100%&height=100%, 6.
[164] Ibid.

commander's desires. This will allow the commander the flexibility to view automatic tabulation and fusion of gathered information to maintain tempo in decision-making.

Automation will be a necessity as the volume of information gathered, transmitted, and processed grows. With the rapid rate that information is available the requirement for automated analysis and collaboration between sources is essential. A commander cannot hope to maintain tempo if the incoming information has to be analyzed by one of the operational staff members. This type of automation would involve improvement and exploitation of existing technology. Goffredo et. al. has developed software to recognize gait patterns from multiple camera angles without registration of the cameras in biometric analysis.[165] This type of automated analysis will be required for all incoming sensor data. The information will then need to be fused into a larger context for the operational commander to make macro level decisions. Alberts noted that this process would change the shape and scope of command and control, allowing for smaller staffs to accomplish more at a higher tempo.[166] Endsley would note that automation can cause human intervention to be slowed, when necessary.[167]Small staffs have not and if Endsley is correct, may not follow Alberts trend. A United States military example is that of United States Central Command. Central Command is the combatant commander responsible for an area of 4,600 miles by 3,600 miles with a staff of over 900

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[165] Michela Goffredo, Imed Bouchrika, John N. Carter, and Mark S. Nixon. "Performance Analysis for Automated Gait Extraction and Recognition in Multi-Camera Surveillance." *Multimedia Tools and Applications* 50, no. 1 (Oct 2010, 2010), 75-77.

[166] Alberts, David Stephen, John J. Garstka, Richard E. Hayes, and David T. Signori. "The unintended consequences of information age technologies." (1996), last accessed 20 April 2013, http://www.dodccrp.org/files/Alberts_Unintended.pdf?iframe=true&width=100%&height=100%, 8.

[167] Endlsey, Mica R. "Automation and Situation Awareness." in *Automation and Human Performance: Theory and Application.* ed. R. Parasuraman and M. Mouloua, 163-181, (Mahwah, NJ: Lawrence Eribaum, 1996), 1.

personnel.[168] This number seems modest for the geographic area of responsibility, however, there are a multitude of supporting commands that have headquarters supporting current operations. In

Afghanistan alone, United States military commanders head there are 3 regional headquarters, the NATO training mission command, and the International Security Assistance Force.[169] The addition of service component commands to support this hierarchy creates an even larger staff requirement. This is not the small efficient, automated, staff as envisioned by Alberts.

The overwhelming amount of information the commander now has available has not streamlined the decision-making capability with its existence. The requirement for the commander to take an active role in decision-making still requires a model for the commander to use. Using the three models previously discussed, the commander has options for intuitive decision-making during execution. Using the efficiency thoroughness trade off method a commander can use the information at hand, without waiting for confirmatory information or analysis to make a quick decision to maintain tempo.[170] Recognition-primed decision-making could be invaluable to an operational command during execution with the proper conditions. The information available has to be processed, fused, and displayed in a manner that the commander can cognitively process all the pertinent information, gain level 3 situational awareness, to then act based on recognized models.[171] Finally, if only key portions of the information are displayed

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[168] Global Security, "U S Central Command," last accessed 20 April 2013, http://www.globalsecurity.org/military/agency/dod/centcom.htm.
[169] http://www.nato.int/isaf/docu/epub/pdf/placemat.pdf
[170] Erik Hollnagel. The ETTO Principle: Efficiency Thoroughness Trade Off, Why things that go right sometimes go wrong. (Surrey: Ashgate, 2009), ebook, Time to think time to do.
[171] Mica Endlsey, "Toward a Theory of Situation Awareness in Dynamic Systems." *Human Factors: The Journal of Human Factors and Ergonomics Society* 32, (1995), 37.

and the commander quickly surmises a useful decision then the commander would be "thin slicing" and tempo would increase substantially. The key component of all of these models and their use to the commander are the amount of information available; a logical structure to ensure processing fluency of the observing commander; and the speed at which the commanders decision can be translated into action by supporting commanders.

The idea of too much information or too much thought to make a decision has also been mentioned in other contexts. The Oxford Dictionary of Sports Science and Medicine describes "paralysis by analysis" as: "The idea that, once a skill has become automated, thinking too much about its execution can disrupt performance"[172] This concept is put into practice in many different domains. Athletes practice a particular movement to the point that it becomes automatic. Military pilots practice in flight emergency procedures until they become automatic. Military training is steeped in repetition of tasks to gain automation. Then, decision-making is another skill that if practiced in the proper context could become automatic.

Another side of analysis paralysis is comparative with information overload. Given too many options a person can freeze and choose a "default" action.[173] Dan and Chip Heath go on in their later book to make the statement that "decision paralysis disrupts medical decisions and retail decisions and investment decisions."[174] This idea pervades many other environments than personal choice. Too many conflicting protocols have driven decision makers in the United States Forest Service to "analysis paralysis" in

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[172] "paralysis by analysis," Kent, Michael. *The Oxford Dictionary of Sports Science & Medicine* Oxford ; Oxford University Press, c2006, last accessed 20 April 2013, http://www.oxfordreference.com/view/10.1093/acref/9780198568506.001.0001/acref-9780198568506-e-5069?rskey=1xzwoJ&result=1&q=paralysis%20of%20analysis.

[173] Heath, Chip and Heath, Dan, "Analysis of Paralysis," Fast Company, 120, November 2007, last accessed 21 April 2013, http://www.fastcompany.com/60934/analysis-paralysis.

[174] Heath, Chip and Heath, Dan, *SWITCH: How to Change Things When Change is Hard*, Canada: Random House, 2010, KOBO ebook, script the critical moves.

their attempt to control wildfires.[175] This conclusion from Steelman and Burke demonstrates an example of analysis paralysis in a collective decision-making environment. Tugrahl Yamin offers a counter to the idea of analysis paralysis. He contends that Pakistani military officers subscribe and teach, from the earliest officer cadet throughout the officer's career, to "appreciate the situation" also called rational decision-making as a system of accountability to the nation and call what others might call analysis paralysis but what Yamin calls, "[to] encourage honest debate before strategic choices are made."[176] While honest debate is worthwhile, it must be considered that too much information or thought on a problem leads to indecision. This can be overcome by applying intuitive decision-making by the operational commander.

Execution is the facet of operational command that is most evaluated to decide success or failure of the commander. The time aspect of decision-making in execution was examined. Next, the information presented to the commander for decision-making was discussed. Finally, decision-making in this information laden environment is evaluated with the proposed decision-making models. Time is always a luxury in the execution of military operations; decision-making in this domain is one the operational commander must master.

THE WAY AHEAD

[175] Todd A. Steelman and Burke, Caitlin A, "Is Wildfire Policy in the United States Sustainable?", *Journal of Forestry*; Mar 2007; 105, 2; ProQuest Research Library, 68.
[176] Tugrahl Yamin, "An Appreciation of Pakistani Military Thought Process," last accessed 20 April 2013, http://www.issi.org.pk/publication-files/1361514613_10050564.pdf, 114-128.

The way ahead for operational commanders is one that is rife with information and limited in time to maintain operational tempo. Items such as complexity and information gathering are to be discussed. Next, a discussion of the planning process and the need to use intuitive decision-making is examined. Also, the intuitive decision-making models and their application to the different domains of the operational commander are discussed. Finally, a look at the effect of technology, information, complexity, and the future of decision-making is examined. Future operational commanders will have a new battlefield of information and decisions, to be properly armed for success these commanders will need to embrace technology and new "old" paradigms in decision-making.

With technology continuing to improve and environments increasing in complexity, operational commanders have more to concern themselves with than ever before. If the past is any indication of the future the United States Military will conduct operations in these complex arenas. The decisions a commander makes will decide the success or failure. This fact makes the process of decision making of the utmost importance. The question is how to improve the decision-making.

The road ahead for operational commanders and their staff is not clear. Based on the information presented an alternate path can be taken. The first step is to continue to develop technology. The information gathered is invaluable and must continue to be exploited. This continued collection capability must come with better processing methods. The sheer volume of information will become overwhelming for a staff to compile, process, and fuse. Automation is the key to the analysis and fusion of the immense amount of information to be compiled, and fused. Computer software and

algorithms must be improved to connect key facts, synthesize, and format output data for easier use in shorter time. This processing has to allow large amounts of data to quickly be sorted, parsed, and formatted for ease of use by the staff during planning.

The planning process is at its very core a process driven endeavor and therefore requires a staff to be process oriented and analytic in their decision process. The key limiter in the process is the time available for a decision to be made. The commander has the ultimate responsibility for the decision-making. For this process to remain efficient the staff then must take all the information available and distill that to the information needed for the commander to make a decision. This is the first interface of analytic process and decision-making. The commander's decision-making process must be quick enough to allow the staff to continue and refine the plan based on the commander's guidance. This need for quick decisiveness is solved with intuitive decision-making.

Of the three types of intuitive decision-making discussed in this paper each has a domain with which it would be most effective. In planning, thin slicing would be an effective method of making intermediate decisions by the staff or the commander. Looking at a small set of data and making a thin sliced decision on that data to enable the planning to continue would be an example of its use. The efficiency thoroughness trade off should be used in planning when time is critical. The dismissal of additional information in order to make a timely decision on a course of action is an example of its use; this could also be an example of recognition-primed decision-making with level 1 and partial level 2 situational awareness. Recognition-primed decision-making is the most applicable to the planning phase for the operational commander. When the staff

presents their courses of action, the commander can apply previous experiential knowledge on which to base a decision and then make the decision.

Once an operation has commenced the commander must balance the assets of technology with the ability to continue to make intuitive decisions. This is the stage at which over analysis can be tempting. The ability to gain more situational awareness is directly related to the time available; intelligence, surveillance, and reconnaissance assets; and the staff's ability to process the information. The more information a commander has available can be a mission enhancer, to an extent. If the desire to gain more information is equated by that commander or staff to making better decisions, then decision-making becomes more analytical than intuitive. This can occur if a key error in the training of the staff and the commander has been made. The United States military has been shown to train its officers in intuitive decision-making and this must continue as information and complexity increases.

At some point, this training shifts to educating officers to become members of higher headquarters staff members. These staff members must become experts at the process driven process of operational planning. This is a possible flaw in the education and training of military officers. The training of intuitive decision-making has to continue throughout an officer's career to develop a larger experience base of larger forces, larger operations, and at higher levels of command. This training will allow the officer to continue to hone the skills of intuitive decision-making.

Miller and Shattuck presented a model of situated cognition in 2004 that visualizes the challenges that face operational commanders in figure 5.1. This pictoral representation will be used to illustrate the level of info overload that can occur in the

information laden environment of the modern operational level battlefield. The lenses that are represented are the operation order, situation, doctrine and experience. If lens A is expanded to include media concerns, social media, and political ramifications the amount of data to be perceived by the commander increases as well. If the commander is to make intuitive decisions with successful outcomes shifts would need to occur. Then lenses B and C have to increase as well to provide an accurate projection for the commander's decision. This increase in perception can only be accomplished by

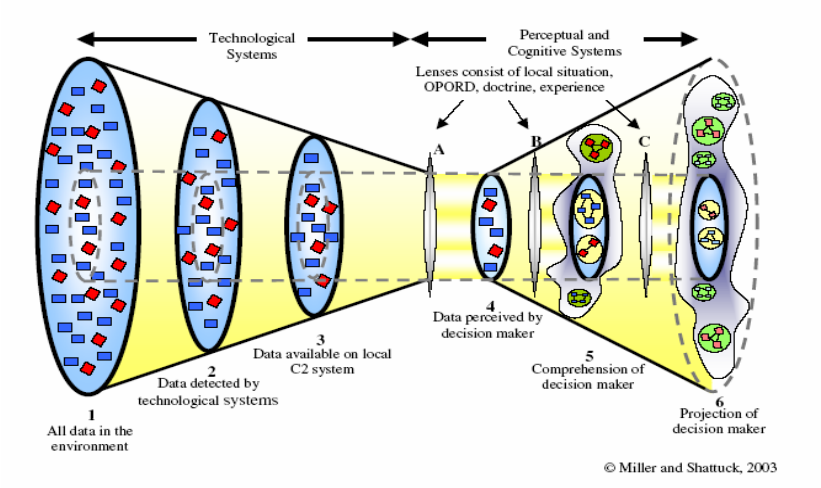

Figure 5. A Dynamic Model of Situated Cognition
(Miller & Shattuck, 2004)

Figure 5.1[177]

increasing the experience base, by continued practice in intuitive decision-making. This process can be maximized if the data from the technological systems can be focused and fused, it will increase the "density" of information through the lens. This coupled with continued increase in proficiency will allow the commander to make timely decisions using larger amounts of information, without turning to process driven analytics. An

[177] Nita L. Miller and Lawrence G. Shattuck, "A process model of situated cognition in military command and control." NAVAL POSTGRADUATE SCHOOL MONTEREY CA DEPT OF OPERATIONS RESEARCH, 2004, last accessed 20 April 2013, http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA466093, 185.

increase in training will not allow the increased information to cause analysis paralysis of the operational commander.

As efforts continue to improve the common operational picture concept, its use in operations will continue to increase. The choice of how it is implemented will either aid or handicap an operational commander's decision-making. The technology can be used to allow the operational commander to monitor and intervene in the tactical level. This would even further exacerbate the volume of information the commander has to process, increasing the likelihood of a shift to time consuming analytic decision-making. However, the ability to monitor tactical level operations can provide information for the operational commander to remain engaged with the support activities to enable the tactical forces to continue their operations. This "push" of support enables tactical commanders to continue their mission knowing that the operational staff will provide needed support in a timely manner, without the time consuming process of requests. This type of support will also require continued technological advances to provide automation of the transfer of tactical updates to the support agency required.

Technology is a mission enabler to the operational commander. Every operational commander desires more information to make a better decision. The amount of information is limited only by the time available to gather the information. This desire for more information can push operational commanders away for time efficient intuitive decision-making. This move from intuitive to a process based analytical style of decision-making drives the need for more information. This drives the need for more time. Time is a commodity that a operational commander rarely has an abundance. The ability to acquire information in volumes actually drives commanders away from intuitive

decision-making. Technology, if not used correctly, slows the decision making process of the operational commander.

The operational commander of today and tomorrow will have to master the information domain as never before. Complexity and information have been shown to be a constant on the battlefield. A process driven planning process can take advantage of technology and its ability to provide information on which to base decisions. Intuitive decision-making was shown to be an available process to reduce the information overload and analysis paralysis that can occur. Lastly, an evaluation of technology, information, and complexity and its affect on decision-making was evaluated. The future of operational command has significant hurdles to clear as the future leaders are developed.

CONCLUSION

This paper examined several aspects of operational command on the modern battlefield. Command and control has been shown as the combination of the process of command and all the personnel and structures to execute control of that commander's forces. Intuitive decision-making has been studied extensively, and the three methods of efficiency thoroughness trade off, recognition-primed decision-making, and thin slicing. Technology has created information overload on operational commanders slowing the decision-making process. The use of data links and real time battle tracking technology allows the operational commander to display all the movements of forces. The addition of intelligence, surveillance, and reconnaissance information has left commanders and their staffs left to deal with a mountain of data.

In analysis, several items were discussed to avoid the pitfalls of information overload. In the complex battlefield of today the amount of information the commander has to process is overwhelming. The key is the processing of this data and fusing it into a common operational picture that represents the reality of the battlefield. This volume of information, in conjunction with process driven design of planning, leads inevitably to the use of analytic decision-making. The use of intuitive decision-making has been shown to be an answer to this dilemma for the future.

Analysis showed that even with immense amounts of information, decisions can be made efficiently by using one of the three methods discussed. Technology will continue to improve, information will continue to pile up, and battlefields will continue to be complex. All these reasons are why technology continues to slow decision-making of the operational commander. The key to reversing this trend lies in the decision-making the commanders already know, intuitive decision-making can help them make sense of all the information but more importantly it will make them time, a luxury on the battlefield.

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