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THE IMPORTANCE OF CRITICAL THINKING: HOW DEPARTMENT OF DEFENSE PERSONNEL CAN THINK SMARTER

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Due to the strategic advances of our adversaries and the fiscal constraints in the last decade, Air Force and Department of Defense (DoD) senior leadership have made calls for critical thinking. The 2018 *National Defense Strategy* also states that the United States must change the way it does business to maintain its competitive advantage. Changing the bureaucratic stagnation in the DoD will require a new way of thinking, and thinking about our thinking. The purpose of this thesis is to explore why critical thinking is significant by identifying some gaps in the way the DoD educates and by conducting elements of a comparative analysis of critical thinking, strategic thinking, and entrepreneurial thinking. Using the findings, elements of a module curriculum will be created that grants the DoD workforce a framework to approach problems in new ways.

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THE IMPORTANCE OF CRITICAL THINKING: HOW DEPARTMENT OF DEFENSE PERSONNEL CAN THINK SMARTER

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ABSTRACT

Due to the strategic advances of our adversaries and the fiscal constraints in the last decade, Air Force and Department of Defense (DoD) senior leadership have made calls for critical thinking. The 2018 *National Defense Strategy* also states that the United States must change the way it does business to maintain its competitive advantage. Changing the bureaucratic stagnation in the DoD will require a new way of thinking, and thinking about our thinking. The purpose of this thesis is to explore why critical thinking is significant by identifying some gaps in the way the DoD educates and by conducting elements of a comparative analysis of critical thinking, strategic thinking, and entrepreneurial thinking. Using the findings, elements of a module curriculum will be created that grants the DoD workforce a framework to approach problems in new ways.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACSC	Air Command Staff College
AF	Air Force
AFFOC	Air Force Future Operating Concept
BBP	Better Buying Power
CLM	Continuous Learning Module
CMBOK	Contracting Management Body of Knowledge
DAS	Defense Acquisition System
DAU	Defense Acquisition University
DoD	Department of Defense
DIUX	Defense Innovation Unit
FAR	Federal Acquisition Regulation
FCS	Future Combat System
FM	Field Manual
GNA	Goldwater Nichols Act
IPT	Integrated Product Team
JPME	Joint Professional Military Education
MILSPEC	Military Specification
MRAP	Mine Resistant Ambush Protected Vehicle
MCO	Major Combat Operations
NCMA	National Contract Management Association
NDS	National Defense Strategy
OODA	Observe Orient Decide Act
RCC	Reinforced Carbon-Carbon
SWOT	Strengths Weaknesses Opportunities Threats
SDD	System Development and Demonstration

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I. INTRODUCTION

Critical thinking is a concept that's been around for thousands of years. Historical figures such as Socrates and Aristotle put critical thinking at the forefront of their thinking (Paul, Elder, & Bartell, 2018). Challenging the status quo became the norm that had a lasting impact on their place in history (Paul et al., 2018). If the U.S. military wants to succeed in the current ambiguous military landscape, we must challenge the status quo. The calls for critical thinking from senior leaders show how they recognize that we must change the way we think to maintain battlefield superiority.[1] This thesis aims to contribute to the improvement of Professional Military Education by emphasizing the importance of critical thinking, and explicating the critical thinking process, and take some steps towards formulating a suggested module that can be used by the DoD to enhance critical thinking among personnel.

Strategic thinking, critical thinking, and entrepreneurial thinking are similar (and partly overlapping) concepts but not identical that are used as approaches to decision-making.[2] They are used as an approach to decision making and can be useful to improve our thinking skills

A. THE EVOLUTION OF CRITICAL THINKING

Critical thinking is a concept often used but less often well understood. Despite the lack of understanding, critical thinking is not a new idea. Its beginnings date as far back as the time of Socrates, 2,500 years ago (Paul et al., 2018). Socrates found that using deductive reasoning to ask questions has profound results (Paul et al., 2018). When probing individuals in powerful positions, he found most were irrational and lacked the knowledge one would expect from authoritative figures (Paul et al., 2018). Socrates' curiosity made

[1] See (Mattis 2018) specifically pages 2 and 5, (Williams, 2013), (James & Welsh, 2015), (Felton, 2014), (Danzig, 2011), (Kendall, 2017, p. 10) http://cimsec.org/leading-military-innovation-past-and-present/37073, https://warontherocks.com/2017/08/ikes-lament-in-search-of-a-revolution-in-military-education/

[2] See Augier & Marshal (2017) page 278, Paul and Elder (2014), and Thornberry (2003) for more information.

him understand the significance of deeply thinking about a solution before believing it's the right course of action (Paul et al., 2018). He emphasized the importance of distinguishing between reasonable beliefs and the ones that appeal to our personal bias because they may be irrational (Paul et al., 2018). Today, law schools especially still use "Socratic Questioning" as a tactic to highlight the need for logic and clarity (Paul et al., 2018).

Plato and Aristotle followed in Socrates' footsteps by training their minds to question the status quo because things commonly differ from how they appear (Paul et al., 2018). During the middle ages, a visionary named Thomas Aquinas personified systematic critical thinking (Paul et al., 2018). When writing about his ideas, he always cross-examined his notions by considering and answering criticisms (Paul et al., 2018). His thought process showcases that critical thinking involves only rejecting beliefs that are not reasonable (Paul et al., 2018). There are other historical examples of essential figures of thinking who value thinking through introspection (Paul et al., 2018).

Critical thinking history along with basic Socratic questions helps us frame basic principles that can be used to gain an understanding of thought and reason (Paul et al., 2018). Richard Paul, Linda Elder, and Ted Bartell drew inspiration from Socrates and other critical thinking figures to frame nine concepts of questioning:

- "Ends and objectives" (Paul et al., 2018)
- "The status and wording of questions" (Paul et al., 2018)
- "The sources of information and fact" (Paul et al., 2018)
- "The method and quality of information" (Paul et al., 2018)
- "The mode of judgement and reasoning used" (Paul et al., 2018)
- "The concepts that make that reasoning possible" (Paul et al., 2018)
- "The assumptions that underlie concepts in use" (Paul et al., 2018)
- "The implications that follow from their use, and" (Paul et al., 2018)

- "The point of view or frame of reference within which reasoning takes place" (Paul et al., 2018)[3]

The baseline of critical thinking now involves using these essential characteristics when posing questions (Paul et al., 2018). Any person interested in honing their critical thinking ability needs to understand that intellectual errors are possible in any of the nine notions in the listed above (Paul et al., 2018). The concepts of questioning are all considered when Paul created the elements of reasoning that detail an organized way to approach problem-solving (Paul et al., 2018). The elements of reasoning will be discussed further in the literature review (Paul et al., 2018).

B. CALLS FOR CRITICAL THINKING

1. Department of Defense

The strategic environment has always evolved, but recently there have been substantial changes. U.S. peer and near-peer adversaries are taking aggressive actions and advancing technological capabilities that threaten the US' dominance (Crock, 2018). China's sole declaration of rights to the South China Sea to Russia's annexation of Crimea in 2014 are a few examples of the increasingly divisive actions of our adversaries (Mattis, 2018, p. 2). To continue our dominance on the battlefield, we must change the way we think. Military personnel at the operational level up to the strategic level need to improve their ability to think about problems critically. Richard Danzig, a former Secretary of the Navy, recently noted that the DoD selects and acquires weapon systems by relying on subjective forecasts of future threats (Danzig, 2011). Danzig states that although history paints a picture of an ambiguous national security atmosphere, the U.S. continues to bet their future capabilities on ambiguous predictions (Danzig, 2011). He recommends improving our predictive abilities while also preparing to be adaptable and flexible when U.S. forecasts are incorrect (Danzig, 2011).

[3] This list can be found at http://www.criticalthinking.org/pages/a-brief-history-of-the-idea-of-critical-thinking/408.

The National Defense Strategy (NDS) states that U.S. adversaries are challenging our country's dominance by exerting their grip on the world through the modernization of their militaries and aggressive behavior that has not been seen since the height of the Cold War. Today's battlefield is becoming deadlier and more disorderly due to the ambiguous technologies our adversaries are using to contest all domains (Mattis, 2018, p. 1). To maintain our competitive advantage, the Department of Defense (DoD) must transform the way it "conducts business" (Mattis, 2018, p. 2). The NDS also notes how Professional Military Education (PME) has "stagnated" because there's been more emphasis placed on fulfilling credits than cultivating "lethality and ingenuity" (Mattis, 2018, p. 2). Injecting critical thinking concepts into PME could help align with the NDS' goals of improving how we train our military personnel and give troops a framework that will motivate challenging the current bureaucratic system by changing the way they think (Mattis, 2018, p. 2).[4]

Air Force Senior leaders have acknowledged the importance of critical thinking on many occasions. The 2015 Air Force Future Operating Concept (AFFOC) emphasizes the need for the Air Force to "recruit [and] assess individuals with [the] demonstrated potential for critical thinking" if we want to win battles fought in uncontested environments (James & Welsh, 2015, p. 43). In 2012, the Military Review assessed the quality of Army Leader Development and Leadership (Williams, 2013). The authors found that Army leaders continue to be "dissatisfied, particularly in the areas of critical thinking and problem solving" (Williams, 2013, p. 49). Searching the Army War College, Naval War College, and Air Force War College libraries using the words "critical thinking" produces hundreds of results (Williams, 2013, p. 49). Marine Air and Staff College contains specific lessons on critical thinking (Marine Corps University, 2018). One of the lessons in the first week of this form of marine PME is titled "thinking and reading critically" (Marine Corps University, 2018, p .9). The lesson involves examining "critical thinking and decision-

[4] The Navy is currently engaged in improving sailors' critical thinking and strategic thinking skills. https://news.usni.org/2018/08/16/35846

Frisbee and Reynolds recommend revamping "all entry-through senior-level training courses to engage students in critical thinking about the subjects being taught." https://apps.dtic.mil/dtic/tr/fulltext/u2/a611330.pdf

making skills needed to implement change and sustain innovation" along with many other objectives (Marine Corps University, 2018, p .9). Additionally, retired Lt. Gen. Richard Zilmer who served in the Gulf War and Iraq stated in 2014 that "it's critical to think more creatively, introspectively about the [corps] roles and missions, relevant to the future" (Felton, 2014, para. 4).

How could the military critical thinking gap continue to be a problem if our senior leaders acknowledge the issue? At least part of the answer is the training, Professional Military Education (PME), and various other ways we develop our military officers are deficient. Officers are forced to memorize doctrine and processes, which is a rudimentary form of learning (Williams, 2013). The DoD attempts to teach students "how to think," but the current system is filled with an extensive curriculum that obstructs thinking growth[5] (Williams, 2013, p. 50). The Secretary of Defense and Secretary of the Navy both understand that we need to change the way we teach PME. The NDS discusses PME revitalization, and the Secretary of the Navy has ordered an Education for Seapower report to conduct a review of the current system with the hopes of garnering recommendations on how to "[instill] critical and strategic thinking skills in the enlisted and officer corps" (Werner, 2018). If we want to make our officers innovative and solve the problems of the future, we must put critical thinking at the forefront of officer education (Drew, 2005, p. 18).

2. Acquisition

Due to the technological advances of our adversaries and the fiscal constraints over the last decade, the Air Force (AF) and DoD senior leadership have made calls for improved innovation. Programs like Better Buying Power, AFWERX, and DIUX are all examples of initiatives created to inspire creative ideas. The Honorable Frank Kendall, the Under Secretary of Defense for Acquisition, and Technology acknowledges the complexity of fielding weapon systems. In his memorandum dated April 24, 2013, Mr. Kendall stated:

> The first responsibility if the acquisition workforce is to think. We need to be true professionals who apply our education, training, and experience

[5] https://keydifferences.com/difference-between-training-and-education.html.

> through analysis and creative, informed thought to address our daily decisions. Our workforce should be encouraged by leaders to think and not to automatically default to a perceived "school solution" just because it is expected to be approved more easily. (Frisbee & Reynolds, 2014, p. 18)

Mr. Kendall issued a publication titled "Getting Defense acquisition Right" in January 2017. In this document, he acknowledges the positive and negative effects of acquisition reform. He also mentions Better Buying Power (BBP), which he created with the hope of improving the acquisition corps as a whole (Kendall, 2017). Critical thinking is the theme that motivated the second iteration of BBP (Kendall, 2017). The third principle is "Critical thinking is necessary for success; fixed rules are too constraining" (Kendall, 2017, p. 10). Including a principle in the initiative to improve the entire force shows Mr. Kendall values quality thinking (Kendall, 2017). He also states acquisition professionals attempt to use "one-size-fits-all" solutions that usually fail because procurement complexity often varies (Kendall, 2017, p. 12). The most common question Mr. Kendall receives as a senior leader is "why" (Kendall, 2017, p. 12)? Choosing the best course of action in a complex environment requires deep thinking, and Mr. Kendall challenges all of us to hone our critical thinking ability.

After World War II, Congressional commissions identified the need for "competent, trained, and educated civilian and military acquisition personnel" (Layton, 2007, p. 4). Despite the call for a standardized training program, nothing changed until acquisition scandals began to appear in the 1980s (Layton, 2007). In 1991, DoD Directive 5000.52 ordered the creation of a Defense Acquisition Education, Training, and Career Development Program (Layton, 2007). The directive established Defense Acquisition University (DAU), which is now the premier training organization for various DoD career fields, including acquisition (Layton, 2007, p. 4). The institution that trains the future of acquisition acknowledges the current system is not designed to produce critical thinkers (Layton, 2007). DAU develops professionals by improving students understanding of the Defense Acquisition System (DAS) and teaching them to use the Federal Acquisition Regulation (FAR) (Layton, 2007). Mandatory online classes, reading, memorization, and multiple-choice tests are all DAU instruction weaknesses (Frisbee & Reynolds, 2014). All courses at DAU fail to give students the opportunity to develop critical thinking skills

because they lack the depth that grants a profound understanding of their craft (Frisbee & Reynolds, 2014, p. 18–19). Also, DAU recently created a new critical thinking continuous learning module (CLM), which acknowledges it's an area in need of improvement. The problem is this CLM is taken online and is not even mandatory in the curriculum. The best way to improve DAU is to inject the fundamentals of critical thinking into all courses, starting at the entry-level. Presenting a framework for students to "think about their thinking" will have a substantial impact (Paul & Elder, 2014).

The DoD acquisition system is a three-pronged approach that involves developing requirements, establishing funding, and procuring desired weapon systems (Lane & Johnson, 2018). Diagnosing the gaps in the military and the capabilities needed for the future fueled the original intent of the Joint Capabilities Integration Development System (JCIDS) (Lane & Johnson, 2018). Currently, the JCIDS process stifles innovation because it focuses more on engineering pre-determined internal solutions than adequately identifying the problems (Lane & Johnson, 2018). Considering all courses of action that resolve capability gaps should be included in the determining factor for future warfighting capabilities (Lane & Johnson, 2018). Section 809 of the FY16 National Defense Authorization Act (NDAA) tasked an 18-person panel to look for ways to "streamline and improve the defense acquisition process" ("About Us," 2018). In Volume one of their report, the group acknowledged the importance of adaptability and responsiveness (Ahern, Blake…Williams, 2018). The board detailed the Mine Resistant Ambush Protected Vehicle (MRAP) vehicle program's successes to show how the acquisition process can thrive (Ahern et al., 2018). Instead of drafting an internal solution, the DoD conducted market research to find pre-existing systems that could meet the needs of the warfighter (Ahern et al., 2018). After weighing the cost and benefits of the alternative approaches found, the DoD chose a MILSPEC version of a vehicle already being purchased (Ahern et al., 2018). Waivers, tailored processes, and the backing of the Secretary of Defense were all utilized to field a capability that saved troops' lives (Gates, 2015). While the program was an overall success, the Secretary of Defense faced enormous obstacles in pursuit of a way to save the lives of American troops (Gates, 2015). Fielding a new system in the acquisition system usually takes years, even decades (Gates, 2015). The acquisition process is complex

whether in wartime or peacetime as Secretary Gates states in his book. Without the backing of Congress and various other heroes who helped Secretary Gates, the MRAP program would have taken much longer (Gates, 2015). The success of the MRAP program showcases that the acquisition process can work if we tailor the way we do business. The 809 panel stresses the need to "create an organization that is malleable, and at times decentralized" (Ahern et al., 2018, p. 8–9). Finally, the committee mentions creating policies and procedures that grant personnel and promote the use of Cross-Functional Teams that focus on collectively solving problems (Ahern et al., 2018, p. 8–9).

C. METHODOLOGY

This next section will review parts of relevant literatures in the fields of critical thinking, entrepreneurial thinking, and strategic thinking. The literature will be retrieved from extensive library and database research including literature, theses, articles, and governed publications on critical thinking, strategic thinking, and entrepreneurial thinking. The goal is to find some commonalities between these approaches using the literature available and incorporate the findings into a module that can be used to improve the critical thinking skills of personnel in the DoD.

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II. LITERATURE REVIEW

The following literature review builds on parts of research in the fields of critical thinking, strategic thinking, and entrepreneurial thinking. The review gleans connections between the three types of thought to find concepts that will assist in building a module to improve the cognitive ability of DoD personnel. As mentioned in the introduction, there are many calls for critical thinking in the DoD.[6] Comparing some relevant aspects of these literatures will assist in providing different viewpoints in decision-making and cognition, which is one of the components of critical thinking.

Elements of the literature from experts is also included. A proven record of performance is what sets experts apart from novices. Webster's dictionary defines an expert as "one who is very skillful and well-informed in some special field" (Ericsson, Hoffman, Kozbelt, & Williams 2018). It's common for people to be recognized as experts even though they do not display expertise in their respective domain (Ericsson et al., 2018). The difficulty lies in the task of finding experts who are proficient in their respective fields of study because objective criteria are not always available, which is why the development of expert performance is frequently misunderstood (Ericsson et al., 2018). Increasing knowledge and skills through study and experience does not constitute expertise (Ericsson et al., 2018). To become an expert, one must integrate everything they learn and apply their knowledge to "specific tasks and problems" (Ericsson et al., 2018). The literature review will choose experts who have objectively proven their proficiency through publications, research, studies, or real-world application that showcase positive results (Ericsson et al., 2018).

A. CRITICAL THINKING

Critical thinking is one of the most widely used concepts for deep thought, but often poorly understood. Critical thinking requires understanding our thought processes and continued practice just like any other strenuous activity; The first step in improving our

[6] See Mattis (2018), Danzig (2011), James & Welsh (2015), Williams (2013), and Felton (2014) for more information.

cognition is becoming a "critic" of our thinking by assessing how we think (Paul & Elder, 2014, p. 16). Throughout our lifetime, we've developed bad habits, assumptions lacking evidence, "stereotypes that influence thinking," a narrow point of view, and a defensive mechanism to attack opposing views (Paul & Elder, 2014, p. 11). Deep introspection helps diagnose problems associated with our thinking and has drastic improvements in our decisions; Thinking itself is easy because humans automatically think and make decisions without using much thought; If we leave thinking to itself, our decisions are "biased, distorted, impartial, uniformed, or downright prejudice" (Paul & Elder, 2014, p. 19). The value of improving the way we think can not be stressed enough because it directly affects our quality of life (Paul & Elder, 2014, p. 6).

The definitions of critical thinking vary, and typically, the source providing a description presents a generalized meaning that assumes you already understand the process. Murawski states that "while there is general agreement among higher education professionals that critical thinking skills are important, there is lack of clarity about what critical thinking is" (Murawski, 2014, p. 26). A study in the state of California "found that only 19 percent of faculty could give a clear explanation of critical thinking even though the vast majority (89 percent) indicated they include it in their curriculum" (Murawski, 2014, p. 26). If faculty members do not fully comprehend a subject, how can they effectively teach students?

Developing a conclusive definition requires looking at literature to determine the similarities and differences among critical thinking descriptions. Table 1 lists an array of critical thinking definitions that all share similar themes, but are dramatically different. A few of the definitions discuss intellectual traits, while others only talk about the process of critical thinking. None of the definitions provide a complete definition of critical thinking. In Paul and Elder's "Critical Thinking" publication, there are numerous definitions showcasing the complexity of the process. The common themes among the definitions include introspection, discipline, intellectual traits, research, evaluation, clarity, empathy, rationality, introspection, and evaluation. A comprehensive definition using the definitions and themes found in Table 1 is:

The literature on critical thinking suggests that, broadly speaking, it consists of three fundamental processes:

- The practice of evaluating the thinking of all parties (McGuyer, 2006, p. 18) to understand the biases present in cognition (Paul & Elder, 2014).
- Gaining an understanding of one's thought process and using "intellectual standards" to define a "purpose," identify the "problem," gather "information," establish "ideas," detail the "assumptions" present, determine the potential "implications and consequences," and list the "inferences" made in order to make a logical decision (Paul & Elder 2014).
- Actively using the intellectual standards to evaluate the "elements of reasoning" to solve a problem with the goal of internalizing "intellectual traits" (Paul & Elder, 2014).

Acknowledging the complexity of critical thinking is important because it can not be easily learned. It requires adopting intellectual traits to a systematic process that evaluates the quality of our thinking, adopting intellectual traits, and using the elements of reasoning and intellectual standards to reach the most rational outcome (Paul & Elder, 2014).

Table 1. Critical Thinking Comparison: Definitions, Sources, and Themes

Critical Thinking Comparison: Definitions, Sources, & Themes		
Critical Thinking Definitions	**Source**	**Themes**
"(1) The art of analyzing and evaluating thinking with a view to improving it. (2) Disciplined, self-directed thinking that meets appropriate intellectual standards within a particular mode or domain of thinking. (3) Thinking that commonly displays intellectual skills, abilities and traits. (4) Thinking about your thinking while you are thinking in order to make your thinking better: more clear, more accurate, and more reasonable. (5) Self-guided, self-disciplined thinking that attempts to reason at the highest level of quality in a fair-minded way."	Paul, Elder, 2014, p. 367	Introspection Humility Discipline Accuracy Improvement Evaluation Reasoning Fairmindedness
"Critical thinking is the disciplined art of ensuring that you use the best thinking you are capable of in any set of circumstances."	Paul, Elder, 2014, p. 9	Discipline Improvement
"Critical thinking is that mode of thinking-about any subject, content, or problem-in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them."	Paul, Elder, 2014, p. 19	Improvement Intellectual Standards Structure
"Critical thinking is disciplined thinking governed by clear intellectual standards."	Bassham, Irwin, Nardone & Wallace, 2013, p. 1	Discipline Intellectual Standards
"Critical Thinking is the ability to be in control of one's thinking. It includes the ability to consciously examine the elements of one's reasoning, or that of another, and evaluate that reasoning against universal intellectual standards – clarity, accuracy, precision, relevance, depth, breadth, and logic."	Eichhorn, Roy	Introspection Rationality Evaluation Intellectual Standards Empathy
"The systematic evaluation or formulation of beliefs or statements, by rational standards."	Stone, 2017, p. 54	Evaluation Systematic Intellectual Traits Rationality
"A composite of attitudes, knowledge, and skills. This composite includes: (1) Attitudes of inquiry that involve an ability to recognize the existence of problems and an	Brinberg & Jaccard, 2011, p. 102	Research Analysis Evaluation Intellectual Standards

Critical Thinking Comparison: Definitions, Sources, & Themes		
acceptance of the general need for evidence in support of what is asserted to be true; (2) Knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence are logically determined; and (3) Skills in employing and applying the above attitudes and knowledge."		Logic
"The ability to analyze, criticize, and advocate ideas; to reason inductively and deductively; and to reach factual or judgmental conclusions based on sound inferences drawn from unambiguous statements of knowledge or belief."	Lazere, 2018	Research Evaluation Clarity Empathy
"A critical thinking attitude involves asking questions, defining a problem, examining evidence, analyzing assumptions and biases, avoiding oversimplification, considering other interpretations, and tolerating ambiguity."	Irandoust & Boury-Brisset, 2005, p. 2	Reasoning Analysis Evaluation
"Critical thinking is defined as a structured process involving reasonable and reflective thinking about ideas, concepts and beliefs focused on finding the truth. Critical thinking is also described as "thinking about thinking" or "thinking out of the box."	Usry, 2004, p. 2	Structure Introspection Integrity Rationality Introspection
"Critical thinking is the general cognitive skill of developing the best solution when there is not a single correct answer. It consists of two key elements, the development of a solution and then a meta-cognitive process of examining the reasoning behind the solution."	Drew, 2005, p. iii	Meta-cognition Research Evaluation
"Critical thinking is the ability to logically assess the quality of one's thinking and the thinking of other's to consistently arrive at greater understanding and achieve wise judgements."	McGuyer, 2006, p. 18	Logic Reasoning Introspection Rationality

1. Intellectual Standards

Actively assessing one's reasoning is a central component of critical thinking. Taking time to evaluate our thinking using standards of thought is a requirement for refining our quality of thinking (Paul & Elder, 2014). The objective of reasoning is to

pursue an underlying purpose and critical thinkers acknowledge the importance of evaluating one's thinking utilizing a fundamental set of standards: "clarity, relevance, logicalness, accuracy, depth, significance, precision, breadth, and fairness" (Paul & Elder, 2014, pp. 127–128). These universal intellectual standards present a framework to rationally evaluate our thought process and provides checks and balances to achieve the desired result (Paul & Elder, 2014). Practicing the utilization of the intellectual standards is paramount because it's how we measure the elements of reasoning (Paul & Elder, 2014, pp. 127–128). The following sections discuss the intellectual standards, formulated by Paul and Elder, in detail.

a. Clarity

Without clarity, finding the purpose of a statement is difficult and can even be impossible if one does not search for an explanation (Paul & Elder, 2014). Paul and Elder refer to clarity as a "gateway standard" because, without a clear statement, you can not accurately determine whether the statement is relevant, logical, significant, or meets any of the other standards.

b. Relevance

Relevance pertains to anything that is linked and applicable to the problem you are attempting to solve (Paul & Elder, 2014). Determining relevance is directly associated with discipline. Without correctly determining the relevance of ideas, individuals may choose a solution that will result in failure or have a notion that is false (Paul & Elder, 2014). Categorization of information through the use of relevance can lead to more ideas and connections between them (Paul & Elder, 2014, p. 134).

c. Logicalness

Thinking involves a combination of thoughts that take place in a way that can be logical or illogical (Paul & Elder, 2014). Supporting thoughts that complement each other are an example of logicalness (Paul & Elder, 2014). Humans have innate beliefs that conflict one another, and we subconsciously accept contradictions without realizing it's

happening (Paul & Elder, 2014). Verifying whether or not a belief or idea is logical promotes deep rational thinking (Paul & Elder, 2014, p. 137).

d. Accuracy

Accuracy can be present in a statement, and the statement can still lack clarity (Paul & Elder, 2014). It is common for people to provide false descriptions subconsciously. Individuals mistakenly present information they read or hear from a "trustworthy" source as fact when the data could be false (Paul & Elder, 2014). Accuracy is an integral part of rational reasoning because it promotes "healthy" skepticism about information that may not be true (Paul & Elder, 2014, pp. 130–131).

e. Depth

When facing a problem, we must peel back the layers to examine the internal intricacies (Pau & Elder, 2014). Addressing the complexities of a problem is required for a successful solution (Pau & Elder, 2014). Intricate issues are hard to solve, which is why we should ask questions to comprehend what we're attempting to explain to choose an articulate course of action (Paul & Elder, 2014, pp. 134–135).

f. Significance

Rational reasoning requires sorting relevant information and diagnosing the most significant pieces (Paul & Elder, 2014). Failing to recognize the importance of evidence forces superficial thought (Paul & Elder, 2014). Not asking proficient questions can hinder thinking by limiting our view (Paul & Elder, 2014). Developing the ability to investigate significance will improve our quality of thinking (Paul & Elder, 2014, p. 138).

g. Precision

Despite how it sounds, precision is different than accuracy (Paul & Elder, 2014). Clarity and accuracy can be present in a statement and still lack precision (Paul & Elder, 2014). Accuracy is about verifying the validity whereas precision is specifying the details (Paul & Elder, 2014). The details are always important, but knowing how specific one needs to be is the art critical thinkers must master (Paul & Elder, 2014). Classifying the

particulars of a problem, the variables that drive the problem, and a list of solutions are also central precision considerations (Paul & Elder, 2014). Enhancing our precision ability will expand our minds to deeply think about the issue at hand and find a clear solution that meets the purpose we seek (Paul & Elder, 2014, pp. 132–133).

h. Breadth

Breadth is directly connected to empathy because a declaration can satisfy all the intellectual standards and lack breadth (Paul & Elder, 2014). Broad thinking is the key to seeing all views because when an issue is complex, multiple approaches are required for a practical solution (Paul & Elder, 2014, p. 135). Typically, when a point of view differs from our own on an emotional topic, we feel threatened (Paul & Elder, 2014). If we feel strongly about a subject, it's easy to ignore other viewpoints (Paul & Elder, 2014). Intellectually empathizing with others through is a practice critical thinkers exhibit (Paul & Elder, 2014). To analyze breadth, we should fight our urge to unconsciously refuse opinions that differ from our own to expand the way we think (Paul & Elder, 2014, p. 136).

i. Fairness

Rationality and reason should guide the way we think (Paul & Elder, 2014). Ensuring fairness when attempting to tackle a problem can be accomplished through the utilization of the seven intellectual virtues (Paul & Elder, 2014). Fairness is a separate intellectual standard to emphasize the power of self-deception (Paul & Elder, 2014). Manipulation of concepts, making assumptions that are not justified, and ignoring applicable information are all things we do to prove our point of view when being fair and impartial could cause us to change our minds (Paul & Elder, 2014, p. 139). Considering our assumptions and looking at how our thinking is distorted is an essential component of critical thinking (Paul & Elder, 2014, p. 140).

j. Areas of Consensus and Differences

There are various areas of consensus in critical thinking literature. Bassham, Irwin, Nardone, and Wallace use critical thinking standards in their textbook that are similar to Paul and Elder's. Clarity, precision, accuracy, relevance, consistency, logical correctness,

completeness, and fairness are the most important ideals they list as necessary to have "disciplined thinking governed by clear intellectual standards" (Bassham, Irwin, Nardone & Wallace, 2013, p. 1). Clarity, precision, accuracy, relevance, and fairness are also included in Paul and Elder's intellectual standards (Paul & Elder, 2014. While logical correctness, completeness, and consistency are not exact translations of Paul and Elder's, they are similar. Logical correctness is a translation of logicalness, which emphasizes drawing "accurate and well-supported beliefs" (Bassham et al., 2013, p. 5). Completeness is another word for breadth because it stresses "deep thinking" over "shallow thinking" (Bassham, et al., 2013, p. 6). Consistency is a standard Bassham, Irwin, Nardone, and Wallace use that Paul and Elder don't. Being consistent in logical reasoning is an integral part in critical of critical thinking. Instead, Paul and Elder stress consistently practicing critical thinking to be more effective (Paul & Elder, 2014). Additionally, the Fort Huachuca Quality Assurance Office states that "all thinking needs to be assessed for quality and can be accomplished by applying a set of standards: clarity, accuracy, precision, fair-mindedness, objectivity, and logic" (Fort Huachuca Quality Assurance Office, 2006, p. 22). The similarities among these three publications showcases the importance of using an effective set of principles to evaluate the way we think.

2. Elements of Reasoning

The elements of reasoning are a framework developed by Paul and Elder to define a structure for critical thinking. Paul and Elder stress the importance of viewing the model as a systematic process; For the model to work as it was designed, considering all of the elements at the same time, equally is vital; The elements of reasoning, also known as the universal structures of thought, can be summarized in one sentence: "reasoning takes place in a point of view using circumstances to make inferences that utilize information and concepts to solve a problem with the goal of achieving a purpose" (Paul & Elder, 2014, p. 89). Understanding the elements of reasoning is crucial in the field of critical thinking; Tackling problems using this framework with the structure of intellectual virtues and intellectual standards allows you to become comfortable with a proven model, which will have dramatic improvements in your critical thinking ability (Paul & Elder, 2014, p. 90).

The following sections discuss the elements of reasoning, formulated by Paul and Elder, in detail.

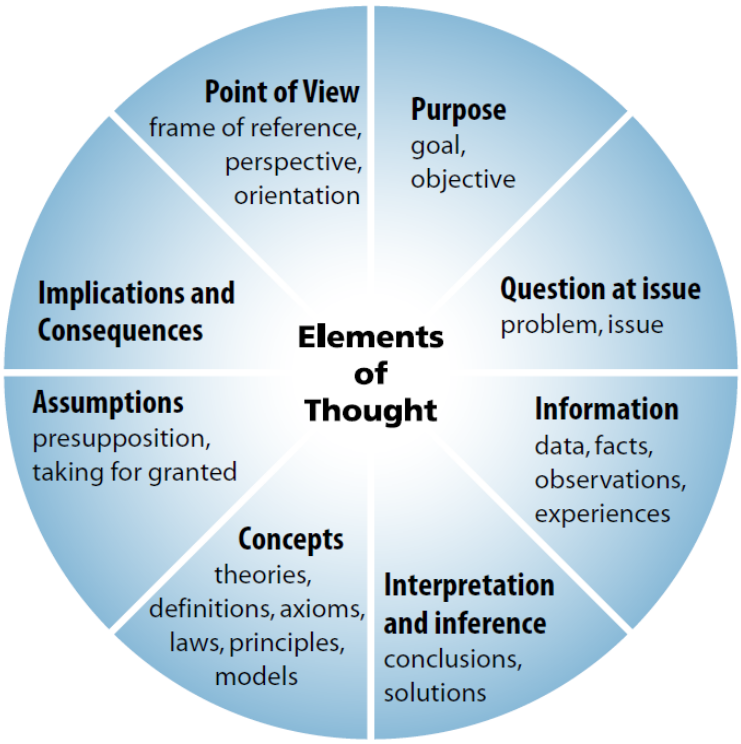

Figure 1. Elements of Reasoning or Thought. Source: Paul and Elder (2006).

a. Purpose, goal, or end in view

Reasoning takes place with the goal of accomplishing an objective; we think in patterns that are shaped throughout our lifetime and always takes place with a goal in mind; A defect we all have is unknowingly pursuing unrealistic purposes, goals, or ends in view; Evaluating our thinking is important because we all have subconscious goals that can be egocentric (Paul & Elder, 2014, p. 91). Stating the intention should be one of the first steps in solving a problem and is imperative to the development of critical thinking (Paul & Elder, 2014, p. 144).

b. Question at issue or problem to be solved

Decision-making requires formulating a question or problem; Confronting the difficulty of expressing the question will boost our thinking ability; Changing or modifying a question or problem will completely change the criteria required for resolution; Identifying an irrational question or problem can happen, which is why we must challenge the validity of the issue we're trying to resolve (Paul & Elder, 2014, p. 92). Formulating the question(s) or problem(s) at hand in a concise "clear relevant way" is a necessity of critical thinking (Paul & Elder, 2014, p. 144).

c. Point of view or frame of reference

Reasoning constitutes doing so using a point of view; If there's an issue with the point of view, the reasoning that follows may be defective; Paul and Elder state "a point of view may be too narrow, may be based on false or misleading information, may contain contradictions, and may be narrow or unfair" (Paul & Elder, 2014, p. 145). This statement summarizes the need for considering other points of view, having empathy, and ensuring we institute fairness and breadth while thinking; Striving for a fair point of view, even though they may oppose our own, is something critical thinkers' must practice; Considering the various points of view will broaden our thinking and encourage rational intellectual thought (Paul & Elder, 2014, p. 145).

d. Information, data, experiences

Active cognition relies on gathering relevant information to make informed decisions; We tend to use information that we think is accurate due to the belief that the information source is credible; Conclusions should always be made using factual evidence; Evaluating the information, we use in producing conclusions, is an action any developing thinker should do in all aspects of life; Paul and Elder mention two critical thinking axioms: "check your facts and check your data!" (Paul & Elder, 2014, p. 146). Finally, using factual information strengthens the rationality of our intellectual capacity and is a dynamic component of critical thinking (Paul & Elder, 2014, p. 146).

e. Concepts, theories, ideas

We all "interpret, classify, or group" information, which is why reasoning concepts are noteworthy; Thinking deeply about the concepts, theories, or ideas in our reasoning improves our ability to diagnose what drives our thinking (Paul & Elder, 2014, p. 147). Reflecting on our ideas, theories, and concepts is necessary to identify flaws in our reasoning (Paul & Elder, 2014, p. 147).

f. Assumptions

Measuring our reasoning proficiency involves distinguishing assumptions using applicable standards; Whenever we think it begins with assumptions that could be true or false; False assumptions can be dangerous because they pose a threat to rationality (Paul & Elder, 2014, p. 148). Asking questions that investigate the assumptions of all parties involved in a decision will significantly improve the quality of our cognition.

g. Implications and consequences

All decisions we make have consequences, and when we reason, implications follow; Studying the potential implications and consequences will forecast what direction our actions are taking us; Anticipating issues before they happen is something all critical thinkers achieve; Appraising where our actions and decisions will take us is a pivotal part in considering the second and third order effects and reducing decision imperfections (Paul & Elder, 2014, p. 148). Emphasizing the potential consequences of our decisions will help us understand the risks involved and better prepare us to expand our rationality and reduce risk (Paul & Elder, 2014, p. 149).

h. Inferences

Anytime we make conclusions; we're making inferences; Every day, we draw inferences about everything we do, which is why critical thinkers are adept at this element; Firstly, you want to identify when you or someone else makes an inference and then evaluate whether or not they are sound logical conclusions (Paul & Elder, 2014, p. 150). Paul and elder use the phrase "Because this, therefore that" to demonstrate how our mind

concludes using what it perceives as facts (Paul & Elder, 2014, p. 150). Verifying that the inferences we make by obtaining facts area requirement for rational reasoning.

i. Parallels in other literature

All critical thinking frameworks use elements to evaluate ideas with the goal of improving the outcome. Murawski states that critical thinkers use a multitude of methods to "enable them to discover new and often improved ideas" (Murawski, 2014, p. 26). Furthermore, Murawaski states "critical thinkers tend to see the problem from many perspectives, to consider many different investigative approaches, and to produce many ideas before choosing ideas" (Murawski, 2014, p. 26). In 1998, forty-six critical thinking experts came together and formed the Delphi Panel. One of the many conclusions of the panel was "that a good critical thinker had both certain cognitive skills and the disposition to use those skills" (Jones, 2016, p. 13). The skills that are at the core of critical thinking included: interpretation, analysis, inference, evaluation, explanation, and self-regulation (Jones, 2016, p. 13). DAU states there are six requirements for effective critical thinking: "interpretation, analysis, evaluation, inference, explanation, and self-regulation" (Tools for Improving Critical Thinking, n.d.). DAU's list is comparable to the other literature listed above. Despite the slight framework differences of the literature listed above, the underlying characteristic tones are analogous. Murawski's findings, the conclusions of the Delphi panel, DAU's requirements for effective critical thinking, and the elements of reasoning offered by Paul and elder present a basis of inferring, interpreting, analyzing, and evaluating with the goal of promoting rational decision-making (Paul & Elder, 2014).

3. Intellectual Traits

Paul and Elder emphasize the criticality of fairmindedness; Consideration of all viewpoints while also removing bias and prejudice is how one showcases fairmindedness; Whenever others present their views, we automatically separate them into two categories: "favorable" and "unfavorable" (Paul & Elder, 2014, pp. 26–27). If the interpretations are similar to our own, we grant more weight to the "favorable" view; An example of this is the subject of politics. When a person shares our political beliefs, we tend to gravitate towards that individual while discounting the opposing view; Another example, given by

Paul and Elder, is the self-centered nature of manufacturers in the asbestos industry; Companies were aware of the harmful effects' asbestos could have on the consumer; Despite the probable damage to the welfare of others, they continued to advocate and produce the product to raise their profits (Paul & Elder, 2014, p. 26–27). Becoming fair-minded is the foundation for developing critical thinking and requires the application of intellectual traits; While these virtues are not frequently taught, the military includes many of them in their core values and leadership training; The difference is the emphasis on leadership and decision-making instead of applying these traits to our intellectual ability (Paul & Elder, 2014, p. 27). The following sections discuss the intellectual trais, formulated by Paul and Elder, in detail.

a. Integrity

Holding ourselves accountable for the same standards that we expect of our rivals is the fragment of intellectual thinking called integrity; To hold ourselves to a set of standards, we must vigorously search for discrepancies in the way we think; We all fail to exhibit intellectual integrity at some point in our life; Active reflection on judgments we made will identify paradoxes that are present in our thought process. (Paul & Elder, 2014, pp. 37–38).

b. Humility

Intellectual humility requires recognizing that we do not know everything; Every individual has a knowledge limitation, and it's vital that we avoid self-deception by diagnosing our biases, prejudices, and not assume we are well-informed on every subject; The way humans learn is shallow at its core. Most of our learning involves gathering limited Information and quickly forming our own opinions resulting in a false sense of arrogance (Paul & Elder, 2014, pp. 27–28). Being unaware of the biases that formed throughout our lifetime results in a flawed thought process; Becoming intellectually humble is vital to improving the quality of our thinking because it will help identify our biases and prejudices while also cultivating our ability to learn (Paul & Elder, 2014, pp. 28–29). Nelson discusses the importance of insight in the decision-making process. He

quotes Maj. Gen John H. Cushman who debriefed as the "commanding general of the Delta Regional Assistance Command in Vietnam" Cushman stated:

> Insight-or the ability to see the situation as it really is-is the most valuable asset an adviser can have. The reflective, testing and tentative manner in which insight is sought does not mean indecisiveness. It simply raises the likelihood that the decided course of action will be successful, because it is in harmony with the real situation that exists. I am convinced that the subjective insight into the conditions which actually prevail comes about only in the way I describe. (Nelson, 2016, p.34)

Cushman lists "openness, curiosity, observation, testing, evaluation, reviewing assumptions, listening to others, and targeted discussions will well informed" as components of insight (Nelson, 2016, p.34). Gaining insight through humility is one way of becoming knowledgeable and refining your decision-making process.

c. Perseverance

Solving problems can be intellectually complex and require perseverance to find a rational solution; It's easy to give up when presented with complications, and this is why many people give up in the beginning steps of problem-solving; Showcasing intellectual perseverance allows us to enter deep thought and think through an issue. Intellectual perseverance is required to improve the quality of our thinking and solve complex questions or issues (Paul & Elder, 2014, pp. 39–40).

d. Confidence in reason

Sound reasoning is a requirement of critical thought. Developing a rational process to create various viewpoints and make reasonable inferences using the standards of thought improves confidence in reasoning; "Blind" faith is more common than confidence in reason. "Blind" faith in a belief or idea is irrational because it hinders one's ability to detect what is myth or fact; As long as there is evidence to support your faith in something, it can still exhibit confidence in reason; There's been an instance for everyone where they shifted their view after finding evidence that their belief wasn't reasonable; Reflecting on your passionate beliefs and searching for evidence to support them will improve your confidence in reason (Paul & Elder, 2014, p. 42).

e. Courage

Intellectual courage involves consciously addressing contrary viewpoints, ideas, or beliefs that we are emotionally passionate about and would otherwise not consider; Problems are often presented in society and deemed too complex to solve because leaders lack the courage to consider risky ideas that seem illogical based on their limited or biased view; Failing to consider various viewpoints removes our ability to judge impartially; Just by merely having the courage to ask "why," an individual can diagnose irrational behavior; The reason for the word "courage" is because you must circumvent your innate desires to go against what you believe; Exemplifying intellectual courage will help remove the barriers in your mind to promote fairmindedness and hone your critical thinking ability (Paul & Elder, 2014, pp. 32–33)

f. Empathy

Intellectual empathy involves gaining an understanding of others opinions by having the awareness to place ourselves in their mental shoes; Changing our perspective on a set of issues or problems is impossible if we do not attempt to comprehend the feelings, thoughts, and emotions of others; Paul and Elder state that intellectual empathy is one of the hardest skills to acquire due to our natural tendency to display self-centeredness; Our needs are usually more pressing than the needs of others; While attempting to improve one's cognitive capability, you must look at why others have formed their beliefs because we can not always be correct (Paul & Elder, 2014, p. 36).

g. Autonomy

Independent thinking with the assistance of intellectual standards is intellectual autonomy; Taking command of our thinking requires deep introspection of our beliefs, values, and thinking processes (Paul & Elder, 2014, p. 44). Critical thinkers evaluate ideas that others would mindlessly accept; People frequently become mirrors; Instead of thinking for themselves, they reflect the ideas and beliefs of those around them; The medical field has a history of rejecting medical practices that do not align with the mainstream views; In the early 20th century, the medical community rejected the idea that doctors and nurses could pass germs that cause infections; When we conform to the status quo, we confine our

thinking to widely accepted viewpoints that could be false; Intellectual autonomy is a requirement to think in various perspectives (Paul & Elder, 2014, pp. 45–46).

h. Areas of consensus and differences

While none of the critical thinking literature reviewed contained intellectual traits, they all included statements related to the importance of deeply thinking about your thinking. Murawski states that critical thinkers "keep an open-mind, are interested in others ideas, avoid emotionalism, and engage in active listening" (Murawski, 2014, p. 26). Bassham, Irwin, Nardone, and Wallace describe how critical thinkers "discover and overcome preconceptions and biases." To properly achieve the characteristics listed in the two sources, one should attempt to find a way to internalize them" (Bassham et al., 2013, p. 1). Values or traits are a proven way to give people a shared sense of identity. Air Force research recognized three factors that help an organization manage diversity (Military Leadership Diversity Commission, 2009, p. 2). "Creating a shared identity focused on the mission" is the factor that is the most related to values (Military Leadership Diversity Commission, 2009, p. 2). And while the research is talking about diverse organizations, it is linked to instilling critical thinking to a diverse population. Paul and Elder established intellectual traits with the goal of giving critical thinkers a set of values that improve their thinking and gives them an identity. Although none of the sources contained specific traits, the facets of critical thinking discussed alluded to the internalization of values. The demonstrated values or traits adopted by the military and many other organizations support the need for providing a method of internalization to those attempting to improve their thinking.

B. STRATEGIC THINKING

Strategic thinking is a concept that's drastically enhanced American defense strategy for more than half a century (Krepinevich, Watts, & Gates, 2015, p. 247). Figures like Andrew Marshall and John Boyd had a tremendous impact on the strategy community by introducing innovative ideas such as net assessment and the Observe-Orient-Decide-Act (OODA) Loop that are still utilized by the U.S. military today. The U.S. has maintained our competitive advantage for quite some time through the use of effective strategic

thinking. With China and Russia developing new technologies, the US' dominance is currently being challenged. The U.S. must understand its enemies and diagnose the technologies of the future that will grant dominance over the battlefield to maintain our strategic advantage.

1. What is Strategy?

Understanding our adversaries by analyzing their capabilities and manipulating advantages is at the core of strategy (Augier & Marshall, 2017). Strategy is a daunting process because competitors will always attempt to challenge their opponents (Augier & Marshall, 2017). It requires acknowledging that we can not solve all of our problems and asking "why" we can not resolve issues (Augier & Marshall, 2017). Thus, strategy is long-term and must be conducted thoroughly using a stable organization (Augier & Marshall, 2017, p. 275). The following definition of strategy is an integrated and extension of descriptions depicted by Secretary Mattis, Alfred Chandler, and Kenneth Andrews:

> The dynamic process of identifying, creating, and exploiting asymmetric advantages that can be used to create, achieve, or improve sustainable competitive advantages. Strategic thinking is about looking for possible current and future asymmetric advantages that can be used to achieve or improve our competitive advantages in the long-term competitive situation. As a central part of this, we must understand how the organizational characteristics of ourselves as well as our competitors both contribute to facilitating as well as creating obstacles to strategy; and we must understand how cognitive, psychological, and cultural factors influence the decision makers in and among the organizations. (Augier & Marshall, 2017, p. 278)

Strategy and organizational behavior are interrelated because an entity can not conduct strategy without analyzing the cultures of opponents, what drives their decision-making processes, and how decision-making is conducted within itself (Augier & Marshall, 2017). The psychology behind what drives an opponent to a decision can help understand why they are choosing a particular choice and grant potential asymmetric advantages (Augier & Marshall, 2017). Similarly, if an organization does not grasp what's affecting their own decisions, their long-term strategic advantage could be lost (Augier & Marshall, 2017). Improving long-term strategy requires an organization to properly examine

structural characteristics of its organization and competitors (Augier & Marshall, 2017, p. 279).

Bounded rationality is an idea developed by Herbert Simon that human beings are limited in their capacity (Arthur, 1994). Instead of using deductive logic to evaluate multiple perspectives, human beings often exhibit inductive reasoning by identifying patterns that involve a one-sided, biased view (Arthur, 1994). Acknowledging that humans commonly use inductive reasoning for decision-making and are rationally bounded is an important part of strategy (Arthur, 1994). Actors with conflicting interests exist in organizations and in competitors showcasing that there is no pattern associated with goals (Arthur, 1994). Investigating organizational behavior through the lens of inductive reasoning and bounded rationality can help answer "why" a competitor or organization makes decisions (Arthur, 1994).

2. Strategic Thinking and Strategic Planning

Strategic Planning and strategic thinking are similar concepts that are often confused with one another (Augier & Marshall, 2017). Strategic planning is a measurable process whereas strategic thinking is ambiguous (Augier & Marshall, 2017). Both notions involve discrete cognitive processes (Augier & Marshall, 2017). Strategic thinking is a creative process that requires interactive participation to create a vision of the future (Augier & Marshall, 2017). Strategic planning is a systematic process used by organizations to predict the future. A strategic plan consists of creating a goal for each step, considering the consequences associated with each step, and specifying the implementation required for all steps (Augier & Marshall, 2017). Strategic thinking is a subset of strategic planning and strategic management because it stresses agility and innovation instead of a formulated process (Augier & Marshall, 2017). It involves exploring rational opportunities from multiple perspectives. Strategic planning was established in the mid-1960s as a way "to devise and implement strategies that would enhance the competitiveness of each business unit" (Mintzberg, 1994, para. 1). Today, strategic planning is not as effective as it once was. Planning is now conducted by looking at strategies or visions that already exist (Mintzberg, 1994). Instead, strategic planning should contribute "around the strategy-making process rather than inside it" (Mintzberg, 1994, para. 4). Over formalizing any

creative initiative hinders an organization's ability to innovate (Mintzberg, 1994). Dealing with competitors requires anticipating the future through competitor analysis, problem-solving, and decision-making. Strategic thinking gives organizations the ability to formulate a vision and strategic planning how organizations can execute their plan of action (Haycock, Cheadle, & Bluestone, pp. 2–5).

3. John Boyd's "OODA" Loop

John Boyd was "one of the primer military strategists of the twentieth century and the only strategist to put time at the center of his thinking" (Coram, 2002, p. 445). Boyd had many contributions to the U.S. military, most notably he worked extensively on the F-15 program and created the OODA loop that the U.S. military still uses today as one of its primary decision-making frameworks (Coram, 2002). His findings ultimately resulted in the successful production of the F-15 and inspired the F-16 and F-18 fighters that granted the U.S. military air superiority for decades (Coram, 2002).

Boyd studied history's primer military strategists to glean the best practices that ultimately inspired his "patterns of conflict" briefing that detailed the historical patterns of conflict (Coram, 2002, p. 333). He annotated similarities among battles in history where an army defeated their opponent despite overwhelming odds. Instead of fighting a "war of attrition" military commanders with inferior forces used "deception, speed, the fluidity of action, and strength against weakness" (Coram, 2002, p. 332). The examples Boyd found shared many characteristics that are in Sun Tzu's Art of War (Coram, 2002). Boyd's findings made him value Sun Tzu's philosophies over Von Clausewitz who is considered to be one of the greatest military theoreticians (Coram, 2002). Boyd attributed the massacres of World War I to Clausewitz's philosophies and the failure of generals to adjust to the changing battlespace (Coram, 2002, p. 332).

Boyd also analyzed the German tactic of "Blitzkrieg" that relied upon instituting paralysis through the utilization of immense tank forces, airplanes, and effective communication to exploit enemy weaknesses (Coram, 2002). His study of historical conflict inspired his "Patterns of Conflict" briefing (Coram, 2002, p. 333). The briefing starts with Boyd's infamous OODA loop (Coram, 2002). Despite the wide use and

knowledge surrounding Boyd's OODA Loop, the framework is often misunderstood (Coram, 2002). The military views the OODA loop as a "one-dimensional cycle" of observing, orienting, deciding, and acting (Coram, 2002, p. 334). Reducing the complexity of Boyd's model simplifies the training, emphasizes speed, and improves the military's ability to use computer modeling (Coram, 2002). While speed is integral, orientation is the most significant step in the sequence (Coram, 2002). To properly orient a competitive condition, one must evaluate "cultural traditions, genetic heritage, new information, previous experience, and analysis/synthesis process of the person doing the orienting" (Coram, 2002, p. 335). Due to inductive reasoning and bounded rationality, every person conducts this phase differently leading to ambiguity (Coram, 2002). People often view the entire process as linear, but feedback is required at every stage making the cycle non-linear (Coram, 2002). If one executes each stage of the loop properly and continues to accelerate, the enemy's information will have outdated information causing confusion (Coram, 2002). As the tempo increases and the environment becomes more ambiguous, one can bypass the "Orientation and Decision" phases by observing and acting concurrently (Coram, 2002, p. 336).

While the OODA Loop is a strategic thinking framework that was created to "get inside" the enemy's mind and grant an understanding of their decision-making through paralysis, it can be also adopted a useful decision-making framework for any situation (Coram, 2002, p. 335). The loop, shown in Figure 2, displays critical thinking and strategic thinking concepts in a simplified, organic model. The OODA loop has been adopted by many fields of study for effective decision making showcasing its widespread applicability.[7]

[7]The F-35 uses the OODA Loop to institute paralysis
https://www.usni.org/magazines/proceedings/2016-03/f-35s-new-ooda-loop

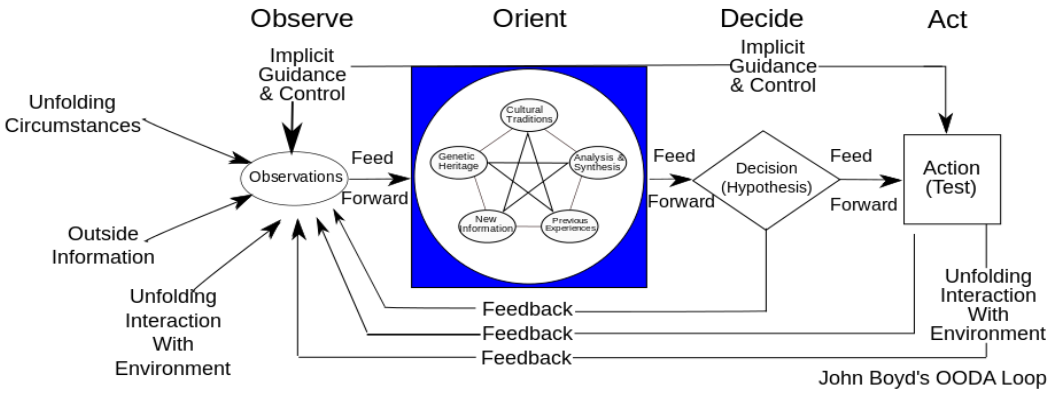

Figure 2. John Boyd's OODA Loop. Source: Coram (2002, p. 344).

4. Challenges & Areas of Consensus

Understanding the internal strengths and weaknesses and those of competitors is at the core of strategic thinking. Whether an organization is conducting a SWOT analysis or executing the OODA loop, both tools are vital assets to getting in the mind of your opponent and how one's organization operates. Between 1981 and 1983, Ronald Reagan and his advisors fashioned an articulate strategy aimed at defeating the Soviet Union (Mahnken, 2014). The approach relied on the idea of conducting a clear net assessment of the strengths and weaknesses of the United States and the Soviet Union (Mahnken, 2014) Reagan changed the strategy of his predecessors by focusing on handling the "domestic sources of Soviet foreign behavior instead of containing the spread of the Soviet Empire's reach (Mahnken, 2014). The coherent strategy developed by the U.S. had a direct correlation to the fall of the Soviet Union (Mahnken, 2014). The consistency and agility of U.S. strategy "forced the Soviet government to implement sweeping change in a bid to save the communist regime" (Mahnken, 2014).

Despite the success during the Reagan administration, his predecessors were unable to succeed; the reason is because strategy is difficult. Professor Duyvesteyn lists the following reasons why strategy is so difficult:

- "The short time horizon of electoral cycles in democracies, usually four or five years, forms an obstacle to develop a long-term vision" (Duyvesteyn, 2013, p. 12).

- "Abstract theory with a link to reality does not make translating ideas into practice easier. What is held to be true or essential scientifically might not always be politically feasible or appropriate" (Duyvesteyn, 2013, p. 12).

These are just two examples of challenges nations face in developing effective strategies. Another barrier to strategic thinking is the variance in the definitions of strategy. Analyzing historical examples explicitly can present variances in the meaning of strategy. Depending on the time horizon, cultural factors can result in strategy misinterpretation (Murray & Sinnreich, 2014, pp. 432–433).

Harry Yarger discusses the challenges of strategic thinking in the 21st century in his Joint Special Operations publication. The world is more unstable than policymakers predicted at the end of the Cold War (Yarger, 2007, p. v). Yarger argues that the accelerated rate at which the world is developing will require "use of all the socially determinant elements of U.S. power-economic, informational, diplomatic, and military" (Yarger, 2007, p. 2). Yarger also defines strategy as: "The art and science of developing and employing instruments of national power in a synchronized and integrated fashion to achieve theater, national, and/or multinational objectives" (Yarger, 2007, p. 15). He also emphasizes the need for military strategists to understand the complexity of strategy because it encompasses many facets that require synchronization. (Yarger, 2007). Wolters, Grome, and Hinds argue that there is confusion about the definition of strategic thinking. They cite the main reason "is exacerbated by the confounded concepts of strategic thinking, strategic planning, strategy, and the strategic thinker" (Wolters, Grome & Hinds, 2013, p. 1).

All of the literature reviewed alludes to analyzing the decision-making processes internally and those of external competitors. The SWOT analysis is used to analyze the internal strengths and weaknesses and the opportunities and threats of competitors. The OODA loop is a tool that can be used to make agile decisions integrated with feedback loops to analyze how the enemy thinks and institute paralysis. Discerning the

psychological, cultural, and cognitive aspects involved in decision making are additional obstacles to formulating strategy mentioned in Augier and Marshall's comprehensive definition of strategic thinking. And unlike our historical predecessors, the United States is bounded by the "liberal democratic societies" of the world making the defeat of unconventional adversaries' difficult (Murray & Sinnreich, 2014, p. 446). The dynamic use of SWOT analysis, net assessment, and the OODA loop are a few of the many strategic thinking tools can be utilized to improve strategic thinking. In order to maintain or competitive advantage, the United States must continue to hone its strategic thinking craft.

C. ENTREPRENEURIAL THINKING

Entrepreneurial thinking is a concept that's gained momentum in the business world. Entrepreneurship courses are offered at a majority of business schools. Colleges have acknowledged that there is value in teaching students how to pursue opportunities in ambiguous environments. Businesses pay consultants to inject the entrepreneurial spirit in their employees. While the concept is highly sought after, the most considerable successes often place a shroud over what made the entrepreneurs succeed in the first place. Individuals usually think of Inspirational entrepreneurs such as Jeff Bezos or Steve Jobs that are viewed as "visionaries" of business because they successfully identified unseen opportunities, took risks, and overcame obstacles (Read, Sarasvathy, Dew, & Wiltbank, 201. Ultimately, Bezos and Jobs built two of the most successful companies the world has ever seen (Read et al., 2017). Despite the long list of successful entrepreneurs in the US, the actual reason they succeed is usually misconstrued (Read et al., 2017). Myths surrounding entrepreneurs include: searching for a "new, high potential" opportunity, discovering a new idea that's never been thought of, writing a business plan, raising capital investment from venture capitalists, hiring a great team, hiring a proficient team, building a product, prepare a huge launch, achieving gradual or "hockey-stick" growth, and selling the venture or pursuing an initial public offering (Read et al., 2017, p. 3). An academic study looked at five hundred firms, and only 28% of the sample created a formal business plan (Read et al., 2017). Moreover, the average capital required to "start a business in the U.S. is less than $30,000" (Read et al., 2017, p. 3).

What makes the proven "mythical" entrepreneurs different from other entrepreneurs that have great ideas, but fail? Dew, Read, Sarasvathy, and Wiltbank studied proven entrepreneurs in their publication "Effectual Entrepreneurship." Their research pinpointed a common logic "across industries, geographic locations, and time." that they call an "effectuation" among expert entrepreneurs (Read et al., 2017, p. vii). The idea is to analyze the common principles shared among expert entrepreneurs to understand how they identify opportunities and succeed despite uncertainty (Read et al., 2017, p. vii).

1. Good Ideas are Infinite

"Effectual Entrepreneurship" states that "good ideas are everywhere." There is no way to know whether an idea will be good or bad (Read et al., 2017). Entrepreneurs and investors, that are successful, state the only way to know if an opportunity is good or bad is to "give it a try" (Read et al., 2017). Sometimes companies have a long period before they find a product that prospers (Read et al., 2017). Earl Bakken founded Medtronic, a medical device firm in 1949 (Read et al., 2017). Bakken spent the first eight years after he founded his company repairing medical equipment (Read et al., 2017). He created the pacemaker using his knowledge from medical equipment repair (Read et al., 2017). Once he invented the product, medical industry analysts predicted a total of ten thousand units for the entire life of the product (Read et al., 2017). Bakken celebrated because his company was only selling one hundred units per year (Read et al., 2017). Now his company is worth over $20 billion and a "leader in the medical services field (Read et al., 2017, p. 11)" The fact is there are no "good" ideas; we either implement ideas, or we do not (Read et al., 2017). Both Jeff Bezos and Steve Jobs started their businesses in a garage to pursue their opportunities. Ideas are anything one can come up with plus yourself (Read et al., 2017). An opportunity is an idea coupled with action (Read et al., 2017). The action is what sets entrepreneurs apart from others (Read et al., 2017). An action is a "function of interaction with the world" (Read et al., 2017). Once you have an opportunity, you must find commitment (Read et al., 2017). Finding another individual who also thinks your idea is valuable enough for another to commit is an important step in determining if your concept constitutes action (Read et al., 2017, p. 17).

2. Most Ventures Need Minor Capital to Start

The main reason most entrepreneurs give for pursuing their venture is "lack of adequate startup capital" (Read et al., 2017, pp. 23–24). How does one know when they have enough money to proceed? Zaplet was a Silicon Valley Company founded in 1999 with the goal of delivering "dynamic, updatable, web-like messages and applications through email" (Read et al., 2017, p. 23). The company pleased investors with their plan for success and raised ninety million dollars through venture capitalists (Read et al., 2017). Zaplet was ultimately a failure despite significant startup capital (Read et al., 2017). Conversely, RightNow Technologies started with five thousand dollars with the goal of commercializing software to help companies "respond to their customers' emails quickly and effectively" (Read et al., 2017, pp. 23–24). In the first year, RightNow Technologies earned twenty thousand dollars in revenue (Read et al., 2017). There is no specific amount of capital needed to start a business (Read et al., 2017). Successful entrepreneurs find creative ways to boost their money through accounting techniques and identifying slack resources (Read et al., 2017, pp. 23–24).

3. Fail Early and Adapt

Failure is a complicated subject in business. People often think if a venture fails it means you owe money and can potentially go bankrupt (Read et al., 2017). Others believe quitting is failing or earning less money than working in another job is an example of failure (Read et al., 2017). If you talk to entrepreneurs in Silicon Valley, failure is an experience they all share (Read et al., 2017, p. 29). The truth is failure is a recipe for learning (Read et al., 2017). Even the most challenging learning process in the world, the scientific method, is the design of calculated failures (Read et al., 2017). The key is to keep failures small to minimize the loss (Read et al., 2017). Limiting your investment to choose an "an acceptable level of loss" reduces the magnitude of failure (Read et al., 2017, pp. 43–44). Passion is another trait entrepreneur have (Read et al., 2017). If you're passionate in pursuit of an opportunity, it grants you the ability to reflect and learn from the loss instead of grieving (Read et al., 2017). Apples multiple failures didn't stop Steve Jobs for continuing to seek

new opportunities (Read et al., 2017). Learning from the mistakes of the past will give you the chance of improving your next venture (Read et al., 2017, pp. 43–44).

4. Opportunity Discovery and Creation

Opportunities are both discovered and created (Read et al., 2017). Discovery is when entrepreneurs look at market segments that are untouched (Read et al., 2017). Once they analyze the competition and develop a business plan, they embark on a journey to gain a competitive edge in an otherwise undiscovered piece of the market (Read et al., 2017). Creation refers to an entirely new market that can not be defined (Read et al., 2017). In this area, consumers are not even aware of what they want (Read et al., 2017). Entrepreneurs create new opportunities from "mere possibilities" (Read et al., 2017, p. 73). In the world of entrepreneurs, the creation category prevails over the discovery. Entrepreneurs use "effectuation" to navigate the uncertain environments they operate under (Read et al., 2017, p. 73).

5. Effectuation

Entrepreneurs operate in ambiguous environments. Instead of attempting to predict the future, they develop "winning strategies" (Read et al., 2017, pp. 97–98). Their strategies involve four basic principles (Read et al., 2017). The first principle is "start with your means" (Read et al., 2017, pp. 97–98). The means involves analyzing who you are, what you know and who you know (Read et al., 2017). Using these means together, entrepreneurs envision ideas and start acting (Read et al., 2017). After acting, implementation takes place without any substantial planning (Read et al., 2017). Ultimately, achievable goals appear, which are the result of "imagination and aspirations" (Read et al., 2017, pp. 97–98). The second principle is "set affordable loss" (Read et al., 2017, p. 99). Instead of thinking of maximizing returns by selecting the most appropriate strategy, entrepreneurs decide what loss they deem affordable (Read et al., 2017). Thinking in terms of failure allows entrepreneurs to estimate the downside and what they are "willing to lose" (Read et al., 2017, p. 99). Additionally, it allows entrepreneurs to use the loss as a means to drive decisions instead of relying on prediction (Read et al., 2017). This allows for the cultivation of opportunities and enables adaptability (Read et al., 2017). The third

principle is “leverage contingencies” (Read et al., 2017, pp. 101–104). The idea of leveraging contingencies is at the core of entrepreneurship (Read et al., 2017). Entrepreneurs learn to not only expect surprises but also exploit them (Read et al., 2017). Since entrepreneurs are working with ideas they created and markets that are not defined, everything that occurs is an unexpected opportunity that can lead to value (Read et al., 2017). The fourth principle is “form partnerships” (Read et al., 2017, pp. 101–104). Establishing partnerships allows entrepreneurs to get buy-in from other individuals proving the worth of their idea and can mitigate their affordable loss (Read et al., 2017). Pursuing strategic partnerships can help determine what markets to enter (Read et al., 2017, pp. 101–104).

6. Embodying an Entrepreneurial Culture

A constant challenge for companies is keeping their entrepreneurial mindset once they’ve grown into a large corporation (Read et al., 2017). Firms grow because they can create markets and sell the same products annually through the use of prediction (Read et al., 2017). Prediction causes growth but removes the ability for managers to pursue uncertain new opportunities (Read et al., 2017). Google encourages employees to dedicate twenty percent of their time to side projects (D’Onfro, 2015). Many of their most successful services including Gmail and Google Maps have been from this ingenious yet straightforward program (D’Onfro, 2015). When firms grow, they must manage the scale of operations. Once a company experiences growth, specialized teams are created and operate under a hierarchy (Read et al., 2017). The structure removes the ability of entrepreneurs to act quickly (Read et al., 2017, pp. 236–237).

How can companies change their culture to become more entrepreneurial? Executives are trained to use prediction to forecast sales and balance the budget (Read et al., 2017). Convincing executives to view threats as opportunities is the key to molding the culture (Read et al., 2017). Every industry has a time where the once stable environment becomes uncertain (Read et al., 2017). If executives see this as an opportunity to innovate, it can help inject the entrepreneurial mindset into the culture (Read et al., 2017). Furthermore, most large organizations operate using a hierarchical structure (Read et al.,

2017). Improving the structure's functionality involves firms considering to change their organizational structure to reflect an internal market that "opens the market to all potential innovators and investors, encourages iterative opportunity development, eliminates minimum investment sizes, makes everything negotiable, supports projects that compete with the core business, and embraces failure" (Read et al., 2017, pp. 238–244) Approaching a firm's structure with the goal of creating a market will help instill entrepreneurial characteristics that will revolutionize the organization (Read et al., 2017).

7. Entrepreneurial Characteristics

The "Entrepreneurial Mindset" by McGrath and Macmillan lists five entrepreneurial characteristics that habitual entrepreneurs have in common:

a. Passionately seek new opportunities

Entrepreneurs actively seek the chance to capitalize on "change and disruption" (McGrath & MacMillan, 2000, p. 2). The most revolutionary changes occur when they decide to create entirely new business models that change the way revenue is generated, costs are realized, or how operations transpire (McGrath & MacMillan, 2000).

b. Pursue opportunities with enormous discipline

Entrepreneurs spot or create new opportunities and always act (McGrath & MacMillan, 2000). It's common for entrepreneurs to create a register that lists all their unexplored opportunities (McGrath & MacMillan, 2000). They consistently revisit their opportunity list and take action when they think the time is right (McGrath & MacMillan, 2000).

c. Pursue only the best opportunities

Entrepreneurs choose to exploit the best opportunities available while avoiding the urge to chase every possibility (McGrath & MacMillan, 2000). They have the discipline to track a strong opportunity portfolio that could be at different development stages (McGrath & MacMillan, 2000). All of their tracked opportunities are linked to their overall strategy (McGrath & MacMillan, 2000).

d. Focus on execution

Adaptive execution is the focus of entrepreneurs. Instead of over-analyzing potential ideas, entrepreneurs execute (McGrath & MacMillan, 2000). The problem is opportunities are continually evolving (McGrath & MacMillan, 2000). Entrepreneurs have to adapt as changes occur and find the best way to exploit the real opportunity (McGrath & MacMillan, 2000).

e. Engage everyone in their domain

Entrepreneurs involve people from both inside and outside of their organization (McGrath & MacMillan, 2000). Establishing and maintain a network of relationships is an integral part of their success (McGrath & MacMillan, 2000). Utilizing the resources of others can be a force-multiplier (McGrath & MacMillan, 2000).

8. Areas of Consensus

The literature reviewed contains similar characteristics of entrepreneurial thinking. Read, Sarasvathy, Dew, & Wiltbank discuss the myths surrounding entrepreneurship and the commonalities among successful entrepreneurs. The themes of failure, discovering and creating opportunities, and persistence are spread throughout entrepreneurial literature. Thornberry lists three facets of successful entrepreneurs: "They Identify opportunities, shape and develop these opportunities, and create a business structure to turn these opportunities into successful businesses" (Thornberry, 2003, p. 336). Pursuing a new idea by changing, shaping, modifying, or discarding it for something better is at the heart of what entrepreneurs do (Thornberry, 2003, p. 336).

In his literature review, Christian Harrison argues that while there are various definitions of entrepreneurial leadership, there are not sufficient tools available to measure the "characteristics and behaviours of entrepreneurs (Renko et al., 2012b)" (Harrison, n.d.). In his paper, he cites Gupta's definition of entrepreneurial leadership: "a type of leadership that creates visionary scenarios that are used to assemble and mobilise a supporting castof participants who become committed by the vision to the discovery and exploitation of strategic value creation (Gupta et al., 2004, p. 242)" (Harrison, n.d., para. 4). He also uses

the definition of Greenberg et al., (2013) that discusses entrepreneurial leadership that's used "…to solve complex, social, and environmental problems" (Harrison, n.d, para. 4). While Harrison's paper discusses entrepreneurial leadership, the definitions from Gupta and Greenberg mention exploiting environments, opportunity creation, and solving intricate problems that are all similar entrepreneurial themes to the other forms of literature reviewed (Harrison, n.d.).

The most noteworthy similarity among the literature is the importance of execution. In order to seize opportunities, one must choose a course of action, execute, and improvise as problems arise. The difficulty of innovation in bureaucratic organizations is directly related to risk. Without the backing of leadership to welcome and promote new ideas, organizations will be unable to inject entrepreneurial thinking. There are many people who believe entrepreneurship is not something that can be taught (Thornberry, 2003). Studying the traits shared by entrepreneurship can improve innovation and creativity. Thornberry conducted entrepreneurship training at four corporations. He experienced success through training and coaching corporate employees. Thornberry concluded that:

> None of these opportunities would have been discovered had these participants not been exposed to a training milieu, in which ideas were not only encouraged and supported but challenged as well. So, the ability to think creatively and to be innovative is a human condition. (Thornberry, 2003, p. 337)

Giving personnel the opportunity to pursue new ideas with vigor and the backing of leadership can improve innovation. Accepting the risks, failing early, and adapting are integral facets of entrepreneurial thinking that organizations should consider when attempting to change managers to entrepreneurs.

D. ADDITIONAL OBSERVATIONS

Critical thinking, strategic thinking, and entrepreneurial thinking are all inter-related. Strategic thinking and entrepreneurial thinking both require critical thinking to assess and evaluate ambiguous environments. Entrepreneurs focus on pursuing an idea to test whether it's good or bad and try to fail early and adapt as problems arise. Strategic thinkers share the emphasis of agility to look for "current and future asymmetric

advantages" to grant long-term dominance and for "understanding the cognitive, psychological, and cultural factors influence decision makers in and among the organizations" (Augier & Marshall, 2017, p. 278). John Boyd's OODA loop has feedback loops at every step because environments are always changing, which is similar to how entrepreneurs adapt as difficulties are realized and how critical thinkers (Coram, 2002). The variety of concepts within strategic thinking and lack of a common definition and understanding is the same problem entrepreneurial thinking and critical thinking face.

All three fields stress persistence, analysis, execution, and improvisation. The main difference between the disciplines is the utilization of critical thinking. Entrepreneurs create opportunities by identifying untouched market segments. The analysis of their decision to pursue an idea requires the rapid execution of surface-level critical thinking principles. Strategic thinkers assess the way their organization thinks and how their competitor thinks. This is done by considering all factors affecting the internal and external decision-making processes. Critical thinkers take their time assessing all of the factors involved in choosing the most rational decision. Critical thinkers, strategic thinkers, and entrepreneurs all use critical thinking differently to achieve what they believe to be the best course of action.

E. CHAPTER SUMMARY

Critical thinking, strategic thinking, and entrepreneurial thinking are all important concepts that are important and interrelated. Critical thinking involves assessing one's cognition to understand how we think and familiarize ourselves with the biases we have developed throughout our life; Once we have evaluated our own thinking, we should use the intellectual standards to evaluate the elements of reasoning; This allows for a systematic process that makes us consider the "purpose, point of view, question at issue, information, concepts, assumptions, implications and consequences, and inferences"; Over time, as we use the process, we will adopt intellectual traits that improve the overall quality of thinking; Strategic thinking involves exploiting asymmetric advantages with the goal of gaining a competitive advantage over opponents (Augier & Marshall, 2017). Advantages could be understanding the internal decision making of an organization or determine how and why

enemies make decisions. John Boyd's developed the OODA Loop to "get inside" the mind of the enemy (Coram, 2002). If used properly, it can exhibit paralysis on the battlefield (Coram, 2002). Entrepreneurial thinking involves identifying opportunities in ambiguous environments and exploiting them. Mystery surrounds what makes an entrepreneur successful (Read et al., 2017). Research shows there are commonalities among all entrepreneurs that make them triumph over their peers (Read et al., 2017). Large organizations should study entrepreneurial "effectuation" to help improve the way they operate (Read et al., 2017). Uncertainty, thinking outside of the box, and problem-solving are similarities among all three concepts. Strategic thinking and entrepreneurial thinking require critical thinking to succeed. Organizations can learn new ways to innovate through the use of critical thinking, strategic thinking, and entrepreneurial thinking.

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III. FINDINGS AND RECOMMENDATIONS

A. GAPS

1. PME

The National Defense Strategy (NDS) discusses the current strategic environment that's filled with rogue regimes and aggressive competitors all attempting to target the United States. Changing the way, the U.S. "conducts business," building a lethal force, and transitioning to a culture of performance is an integral part in continuing our ability to dominate the battlefield (Mattis, 2018, p. 1). PME is listed under "cultivate workforce talent" as a means to advance and retain a "high quality" workforce. The Secretary of Defense (SECDEF) specifically states "PME has stagnated" due to the focus of meeting credits while eroding "lethality and ingenuity" Critical thinking is at the core of the SECDEF's inclusion of "intellectual leadership" (Mattis, 2018, p. 8). Improving the cognition of the military workforce could be a lethality force multiplier. Although many services include critical thinking courses in their PME curriculum, they are still teaching "what to think" instead of "how to think" (Mattis, 2018, p. 8).

The Goldwater Nichols Act (GNA) was enacted in 1986 with the purpose of improving the Department of Defense (Kamarck, 2016). One of the main goals of the act was to "improve joint interoperability among the military services through a series of structural changes and incentives for participation in joint matters" (Kamarck, 2016, p. 1) The act modified the officer management system with the goal of enhancing the "quality, experience, and education of joint officers" (Kamarck, 2016, p. 1). Joint Professional Military Education (JPME) became a mandatory requirement for officers to be eligible for specific "joint assignments and promotion categories" (Kamarck, 2016, p. 1) Despite the extensive changes, many have questioned if the changes were successful and more specifically if the JPME curriculum, instruction, and structure fulfill the needs of "today's strategic environment and force structure needs" (Kamarck, 2016, p. 1). The Senate Armed Services Committee ordered a review of the GNA in November 2015 to determine if the intent of the act succeeded in improving the defense department (Kamarck, 2016). Since

1986, JPME has evolved through various statutory changes (Kamarck, 2016, p. 1). Twenty years after the GNA was passed, a review of JPME had various findings. The following conclusions showcase how serious improvements were still required two decades later:

- "Approximately one-third of officers who had completed JPME II prior to a joint assignment considered the course to have low preparatory value and, on average, the 10- or 12-week JPME II courses were given practically the same rating as the 10-month course in terms of usefulness" (Kamarck, 2016, p. 9).
- "JPME I provides insufficient preparation for the competencies needed to serve on joint duty assignments" (Kamarck, 2016, p. 9).
- "Completion of and demand for JPME appear to be more closely tied to promotion potential rather than to developing required competencies to serve in joint duty assignments" (Kamarck, 2016, p. 9).
- "The JPME model for developing joint officers focuses on building generalists and does not adequately address a requirement for specific joint competencies" (Kamarck, 2016, p. 9).

The conclusions highlighted above demonstrates how the curriculum is not sufficient for improving joint-warfighting lethality and reiterates Secretary Mattis' statement on the current issues with PME twelve years after these congressional findings.

The Air Force and the Army acknowledge the importance of critical thinking for officer development by incorporating critical thinking in PME. How effective are the PME critical thinking modules at improving cognition? Research conducted by Major George Emilio compared the Air Command Staff College (ACSC) curriculum to other critical thinking programs using a checklist developed using "common aspects of other CT programs" (Emilio, 2000, p. 2). The checklist included questions centered around the mission statement, objectives and courseware, standards, assessment, levels-of-learning, and faculty development. The findings included:

- "The mission statement of ACSC alludes to critical thinking but doesn't have a specific critical thinking mission statement" (Emilio, 2000, p. 18).
- "A definition of critical thinking that lacked scope or application. Additionally, critical thinking skills aren't linked to course objectives" (Emilio, 2000, p. 17).
- "No critical thinking objectives "have been developed and published for the school" (Emilio, 2000, p. 18).
- "There are no written standards for critical thinking concerning reading, writing, and class discussion. The only course that discusses written standards is an elective and not available for all students" (Emilio, 2000, p. 19).
- "Written assignments aren't an accurate assessment of students' cognitive skills or affective behavior. The grading is subjective, and students aren't evaluated before entering the course and after it's concluded" (Emilio, 2000, pp. 19–20).
- "Bloom's taxonomy is used to develop Air Force course syllabi. Due to varying interpretations, this may not be suitable for improving critical thinking" (Emilio, 2000, p. 20).
- "While faculty development is robust, there is no emphasis placed on critical thinking" (Emilio, 2000, p. 20).

Even with all of the changes made by GNA and various National Defense Authorization Acts, there continue to be deficiencies found in the way we develop our military and civilian workforce. Over the years, there have been many calls for critical thinking. Even with senior leaders stressing the vitality of critical thinking, the way we educate our military fails to advance. Improving our military's decision-making ability through the use of proven critical thinking concepts is essential to becoming a more lethal force.

2. DAU

In 1990, the Defense Acquisition Workforce Improvement Act (DAWIA) became law (Jones, 2016). The act established various functions that helped improve the Secretary of Defense's ability to "effectively manage the DoD Acquisition Workforce" (Jones, 2016, p. 18). The creation of the Defense Acquisition Workforce is one of the functions designed to educate the Acquisition corps by mandating certifications for specific career fields (Jones, 2016). DAU attempts to utilize lectures, exercises, simulations, and computer-based training for instruction (Jones, 2016, p.18). Respondents of a survey conducted by DAU contradicted the goal of DAU's instruction by indicating "more hands-on exercises, case-based training, more simulation, and more interaction would improve their ability to learn" (Jones, 2016, p. 34). The study resulted in nine recommendations:

- "DAU's mandatory contracting curriculum courses should use more hands-on exercises, case-based and simulation training, and more interaction, discussion, and Socratic questioning in resident classes to effectively teach critical thinking skills to contracting personnel" (Jones, 2016, p. 66).
- "DAU should stress individual critical thinking work in DAU courses" (Jones, 2016, p. 66).
- "DAU should review the faculty evaluation policy to ensure there are no disincentives for faculty members to fail students not able to demonstrate a mastery of course material" (Jones, 2016, p. 67).
- "DAU should conduct further research on increasing the effectiveness of critical thinking training for the entire workforce" (Jones, 2016, p. 67).
- "The Office of Personnel Management should consider mandating assessments of critical thinking skills in the hiring process for 1102 series employees" (Jones, 2016, p. 67).

- "If recommendation 5 is not plausible, the DoD should mandate the assessment of mandatory minimum level of scholastic abilities in reading comprehension, writing, mathematics, and computer skills before contracting personnel begin level I certification courses" (Jones, 2016, pp. 67–68).

- "Contracting organization should consider assessing the critical thinking skills of Contracting Officers prior to issuing them Contracting Officer warrants or prior to critical assignments" (Jones, 2016, p. 68).

- "Contracting organizations should promote critical thinking in the contracting workplace environment" (Jones, 2016, p. 68).

- "Contracting organizations should ensure that the certified Level III contracting workforce is aware of training opportunities to enhance critical thinking skills" (Jones, 2016, p. 68).

Despite all of the recommendations of this study, the only designated critical thinking courses offered by DAU are online continuous learning modules. Effectively teaching critical thinking requires in-resident courses that use exercises designed to develop cognitive abilities. The incorporation of case-studies can help improve students' ability to problem-solve. Critical thinking is the core of what the acquisition workforce's mission. DAU needs a designated critical thinking course required for Level I certification to give acquisition professionals a critical thinking foundation.

3. DoD Contracting Competency Model

The way DoD organizes its acquisition training is also deficient. The DoD developed its "DoD Contracting Competency" model in 2007 to "assess the DoD contract management workforce competencies, determine competency gaps, and identify opportunities for training and development to close those competency gaps" (Rendon & Winn, 2017, p. 69). The National Contract Management Association (NCMA) developed the Contracting Management Body of Knowledge (CMBOK) to provide "a common understanding of the terminology, practices, policies, and processes used in contract

management" (Rendon & Winn, 2017, p. 69). Rendon and Winn conducted a comparative analysis of the "DoD Contracting Competency Model" and the CMBOK to assess the effectiveness of the DoD's model (Rendon & Winn, 2017). Their findings were quite concerning considering how the GAO continues to label contract management as "high-risk" and the emphasis the DoD places on "contract management training and workforce development" (Rendon & Winn, 2017, p.69). The most noteworthy differences between the DoD model and CMBOK lies in the competency details and curriculum (Rendon & Winn, 2017). The CMBOK "provides greater granularity" by "breaking down" the contracting life cycle phases for both buyers and sellers (Rendon & Winn, 2017, p. 79). Additionally, the CMBOK uses a broad structure and concentrates on areas that relate to "business management, financial management, project management, risk management, and supply chain management" (Rendon & Winn, 2017, p. 79). Instead of teaching a broad curriculum that focuses on all parties involved in the contract management process, the DoD remains focused on Federal Acquisition Regulation-based content (Rendon & Winn, 2017). While the regulation is important, basing the entire training model on regulation bounds contracting professionals to only think within the boundaries of regulation and restricts their ability to consider the private sector buyer and seller perspectives.

4. U.S. Education

Society is changing at an alarming pace. Technology has granted unlimited access to information that exceeds our comprehension ability (Emilio, 2000, p. 18). Richard Paul states "how can we adapt to reality when reality won't give us time to master it before it changes itself, again and again, in ways we cannot anticipate" (Scanlan, 2006, p. 8). According to Paul, "Ever-accelerating change" is what drives decision-making of the twenty-first century:

> A world in which information is multiplying even as it is swiftly becoming obsolete and out of date, a world in which ideas are continually restructured, retested, and rethought, where one cannot survive with simply one way of thinking, where one must continually adapt one's thinking to the thinking of others, where one must respect the need for accuracy and precision and meticulousness, a world in which job skills must continually be upgraded and perfected – even transformed. (Scanlan, 2006, p. 8)

He goes on to say how our current educational system is not equipped to give students the skills they need to flourish in the current environment that is accelerating at an alarming pace due to the technological changes in the last century (Scanlan, 2006, p. 8).

Unfortunately, the American education system has not made the necessary strides toward improving the cognition of students (Emilio, 2000). In 1998, Donna Pawlowski and Mary Danielson published a paper that evaluated whether or not the U.S. educational system was meeting the critical thinking needs of students (Emilio, 2000). Using education assessments, Pawlowski and Danielson concluded that "among other things, students lacked basic critical thinking skills" (Emilio, 2000, p. 5). Although this study was conducted in 1998, the class instruction in public schools has not collectively altered the instruction to improve critical thinking skills (Emilio, 2000). Students are still required to complete basic assignments and are tested through the use of multiple-choice testing or tests that require memorization (Emilio, 2000). Some educational systems are starting to respond by changing their mission from a focus on instruction to "producing learning" (Emilio, 2000, p. 6). Colleges around the nation are also responding. Over 800 colleges and universities are offering critical thinking courses (Emilio, 2000). The effectiveness of these courses has yet to be validated, and with such a wide array of critical thinking definitions and frameworks, the effectiveness of advancing students' cognition may be low (Emilio, 2000, p. 6).

Humans tend to gravitate toward reshaping the facts to fit a more popular solution instead of formulating rational solutions based on reality (Emilio, 2000). And with unrestricted information at our fingertips, it's easy to make biased, irrational decisions. Human life is full of countless decisions that all affect our well-being (Emilio, 2000, p. 1). Although choices we make have consequences on our lives, the school system still does not value the art of critical thought over learning cookie-cutter subjects (Emilio, 2000). One thing is certain; the U.S. educational system must adapt to meet the increasing need for critical thinking in society.

B. RECOMMENDATIONS

Mandate a critical thinking test for all incoming DoD personnel

The U.S. educational system fails to improve students' ability to think critically. If the DoD wants to produce innovative thinkers, all personnel need to be assessed on their critical thinking ability upon entering the DoD. A test should be required officer and enlisted recruits and before hiring civilian employees. The three most broadly used tests to appraise critical thinking are the Watson-Glaser Critical Thinking Appraisal (WGCTA), Cornell Critical Thinking Test (CCTT), and the California Critical Thinking Skills Test (CCTST) (Fischer, Spiker, & Riedel 2009). There advantages and disadvantages to each test and they all share similar characteristics (Fischer, Spiker, & Riedel 2009). The state of Tennessee requires all students attending state-supported universities to take the CCTST (ETSU Homepage). The CCTST is also used by Clemson University, Troy University, and many other universities as a means to test critical thinking skills. Clemson University states "The California Critical Thinking Skills Test (CCTST) is the premier critical thinking test in the world today" (Knox, 2013, Slide 2). My research showcases the CCST as one of the most widely-used critical thinking tests by universities, but more research would need to be conducted to determine the most advantageous test to evaluate military personnel. Once the most appropriate test is chosen, each military branch should govern when the initial test will be taken and how often personnel should be re-evaluated. The test results can be used to tailor critical thinking education programs. The military could also integrate the test results into the job placement process.

Integrate critical thinking courses in all PME and evaluate military course instruction

Learning any new skill takes practice, and critical thinking is no different. One critical thinking course is not going to develop rational cognition just like one football practice won't alter one's football ability; The only way the military will ever improve the critical thinking capability of personnel across the enterprise is to integrate critical thinking courses in all PME. Granting the tools necessary to critically think in all PME institutions, enlisted and officer, will allow students to revisit and build upon concepts they've learned

at career milestones. The military already experiences challenges with molding recruits to live by the core values of each branch. To develop traits requires consistency and practice, which is why the military should use the lessons learned from decades of training recruits to be warfighters to determine the integration required to achieve the desired results. Formulating a critical thinking course will require "…knowledge of the obstacles that hinder clear and logical thinking, as well as, specific skills such as the ability to ask essential questions and frame arguments" (Wolters, Grome & Hinds, 2013, p. 24). If the military wants to be successful in improving the critical thinking skills of personnel, it needs to understand that critical thinking development is a long-term endeavor that requires the practice of systematic frameworks, not prescriptive checklists (Wolters, Grome & Hinds, 2013). Finally, the military needs to appraise the way it currently instructs students to decide whether it's effective and find a way to promote critical thinking in all courses.

Add mandatory critical thinking courses to all DAU certification levels and career field technical schools

Problem-solving and critical thinking are at the core of the acquisition mission and the acquisition community and DAU both acknowledge the need for critical thinking. DAU should generate critical thinking courses for all certification levels. Instituting in-resident courses for all certifications will allow DAU students to practice critical thinking and apply the concepts to acquisition-related topics. Designing courses using the case method may be a practical course of action. Harvard Business School started using the case method "to teach students how to evaluate business situations and make appropriate decisions as early as 1919" (Jones, 2016, p. 15). The case method promotes deep thinking through the analysis of real-world events, which is why this form of instruction may be a good fit for DAU.

C. MODULE CURRICULUM

The module curriculum was developed using the case study method. David Garvin, a Harvard Business School professor, "indicates that the Harvard Business School began using the case study method to teach students how to evaluate business situations and make

decisions as early as 1919 (Garvin, 2003)" (Jones, 2016, as cited in Garvin, 2003). Garvin also states:

> Cases include irrelevant and incomplete information, forcing students to use critical thinking skills. The case study method teaches students to evaluate ambiguous situations, make difficult choices, develop analytical and persuasive skills, and think a different way to resolve problems (Garvin, 2003). (Jones, 2003, as cited in Garvin, 2003)

This next section will outline what a module could look like based on the research in this thesis, the principles in previous sections, and my own Air Force experience. The module includes outlines of a sample syllabus, potential instructor information, exercises designed to improve cognition, and four case studies. The case studies were developed using significant historical events and visionary thinkers. The Columbia case study focuses on the decision-making process and communication failures that prevented NASA from identifying the damage caused by the foam that struck the Columbia. The Steve Jobs and John Boyd case studies look at how these visionary leaders revolutionized their respective industries. Finally, the Future Combat System case study looks at the management challenges the program team faced overseeing the largest acquisition program in U.S. history. Individual instructors can flesh out the material and tailor the module content to their own students. In detailing and elaborating the syllabus, instructors can also adjust for the length of their course.

Syllabus

1. Critical Thinking Module

Module Description: Critical thinking is one of the most widely used concepts for deep thought, but often misconstrued; Throughout one's life, every person is molded by forces out of their control; The forces that defines us distorts our thinking with biases; Our entire life is determined by the decisions we make, which is why it's vital that we attempt to gain an understanding of how we think with the goal of improving the quality of our decisions; This module is designed to make students become a critic of their thinking by motivating introspection through the assessment of decisions made by historical figures and personnel involved in disasters that could have been avoided. Students will be required to participate in in-class exercises, read the case studies, conduct a thorough case study analysis, and actively engage in class discussion. By the end of the module, students should have a basic idea of what critical thinking is, the biases that affect their cognition, and be able to utilize a critical thinking framework that can be applied to any decision or problem-solving activity.

Module Objectives:

1. Properly define critical thinking
2. Motivate students to engage in reflection of their own thinking
3. Make students aware of the biases that distort their cognition
4. Apply intellectual standards and elements of reasoning
5. Grant students a universal framework that can be used to assess decisions

Critical Thinking Background:

Despite the lack of understanding, critical thinking isn't a new idea. Its beginnings date as far back as the time of Socrates, 2,500 years ago (Paul, Elder, & Bartell, 2018). Socrates found that using deductive reasoning to ask questions has profound results (Paul et al., 2018). When probing individuals in powerful positions, he found most were irrational and lacked the knowledge one would expect from authoritative figures (Paul et al., 2018). Socrates' curiosity made him understand the significance of deeply thinking about a solution before believing it's the right course of action (Paul et al., 2018).

The first step in improving our cognition is becoming a "critic" of our thinking by assessing how we think (Paul & Elder, 2014, p. 16). Throughout our lifetime, we've developed bad habits, assumptions lacking evidence, "stereotypes that influence thinking," a narrow point of view, and a defensive mechanism to attack opposing views (Paul & Elder, 2014, p. 11). Deep introspection helps diagnose problems associated with our thinking and has drastic improvements in our decisions (Paul & Elder, 2018). Thinking itself is easy because humans automatically think and make decisions without using much thought; If we leave thinking to itself, our decisions are "biased, distorted, impartial, uniformed, or downright prejudice" (Paul & Elder, 2014, p. 19).

Critical thinking consists of three fundamental processes (See Table 1 for sources):

- The practice of evaluating the thinking of all parties (McGuyer, 2006, p. 18) to understand the biases present in cognition (Paul & Elder, 2014).
- Gaining an understanding of one's thought process and using "intellectual standards" to define a "purpose," identify the "problem," gather "information," establish "ideas," detail the "assumptions" present, determine the potential "implications and consequences," and list the "inferences" made in order to make a logical decision (Paul & Elder 2014).
- Actively using the intellectual standards to evaluate the "elements of reasoning" to solve a problem with the goal of internalizing "intellectual traits" (Paul & Elder, 2014).

Acknowledging the complexity of critical thinking is important because it can't be easily learned (Paul & Elder, 2018). It requires adopting intellectual traits to a systematic process that evaluates the quality of our thinking, adopting intellectual traits, and using the elements of reasoning and intellectual standards to reach the most rational outcome (Paul & Elder, 2014).

Module Schedule:

Day 1: Exercise 1, Introduce Exercise 4, *Columbia Space Shuttle*

Day 2: Exercise 2, *Steve Jobs*

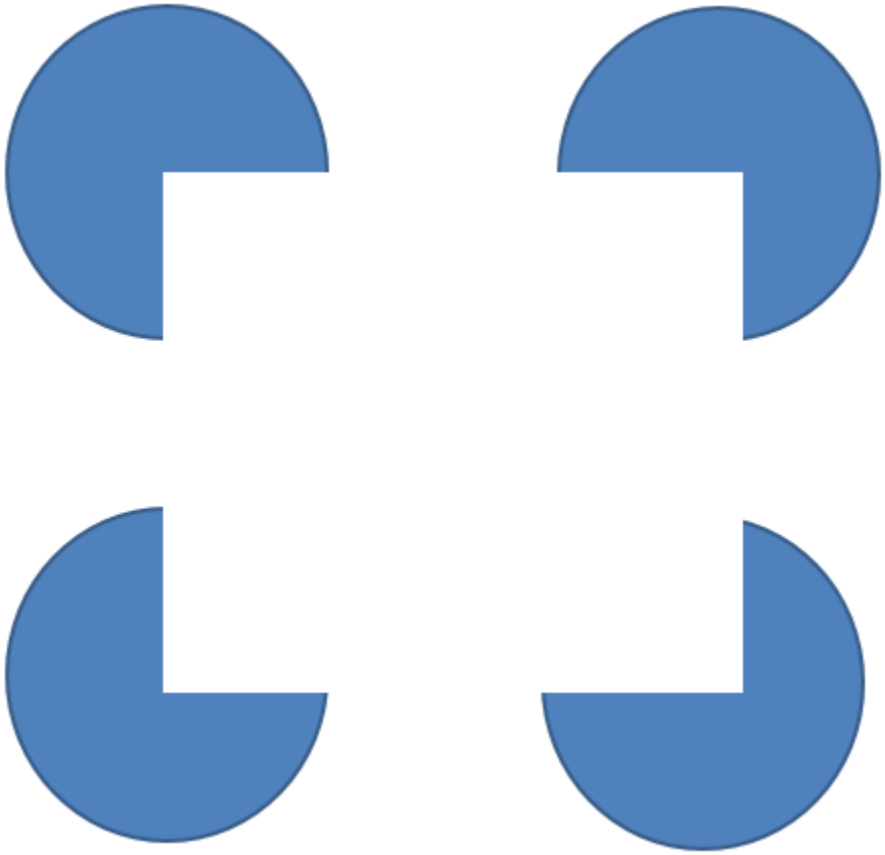
Day 3: Exercise 3, *Future Combat Systems*

Day 4: Exercise 4, *John Boyd*

2. Module Exercises

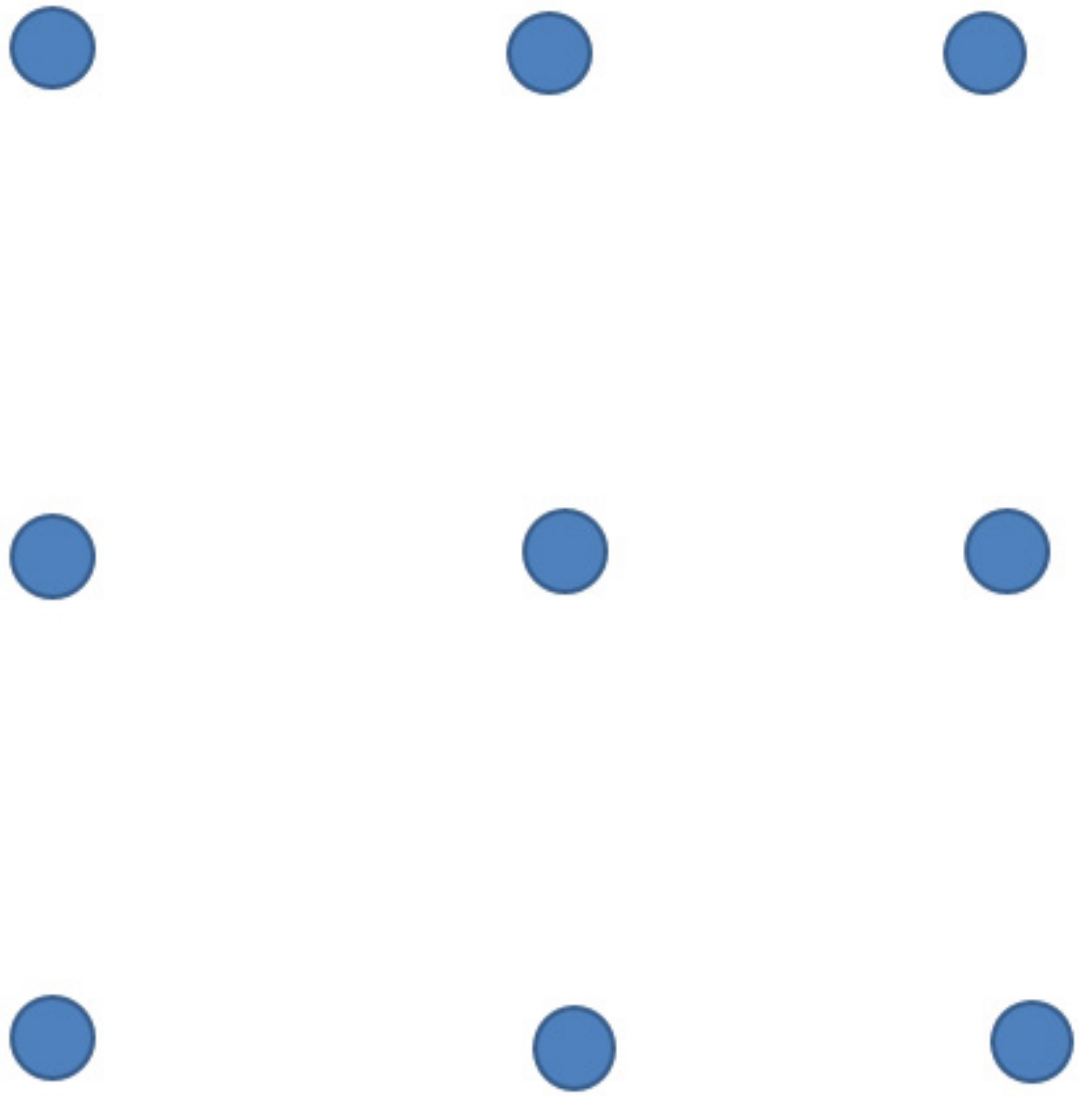
Exercise 1 (Kallet, 2014, p.6)

This exercise is designed to show students that their brain inputs images subconsciously. There is no square in this figure, it only contains three circles with a blank space.



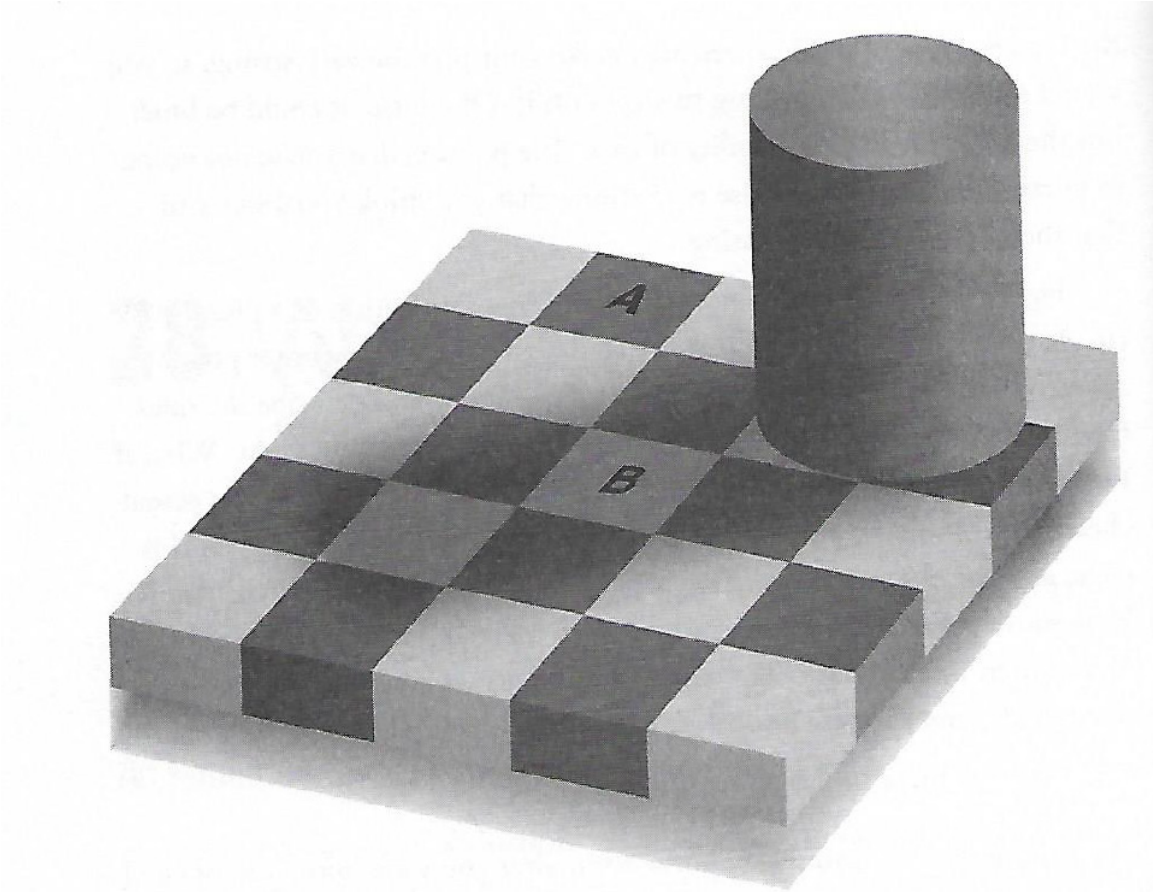
Exercise 2 (Kallet, 2014, p. 160)

This exercise is designed to make students think "outside-of-the box." Start by asking students to connect the dots without taking their pen or pencil off the paper. The only way to solve this puzzle is for students to continue the lines past the dots.



Exercise 3 (Kallet, 2014, p. 166)

This exercise is similar to exercise 1. Square B appears lighter than square A because our brains input a shadow. This is an example of how our brain sees an image thousands of times in our lifetime and distorts our perception. If you cut out square B and place it beside of square A, they are the same color.



Exercise 4 (Kallet, 2014, p. 4)

Our brain fills in images and text based on what we've learned throughout our life. This exercise is another example of the brain working in "automatic mode."

You mghit tnihk I'ts aaminzg that you can raed this with vrlialuty no diluftficuy even tuohg the ltetres are mxeid up. It trnus out that all you need are the fsrit and lsat leetrts in the crocert pcale. This is an eaxplme of your barin rnuning in aoumtatic mdoe.

Exercise 5 (McGrath & MacMillan, 2000) (Paul & Elder, 2014)

This exercise was created using the opportunity register from McGrath & MacMillan and Paul & Elder's elements of reasoning. The purpose of the opportunity register is to have a list of your entrepreneurial ideas and constantly list new ideas and evaluate them. Students can use this exercise to evaluate decisions or questions at hand.

Question at Issue (Problem)	Information (Data, Facts, Observations, Experiences)	Interpretations & Inference (Conclusions, Solutions)	Concepts (Theories, Definitions, Axioms, Laws, Principles, Models)	Assumptions (Presupposition, Taking for Granted)	Implications & Consequences	Points of View (Frame of Reference, Perspective, Orientation)	Purpose of the Thinking (Goal, Objective)

3. Case Studies

Case Study 1

Space Shuttle Columbia

Source: Space (2018)

Introduction

In 1981, the Columbia Space Shuttle successfully flew to space making it the first shuttle to conduct spaceflight (Howell, 2017). Only five years later, after nine successful missions, the Challenger Space Shuttle was lost after an explosion took place shortly after liftoff (Gehman, Barry… Windnall, 2003). After the accident, President Reagan instituted the Rogers Commission to conduct a thorough investigation to determine how such a tragedy could occur (Gehman et al., 2003). The failure of the "joint and seal between the two lower segments of the right Rocket Booster" was the cause of the shuttle explosion (Gehman et al., 2003, p. 99). The commission concluded that poor communication coupled with deficient decision-making caused "internal flight safety problems to bypass key shuttle managers" (Gehman et al., 2003, p. 100). Ultimately, the leaders who were responsible for the launch decision didn't have the facts because NASA policy required "a contractor to prove that it was not safe to launch, rather than proving it was safe" (Gehman et al., 2003, p. 100). The Rogers Commission findings resulted in comprehensive changes across the U.S. Space enterprise that ranged from the removal of NASA launching national security payloads to significant organizational changes with the hope of preventing communication deficiencies (Gehman et al., 2003). Under Administrator Daniel Goldin's leadership, a philosophy of "faster, better, cheaper" was adopted resulting in a workforce reduction of 25 percent and a 10 percent budget reduction for human spaceflight over a nine-year period (Gehman et al., 2003, p. 103). All of the changes made at NASA during the 17-year period between the Challenger and Columbia accidents fostered an environment where mistakes could be made, but they weren't the primary reasons why a tragedy occurred (Gehman et al., 2003). This case study will focus on the missed opportunities that could have helped NASA determine the damage caused during liftoff (Gehman et al., 2003, p. 99).

Shredding of External Tank Foam

The object that caused the Columbia accident, the shedding of external tank foam, wasn't a new phenomenon (Gehman et al., 2003). NASA had been concerned about the dangers of foam shedding since the early days of the Space Shuttle Program, as design engineers warned that it posed a significant hazard to the shuttle--in particular, to its delicate Thermal

Protection System (Gehman et al., 2003). NASA shuttle design requirements specified the preclusion of external tank foam shedding (Gehman et al., 2003). Photographic evidence showcased foam shedding in 65 of 79 missions that spanned between the first space shuttle mission to the challenger (Gehman et al., 2003). Space Shuttles returned with "an average of 143 divots in the upper and lower surfaces of the Thermal Protection System tiles" (Gehman et al., 2003, p. 122). After the Challenger tragedy and knowing the severity of foam shedding, how could NASA let this continue?

The Columbia Ascent

On January 16, 2003, after 13 delays over a two-year period, Columbia launched (Gehman et al., 2003). After 57 seconds, Columbia experienced a wind shear until the rocket booster separated at 127 seconds after launch (Gehman et al., 2003). Two hours after takeoff, the Interceptor Photo Working Group examined tracking camera video and found no unusual events (Gehman et al., 2003). The next day the Working Group found that a debris strike occurred 81.9 seconds after launch (Gehman et al., 2003). Analysis performed by the Working Group found a large foam piece approximately 21–27 inches long, and 12–18 inches wide struck the Space Shuttle between Reinforced Carbon-Carbon Panels five through nine (Gehman et al., 2003). The size and momentum of the object worried the Working Group personnel, and due to the camera view limitation, the damage sustained was uncertain (Gehman et al., 2003).

Decision Making During the Flight

Missed Opportunity - Engineering

On day two of the flight, the Chair of the Intercenter Working Group, Bob Chair, contacted the Shuttle Program Manager at Kennedy Space Center along with the head of Space Shuttle Systems Integration (Gehman et al., 2003). The purpose was to notify management that Boeing was analyzing the debris impact (Gehman et al., 2003). Various other management individuals received a notification about the analysis (Gehman et al., 2003). On the same day, opinions regarding the resiliency of the Reinforced Carbon-Carbon panel were distributed via email (Gehman et al., 2003). NASA engineers and United Space Alliance technical managers were the experts spreading pre-conceived sentiments without concrete imagery of the Space Shuttle (Gehman et al., 2003, p. 99).

NASA has a model called Crater that uses an algorithm to assess the damage caused by ice impacts (Gehman et al., 2003). The results were often more severe damage than observed, so the model was labeled a "conservative" tool (Gehman et al., 2003, p. 143). Boeing analysists used images from photo and video to generate the possible sizes of the debris, which they used to test with the Crater model (Gehman et al., 2003). An inexperienced certified Boeing engineer received the responsibility of using Crater to use the debris sizes (Gehman et al., 2003). Although he failed to consult with more experienced engineers, the testing results showed the debris strike did significant damage to the Thermal Protection system tile that exceeded the tile thickness and "exposed the Orbiter's aluminum airframe to extreme temperatures (Gehman et al., 2003, p. 145). Additionally, the debris assessment team concluded that any "impact angles greater than 15 degrees would result in RCC penetration" (Gehman et al., 2003, p. 145). One scenario predicted the RCC edge being hit

at a 21-degree angle. Instead of using these results, the assessment team used a qualitative extrapolation because the foam was less dense than ice (Gehman et al., 2003). The second scenario predicted that foam impact up to 21 degrees would not pierce the RCC panels (Gehman et al., 2003). While there were engineers that were uncomfortable with the results, there were no more RCC panel tests. Instead, the team decided to analyze other impact locations because the foam was not believed to be a threat to the RCC panels (Gehman et al., 2003).

Missed Opportunities - Communication

1. Flight Day 4 - An inquiry is made by Rodney Rocha, debris assessment co-chair, to see if anyone asked the crew to assess the damage (Gehman et al., 2003). All email correspondence remains in local channels, and no notification is sent to the Mission Management Team because they were separated in "distance and rank" (Gehman et al., 2003, p. 192)
2. Flight Day 6 – David Brown had a video of the External Tank Separation and Mission Control never asked him to retrieve the visual evidence (Gehman et al., 2003). This footage could have revealed the missing foam (Gehman et al., 2003).
3. Fight Day 6 - A speaker mentioned the foam strike in a meeting between NASA Headquarters and the National Imagery and Mapping Agency (Gehman et al., 2003). The personnel suggested a request for Department of Defense (DoD) imagery support may be beneficial (Gehman et al., 2003). Despite the discussion, no one acted (Gehman et al., 2003).
4. Flight Day 7 - Linda Ham, chair of the Mission Management Team, terminated the Shuttle Program Manager's request for Department of Defense imaging assets (Gehman et al., 2003).
5. Flight Day 7 – Mike Card contacts a ranking safety official to discuss a request for DoD imaging assets (Gehman et al., 2003). No action is taken because the official categorized this as an "in-family" event (Gehman et al., 2003, p. 122).
6. Flight Day 7 - Mike Card contacts the Associate Administrator for Safety and Mission Assurance regarding the utilization of DoD imaging assets (Gehman et al., 2003). The official deferred to Shuttle Management and stated they should handle the request (Gehman et al., 2003)
7. Flight Day 8 - Barbara Conte contacts the STS-107 ascent/entry Flight Director who asks the Chief of the Flight Director's office who denies the request (Gehman et al., 2003).
8. Flight Day 14 - Mike Card talks with the Associate Administrator for Spaceflight about the possibility of an imaging request (Gehman et al., 2003). The official states that the only way imagery should be gathered is on a "not-to-interfere" basis (Gehman et al., 2003, p. 166). No such basis existed (Gehman et al., 2003).

Columbia Re-entry

The Entry Flight Control team started their duty shift at 2:30 a.m. Eastern on February 1, 2003 (Gehman et al., 2003). There were no concerns among team members about the debris impact resulting in the normal re-entry process. At 8:10 a.m. Flight Control gave de-orbit

burn authorization (Gehman et al., 2003). The Columbia began its atmosphere re-entry at 8:15 a.m. No problems were detected until 8:48 a.m. when a left-wing sensor showed abnormal heat strains (Gehman et al., 2003). Debris began shedding from the Space Shuttle at 8:53 a.m. At 8:59 a.m. (Gehman et al., 2003). Mission Control notified the crew that they were aware of the pressure loss and sensor indicators (Gehman et al., 2003). Approximately 17 seconds after the crew was notified, Flight Control received a broken response "Roger, [cut off in midword]…" (Gehman et al., 2003, p. 39). No other communication occurred and at 9:00 a.m. visual confirmation of the shuttle disintegrating was made by ground observers (Gehman et al., 2003.

Case Study 2

Source: (Elkins, 2017)

The Evolution of Apple

On February 24, 1955, Steve Jobs was born (Maheshwari, n.d.). Thanks to his father, experimenting with electronics became one of Steve's favorite hobbies after he learned how to assemble and disassemble electronic devices (Maheshwari, n.d.). As a high school student, Steve decided to contact the President of Hewlett Packard (HP) to request parts to use for a project (Maheshwari, n.d.). The president was impressed and decided to offer him a summer internship at the company along with the parts (Maheshwari, n.d.). Jobs met Steve Wozniak at HP who was an engineer who happened to live a few houses away from his parents (Maheshwari, n.d.).

After dropping out of college and traveling the world, Jobs decided to pursue his passion by creating the Apple I in his garage with Woziniak (Maheshwari, n.d.). Steve saw the potential of computers and his vision resulted in the creation of the Apple II which by 1979, had sales of $200 million (Maheshwari, n.d.). By 1980, the once-dominant company began to struggle (Maheshwari, n.d.). Apple's next computer iterations failed to deliver that led to the company losing half of the markets share to IBM (Maheshwari, n.d.). In 1983, after

clashing with the board of directors, Steve was removed from the board ultimately leading to his resignation in 1985 (Maheshwari, n.d.).

Jobs purchased Pixar Animation Studios from George Lucas in 1986 (Staff, 2008). A few years later, Pixar landed a deal with Disney that included three computer-animated pictures (Staff, 2008). "Toy Story' was released in 1995 making over $361 million worldwide (Zorthian, 2015). The achievement of creating the first 3D computer-animated movie may have been one of the most significant milestones since the invention of color (Zorthian, 2015). Jobs' owned 80 percent of Pixar and in 1996, he took the company public (Staff, 2008). By the end of the first day, the company's net worth was 1 billion dollars (Staff, 2008). Although Apple fired Steve from the company he founded, they never stopped following his career (Maheshwari, n.d.). A few days after the successful Pixar IPO, Apple purchased Steve's struggling computer company, NEXT, for $400 million and re-appointed Steve as an advisor to the CEO (Maheshwari, n.d.). At this point, Apple was struggling to stay afloat because they only had 5.3 percent of the PC market share (Maheshwari, n.d.). In late 1997, Apple reported a $708 million quarterly loss. Not long after this, the CEO resigned and Jobs took over as interim CEO (Maheshwari, n.d.). Steve decided to make a deal with its biggest competitor, Microsoft, to ensure the survival of the company (Maheshwari, n.d.). Microsoft's investment of $150 million gave Steve the lifeline he needed to turn the company around (Maheshwari, n.d.). His simple idea to install a new microprocessor in Apple computers and develop the iMac led to one of the most surprising turnarounds in business history (Maheshwari, n.d.). By the end of 1998, Apple became profitable once again after reporting sales of $5.9 billion (Maheshwari, n.d.). Apple was back thanks to Steve Jobs (Maheshwari, n.d.). Thanks to Steve's innovation, Apple continued to release revolutionary products continuously over the next decade. iTunes, the iPod, iPhone, iPad, and iCloud were all invented thanks to Steve's leadership (Maheshwari, n.d.).

Steve's Keys to success

Precision

In 1997, Apple had a wide range of computers and peripherals. Jobs drew a two-by-two grid (Maheshwari, n.d.). The grid was categorized with Consumer/Professional on the columns and Desktop/Portable on the rows (Maheshwari, n.d.). Steve instructed the product review team to focus on one product in each quadrant (Maheshwari, n.d.).

Relevance

Another talent of Jobs involved eliminating anything that he viewed as unnecessary (Maheshwari, n.d.). Apple's first marketing quote was "Simplicity is the ultimate sophistication" (Maheshwari, n.d., p. 7). Whether it was the Apple II or the iPhone, Steve's goal was always to aim for simplicity to produce a product that is comfortable for consumers to use (Maheshwari, n.d.).

Breadth

The vision of simplicity drove Steve's initiative to create an ecosystem by integrating Apple's hardware, software, and peripheral devices (Maheshwari, n.d.). Today, Apple customers are reliant on iTunes and the iCloud (Maheshwari, n.d.).

Fairness

Steve always believed that if you focus on producing an amazing product, profits will ensue (Maheshwari, n.d.). Although he ran a business, his focus was on inventing the best product possible, not maximizing profits (Maheshwari, n.d.).

Depth

The original Macintosh team asked Steve if they could conduct market research to see what the consumer wanted (Maheshwari, n.d.). Steve said no "because customers don't know what they want until we've shown them" (Maheshwari, n.d., p. 9). He shared the same belief as Henry Ford who said: "If I'd asked customers what they wanted, they would have told me, 'A faster horse!" (Maheshwari, n.d., p. 9).

Logicalness

Larry Kenyon, the engineer for the Macintosh operating system, told Steve it was impossible to reduce the Mac boot up time (Maheshwari, n.d.). Steve stopped him mid-sentence and said, "If it would save a person's life, could you find a way to shave 10 seconds off the boot time?" (Maheshwari, n.d., p. 10). Steve walked over to a whiteboard and showed Kenyon if it took 10 seconds extra to turn on a Mac every day and five million people were using the device, they would waste 300 million hours in a year, which is approximately 100 lifetimes (Maheshwari, n.d.). Kenyon made the machine boot up time 28 seconds faster in a matter of weeks (Maheshwari, n.d.).

Accuracy

While developing all Apple products, Steve would always question if the product was perfect and eventually rethink the entire idea (Maheshwari, n.d.). After working on the iPhone design for 9 months, Steve told the iPhone design team "Guys, you've killed yourselves over this design for the last nine months, but we're going to change it" (Maheshwari, n.d., p. 11). Despite all the work done by the iPhone design team, they agreed (Maheshwari, n.d.).

Clarity

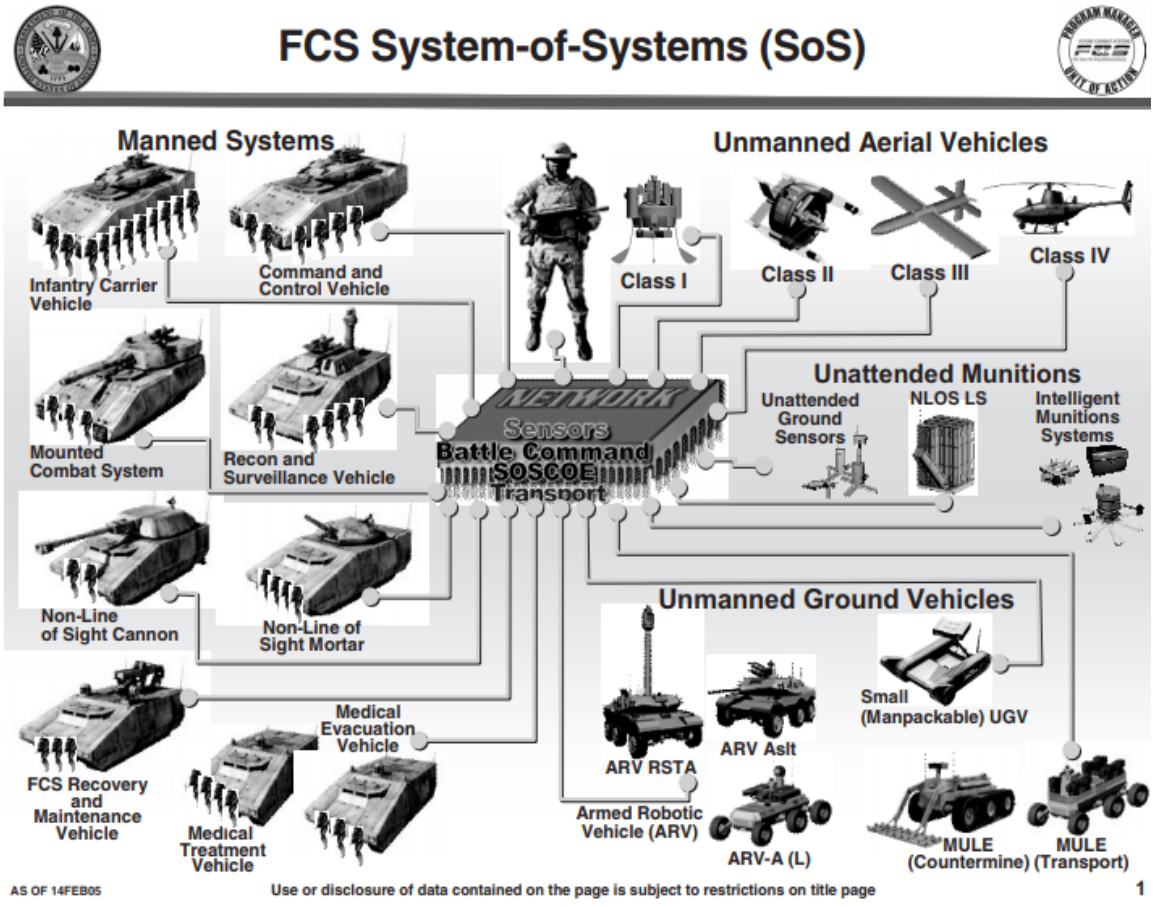
Steve had an uncanny ability to focus on the essence of products and removing unnecessary elements (Isaacson, 2014). Apple's first marketing brochure used the slogan "Simplicity is the ultimate sophistication" (Isaacson, 2014, para. 9). During the development of the iPod, Jobs focused on ways to reduce clutter (Isaacson, 2014). He would ask questions like "why do we need that screen?" (Isaacson, 2014, para. 14). Concentrating his efforts toward clarifying his vision to his employees redefined problems and the team's approaches to meet the demands for simplicity (Isaacson, 2014).

Significance

Upon returning to Apple in 1997, Steve was shocked at the disproportionate array of computers and peripherals the company produced (Isaacson, 2014). It only took a few weeks for him to turn Apple's current strategy on its head. "Stop!" "This is crazy" Steve shouted at his employees (Isaacson, 2014, para. 5). He took a marker and drew a two-by-two grid (Isaacson, 2014). He labeled the columns "Consumer" and "Pro" and the rows "Desktop" and "Portable" (Isaacson, 2014, para. 5). At this moment, Steve changed the entire vision of Apple by focusing on one great product in each of the quadrants (Isaacson, 2014). Steve's simple decision to focus on what the consumer found significant saved the company (Isaacson, 2014).

Case Study 3

Future Combat System (FCS) Case Study



Source: Feickert and Lucas (2009).

Background

During the 1990s, the Army was in a period of evolution. While they were successful in the Gulf War, mobilizing their forces took months (Pernin, Axelband… Sollinger, 2012). The issues in both the Gulf War and Kosovo caused the Army to question their force altogether placing emphasis on increasing their deployment agility (Pernin, et al., 2012). The technological advancements happening made the Army look to a warfare approach that might revolutionize warfighting (Pernin et al., 2012). The concept was to develop an agile force with the ability to rapidly deploy anywhere (Pernin et al., 2012). The ambitious complexity and scope of this acquisition increased the need for the Army to use alternative procedures to manage the program (Pernin et al., 2012). The acquisition team decided to use an incremental approach to develop a System of Systems (Pernin, et al., 2012). As the technology reached maturity, the increments would be integrated into the appropriate FCS brigades (Pernin et al., 2012).

The Army realized they weren't capable of managing such a complex integration so they decided to employ a Lead Systems Integrator to accomplish this task while using Integrated Product Teams (IPTs) to create a cohesive team of Government and industry personnel (Pernin, et al., 2012). The initiatives taken by the Army were overshadowed by the unrealistic schedule and the decision to field critical capabilities from systems that were being developed elsewhere meaning the program managers had no oversight or control over them (Pernin, et al., 2012). The scope of the program eventually grew to 18 systems in addition to the Network and the soldier, which was known as "18+1+1" (Pernin, et al., 2012, p. 1). GAO estimated the program would cost $160.7B in 2006, which was a 76% increase from the original estimate making it the Army's most expensive and ambitious acquisition effort (Pernin, et al., 2012).

Program Challenges

- The FCS program went through a myriad of program changes. "The program restructured two times in significant ways, changed contract types, and added 'spin-outs'"--which Feickert and Lucas (2009) define as capabilities from the FCS program aimed at the current force --"all of which added new elements of difficulty into an already ambitious acquisition program" (Pernin et al., 2012). "These shifts and others made the FCS program difficult to understand and tough to manage, and in many ways, this sacrificed internal and external support for the effort" (Pernin, et al., 2012, p. xix).
- The technical feasibility analysis relied heavily on "assumptions that the acquisition community could develop and integrate items both evolutionary and unknown revolutionary technologies" (Pernin, et al., 2012, p. xx). The team was "overly optimistic" that the technological capabilities required for the program could be achieved (Pernin, et al., 2012, p. xx).
- The acquisition timelines were rushed, and program members forced unrealistic schedules (Pernin, et al., 2012).

- The ongoing wars in Iraq and Afghanistan changed the Army's assumption that FCS would be dominant in significant combat operations (MCO) and they still pursued development (Pernin, et al., 2012).
- All of the operational planning documents for the FCS documented the strengths of the FCS program concept in great detail, but "its relative weaknesses were not articulated with equal clarity, even though they were equally important" (Pernin, et al., 2012, p.xxii)
- The requirements weren't properly defined which created many problems after Milestone B (Pernin, et al., 2012). "The lack of firm requirements created problems for engineers as they began developing design solutions for requirements that remained unsettled and continued to change in major ways more than two years after Milestone B" (Pernin, et al., 2012, p. xxiii)
- The Army lacked the internal capability to effectively monitor the contractor which resulted in "distrust, evolving roles and responsibilities, and general uncertainty on what to expect from each partner" (Pernin, et al., 2012).
- The "complementary programs" reached scope over one hundred during development (Pernin, et al., 2012, p. xxvii)
- The senior leaders in the program acknowledged the risks of "relying on complementary programs, yet a formal complementary programs management plan had not been completed at SDD kickoff" (Pernin, et al., 2012, p. xxvi).
- The FCS was "expected to interoperate with legacy or developmental radio systems" (Pernin, et al., 2012, p. xxviii). Many of the programs were managed or developed externally making integration difficult (Pernin, et al., 2012).

Conclusion

The FCS program "was the largest and most ambitious planned acquisition program in the Army's history" (Pernin, et al., 2012, p. xxvii). The program required the fielding and integration of "a suite of systems" (Pernin, et al., 2012, p. xvii). The acquisition approach used also required the development of new doctrine and the integration of fielded systems using a wireless network (Pernin, et al., 2012). The significant challenges the Army faced with such a complex System of Systems are why the program was canceled in 2009 costing taxpayers approximately $14B (Pernin, et al., 2012). The FCS program has been deemed an overall failure and battered the Army's acquisition reputation internally and externally (Pernin, et al., 2012).

Case Study 4

Boyd Case Study

Background

Source: Brown (2015)

In 1951 John Boyd joined the Air Force and flew near the end of the Korean War (Hammond, 2012). During the war, Boyd became captivated by air-to-air tactics and decided to take an assignment at the USAF Fighter Weapons School (Hammond, 2012). His flying ability was unmatched at the Fighter Weapons School where he had a $40 bet with all pilots at Nellis AFB that "he could put them on his six and outmaneuver them for a kill in less than 40 seconds" (Hammond, 2012, p. 5). During his six years as an instructor, "he never lost the bet" (Hammond, 2012, p.5). Boyd had high expectations of his students and expected a lot of himself when it came to air tactics (Hammond, 2012). He continuously challenged "the tactics of the day" and even wrote the first manual on jet air-to-air combat known as the "Aerial Attack Study" (Hammond, 2012, p. 5). Despite the manual being groundbreaking, the Air Force originally rejected his manual, which is why it was quietly dispersed between pilots and across squadrons until the Air Force "decided to adopt it" (Hammond, 2012, p. 5). At his next assignment, Boyd revolutionized aircraft design by diverting hundreds of thousands of dollars' worth of computer time using dummy accounts to study fighter aircraft (Hammond, 2012, p. 5). He found that "every Soviet fighter had greater maneuverability when compared to its American counterpart" (Hammond, 2012, p. 5). The findings were a game-changer and aren't surprising considering how "the 10 to 1 kill ration against MIGs in Korea came closer to 1 to 1 in Vietnam" (Hammond, 2012, p. 4). The Air Force almost court-martialed him for theft but decided not to after he won two Air Force awards for his findings that eventually became known as the "Energy-Maneuverability Theory" (Hammond, 2012, p. 5).

Fighter Development

Boyd was sent to the Pentagon to work on the development of the next Air Force fighter "which became the F-15" (Hammond, 2012, p. 5). At the time of his arrival, the design included "an 80,000-pound swing wing F-111" described as a "fighter" (Hammond, 2012, p. 5). He was asked about his opinion of the current specifications where he responded "I could screw-up and do better than this" (Hammond, 2012, p. 5). Boyd disagreed with the direction the Air Force senior leadership, which consisted of bomber generals from Strategic Air Command (SAC), chose (Hammond, 2012). Boyd changed the original fighter design to the lighter, "twin-tailed, twin-engine F-15 we know today"

(Hammond, 2012, p. 5). Even though he significantly reduced the size and weight of the design, Boyd still believed the F-15 "was too big, too costly and that too few would be built" that would ultimately result in significant losses in the next war (Hammond, 2012, p. 5). Without approval, Boyd designed "the Light Weight Fighter that became the F-16" (Hammond, 2012, p. 5). Being a staunch critic of the F-15, which was the crown jewel of the Air Force "nearly cost him his career and promotion to Colonel" (Hammond, 2012, p. 5). Thanks to Boyd's determination and vigor, the Secretary of Defense decided to proceed with the development of the F-16 against the wishes of the Air Force Leadership (Hammond, 2012). The F-16 is the "only fighter in Air Force history, which cost less than its predecessor" (Hammond, 2012, p. 6). More than 20 nations have purchased the F-16, and over 5,000 have been built (Hammond, 2012).

OODA Loop

After retiring from the military, Boyd became captivated by military history (Coram, 2012). Boyd studied history's primer military strategists to glean the best practices that ultimately inspired his "patterns of conflict" briefing that detailed the historical patterns of conflict (Coram, 2002, p. 333). He annotated similarities among battles in history where an army defeated their opponent despite overwhelming odds (Coram, 2002). Instead of fighting a "war of attrition" military commanders with inferior forces used "deception, speed, the fluidity of action, and strength against weakness" (Coram, 2002, p. 332). His study of historical conflict inspired his "Patterns of Conflict" briefing (Coram, 2002, p. 333), which discusses the OODA Loop (Hammond, 2012, p. 6). Being a fighter pilot is where Boyd learned how to think critically (Hammond, 2012). In the air, fighter pilots must make split-second decisions, analyze their enemy's response to their maneuvers, and continue to adapt to win dogfights (Hammond, 2012, p. 8). Boyd's fighter pilot mentality and inspired his "Patterns of Conflict" briefing where the OODA Loop was first introduced (Coram, 2002, p. 333). The OODA Loop took the world by storm and is a decision-making tool that is extensively used today. The OODA loop transcends barriers and applies to decision-making in any situation. While the OODA Loop is complex, the orientation phase is the central step in the process. Boyd referred to the orientation phase as "the big O," because "it is an amalgam of our genetic heritage, culture, education, experiences, and our analysis and synthesis-literally how and why we think as we do" (Hammond, 2012, p. 9).

Conclusion

Boyd had a mixed reputation throughout his military and civilian career (Hammond, 2012). Many people didn't think he was charming because he spoke his mind and would jump the chain of command, sometimes all the way to the Secretary of Defense, if he felt strongly about something (Hammond, 2012). All of the adversity he faced showcases "his courage to state his views- and defend them regardless of consequence-his integrity and willingness to challenge and persevere" (Hammond, 2012, p. 7). Boyd didn't fear challenging the status-quo. Dr. Grant Hammond stated:

> He challenged fighter tactics in his "Aerial Attack Study," revolutionized fighter aircraft design with Energy-Maneuverability Theory, and developed the F-15 and F-16 aircraft themselves with his design work. Moreover, he challenged the theory of how wars were to be fought and won in his 15-hour briefing "A Discourse on Winning and losing. (Boyd & Hammond, 2018, p. 4)

Boyd's contributions were almost always rejected at first and adopted later. Without his unwavering service and dedication to his country and the current strategic landscape would be drastically different; His life embodied the art of critical thought and showcases the importance of rational reasoning through the use of data and facts.

1. Critical Thinking Information

The following information was compiled to provide the module instructor with critical thinking concepts that can be used to evaluate the module case studies. The Paul and Elder diagram illustrates how applying intellectual standards to the elements of reasoning can help internalize intellectual traits; The dimensions of decision-making are an example of how Paul and Elder's elements of reasoning can be used to evaluate potential outcomes (Paul & Elder, 2014. Finally, the critical thinking model was developed using Paul and Elder's framework with John Boyd's OODA loop. All of the information presented is to assist instructors with case study facilitation.

a. Paul and Elder Diagram

Figure 3 showcases how Paul and Elder's critical thinking concepts should be applied; The intellectual standards are used to evaluate the elements of reasoning; Over time, as individuals practice using the standards and elements, intellectual traits will develop.

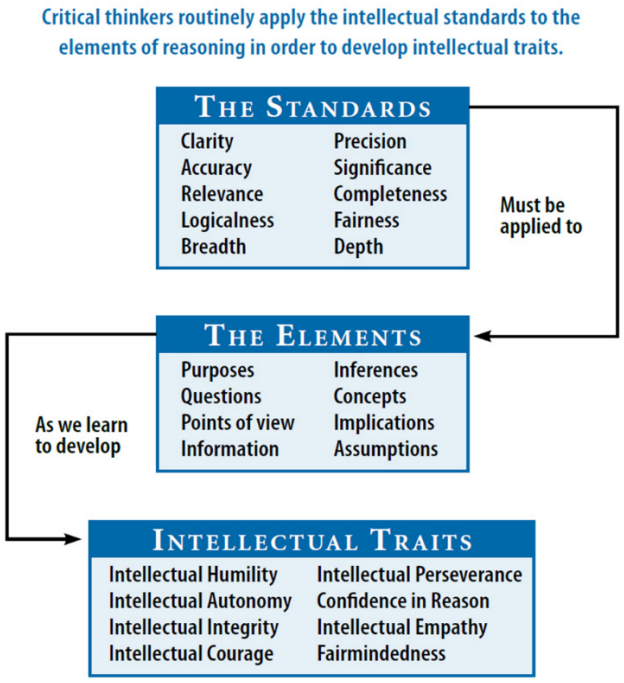


Figure 3. Critical Thinking Process. Source: Paul and Elder (2006).

b. Dimensions of Decision-Making

The elements of reasoning are a framework we can use to make coherent decisions. The elements of reasoning can be used in the following fashion:

- "Recognize the goals, purposes, and needs that are essential" (Paul & Elder, 2014, p. 191)
- "Use precision to clearly formulate the alternatives and tackle problems and decisions one at a time" (Paul & Elder, 2014, p. 191)
- "Evaluate the conditions for all possible choices and classify the implications that will take place after each decision" (Paul & Elder, 2014, p. 191)
- "Search for the information needed to make a well-versed decision" (Paul & Elder, 2014, p. 191)
- "Cautiously examine the data collected to make articulate inferences" (Paul & Elder, 2014, p. 191)
- "Consider your limitations and analyze actions available to contemplate what you can do in the short-term and long-term" (Paul & Elder, 2014, p. 191)
- "Rank the advantages and disadvantages of your accessible decisions" (Paul & Elder, 2014, p. 191)
- "Pick a strategy to execute your decision using this approach" (Paul & Elder, 2014, p. 191)
- "After acting, monitor the consequences and be ready to improvise by adjusting your plan" (Paul & Elder, 2014, p. 191)

The dimensions listed above provide an abstract look at decision-making using the elements of reasoning; The steps shouldn't be used as a catch-all process for making

decisions; They portray the systematic nature of the elements of reasoning framework and showcase scopes to consider when contemplating a decision (Paul & Elder, 2014, p. 191).

c. Critical Thinking Model

The following critical thinking model in Figure 4 combines Paul and Elder's elements of reasoning and intellectual standards with John Boyd's OODA loop. The elements of reasoning and intellectual standards are used to evaluate decisions, which is why both areas were applied to the "orient" phase.

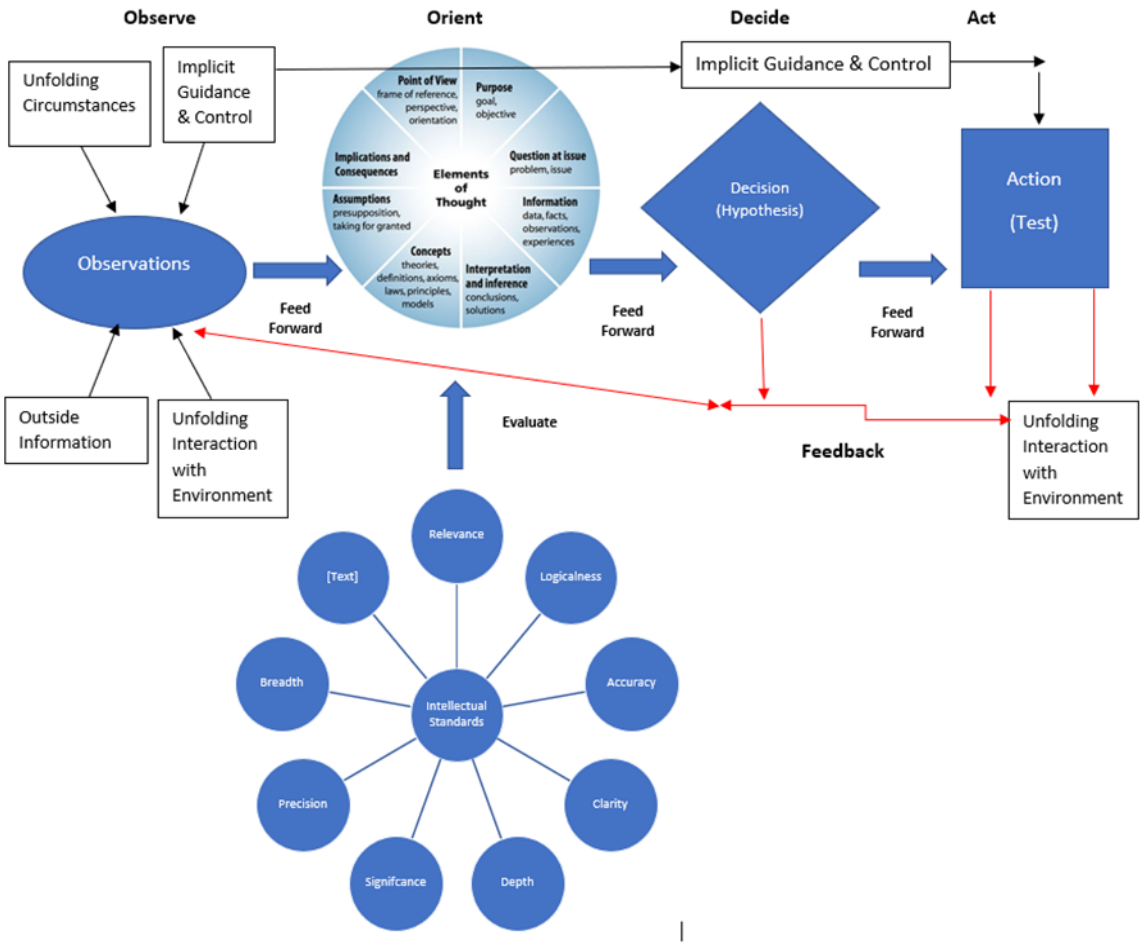


Figure 4. Critical Thinking Model Adaptation. Adapted from Coram (2002, p. 344) and Paul and Elder (2014).

2. Next Steps

The module developed above contains content from proven frameworks that can improve cognition and decision-making ability. While the module is a step in the right direction, the teaching material still needs to be fleshed out. A discussion schedule should be created to give instructors an idea of how to guide the case study discussions. It's also worth noting the typical Harvard Business School case study takes "typically two months to complete" with a network of resources at a faculty member's disposal (Faculty & Research, n.d.). The case studies in the module have not been tested or proven in the classroom. More research needs to be conducted regarding their effectiveness in the classroom.

D. CHAPTER SUMMARY

There are various gaps in PME, DAU, the DoD Contracting Competency Model, and in the U.S. education system, partly due to a deficiency in course instruction and organization. Most courses require memorization to prepare for one-dimensional assessments such as multiple-choice testing; a teaching methodology that is not encouraging for developing thinking. The military could begin to address its critical thinking deficiency by mandating a critical thinking test for all recruits and determine how frequently critical thinking assessments should be conducted. The PME and DAU institutions also need to gauge course instruction and attempt to place critical thinking courses at all levels of education. The module presented in this chapter is designed to help introduce students to basic critical thinking concepts using various exercises and instruction using the case study method. Deep thinking and problem-solving is a fundamental part of the military mission, which is why we need to change the way we train and educate personnel.

IV. CONCLUSION

The beginning of critical thinking can be traced to the time of Socrates who found that challenging the status quo by asking questions changed his view of the biased, irrational elite (Paul et al., 2018). Today, our world is filled with infinite information that we must dissect and use to make decisions; The military acknowledges that we need to alter the way our force thinks to maintain battlefield superiority. The US' competitors are modernizing their military forces and maturing new technologies that can contest our capabilities across all domains (Mattis, 2018). All of their efforts to revolutionize their military coupled with unmatched aggression not seen since the height of the Cold War is why the U.S. military must change the way "it conducts business" (Mattis, 2018, p. 1). The Air Force, Army, Marines, and Navy senior leaders have all made recent calls for critical thinking. In the 2015 AFFOC, the Air Force included the need for potential recruits to show potential for critical thinking (James & Welsh, 2015, p. 43). The Army conducted a review that concluded Army leaders are not satisfied with the critical thinking and problem-solving ability of personnel (Williams, 2013). The Secretary of the Navy has ordered a review of the Navy's training in an attempt to alter the way it teaches enlisted and officers with the goal of instilling critical and strategic thinking skills across the force (Werner, 2018). Additionally, all of the War Colleges contain critical thinking content (Williams, 2013). Including critical thinking in the schools that mold the future senior leaders of the military is another example of how all the branches recognize the importance of this concept.

The recent surge of U.S. competitors is threatening the battlefield advantage we've had over our competitors for the last few decades. All military branches are creating acquisition initiatives in an attempt to inspire creativity and encourage the private sector to do business with the DoD. The Honorable Frank Kendall included critical thinking as one of his Better Buying Principles because he believes critical thinking is at the core of acquisition (Kendall, 2017). He also stated the number one question he receives as a senior leader is "why" (Kendall, 2017). Asking "why" is at the center of critical thinking because we are all biased and make assumptions. DoD Acquisition is a world filled with templates

and cookie-cutter documents making the "why" an integral part of success (Kendall, 2017, p. 12). Finally, the fielding of a new weapon system currently takes decades, which is why the Section 809 panel was mandated by Congress to look for ways to "streamline and improve the acquisition process" ("About Us," 2018).

Critical thinking, strategic thinking, and entrepreneurial thinking partly overlap and are all important concepts in the world today. All three areas encourage perseverance, examination, implementation, and creativity. Furthermore, all of the disciplines use critical thinking differently. Three respected disciplines using critical thinking highlights how the concept is malleable and has many applications. Although the military, U.S. education system, and various fields of study acknowledge the relevance of critical thinking, the definition varies. Table 1 lists 12 different definitions of critical thinking. People often promote critical thinking and do not really grasp the deep understanding required to improve one's critical thinking ability. The variance in defining the concept among experts showcases the complexity of the topic. Even experts do not agree on a cohesive definition further highlighting the need for a more profound understanding.

PME, DAU, the DoD Competency Model, and the U.S. education system all fail to instill critical thinking in students properly. The Goldwater Nicholas Act was passed with the intention of improving the DoD (Kamarck, 2016). Improving JPME was one of the many purposes of the Act (Kamarck, 2016). Unfortunately, students are still not satisfied with the changes to JPME over three decades later (Kamarck, 2016). DAU is responsible for teaching the acquisition workforce (Jones, 2016). Despite many changes since its inception, DAU still falls short of its intended purpose of properly educating acquisition personnel (Jones, 2016). Furthermore, the DoD Contracting Competency Model used by the DoD to teach contracting is based on the FAR instead of promoting thinking outside of the box by utilizing a broad approach content (Rendon & Winn, 2017). Finally, the U.S. education system is failing the future of our country by failing to promote critical thinking (Emilio, 2000). The 1998 review conducted by Donna Pawlowski and Mary Danielson found that students lacked basic critical thinking skills (Emilio, 2000). If the schools in the U.S. are not giving students a foundation for critical thinking, how can we expect anyone to think critically?

The critical thinking module curriculum outlined in Chapter three was created to provide an example of a new way of instruction. Various exercises were included to help students gain an understanding of the way they think and how their perception can be distorted. The module utilizes the case study method to give students real-life examples of mishaps and historical-critical thinkers. The goal is to have students analyze the cases and apply basic critical thinking concepts. The module is designed to promote analysis, synthesis, and introspection.

Everyone is required to make scores of decisions on a daily basis. Unfortunately, the majority of people make decisions with little thought; Due to the biases we've developed over our lifetime and the assumptions we make, we often make split-second choices automatically; This is surprising considering the quality of our decisions is directly correlated with the quality of our life; Three recommendations were made in Chapter three with the goal of improving critical thinking in the DoD:

1. Mandate a critical thinking test for all incoming DoD personnel
2. Integrate critical thinking courses in all PME and evaluate military course instruction
3. Add mandatory critical thinking courses to all DAU certification levels and career field technical schools

All of the recommendations are a direct result of the gaps identified in chapter three. Requiring a test or reflection for new DoD personnel will help assess the critical thinking ability of new personnel that can identify areas that people need to work on, areas of improvement in the way the DoD teaches its staff, and potentially provide feedback to the U.S. educational system on how they can improve student instruction. Integrating critical thinking courses in officer and enlisted PME and adding mandatory critical thinking courses to DAU are the final recommendations. While there are critical thinking courses in PME and DAU, they are brief and, at times, even online courses that fulfill a checklist requirement. More attention needs to be given to critical thinking courses if the DoD truly wants to improve the forces critical thinking ability. The goal of the recommendations and module curriculum is to inspire a developmental path for critical thinking.

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   Monterey, California