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Decision Superiority: Putting the Emphasis Back on the Warfighter

Topic 7: C2 Approaches and Organization

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Abstract
Military operations have all the trademarks of agile decision making due to the complexity, uncertainty, time constraints, high risk and ill-defined goals of the mission environment. Any discussion of the naval command and control environment must address the relationship between the decision maker and the technological systems with which he operates. The U.S. Navy tends to address issues of decision superiority with improved technology, sometimes disregarding what the human operator brings to the picture. We argue that this approach provides limited short-term gains in terms of human performance. Addressing the root cause of decision making problems by realigning professional training, selection, and experience with the prerequisite analytical, intuitive, creative, and affective skills is a superior approach. A decision maker's skill of striking a balance among these abilities, finding the right synthesis for the right situation, adapting to the situation, and moving along the continuum of performance, is what is needed to improve decision making in the maritime environment – not more C2 displays. Through the synthesis and application of the fields of expertise development and decision making, a framework of command tactical performance or "artful competence" is presented that has direct implications for improving decision superiority.

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ABSTRACT

Military operations have all the trademarks of agile decision making due to the complexity, uncertainty, time constraints, high risk and ill-defined goals of the mission environment. Any discussion of the naval command and control environment must address the relationship between the decision maker and the technological systems with which he operates. The U.S. Navy tends to address issues of decision superiority with improved technology, sometimes disregarding what the human operator brings to the picture. We argue that this approach provides limited short-term gains in terms of human performance. Addressing the root cause of decision making problems by realigning professional training, selection, and experience with the prerequisite analytical, intuitive, creative, and affective skills is a superior approach. A decision maker's skill of striking a balance among these abilities, finding the right synthesis for the right situation, adapting to the situation, and moving along the continuum of performance, is what is needed to improve decision making in the maritime environment – not more C2 displays. Through the synthesis and application of the fields of expertise development and decision making, a framework of command tactical performance or "artful competence" is presented that has direct implications for improving decision superiority.

INTRODUCTION

Commander Jones stands behind his Officer of the Deck, preparing to make a decision that could change the success of his mission. His fast attack nuclear submarine (SSN) is hidden at periscope depth off the coast in the Pacific operating area surrounded by merchant vessels and fishing trawlers. His best sonar technicians are on the stacks listening, searching, and tracking contacts. He is thankful that prior to deployment his boat was outfitted with the latest, advanced combat system, which his fire control team is using to develop target solutions. After observing a foreign navy surface warfare exercise for several days, his boat gains a contact with an acoustic signature of a Kilo-class submarine, with a zero bearing rate. He has dozens of displays to consult, from nearly raw acoustic date from the hostile contact, to plots showing tracks to current positions. While he must consider his remaining mission priorities, he must also assess various new courses of action (such as changing his course, speed, and/or depth) in response to the hostile submarine contact given the constraints of his operating environment and rules of engagement.

This hypothetical intelligence, surveillance, and reconnaissance (ISR) scenario provides a brief glimpse of the environment in which a naval commanding officer may find himself: It has all the trademarks of a complex decision making environment. Note that the Commanding Officer (CO) may have all the information necessary to decide on a course of action, but he has no real decision aid. The reason is that the "best" course of action depends on his orders (e.g., should he avoid foreign submarine contact, or attempt to track while avoiding counterdetection), and also on his assessment of the future behavior of the contact, and the current and future environmental conditions (e.g., will they support a favorable detection vs. counterdetection posture?). All of

these considerations are completely cognitive – they are represented in the CO's situational awareness, not in any technological system or display.

In military terms, the goal of operational performance in this vignette would be "decision superiority." Decision superiority is the "ability of the commander, based upon information superiority and situational understanding, to make effective decisions more rapidly than the adversary, thereby allowing one to dramatically increase the pace, coherence, and effectiveness of operations" (U.S. Joint Forces Command Glossary, 2008). This Joint definition is complete in that it accounts for both the command and control (C2) systems involved and the human warfighter's decision making or cognitive ability. Thus, decision superiority is at a higher level than information superiority because it is more than a technological capability – it is a human capability coupled with technology.

Therefore, the concept of decision superiority is much more than merely information superiority with a new name. Yet, military guidance still focuses on the information component of decision superiority. For example, the Chief of Naval Operations' guidance for 2008 included "ensure U.S. Navy forces achieve Decision Superiority (ISR, C4, and Information Operations)" (Chief of Naval Operations, 2007, p. 4). In reality, this will require much more emphasis on the development of cognitive and intuitive skills for effective decision making to take advantage of hardware systems for C4ISR information display.

In this paper we review the misconceptions of situational awareness, and how this has led to neglect of the human decision maker in the development and fielding of technological systems and doctrine. While this is not a completely original idea, the goal is to bring the concept back into collective awareness so as to harness the advances in technology to their full capability. We end with a proposal of the cognitive abilities required for a decision maker to excel in the dynamic military operational environment. With an accurate characterization of the necessary capabilities that support warfighter decision superiority, coupled with a realistic conception of situational awareness, the armed forces will be better prepared to encounter the hybrid warfare environment of the future (Hybrid warfare reference). Although the current argument is presented in the context of undersea warfare operations and commanding officer decision making, similar applications relate across the range of military operational domains.

IT'S MORE THAN A COMMON OPERATIONAL PICTURE: SITUATIONAL AWARENESS MISCONCEPTIONS

In the introductory scenario CDR Jones finds himself at the crux of the state of the art C2 systems and what he brings to the situation as the decision maker. Military operational personnel often believe that the common operational picture (COP) presented on a C2 system is his situational awareness (SA). Take for example, Vego's (2009) statement "…strictly defined, situational awareness refers to the degree of accuracy with which one's perception of the current environment mirrors reality. Situational awareness does not necessarily mean an understanding; it is purely a tactical, not operations or strategic, term. The extensive use of the term situational awareness in the U.S. and other militaries is perhaps one of the best proofs of the predominance of a narrow tactical perspective among information warfare advocates" (p. 44). According to this (mis)characterization, SA is limited to the knowledge of friendly, enemy, and operational

environmental factors generated by both human and technical means derived from the COP. A further example is provided by a discussion of the network centric warfare framework that "envisions dramatic improvements in the COP by 2010 and predict near perfect situational awareness/dominant battlespace awareness in the 2020 timeframe." (Bindl, 2004, p. 5).

This logic is flawed because both authors' definitions of situational awareness are incomplete. SA extends beyond a tactical perspective, and the preferred definition is best captured by Endsley (1995): "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future." Although numerous definitions of SA have been proposed, Endsley's depiction of SA in three levels is the most grounded in the human systems integration (HSI) and research community. As viewed in this light, a COP only applies to the first level of SA – perception of the relevant elements in the operating environment. This level of SA is most closely tied to the C2 systems that support information superiority. The second and third levels of SA are where decision superiority is truly displayed by what the warfighter does with the information, how he comprehends the information, and makes predictions of future states, all influenced by doctrine, training, experience, and his capabilities.

Even if the COP was the only necessary component to achieve SA, the assumption that a COP leads to a common understanding among everyone is incorrect. Bindl (2004) notes that if two different people are given access to identical information they will use different filters to process and comprehend the information; thus their pictures will not be the same. These filters could come from various sources such as a person's experience, training, or general human biases and heuristics (Kahneman, Tversky, and Slovic, 1982).

There is still disagreement about the processes used to achieve SA, and the best manner in which to measure SA, and there are further considerations when addressing the issue of team SA (Letsky, Warner, Fiore, & Smith, 2008). Yet, there remains a disconnect between the concept of SA that is COP-based and that which emphasizes the warfighter. Decision superiority must draw upon two necessary components, 1) the human decision maker, with all that he brings in terms of experience, training, doctrine, judgment, abilities, and 2) the technology that provides the information needed by the warfighter. Decision making is an inherently human act, and C2 technology is a tool to assist the decision maker. Even if the information gathered, collated, and displayed on a system is flawless, the warfighter can still have poor SA and make suboptimal decisions. The current argument is that the C2 community needs to fully integrate the human component in SA and decision superiority.

WARFIGHTER AND TECHNOLOGY SYNTHESIS

The mischaracterization of SA as an instantiation of a technological system via the COP translates to an overemphasis on technological solutions to decision superiority and performance issues. The U.S. military, the Navy in particular, tends to address issues of human performance with newer or more technology, sometimes disregarding what the human operator brings to the picture. Even when HSI best practices are implemented, the solution is still typically new or improved software or hardware. The most important part of SA – the warfighter being able to project into the future what will happen based on those "soft" factors such as experience,

training, doctrine, and abilities – has been neglected by focusing on technology. SA is not something a C2 system has because SA is a uniquely human capability.

Like other armed services, the Navy has embraced technology in its modern day warfare to achieve decision superiority (Lautenschlager, 1983). The success of many naval missions and operations depend uniquely on the success of the technological systems that are used; thus, the Navy's solution to most performance problems is to focus on technology rather than the human decision maker. A confounding factor to this one-sided emphasis is the fact that the organizations that are responsible for the development and fielding of new technology (e.g, the acquisition community) are to some extent disconnected from the organizations in charge of selecting and training the human operators[1], and the organizations that determine who fills what job[2]. Occasionally this lack of alignment and communication can result in a mismatch between the technology and the decision maker, resulting in suboptimal performance (e.g, decision making). For example, the operation of a submarine, both surfaced and submerged, requires the accurate execution of many human and technological processes. Despite advances in sensor accuracy, processing power, and digital displays that provide contact management capability and electronic Voyage Management System plotting, human performance and decision making errors are still made. With such advanced technology, why are there still mishaps? How can these systems and technological advances not support optimal decision making in navigation, contact management, and mariner skills? Only by gaining fundamental understanding of expert tactical decision making processes and best practices in the nearly all digital Control Room team environments, can science and technology investments inform the development of integrated information displays that mitigate the effects of uncertainty, and provide alternatives to existing decision support tools, to achieve improved submarine CO and crew decision making. To date technology has not solved the problems.

While technological solutions can be quicker, more affordable in the short term, and less risky than solutions that focus on the decision maker, there are shortcomings of this approach. Even when designed under the guise of HSI, technology-based solutions often address the symptom, but not the root cause, of performance or decision making problems. It is often a reactionary, ad hoc approach that may provide immediate benefits, but in the long term the performance problems will reemerge. Moreover, when new technology is introduced it follows the "stove pipe" approach without consideration of existing technology. Thus an unintentional consequence becomes too much technology in the form of too many displays or information overload. Or alternatively, "simplified" displays may hide complexity behind abstraction, and therefore require much more expertise for sensemaking. Without devoting similar resources to the user side of the equation, these problems will continue to persist and the technological cycle will continue. As one British submarine Commanding Officer notes, "decision-making involves judgment and no machine has yet to achieve this core skill to the level required to engage in the art of warfighting" (Ramsey, 2007, p. 10).

The relationship between technology and humans has received considerable attention in the HSI field. Specifically, Miller and Shattuck's Dynamic Model of Situated Cognition (DMSC)

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[1] In the U.S. Navy, this is the Naval Education and Training Command (NETC).

[2] In the U.S. Navy, this is the Bureau of Naval Personnel (BUPERS).

describes the relationship between technology and humans in a system, and has been applied to several military domains (Miller & Shattuck, 2004):

> "The DMSC posits that there are various stages of technological and cognitive system performance. On the technological side, all the data in the environment, data detected by technological systems (e.g., sensors), and data available on local command and control systems (C2; e.g., workstations) are included. Each of these stages includes a subset of what was included in the preceding step. Building upon this technology are the perceptual and cognitive systems offered by the human operator. These include data perceived by the decision maker, comprehension of the decision maker and, finally, projection/prediction of the decision maker. These cognitive stages equate to the three levels of SA promoted by Endsley (2000). Embedded between these stages are lenses, which serve to focus or distort an individual's cognitive processes. Such lenses embody the context in which the situation occurs, and includes the individual's unique experiences and cultural background, the local situation and, in military situations, may include the operational order, military doctrine, and rules of engagement."(Miller, Shobe, & Shattuck, 2005, p. 1)

The DMSC applies mostly to system design in that it accounts for real-time dynamic performance of individuals and teams as they interact with technology in a system. The general premise that both the decision maker and technology need to be considered is extended in this paper to include the decision maker characteristics that are necessary for optimal decision making, and the importance of professional development that is appropriately designed to train decision makers in the complex environment. In support, Ramsey (2007) – the British CO – further notes that improving command and control technology (C2) is not the correct approach for ensuring warfighting success. C2 is limited in what it can provide, and decision making skills are the foundation of operational success, especially when immersed in the "fog of war."

ARTFUL COMPETENCE

Decision making in many military operational environments involves many extremely difficult tasks. "Incredibly Complex Tasks" are tasks that are almost unbelievably complicated, in that they require years of highly contextualized study and experience (Wulfeck & Wetzel-Smith, 2008). Features that contribute to task complexity are uncertainty, ambiguity, variability, non-linearity, interactivity, abstraction, and conditionality. These tasks require deep expertise and highly focused practice for successful performance. Successful decision making in this task environment requires "artful competence" – a skill that most people intuitively understand but are unable to define. Artful competence is revealed in what a person does; demonstrating superior performance by handling complexity, instability, and conflict when engaging people and situations (Schon, 1983). But what is "artful competence" really? Can it be defined and measured? Where does it come from? Answers to these questions directly apply to professional development, performance, evaluation, and selection, and can be used to augment technology-based solutions to decision superiority.

A satisfactory framework of artful competence in military operations does not exist. In the undersea warfare domain, recent emphasis has focused on intuitive decision making rather than on analytical reasoning (Casciano, et al., 2005) when both are actually required. In fact, there is

a long history in the field of psychology concerned with this debate. Informed by this, discussions of operational performance require a balanced approach between the intuitive and analytical workings of the mind. Moreover, research on expert performance suggests that a multi-dimensional framework accounts better for this artful competence. In particular, a person's creative and affective abilities also contribute heavily to optimal performance, especially in novel, high risk situations. A CO's skill of striking the right balance among all these components is what sets apart the extraordinary captain from the average captain. Performance in situations characterized by uncertainty, disorder, and indeterminacy, as well as in dynamic situations that consist of complex systems of changing interdependent problems, demands a warfighter who masters the convergence of all these abilities.

What is Artful Competence?

Superior performance is supported by complex cognitive abilities, and requires a capacity for coordinating different abilities into an integrated mechanism. Thus, artful competence stems from a person's optimal synthesis of abilities for the appropriate situation. Focusing solely on intuitive decision making ignores a large portion of what embodies a CO's performance. Reframing the issue in terms of factors which allow a CO to excel by applying the right synthesis of skills at the right time provides greater benefit for assessment, selection, training, development, and operations.

There are many ways of parsing human cognition and abilities, and the current schema borrows from various expertise frameworks in order to determine how a person's unique profile of capabilities[3] supports CO performance. Different areas of expertise require different abilities for success, and therefore different levels of functional integration.

Before discussing what these abilities are, the multi-dimensional and dynamic nature of artful competence should be emphasized. While the abilities mediate superior CO performance, artful competence is best governed by a CO's ability to organize (probably without awareness) the right integration of these abilities in a timely manner for the situation. For example, the required skill configuration necessary for superior performance in a flooding casualty is different from that needed for weapon employment against a hostile contact, which in turn is different from a surface transit with restricted visibility. Moreover, a CO's ability to achieve success depends on his ability to capitalize on his strengths while compensating for his weaknesses. The ability to recognize and reach the right equilibrium of creative, affective, analytical, and intuitive skills in different situations is the holy grail of CO performance. While these are perhaps not exhaustive of all the competencies that contribute to CO performance, these four are highlighted because of their prominence in most critical operational scenarios.

More important in terms of performance, however, is the symbiotic relationship among these abilities. One skill can not be developed, trained, or performed independently of the others. These four abilities need to be developed in concert instead of the current "stovepipe" approach. In situations characterized by uncertainty, disorder, and indeterminacy, as well as in dynamic situations that consists of complex systems of changing interdependent problems, an officer

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[3] The terms ability, capacity, capability, and competency are used interchangeably in this paper.

needs to master the convergence of all these abilities and be able to optimally synthesize them for the appropriate problem space.

CREATIVE ABILITY

A warfighter's artful competence is demonstrated when he[4] is able to recognize that standard methods will not work; that he needs to change his problem solving strategy when he is in a novel situation. This ability is referred to as creativity. A discussion on hybrid warfare specifically points out the importance of this ability: "any force prepared to address hybrid threats would have to be built upon a solid professional military foundation, but it would also place a premium on the cognitive skills needed to recognize or quickly adapt to the unknown." (Gompert, 2007).

This proposal is not novel (Sternberg, 1999), but it is often neglected in discussions of operational performance. Creative ability "entails the capacity to generate ideas that are simultaneously original and adaptive" (Simonton, 2003, p. 214). Creativity is specific to the area of expertise and is multi-dimensional in that it includes abilities, dispositions, and personality traits. The current characterization likens it more to a metacognitive strategy that is necessary in order to cope with unique situations. It is the manner in which the person interacts with a complex situation, characterized as a reflective conversation wherein the person detects and corrects errors in his own performance.

Creative skill is needed for the effective use of specialized knowledge that is applied in restructuring of complex, uncertain situations, especially because expertise tends to reduce cognitive flexibility. Creative ability allows a CO to maintain cognitive flexibility, adapt to the situation, and recognize when the balance between the analytical and intuitive needs to change. Thus, a person's creative skill can be applied to both his analytical and intuitive cognition since it allows the person to determine where he needs to be along the cognitive continuum for the situation. Creative ability prevents perseveration, or functional fixedness, when a new strategy is needed. It is a person's ability to flexibly and effectively adapt to or perform in the environment.

This skill is especially important for experts because they have a well developed intuitive skill based on their level of experience, but as noted below, intuitive cognition is not optimal for unique situations. If a CO relies too heavily on intuitive decision making, his performance may suffer (Erickson, Prietula, & Cokely, 2007). The ability to reflect is needed to overcome this obstacle. He approaches each problem as a unique case attending to the peculiarities of the situation. This skill may be especially important in identifying "weak signals" by combining seemingly unrelated information.

AFFECTIVE ABILITY

Any discussion of a CO's artful competence must address the factors that a high risk operating environment brings to the situation. Cognitive and creative skills need to be embedded within an affective capability, which refers to the ability to regulate emotion or arousal either consciously

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[4] Since this paper draws mostly from the all male submarine community, "he" is used to denote the gender of the CO.

or unconsciously. A person could possess all the relevant knowledge necessary to perform in routine command and control situations, but seriously fail when the situation gets stressful and time critical – when a person "lost the bubble." Likewise, if a situation becomes overly celebratory, a person needs to maintain his ability to think clearly and flexibly.

Emotional regulation is essential during stressful, high anxiety environments because emotion can both guide and inhibit action. Effective regulation of emotion results in limiting extremes producing composure, resilience, calmness, and executive control. A person who exhibits this capability appears objective, engaged but not compulsively attached, and in control of the situation. This provides the person with the mental resources to cognitively reappraise the situation to determine what actions to take, and allows for more tolerance of ambiguity. He is able to assess a troubling situation with calm reflection. Research has demonstrated that there are individual differences in both the conscious and automatic ability to regulate emotion or arousal (Gross & Thompson, 2007). Whatever the basis for the ability to regulate emotional arousal, it is clear that this component of a CO's artful competence contributes to successful performance in operational environments.

ANALYTICAL ABILITY

In discussions on performance, emphasis is usually given to analytical, deliberate, or rational cognitive abilities. Indeed, in some situations a CO's performance is supported by his ability to recall and recognize information, then analyze, evaluate, and judge the information before him. This ability supports problem solving and decision making, and is easiest in situations with little time pressure. Of the four artful competence abilities, the analytical ability is most often studied by scientists and gains most of the attention in both military and public schoolhouses. The successful application of this ability depends partly on meta-cognition, or an awareness of how to control these cognitive processes during the course of performance. For example, recognizing the existence of a problem, defining its nature, deciding on a corrective course of action (COA), then monitoring and evaluating the COA are important meta-cognitive processes.

INTUITIVE ABILITY

Intuitive cognition is also crucial for a person's performance, which is the act of knowing something without the use of rational processes such as deduction or reasoning. The idea that cognitive processing and decision making can occur outside of consciousness is not new, and has the advantage of a long history in psychology (Kihlstrom, 2002). What is new is an appreciation by organizations traditionally focused on analytical problem solving for the importance of intuitive cognition. The organizational application, however, tends to characterize cognitive abilities as either analytical or intuitive rather than as co-occurring processes.

Intuitive cognition is multi-dimensional, and incorporates many different processes, such as perceptual/pattern recognition, pattern matching, framing, situation assessment, and schema instantiation. These skills are learned through experience in a given field of expertise, and are rarely explicitly taught (although they should be). Since it is experience-based, intuition is optimal in routine and familiar situations, but can lead to poor performance in unique situations. Intuition lags behind the development of analytical cognition in a given subject matter area. For

example, a relatively new performer may have the knowledge to perform a procedure, but this knowledge will not become intuitive until he has an adequate amount of experience to develop the automatic associations. Knowledge cannot become intuitive in an expert domain without sufficient experience and training.

Even though this component is built from experience and can usually be applied automatically when needed, it is still amenable to analysis and deliberate practice – it can be explicitly developed. Deliberate practice and thinking is needed to develop this skill for correct application; otherwise intuitive decision making can lead to incorrect solutions. Deliberate practice occurs when a person pursues a well-defined task appropriate for his performance level while allowing for opportunities for errors, error correction, and informative feedback (Ericsson, Prietula, & Cokely, 2007). The capacity for reflection on his intuition in the midst of action allows a CO to cope with unique, uncertain, and novel situations.

Harnessing the advantage of intuitive cognition requires a dedicated effort to make sure the correct factors are included in that intuitive instantiation. The application of intuitive decision making assumes it is based on accurate knowledge structures and processes appropriate for that situation. Over time, an experienced, superior CO constructs retrieval structures indicated by long term memory capability. Pattern matching is the prevailing intuitive cognitive skill that superior leaders demonstrate. However, once a person has activated a pattern, there is a strong cognitive bias to assume it is the right one for the current situation (Feltovich, Spiro, & Coulson, 1997). This bias may lead to over focusing, or to force-fitting competing information to an inappropriate pattern. The creative ability is then required for a CO to manage his intuition and be artfully competent in the variety of situations, including novel ones.

While the creative, affective, analytical, and intuitive abilities mediate superior CO performance, artful competence really is displayed by the CO's ability to find the right equilibrium of these abilities in a timely manner for the situation. How well this integration is aligned with the situation's requirement will determine success. An explicit definition of the abilities that form the basis of superior CO performance helps determine the alignment of Navy selection, advancement, training, and evaluation with these abilities, and will ultimately result in optimal decision making in situations such as the introductory ISR scenario.

WHERE DOES ARTFUL COMPETENCE COME FROM?

Like most domains of expertise, training and experience are the two major contributors to the development of a CO's artful competence. However, the quality of training and experience is as, or more important, than the quantity (Clark, 2008). The suggestion that these abilities are developed from training and experience implies that they are not traits in the traditional sense that they are fixed and rigid characteristics of an individual. These abilities are modifiable, flexible, and dynamic. In other words, they can change over time, especially if the training and exercises influence the extent to which they are applied and developed.

Training

In human systems integration (HSI), total system performance is optimized when training is aligned with the human abilities required for skillful performance. Specifically, the mantra "train like you fight, fight like you train" requires awareness of what is required to fight – not

just now, but in future warfighting conditions. Informed by the extensive literature on expert and naturalistic decision making, we propose that knowledge of the desired end goal, or the knowledge, skills, and abilities (e.g., creative, affective, analytical, and intuitive), for exceptional decision making in military operational environments can be used to better align professional development with optimal decision making.

Current Navy training often excludes this foresight and provides training exclusively for the skills required for the present or subsequent job (e.g., just in time training). However, knowledge about the desired end goal of a person's professional development will optimize performance by laying the groundwork for skills that are currently necessary and others that will become more important in their future naval career. We propose that the misalignment between current training paradigms and the skills required for decision making in the undersea environment is a root cause of current decision making errors; thus technology-based solutions to decision making problems will have a limited effect.

For example, with this knowledge we can begin to better align submarine officer training with these abilities. Other authors have noted this misalignment (Dobbs, 2007), while others have written about the characteristics of what makes a good CO (Casciano, et al., 2005). There is a paradox between the skills trained and required by a submarine junior officer (e.g., engineering, procedural, technical skills) and the skills needed to succeed as an artfully competent CO. How a submarine officer transitions from the current junior officer training pipeline to become a good tactical decision maker as a CO is lost in the picture, and can not be addressed by new technology alone. Waiting until Prospective Executive Officer (PXO) or Prospective Commanding Officer (PCO) training to educate and train the submarine tactical warfighter is not sufficient because these skills need a solid, lengthy base to draw from. Wulfeck and Wetzel-Smith (in press) outline the optimal training strategies that accommodate the characteristics of complex tasks, such as abstraction, variation, interactivity, dynamism, non-linearity, and conditionality, among others. In short, decision making abilities need to be emphasized as much as technical skills given the confluence of factors of incredibly complicated tasks.

Even if a person has the right synthesis of abilities, the organizational system in which he performs may promote or inhibit their application. These are skill sets that need to be developed from the beginning of an officer's career, in their chosen specialty – not waiting until the time in which they may needed. If their professional development is provided in a more holistic manner then there will be little need to "train" them for decision making in their senior positions. In other words, decision making can not be optimal if the right skills and abilities are not engrained from the start of their professional career.

Type of Experience

In addition to training, development of the confluence of these skills also requires the right operational experience.   As with training, experience alone will not produce an artfully competent officer – it is the type of experience. To build up creative, affective, analytical, and intuitive skills an officer needs the opportunity to be able to perform his skills in as many different types of situations as possible. The breadth and depth of operational experience will have the greatest influence (e.g., mission areas, operational areas).

What type of training and experience is needed? First, training that requires the application of these abilities is certainly important. Does the Navy's current training require the use of creative and intuitive abilities to succeed? Do practice scenarios encourage a novel response to a new situation, or cognitive flexibility? If not, then these skills will be less likely to develop, and the synthesis of these skills will not be put to the test. Training by itself is not adequate; it must involve deliberate practice (Ericsson et al., 2007). Moreover, training needs to 1) teach principles underlying abstraction, 2) help learners cope with multiple sources of variability in the environment, 3) provide aids that reduce memory load, 4) provide strategies for dealing with uncertainty and ambiguity, and 5) provide training in problem solving, judgment, and decision making (Wulfeck & Wetzel-Smith, in press). In contrast, training communities tend to focus on the end result of performance, such as the accuracy of a solution. This ignores the cognitive processes or skills that are required to get to that solution. A more effective, comprehensive approach would include training on the development and application of these skills utilizing deliberate practice and reflection. The use of scenario-based training that is varied enough to require the instantiation of all these skills in different configurations is another key component (Ross, Lussier, & Klein, 2005).

This is a cursory look at how the Navy's training and assessment processes are aligned with the skills proposed to support a CO's superior performance supporting decision superiority. A person can develop artful competence and the prerequisite skills only to the extent that the environment allows him. A warfighter may have all the internal attributes, but in the absence of a supportive environment these abilities will remain undeveloped, and will not appear when they are required.

SUMMARY

Military operations require agile decision making due to the incredible complexity of the mission environment. The mischaracterization of SA as an instantiation of a technological system via the COP translates to an overemphasis on technological solutions to decision superiority and performance issues. Preparing people for decision making in this environment requires realigning professional training and selection, and development of training for prerequisite analytical, intuitive, creative, and affective skills. A decision maker's skill of striking a balance among these abilities, finding the right synthesis for the right situation, adapting to the situation, and moving along the continuum of performance, is what is needed to improve decision making in the maritime environment – not more C2 displays. With a renewed focus on the decision maker side of the equation, coupled with the current effort on C2 technological systems, the military's C2 decision making capability has no limits.

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