Technical Report 1339

Identification of Knowledge, Skills and Abilities for Army Design

Heather M.K. Wolters
U.S. Army Research Institute

Trevor Conrad
Christopher Riches
Robert Brusso
Kenny Nicely
Ray Morath
Heidi Keller-Glaze
ICF International

April 2014

United States Army Research Institute for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:

MICHELLE SAMS, Ph.D.
Director

Research accomplished under contract
for the Department of the Army by:

ICF International

Technical review by:

Mark Crowson, Center for Army Leadership
Scott Beal, U.S. Army Research Institute

NOTICES

DISTRIBUTION: Primary distribution of this Technical Report has been made by ARI. Address correspondence concerning this report to U.S. Army Research Institute for the Behavioral and Social Sciences, ATTN: DAPE-ARI-ZXM, 6000 6th Street (Bldg. 1464 / Mail Stop: 5610), Ft. Belvoir, Virginia 22060-5610.

FINAL DISPOSITION: Destroy this Technical Report when it is no longer needed. Do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this Technical Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
April 2014	Final	August 2010 – August 2012

4. TITLE AND SUBTITLE
Identification of Knowledge, Skills, and Abilities for Army Design

5a. CONTRACT NUMBER
W5J9CQ-11-C-0041

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
622785

6. AUTHOR(S)
Heather M.K. Wolters;
Trevor Conrad, Christopher Riches, Robert Brusso, Kenny Nicely, Ray Morath, Heidi Keller-Glaze

5d. PROJECT NUMBER
A790

5e. TASK NUMBER
405

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U. S. Army Research Institute
for the Behavioral & Social Sciences
6000 6th Street (Building 1464 / Mail Stop 5610)
Fort Belvoir, VA 22060-5610

ICF International
9300 Lee Highway
Suite 4300
Fairfax, VA 22031

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S. Army Research Institute
for the Behavioral & Social Sciences
6000 6th Street (Building 1464 / Mail Stop 5610)
Fort Belvoir, VA 22060-5610

10. SPONSOR/MONITOR'S ACRONYM(S)
ARI

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
Technical Report 1339

12. DISTRIBUTION/AVAILABILITY STATEMENT: Distribution Statement A: Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES Contracting Officer's Representative: Dr. Heather M.K. Wolters

14. ABSTRACT

The Army Design Methodology is an evolving concept and this research identifies required knowledge, skills, and abilities (KSAs) for leaders and their staffs to effectively use design. Identified KSAs can inform and direct training and leader development that facilitate the application of design and positively impact operational success. This research employed both qualitative and quantitative methods to determine design KSAs. Results support a framework of six competencies and 43 KSA related to the cognitive and social-communication components of design. In order to enhance the development and application of design competencies broadly throughout the force, the Army needs to identify and select Soldiers with a propensity to demonstrate the KSAs, provide them additional developmental opportunities (both inside and outside the classroom), and finally, reward them for engaging in design thinking.

15. SUBJECT TERMS
Design Methodology, Competencies, Knowledge, Skills, Abilities

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
					Dorothy Young
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER
Unclassified	Unclassified	Unclassified	Unlimited Unclassified	68	703-545-2316

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Technical Report 1339

Identification of Knowledge, Skills, and Abilities for Army Design

Heather M. K. Wolters
U.S. Army Research Institute

Trevor Conrad
Christopher Riches
Robert Brusso
Kenny Nicely
Ray Morath
Heidi Keller-Glaze
ICF International

Fort Leavenworth Research Unit
James W. Lussier, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
6000 6th Street , Building 1464
Fort Belvoir, VA 22060

April 2014

ACKNOWLEDGEMENTS

The authors would like to thank those who provided time, support, and access to research participants, to include COL (R) Todd Ebel, School for Command Preparation; Dr. Bruce Stanley, School of Advanced Military Studies; and Dr. Anna Waggener, U.S. Army War College. In addition, we wish to especially thank all of those who participated in the research and offered their time to share their experiences and insights regarding design.

IDENTIFICATION OF KNOWLEDGE, SKILLS, AND ABILITIES FOR ARMY DESIGN

EXECUTIVE SUMMARY

Research Requirement:

The Army Design Methodology continues to evolve and there is a need to identify the requisite knowledge, skills, and abilities (KSAs) for leaders and their staffs to effectively use design. By ascertaining the relevant KSAs, recommendations could be developed to inform and direct training and leader development that facilitate the application of design and positively impact operational success.

Procedure:

The literature shaped the general understanding of design and the development of a proposed set of competencies from which to further explore the underlying factors associated with being able to effectively apply design methodology. To validate these competencies, design practitioners were asked to share their experience with design or design-type thinking and their views regarding essential KSAs. The input from interviews was then analyzed in order to compare and contrast their perceptions with what was learned from the literature. Once the competency model was revised to reflect the KSAs derived from the analyses, its accuracy and comprehensiveness were assessed via a survey distributed to multiple practitioners.

Findings:

Overall, the research confirmed the accuracy of a general model of six competencies – Holistic Thinking, Sensemaking, Innovative Thinking, Adapting, Sensegiving, and Collaborating, and 43 KSAs required for design. Using existing research and literature as an initial framework for exploring design, understanding of the requirements for applying the methodology grew and evolved through discussions with design practitioners. When the general model was later proposed for review and confirmation, the specified knowledge, skills, and abilities found support from a broad array of Army leaders.

Utilization and Dissemination of Findings

This research provides a framework for understanding the KSAs and competencies that facilitate design thinking and can be used to build a system of screening, developing, and rewarding Army leaders capable of excelling at design. Early-career screening for leaders with the design KSAs can allow the Army to commit developmental time and resources to those most likely to excel in design later in their careers. Additionally, rewarding those who do utilize their design KSAs indicates to others that design thinking is valued in the Army. That will encourage others to develop their skills to successfully engage in design thinking.

CONTENTS

APPENDICES

Identification of Knowledge, Skills, and Abilities for Army Design

> "*Acknowledging the unpredictability of war is fundamental to our view of future conflict. We seek to provide concepts and methods that will better enable us to find our way through the fog, friction, and chaos of warfare*."
>
> General J.N. Mattis
> Commander, U.S. Joint Forces Command

Introduction

Operational Environment

The operational environments of the Iraq and Afghanistan campaigns highlighted challenges faced by commanders attempting to address highly complex and dynamic problems. The Army's existing decision making processes and procedures were not always well suited to framing and addressing the novel and fluid situations faced by Army leaders, and these apparent shortcomings prompted the Army to investigate new procedures.

For example, early in the campaigns of Iraq and Afghanistan, Army leaders were finding it difficult to achieve desired end states using existing concepts such as effects-based operations (EBO). The Israeli Defense Force (IDF) also faced similar difficulties in applying EBO in its own engagements (Matthews, 2008). For example, EBO proved to be too prescriptive, predictive, centralized, and failed to anticipate the reaction of the complex systems involved (Mattis, 2008). In addition, at lower echelons, the Military Decision Making Process (MDMP) could address medium-structured problems, but lost its utility when the problem – and subsequent solution – was difficult to define. For example, Field Manual 5-0 C1, *The Operations Process*, (U.S. Department of the Army, 2011a) describes "establishing a safe and secure environment" as an ill-structured problem faced by the Army in Iraq in 2003 (p. 3-3) that exemplified the type of problem that the current MDMP was not well suited to address.

In 2005 the U.S. Army's School of Advanced Military Studies (SAMS) began to work with the IDF and study how Systemic Operational Design (SOD) philosophy, methodologies, and thought structures could be applied to Army campaigns. SOD is a holistic approach to understanding complexity through systems logic and is thought to be well suited to addressing complex and ill-defined problems. It relies on discourse to identify, explore, and exploit new knowledge that will better frame the problem. In contrast to traditional military thinking, it requires non-linear, constructive, and creative thinking (Sorrells, Downing, Blakesley, Pendall, & Walk, 2005).

The Army recognized the applicability and appropriateness of design for facing complex problems. It presented design as part of a cognitive process in TRADOC Pamphlet 525-5-500,

The U.S. Army Commander's Appreciation and Campaign Design (U.S. Department of the Army, 2008). Design found further adoption at the joint level as the commander of U.S. Joint Forces Command, General Mattis, also recognized the design methodology as better suited than the current MDMP for guiding the thought processes necessary for shared understanding and the development of comprehensive solutions (Mattis, 2008).

Although innovative and adaptive Army commanders had already been applying elements of design informally, the establishment of the Army Design Methodology and its introduction into doctrine helped to codify it as an essential cognitive tool for commanders. In 2010, Field Manual 5-0, *The Operations Process*, described in detail how design is fundamental to the operations process. FM 5-0 describes design as "a methodology for applying critical and creative thinking to understand, visualize, and describe complex, ill-structured problems and develop approaches to solve them" (U.S. Department of the Army, 2010, p. 3-1). In support of conceptual planning, design has four goals: understanding ill-structured problems, anticipating change, creating opportunities, and recognizing and managing transitions.

Existing Need

The Army Design Methodology continues to evolve. As leaders are formally trained to use design and the operational force has time to apply the methodology, more will be learned about its utility and ways to improve its use. In particular, there is a need to identify the requisite knowledge, skills, and abilities (KSA) for leaders (and their staffs) to effectively use design. Improving leader and staff capabilities in design thinking will facilitate the application of a deeper understanding of operational problems.

Research Purpose

This research had two primary tasks:

1. Ascertain the knowledge, skills, and abilities necessary for commanders and their staffs to apply design and facilitate planning and decision making.

2. Develop recommendations for improving the ability of commanders and their staff to apply the Army Design Methodology.

The research was intended to link the academic literature to the practical needs of the Army and its commanders in terms of applying design. By bringing together the experiences of leaders who have applied design and what is known about critical thinking, creative thinking, and collaboration, the research could provide informed recommendations on the expertise, skills, and characteristics necessary for effective design.

Literature Review

A literature review was conducted with the goal of identifying competencies and underlying knowledge, skills, and abilities that support commanders' and staffs' ability to carry out the Army Design Methodology. The focus was on identifying competencies and their

underlying KSAs that appeared critical to effective design and avoiding the pitfall of identifying the myriad of competencies and KSAs required of Army leaders in general.

A number of military articles, papers, and presentations specifically describing the design process (Banach & Ryan, 2009; Grigsby et al., 2011; U.S. Department of the Army, 2010; U.S. Department of the Army, 2011a; Hammerstrom, 2010; Perez, 2011; Ryan, 2011) provided a conceptual overview of design and its components—including descriptions of how design differed from, but also complemented, the Military Decision Making Process (MDMP). To a great extent this body of literature specifically describing the design process and its components helped to guide the literature review and facilitated the organization and interpretation of findings from the review.

The final step of the literature review involved identifying and defining those competencies—represented by clusters of highly related KSAs—that support commanders' and staffs' ability to perform design. A total of six competencies were identified as directly supporting design; these competencies are:

- Holistic Thinking,
- Sensemaking,
- Sensegiving,
- Adapting,
- Innovative Thinking, and
- Collaborating.

A definition for each competency was then developed. The competency definitions are based upon a synthesis of definitions of similar constructs found in the literature and are also informed by the cluster of KSAs comprising the competency.

Holistic Thinking

> **Definition of Holistic Thinking:** Conceptualizing and understanding adaptive relationships and interactions amongst varied entities or variables; involves the application of both critical thinking and systems thinking to develop hypotheses and formulate inferences regarding the problem space and its surrounding environment.

Kasser (2010) defined holistic thinking as, "the combination of analysis (in the form of elaboration), systems thinking, and critical thinking" (p. 1). Research and descriptions of design also highlight the importance of the capabilities of holistic thinking, systems thinking, and critical and reflective thinking in performing design and allude to the conceptual similarity of these capabilities. In a recent article describing a way to think about and perform design, Perez (2011) identified gaining a "holistic understanding" as one of eight critical values comprising the ethos of doctrinal design. This holistic understanding is defined as, "the ability to understand how several disparate variables within and around one's area of responsibility are interrelated" (Perez, 2011, p. 46). Field Manual 5-0, *The Operations Process* (U.S. Department of the Army, 2010) also identified, "gaining a deeper and more thorough understanding of the operational environment" as one of the eight fundamentals of design. It stated that the "learning about the

nature of the situation helps [commander and staff] to understand the groupings, relationships, or interactions among relevant actors and operational variables. This learning typically involves analysis of the operational variables while examining the dynamic interaction and relationships among the myriad other factors in the operational environment" (p. 3-5). Finally, Ryan (2011) also identified critical thinking and systems thinking as vital capabilities required for design. The following sections describe, in greater detail, the various components that comprise holistic thinking and their importance for design.

Systems Thinking

In their description of Systemic Operational Design, Sorrells et al. (2005) described how General Systems Theory provides the theoretical roots for design. They went on to describe how design thinking utilizes a systems-based approach to understanding complex and ill-defined problems. Perez (2011) also described how one of the three building blocks of design thinking is the ability to conceptualize and understand systems and subsystems. Thinking in terms of systems and subsystems requires leaders and their staffs to be able to specify—and have a shared understanding of—the relationships between the various actors, institutions, and structures in order to better discern tensions, flows, and feedback loops between these entities. Burnett, Wooding, and Prekop (2004) also contended that when dealing with complex, adaptive, and interlinked systems (e.g., economies, public opinion), cause and effect relationships are not inherently knowable and that order tends to be an emergent property of the system.

The ability to think about systems and subsystems is less dependent upon specific, individual cause and effect relationships within the environment (i.e., system or subsystem) and more dependent upon how the "multiplicity of factors coalesce to form a holistic dynamic system" (Perez, 2011, p. 47). Though the term "systems thinking" is not used, Field Manual 5-0, *The Operations Process* (U.S. Department of the Army, 2010) also highlighted the importance of gaining an understanding of the environmental frame that includes the history, culture, current state, and future goals of relevant actors in the operational environment. It described how this environmental frame is used to understand and explain behaviors of the relevant actors (i.e., individuals or groups within a social network who act to advance personal interests) within the operational environment.

Critical and Reflective Thinking

Field Manual 6-22, *Army Leadership*, described critical thinking as "examining a problem in depth, from multiple points of view, and not settling for the first answer that comes to mind." (U.S. Department of the Army, 2006b, p. 6-1). Critical thinking is identified as an important cognitive capability that supports commanders' and staffs' ability to perform design. FM 5-0 describes how critical thinking captures the reflective and continuous learning that informs design (U.S. Department of the Army, 2010).

The application of critical thinking by commanders and staff members is also listed as one of the five fundamentals of design and serves to mitigate risks associated with insufficient or unclear guidance provided by higher political or military authorities (U.S. Department of the Army, 2010). Field Manual 5-0 goes on to describe how critical thinking is important for those (i.e., commander and staff) framing the operational environment and problem. Critical thinking

leads to deeper understanding of the higher commander's intent and vision and helps to foster a shared understanding of the situation.

There appears to be some conceptual overlap in the descriptions of critical thinking and reflective thinking as they relate to design. For example, Field Manual 5-0, *The Operations Process*, indicates that the less structured nature of design (versus MDMP) requires that design teams (i.e., commander and design staff) have the capability to move "back and forth between environmental framing and problem framing while considering several operational approaches" (U.S. Department of the Army, 2010, p. 3-8). As the process evolves, commanders and staffs must reflect on how and when to "shift their focus among elements of design while building understanding and refining potential operational approaches to solve the problem" (U.S. Department of the Army, 2010, p. 3-8).

Banach and Ryan (2009) described the importance of reflective thinking, and specifically its role in helping those performing design thinking (i.e., commanders and staff) avoid common cognitive traps and balance cognitive resources among understanding the environment, the problem, and potential solutions. Through reflective thinking, commanders and staff members can improve their awareness of their own capabilities (including strengths and biases) and their capacity to regulate the cognitive focus of themselves and their fellow design team members. The SAMS uses meta-questions as part of design curricula to foster reflective thinking by: (a) serving as probes to determine the depth of current understanding of the system; (b) having participants consider second and third order effects of action; (c) introducing alternative perspectives that may challenge conventional wisdom or the current way of thinking (i.e., current mental model); and (d) helping create the narrative that explains the systemic logic of the operational environment (Banach & Ryan, 2009). For example, when preparing a counterattack, staff officers may also wish to pose the following meta-questions:

- What infrastructure damage could the counterattack incur?
- How would that impact the different actors and tribal groups in the region?
- Are we upsetting the power balance, or creating other unintended consequences?
- What is the logic of the guidance?
- What are the sources of legitimacy of the different power bases within the enemy's social system?

Grigsby et al. (2011) described how the design methodology is focused upon helping commanders and staff better exercise the "elasticity of mind" that is required for effective military action, as well as the importance of applying conceptual thinking as part of design. Grigsby and his colleagues' description of conceptual thinking appears to be highly redundant with others' views of critical and reflective thinking. They viewed conceptual thinking as a prerequisite capability for enacting design that facilitates success in many of the components of design (e.g., reflection, iteration, systems thinking). Grigsby et al. (2011) also contended that unfamiliarity with a problem or situation—rather than its structure or complexity—is the best predictor of design's utility, and thus, the need for conceptual thinking. For example, design methodology is most useful when the commander and staff are least familiar with the problem or situation (i.e., problem is novel, commanders and staff are new to the problem, or the problem

has changed in some unforeseen way). When faced with such a novel problem, a structured approach to conceptual thinking is most useful, and design thinking helps to foster that structure.

Considering the Consequences of Approaches and Actions

Holistic thinking is vital in supporting the various stages of the design process in which the commander and staff must not only reframe situations, but they must also consider the downstream impact of an array of potential approaches for addressing the situation. Only through a thorough or holistic understanding of the system and its subsystems can the design team accurately gauge the consequences of modifications to the system. Per FM 5-0, C-1, *The Operations Process* (U.S. Department of the Army, 2011a), "The commander's visualization and description of the actions required to achieve the desired conditions must flow logically from what commanders understand and how they have framed the problem" (p. 3-1). Developing a solution requires the consideration of different approaches and description of the chosen approach that will inform planning. The operational approach is described as a "broad conceptualization of the general actions that will produce the conditions that define the desired end state" (p. 3-11). The design team must be able to devise multiple potential approaches that may address the problem and give them deliberate consideration. Exploring multiple potential approaches helps to establish the limits of what is possible.

When considering each approach, the design team must assess how well it supports the operational initiative and achieves the desired end state. For an effective assessment, they must be able to accurately identify the constraints and factors that influence the feasibility and desirability of each approach (Garstka, 2003). The constraints and factors include relevant actors, resources, and risks (U.S. Department of the Army, 2011a) and further require an ability to draw inferences regarding possible outcomes associated with each approach. Garstka (2003) posited that being able to predict or infer possible future patterns is an essential element of understanding. Individual or group awareness pertains to existing or past conditions, but individual or group understanding requires inferences regarding what has yet to come. Finally, the team must consider the implications of each approach. Being able to consider the potential intended and unintended consequences of an outcome will allow the commander and staff to devise methods for countering these issues or exploiting them. It also supports the commanders' and staffs' ability to begin to visualize and describe the broad means for directing action to achieve the desired end state.

Others such as Perez (2011) and Banach and Ryan (2009) have also described the importance of the capability to consider the consequences of various approaches as an outgrowth of, or subsequent to, problem framing. Perez (2011) spoke of the "challenge of prediction" in which commanders (and to a lesser degree design staff) must be able to form if-then hypotheses based upon their understanding of the environment. Examples of such leader hypotheses may include: (a) if my Soldiers live among the population, and (b) if my Soldiers partner with host nation forces and attack irreconcilable extremists, and (c) if my interagency partners and I visit regularly with key leaders…then villagers will support the local government instead of the insurgency. Banach and Ryan (2009) also described design as taking place in three cognitive spaces—the operational environment, the problem, and the solution. It is within the solution space that design teams create a theory of action as a way to address the problem. Akin to Perez's description of the need for commanders to make predictions based on if-then hypotheses,

the theory of action is also a hypothesis which Banach and Ryan called "simple and suggestive insight about how to solve the problem" (p. 111) which then gives way to the development of the design concept that includes the identification of potential interventions (i.e., solutions) and the subsequent selection of the optimal intervention from among these options.

Sensemaking

> **Definition of Sensemaking**: Ongoing synthesis of information from the surrounding environment into a meaningful understanding (i.e., frame or mental model) of the environment; this understanding or frame must be continually maintained and enhanced.

Maintaining understanding is engendered by the interdependent relationships between the requisite input and thought processes needed for design and subsequent sensemaking. Specifically, sensemaking is informed by extracted information from the environment in which the problem exists (Madjar, Greenberg, & Chen, 2011). Simply put, in order to solve a problem, one must make sense of the problem itself.

Sensemaking was described by Weick (1993) as the search for answers to the two questions of "what's the story here?" and "what do I do next?" Research that has followed Weick's initial theory development has attempted to refine and advance the concept of sensemaking. For example, Laroche (1995) described sensemaking as the interplay between interpretation (i.e., what's the story here?) and action (i.e., what do I do next?). Taylor and Van Every (2000) further extended this line of thinking by describing sensemaking as "a way station on the road to a consensually constructed, coordinated system of action" (p. 275). At this way station, conditions are "turned into a situation that is comprehended explicitly in words and that serves as a springboard to action" (p. 40). Their work emphasized the social component of sensemaking through the use of terms such as consensually constructed. Sensemaking has also been conceptualized as the primary site where meanings materialize that serve to both inform and constrain identity and action (Mills, 2003). It involves the process of perceiving, extracting cues, and making plausible sense retrospectively, while attempting to enact order into ongoing circumstances and events.

Field Manual 5-0, *The Operations Process*, highlights the importance of sensemaking in the design process. FM 5-0 specifically describes how framing the operational environment—one of the three core elements of the Design Methodology—involves "selecting, organizing, interpreting, and making sense of a complex reality" and that framing also, "provides a perspective from which commanders can understand and act on a complex, ill-structured problem" (U.S. Department of the Army, 2010, p. 3-8). Thus, although they do not explicitly identify sensemaking as a competency that is required to perform design, the authors' description of the design methodology and the design element, framing the operational environment, directly highlight the importance of sensemaking in performing design.

Within the design methodology, multiple forces necessitate effective sensemaking. Mandler (1984) discussed two common situations (labeled as interruptions of an ongoing flow) that trigger sensemaking: 1) the unexpected event that does not fit into the ongoing interpretation of the environment and 2) the expected event that failed to occur. Thus, situations that

necessitate the application of design methodology, such as those taking place within an operational environment marked by instability and increasing complexity, also necessitate sensemaking (Grothe, 2009).

There has also been some degree of consensus that sensemaking conducted as an individual cognitive activity, in isolation from other individuals, does not produce optimal results. Involving others in addressing the central question "what's the story here?" results in these individuals becoming stakeholders or active participants in the process (Leventhal, 1980). The inclusion of others in the process not only leads to increased ownership, it also leads to higher quality sensemaking. Involvement characterized by open discussion leads to both convergent and divergent views provided by participants thereby reducing the likelihood of strategic myopia (Abrahamson & Fomburn, 1994; Eisenhardt, 1992). Strategic myopia is a dysfunctional focus on short term results coupled with an inability to predict, forecast, or see the future state of an organization. Another advantage of involving others in the sensemaking process is an increased likelihood of a shared situational understanding among team members (Orasanu, 1990).

Situation Framing

An important component of sensemaking is situation framing. Situation framing consists of structuring environmental cues and relevant cognitions into salient, relevant structures in order to address the current problem (Gioia, Corley, & Fabbri, 2002; Madjar et al., 2011; Randall, Resick, & DeChurch, 2011). Thus, environmental cues and the cognitions they elicit inform that "framing" process (U.S. Department of the Army, 2011a, p. 3-8). These frames are necessary for individuals to engage in sensemaking as they are the mental models used for problem understanding, without which sensemaking will suffer with inadequate framing (Sieck, Klein, Peluso, Smith, & Harris-Thompson, 2007; Weick, 1995). Furthermore, how an individual decides to frame a problem will ultimately influence how successful they are at solving the problem (Perez, 2011). Thus, for effective sensemaking to ensue, one must possess the abilities relevant for effective situation framing.

For effective situation framing, one must be able to take information from the environment and synthesize it into a new structure (e.g., frame or mental model) or amend it to a current one (Sternberg, 2006). As design is primarily focused on applying solutions to novel situations, design team members must possess the ability to synthesize information into a frame that is conducive for problem solving (U.S. Department of the Army, 2011a, p. 3-37). Additionally, they must also possess the ability to use this frame to identify new information in order to improve the frame. As Sieck et al. (2007) stated, frames are "evoked in order to create" (p. 26). Thus, situation framing is a dynamic process that builds upon itself.

In order to distinguish between relevant and irrelevant information for frame creation and enhancement, individuals must be able to understand and frame the situation, use expertise and prior knowledge to attend to relevant information, and organize this information into meaningful parts while synthesizing it with prior knowledge. Klein, Calderwood, and Clinton-Cirocco (2010) discussed the importance of understanding and framing the situation when examining the behaviors of fire ground commanders (FGC). Specifically, the ability of the FGC to instantly understand and frame a high-pressure situation leads to their successful handling of the situation

(such as directing resources, arriving at a solution for a course of action, and modifying this course of action when necessary) (Klein et al., 2010).

Effective situation framers are also able to use their expertise and prior experience to select relevant information from the environment and frame it accordingly. As Ericsson and Lehman (1996) stated, experts do not simply engage in blind pattern extraction and memory retrieval when solving complex problems. Instead, they gather relevant information and encode it into special frames. It is this ability that separates experts (those who excel at situation framing) from less skilled individuals (Chi, Glaser, & Rees, 1982). Thus, effective situational framers are able to not only distinguish between relevant and irrelevant information, they also are able to organize this information based on custom heuristics with the intention of streamlining problem solving. As an example, Ntuen and Leedom (2007) presented principles of deductive sensemaking for field commanders. These principles were based on prior theoretical work (Kelly, 1955) and interviews with top field commanders. In addition to other important principles, Ntuen and Leedom stated that successful commanders are able to organize information into their own mental model, a model that is based on the context itself as well as relevant military doctrines and rules of operation.

Other Characteristics and Components of Sensemaking

In order to be effective at sensemaking, individuals must also possess a) an acute awareness of the environment (Weick, 1995; Wright, 2004), b) knowledge of relevant history and organizational artifacts such as rules and doctrine (Ntuen & Leedom, 2007), and c) the capability to participate in the sensemaking and sensegiving process as part of a collective (Abrahamson & Fomburn, 1994; Baran & Scott, 2010; Eisenhardt, 1992). Both Weick (1995) and Wright (2004) highlight that knowledge and awareness of the environmental context is vital for effective sensemaking. For example, individuals must interpret environmental cues and information to successfully update existing frames, narratives, or mental models. Failure to attend to the environmental context means that existing frames and mental models become stale, outdated, and obsolete. The importance of knowledge and experience in sensemaking is found within the work of Ntuen and Leedom (2007) and Chi et al. (1982). For example, Ntuen and Leedom (2007) contend that understanding organizational artifacts plays a role in how commanders make sense of the battlefield. Further, prior knowledge and experience (i.e., history) is used to aid in the understanding of novel situations (Ntuen & Leedom, 2007). Although design is concerned with complex, ill-structured problems, if individuals are able to use prior experience of a similar situation to help make sense of the current one, problem solving is not only more likely, but more efficient. Research related to expert problem solving would suggest that an expert's level of knowledge affords them more information with which to make sense of new situations (Chi et al., 1982).

Only with effective sensemaking can design progress. As information related to the problem and the environment becomes available, appropriate framing is necessary to ensure adequate understanding of the problem domain. However, as sensemaking progresses, revisions to situational frames are likely required. These changes are a result of a new or better understanding of the problem environment. Thus, reframing and sensemaking are needed throughout the design process as information becomes more readily available and design brings about changes in the problem context.

One must also consider the social nature of the sensemaking process (Baran & Scott, 2010; Weick, 1995; Wright, 2004). Individuals exist within a larger social context and, therefore, the meaning they apply to events and situations is largely related to the identity of the group (Madjar et al., 2011). Weick (1995) also states that the presence of creative coworkers and the creative actions they bring to the group likely influence sensemaking. Thus, sensemaking necessitates social interaction to aid in the process of understanding and making sense of the environment and problem at hand (Weick, 1993). Possessing the skill to recognize social networks as well as the ability to identify the perspectives of others are necessary for effective sensemaking. Further, to ensure that all individuals within a group share the same mental model, or collective perspective, or frame of a situation, effective sensemakers must provide narratives that construct meaning for the collective. Effective sensemaking relies on narratives that create a common language for the group to successfully understand not only the environment, but the problem itself (Wright, 2004).

Sensegiving

> **Definition of Sensegiving:** Ongoing social communicative process of maintaining and enhancing others' shared understanding of environmental and problem frames; involves continually assessing others' understanding (via questioning and active listening) and providing additional translation of ideas and concepts as required to ensure continual alignment of shared understanding.

Design is employed by Army leaders to "foster iterative collaboration and dialogue while leveraging their collective knowledge, experience, judgment, and intuition to generate a clearer understanding of the conditions needed to achieve success" (U.S. Department of the Army, 2011a). The language in this depiction of design highlights the importance of both the collective and understanding, and indeed one of the greatest strengths of the design methodology is its potential result in a shared understanding of the operational environment, the problem, and the operational approach. The full spectrum operations conducted by today's leaders require engagement with a range of domestic and foreign military and civilian agencies, non-governmental organizations (NGOs), contractors, and other entities that do not share the frames and lexicon common to Army personnel. Even within the Army, the diversity of expertise, training, and experience yields vastly different mental models that shape the way information is perceived.

In such a complex environment, effective planning is nearly impossible if the participants are not speaking the same language. But turning a diverse group of experts into an effective planning team with a shared understanding requires different competencies from those needed to lead traditional combat operations. Chief among them is sensegiving, or what Gioia and Chittipeddi (1991) described as the, "process of attempting to influence the sensemaking and meaning construction of others toward a preferred redefinition of organizational reality". Through the process of sensegiving, leaders rely on evocative language, narrative, and symbols to shape the sensemaking process of other organizational stakeholders (Maitlis & Lawrence, 2007). Leaders who lack this competency "could have a valid and workable concept or mental model and not be able to fully implement it due to the lack of an adequate means of articulating

it in evocative terms" (Hill & Levenhagen, 1995). The following section discusses the practice of sensegiving as a core competency needed by those leading design (i.e., commander), as well as those performing design (i.e., design staff), and highlights the knowledge, skills, and abilities associated with this behavior.

Sensegiving is often described in terms of a leader influencing stakeholders (Gioia & Chittipeddi, 1991). However, sensegiving in the context of design demands a more reflective and thoughtful approach to influence than many commanders or staff may be accustomed. For example, the commander's ability to share his perspective and enable others to adopt his frame will be dependent on the extent to which he/she has examined his/her own assumptions and those around him/her (McNulty & Pettigrew, 1999). This questioning process is related to sensemaking in that it requires that the leader demonstrate ability to seek disconfirming evidence, identify when this evidence does not match one's frame, explain contradictory data and test multiple frames that might better fit the evidence (Browning & Boudes, 2005; Sieck et al., 2007).

In the context of the design methodology, the design team members must also be able to assess the mental models of others (e.g., design team members) through collaboration and dialogue (U.S. Department of the Army, 2011a). This process requires leaders to demonstrate cultural understanding, an ability to perceive the impact of the consequences of one's communications on the audience, and an awareness of one's own assumptions and how they affect interpretation and transmission of ideas (U.S. Department of the Army, 2011a; Morgeson, DeRue, & Karam 2010; Ntuen & Leedom, 2007).

Several studies and reviews have noted the importance of metaphors, narratives, and symbols to create and share meaning with others. For example, Perez (2011) advocates that those performing design should use design drawings as a means for sharing their representation or understanding of what is going on. Hill and Levenhagen (1995) argued that metaphor creation is an important step in the development of shared mental models of the environment and events and that developing new models is a key to organizational innovation and problem solving (both of which are central to design). When faced with complex and intangible issues, the concepts a leader may produce as part of his/her sensemaking process could be very difficult to articulate to others (Ortony, 1975). In this situation, metaphors "provide helpful interpretive schemes to aid in the reduction of equivocality" and interpretation of large amounts of information (Hill & Levenhagan, 1995). Symbolic narratives can be useful to convey meaning while not oversimplifying a complex situation. Browning and Boudes (2005) noted the democratic nature of stories, in that they do not require specialized knowledge or expertise to understand or criticize. In this way, stories could help to bridge the gap in a planning situation where the parties may not share the commander's military background or perspective on the conflict. The authors also noted the potential for narratives to help us make sense of past failures and near misses. By telling a coherent narrative of what failed or could have failed, a commander can help his team to reframe aspects of the design concept and move forward to a new approach.

The use of metaphors, narrative, and symbols is part of a larger theme in the literature that sensegiving can take a tacit concept in the one's mind and give it an explicit meaning in the mind of the audience. This ability plays an important role in design as its success requires that

the design team have access to each other's thoughts and frames in order to refine them and develop a shared mental model. Through sensegiving, participants in the planning process can transfer their private, complex, and abstract thoughts to others in a way that makes them more public, simple, and concrete (Weick, Sutcliffe, & Obstfeld, 2005). Weick et al. (2005) described an even higher order of sensegiving in which one individual interprets the thoughts of another and translates them to a third individual in order for that person to take appropriate action. Thus, the collaborative process of interpreting the perspectives of others, fitting them into one's own mental model, adjusting them if necessary, and articulating them for others is another mechanism whereby sensegiving can facilitate design.

Design Team Leader and Members as Sensemakers and Sensegivers

Social cognition researchers contend that two of the most important roles of the strategic leader are that of sensemaker and sensegiver (Weick, 1993; 1995). Sensemaking and sensegiving can be viewed both as roles as well as individual (and collective) capabilities dependent upon communication that leads to continual, iteratively developed, shared understanding of the changing conditions. This shared understanding has been described as a "…unifying theme for COIN efforts," (U.S. Department of the Army, 2006, p. 2-4). The relation between communication and shared understanding is further described in Field Manual 3-24, *Counterinsurgency,* "…critical discussion provides an opportunity for interactive learning. It deepens shared understanding and leverages the collective intelligence and experiences of many people" (U.S. Department of the Army, 2006a, p. 4-3). The importance of the leader imparting or translating his/her understanding to the design team (as well as team members imparting their understanding to the commander and one another) is highlighted by Weick, Sutcliffe, and Obstfeld (2005) when they described the process of sensemaking as a social communication process by which tacit knowledge is made more explicit or usable. Shared understanding gained via sensemaking involves lifting equivocal knowledge out of the tacit, private, and past so that it can be made explicit, public, and relevant to the situation at hand. At the group level (i.e., design team) the relationship between sensemaking and sensegiving appears to be reciprocal in nature.

The end product of the collaborative process should be a melding of the varied members' perspectives into a common understanding and statement of the situation. If team members are not able to coordinate between disparate perspectives, the organization and function of the team will not be synchronized and creation of an integrated view of the situation will be challenged (Garstka, 2003). Finally, the sharing, reconciliation, and coordination of viewpoints may still not achieve the shared understanding that design seeks to establish. Team members must be able to lead continuous learning, innovation, and adaptation within the group and use their other abilities as the starting point for these new approaches. A team that can manage how it interacts and communicates with existing information can serve as a foundation for identifying and adopting new approaches to the familiar or known information (U.S. Department of the Army, 2010). This innovative thinking may be the source for situation understanding and agreement upon a solution.

Sensemaking and sensegiving are arguably at the very heart of the design methodology. The common scenario in which a commander receives briefings from a handful of experts and promptly develops orders is not sufficient for the larger, ill-structured problems facing modern Army leaders. Each expert may only be aware of one element of the operational environment or

the problem, and without the opportunity for open dialogue, a significant burden is placed on the commander to resolve the complexity and take decisive action. But through the design methodology, even in a highly dynamic environment, a commander must take time to evaluate his own frames in light of the new evidence (sensemaking) and share his mental models with others (sensegiving) in order for all parties to achieve a deeper understanding of the environment, the problem, and the operational approach. Ultimately, this enhanced understanding serves as a foundation to organize action, anticipate risk, and capitalize on opportunities (U.S. Department of the Army, 2011a). Without the capacity to articulate one's frames and concepts to shape the perspectives of others, this process breaks down. By failing to articulate his/her message or doing so in an authoritarian manner, a leader could fail to benefit from important feedback on his/her ideas and possibly pursue a perilous approach. In contrast, a leader who epitomizes the principles of design should demonstrate an awareness of self and others, an ability to use language and metaphor to convey meaning, potential to articulate tacit concepts, and fundamental persuasive communication skills to build consensus and negotiate understanding.

Adapting

> **Definition of Adapting:** Adjusting effectively to new information, requirements, conditions, or constraints; involves maintaining an awareness of gaps in knowledge, skills, and tendencies (in self and staff).

The above definition of adapting is largely based upon descriptions of this capability found within FM 5-0 (U.S. Department of the Army, 2010). The authors of FM 5-0 also identified the ability to adapt to changing conditions as one of the fundamentals of design. FM 5-0 goes on to state that, "Innovation and adaptation lead to capitalizing on opportunities by quickly recognizing and exploiting actions that work well while dismissing those that do not" (U.S. Department of the Army, 2010, p. 3-6). Adaptation relies heavily upon, "continuous assessment to determine what works and what does not… Adaptation in this sense involves reframing the situation to align with new information and experiences that challenge existing understanding" (U.S. Department of the Army, 2010, p. 3-6).

One of the defining aspects of ill-structured problems is that a commander's past knowledge is not always going to directly lead to an immediate or obvious solution. Instead, commanders and staffs engaged in design must adopt a collaborative and iterative approach to understanding, visualizing, and describing complex and ill-structured problems, which enables them to adapt their existing knowledge to the problem at hand. In Ntuen and Leedom's (2007) analysis of interviews with field commanders, one of the many principles that emerged was that, "The commander's sensemaking of a specific battle situation is bounded by reflective knowledge of history, situational information, and beliefs that sustain operational actions and their involvement in those actions" (p. 24). The collaborative aspect of design expands this boundary by leveraging the combined knowledge and experience of an entire team. However, teams can also be prone to groupthink (Janis, 1972) that can degrade their ability to adapt. For example, training doctrine—possibly the most consistent source of shared knowledge among commanders and their staffs—can help to build a common frame in pursuit of the design concept. However, training alone cannot offer solutions to ill-structured problems. The ability to adapt past

knowledge, training, and experience to the problem at hand is therefore critical for commanders (and staffs) attempting to incorporate principles of design.

Self-Awareness

An important precursor to adapting knowledge and past experience to new and complex situations is the self-awareness to recognize what one knows, what one does not know, and what one needs to know to solve the problem. Ntuen and Leedom (2007) emphasized that an agile and adaptive commander regularly engages in metacognitive processes to assess whether the framework he understands is still relevant to the operational environment and how he can use that understanding to influence future events. This point highlights the importance that self-awareness plays throughout design, and specifically as it relates to adapting. Banach and Ryan (2009) also described reflective thinking and metacognition as vital components of design. They described reflective thinking as involving self-awareness of one's abilities and their role in facilitating understanding of the situation at hand, and an awareness of cognitive traps and balancing of cognitive resources among understanding the environment, problem, and solution.

Ongoing Monitoring of the Environment

A vital component of a commander's and staff's ability to adapt to changes in the environment involves their ability to recognize changes as they occur. Commanders and staffs engaged in design must not only adapt their past knowledge to the present situation, they must constantly adapt to an evolving situation. Contrary to some myths about design, it is not meant to be used only for the initial conceptual plan which is then handed off to the detailed planners (Grigsby et al., 2011). It is, in fact, an iterative process that requires commanders and their staffs to constantly reevaluate their beliefs in order to adapt to changing conditions.

Morgeson et al. (2010) found that monitoring one's team and the external environment were key leadership practices, and it is this success in monitoring the environment which informs the adaptation crucial to design. Another of Ntuen and Leedom's (2007) principles applies here as well: "The commander's interpretation of the battle situation is an ongoing process [that] dynamically changes at discrete time intervals to cope with the [adversary's] strategies and tactics" (p. 29). In the context of design, this updating of beliefs is often called reframing. This process involves updating one's perspective on the problem or appropriate solution, as well as, refining or discarding the hypotheses that are the foundation of one's understanding (U.S. Department of the Army, 2011a). Reframing enables the commander to adjust to the dynamic operational environment in order to ensure that tactical actions continue to support the desired end state. Without an ability to update one's beliefs and reframe the operational environment, the problem, and the desired end state for oneself and others, commanders will likely be at a loss when integrating the design methodology into operational planning.

Although commanders should always be prepared to adapt to changes that occur, there is one condition that forces leaders to consider new approaches more often than any other: failure. Even the best designed plan is subject to risk and commanders should be prepared for failures to occur and be able to learn from them when they do. When failures occur, design demands that commanders be prepared to carefully examine the causes of failure and adjust their frames and approaches accordingly (U.S. Department of the Army, 2011a). Although a leader may be more

inclined to relive his successes, failure (or a near miss) is typically more valuable from an educational perspective since the thrill of success often blinds people to what might have gone wrong along the way (Weick & Sutcliffe, 2001). Furthermore, assessing failure aligns well with the collaborative nature of the design methodology since agreement tends to be more readily achieved regarding what is going wrong than what is going right (Snowden, 2003). Essentially, failure is the most prominent and mutually acknowledged warning sign that commanders and their teams have misunderstood something critical. Thus, the ability to adapt one's frame and approach in response to failure greatly enhances the effectiveness of design in an unpredictable environment. However, it is preferable that commanders and design staff continually adapt their frame and approach based upon identified deviations from success (i.e., small movements away from expectations or projections) rather than waiting until failure to adapt or change course.

Innovative Thinking

> **Definition of Innovative Thinking:** Thinking creatively in order to address problems from a new perspective; identifying one or more novel approaches to a problem; includes fostering a culture of originality within the design team.

Due to an ever-changing operational environment, marked by increasing complexity, unconventional warfare, and instability (Grothe, 2009), design methodology is critical. Reliance on systematic steps from previous, and potentially rigid, Army doctrine and training is not always suitable for these environments. Thus, innovative thinking - to see a problem from multiple perspectives and to develop multiple, creative solutions - is an important component of the design concept.

Ideational Fluency and Generation of Alternative Approaches

Once the environment or the problem has been reframed, a leader engaged in design must take it one step further and support the team in generating alternative response actions to take control of the newly defined situation. Latham (1987) depicts the leader as an inventor whose role is to challenge team members with new ideas, strategies, and approaches. The innovative leader enables an environment where team members "continually question the ongoing usefulness of the team's established ways of thinking" (Morgeson et al., 2010, p. 22). Challenging the team in this way has also been shown to encourage opportunistic thinking and adaptation among members of the team, thus magnifying the team's ability to develop new approaches (Pearce & Sims, 2002). The ability to foster this opportunistic approach by suggesting innovative alternatives is crucial to design and mission success, as both hinge on the ability to not only avoid unintended consequences, but seize the initiative. Field Manual 5-0, C1, *The Operations Process*, emphasized that "design is inherently proactive," but that paradoxically, "prompt action requires detailed foresight and preparation" (U.S. Department of the Army, 2011a, p. 3-3).

Leveraging Knowledge and Experience while Questioning Boundaries

For one to think innovatively or creatively, a certain degree of knowledge (i.e., task, contextual, declarative) is required. Specifically, in order to solve a problem from a new perspective, one must possess the requisite knowledge to fully understand the context of the

problem and the problem itself. Sternberg (2006) captured this idea eloquently by stating, regarding the role of knowledge in creative thinking, "…one needs to know enough about a field to move it forward. One can't move beyond where a field is if one doesn't know where it is" (p. 6). Thus, individuals must be able to collaboratively leverage current knowledge and experience in order for effective innovative thinking to ensue.

However, this knowledge is necessary, but not sufficient, for the emergence of innovative thinking. Frensch and Sternberg (1989) stated that numerous abilities are required to use previous knowledge in a novel way. One such ability, as suggested by Frensch and Sternberg, is the ability to question the limits of existing knowledge. In fact, one of the keys to leading design is to continuously question the boundaries of previous knowledge with respect to the problem and the actions taken to address the problem (U.S. Department of the Army, 2010). Specifically, innovation itself requires a person to utilize past knowledge without allowing the knowledge to become a barrier to unique problem solving and novel thought processes (Frensch & Sternberg, 1989). For example, Tversky and Kahneman (1974) described how stored knowledge and experiences that support information processing heuristics (which speed information processing) may also lead to errors in information processing and negatively influence decision making. Similarly, Festinger's (1957) dissonance theory and Abrahamson and Fomburn's (1994) description of strategic myopia are also examples of how the experiences that inform existing heuristics and schemata may also prevent individuals assimilating new information that contradicts these existing information processing tools, thereby harming their ability to question boundaries and identify creative approaches to new problems.

Accepting Complexity, Risk Taking, Openness

Kurtz and Snowden (2003) stated that existing rules, policies, and procedures are usually of little value in responding to the complex, novel problem situations that human decision makers face. When confronted with these complex, sometimes chaotic, situations, it is normal for individuals to attempt to rely on existing heuristics and procedures (Tversky & Kahneman, 1974; Weick, 1988). Relying on these existing heuristics and procedures in complex situations may lead to errors in information processing that impedes both critical and innovative thinking. However, these complex, novel situations also create the potential for innovative thinking to occur if individuals have the ability to acknowledge and accept the complexity (Kurtz & Snowden, 2003). Specifically, in order for effective innovative thinking to occur, individuals must also possess the ability to accept complexity and confront it with diversity of input and information consciousness (Weick & Sutcliffe, 2001).

Although embracing complexity is important, responding to these complex situations in innovative ways can be risky. Risk taking and innovative thinking are intertwined. Innovative thinking involves identifying novel approaches to a problem. With any new idea, approach, or solution, there is an inherent risk (i.e., the risk related to veering away from protocol with an untested idea). Madjar, Greenberg, and Chen's (2011) research demonstrated the relation between creativity and willingness to take risks. Specifically, the authors found that willingness to take risks was a significant predictor of supervisor ratings of subordinates' creative performance. Conger and Kanungo (1992) also highlighted the relation between risk taking and charismatic leadership—which involves the articulation of an unconventional (i.e., innovative) vision. They found that individuals who were more likely to be viewed as charismatic leaders

were more likely to take personal risks in the service of the vision. Finally, Fastabend and Simpson (2004) stated that although there are inherent risks associated with innovative thinking, innovative organizations confront this uncertainty and realize that there are as many opportunities as there are threats. These opportunities would likely go unrealized in the absence of innovative thinking.

Related to risk taking, research has found that openness to experience (Barrick & Mount, 1991) is also related to innovative thinking. For example, Mumford, Constanza, Threlfell, Baughman, & Reiter-Palmon (1993) found that openness helps to foster creative problem solving through its influence on the individual's ability to attend to discrepant information and activate more divergent cognitive heuristics and representations.

Analogical Reasoning

As previously stated, Sternberg (2006) specified that prior appropriate knowledge as well as the ability to leverage this knowledge is required for effective innovative thinking. One manner in which prior knowledge can be leveraged is through the use of analogies. When individuals possess the ability to see similarities across situations, juxtapose these similarities, and use this information to solve problems, they are demonstrating their analogical reasoning ability. However, for effective innovative thinking to occur one must be capable of utilizing knowledge and forming analogies in a manner unique, or at times contrary, to how it was initially encoded. More specifically, the ability to use analogical reasoning to draw inferences about contexts not encoded in existing schemas is also necessary for effective innovative thinking.

A related capability involves the ability to capitalize on imagination and insight and go beyond intuition and reductive decision making processes. Reductive decision making processes lead individuals to believe the world is predictable with the expectation of continuous linear relationships between causes and effects. Indeed, Sternberg (1985) specified that the ability to see problems in new ways (i.e., engage in imaginative problem solving) and escape the bounds of conventional thinking is critical for creative thinking. In relation to design methodology, this is important for two reasons. First, assuming that relationships will occur in a linear fashion when encountering a situation that necessitates design is likely an oversimplification. Thus, the ability to think outside the box or in a non-linear manner is necessary. Second, prior knowledge has the ability to limit the generation of new ideas and insights because of functional fixedness - the idea that once a person determines one use for an object, it is difficult to imagine alternative uses for the same object (Hunt & Ellis, 2004). Specifically, those who lack the ability to overcome functional fixedness and think outside the box are likely to have difficulty envisioning problems in new ways.

Collaborating[1]

Definition of Collaborating: Communicating with and engaging others to apply design concepts in a productive environment; involves management of group interaction and discourse, team development, and guidance.

Successful application of design depends on a design team that functions well. This entails effective leadership and management of the design team through proper development and fostering a climate that supports collaborative team effort. While the commander is the central figure of a design team, the team members share responsibility for ensuring that the team is effectively managed. They too must look to develop the team and maintain its performance in order to create shared understanding (Lindsay, Day, & Halpin, 2011). Thus, this competency must not only be manifest by the leader of the design team (i.e., commander) but by all members of the design team.

Fostering a Supportive Environment

The team members must actively work to foster an environment that supports design. "A positive climate facilitates team building, encourages initiative, and fosters collaboration, dialogue, and mutual trust and understanding. Commanders shape the climate of their organizations, no matter what size their organizations are" (U.S. Department of the Army, 2011b, p. 3-4).

Creating and maintaining this climate requires that team members have the abilities that contribute to a collaborative environment. Collaboration involves comfort in interacting with each other, sharing of information and perspectives, and collectively agreeing upon specific aspects of the situation. The need for collaborative discourse for design relies on team members being able to listen and allow critiques of thoughts, attitudes, and beliefs. They must actively look for evidence that does not fit with their conjecture, be rational and open to critical conjecture of their own reasoning and thought processes, and accurately assess new information that may impact or alter their existing knowledge and understanding (Burnett, Wooding, & Prekop, 2004; Perez, 2011). Further, team members must be able to reconcile perspectives when critiques or new information expose differences (Garstka, 2003). Reconciliation may require seeking further information, continued analysis, or the willingness of one party to adopt the other's perspective.

Team Development

Leaders must possess the skills necessary to develop teams. This includes composing the team, defining the team's mission, establishing expectations and goals, and organizing the team's work. Within design, an absence of any of these skills will impair the team's ability to create a shared understanding of the environment and situation.

[1] The literature review originally elicited a competency similar to collaborating called team leading. However, after further consideration of the literature, interviews, and SME knowledge about design, this competency was re-conceptualized as collaborating.

The design team can be comprised of individuals internal or external to the unit. Field Manual 5-0, *The Operations Process* (U.S. Department of the Army, 2010) stated that the "commander selects these individuals based on their expertise relative to the problem" (p. 3-6). Further, the "commander expects these individuals to gain insights and inputs from areas beyond their particular expertise" (p. 3-6). The quality of team performance is contingent upon selecting individuals with the characteristics and attributes that produce necessary team behaviors. Morgeson, DeRue, and Karam (2010) highlighted the research that clearly links skill in composing teams to performance criteria such as ability to learn and adapt to changing task environments, team creativity, and task and contextual performance.

While the commander may compose the initial design team, he or she may not have constant involvement in the design process. Therefore, the team members must be skilled in composing teams and any sub-teams that might emerge temporarily in the group, as well as identifying the skills and expertise required to support the team. Maintenance of team function and performance can be the team's responsibility during design. Hammerstrom (2010) recommended a team that fluctuates in size in order to adapt to the situation and utilize outside expertise as necessary. Hence, core members must be able to make decisions regarding the characteristics of new members and the numbers that are needed.

The composition of the team alone will not facilitate design. Field Manual 6-22, *Army Leadership,* described the importance of the leader's ability to effectively communicate with and influence others—via ensuring shared understanding, leveraging staff as a communication tool, and skill in persuading others—and these skills appear to be required by both the leader and members of the design team (U.S. Department of the Army, 2006b). For example, the team must understand their purpose and the expectations and goals that align with it. Understanding the team's mission allows members to form a sense of identity and develop cohesiveness around their mission (Morgeson et al., 2010). Skill in defining the team's mission applies to the commander when developing the team and extends to team members as they apply the design methodology. This skill is essential because, over time, changes to the environment or situation may prompt team members to redefine their mission. Clear understanding of the mission permits the commander and team to establish goals related to task performance as well as team learning and development (Morgeson et al., 2010). Leaders that are skilled at establishing goals for the team allow all members to participate in the process. In doing so, they can positively influence the commitment that the members have toward goal attainment and their cohesiveness to reach the goal.

Once the team is established and understands its mission and goals, it must determine how it will structure and plan the team's work. Morgeson et al. (2010) explained that team members need to develop a shared understanding of how to coordinate their action and work together to accomplish team goals. Given that the design team may include a diverse group of individuals and can fluctuate in size, it is important that every member possess the skill to organize the team's work. It must be clear to everyone what their responsibility is, how the team members will accomplish the work, and when they need to do so. This will produce a coordinated effort and direct the team toward the goal.

Method

The literature shaped the general understanding of design and the development of a proposed set of competencies from which to further explore the underlying factors associated with being able to effectively apply design methodology. To validate these competencies, design practitioners were asked to share their experience with design or design-type thinking and their views regarding essential KSAs. The input from interviews was then analyzed in order to compare and contrast their perceptions with what was learned from the literature. Once the competency model was revised to reflect the KSAs derived from the analyses, its accuracy and comprehensiveness were assessed through a survey distributed to multiple practitioners. Details of the method are described below.

Interview Protocol

Interviews and focus group discussions with design practitioners allowed for the literature review findings to be verified and supported further exploration of the personal characteristics requisite to design. The protocol for the interviews or focus groups provided a sequenced set of primary questions to guide the researchers and ensure that the full scope of the research topic was addressed. The critical incident technique (Flanagan, 1954) was a prime component of the protocol. Described by Cooke (1994), this technique enables information to be elicited in a short time frame by providing a context in which participants can describe real world incidents in which they had to apply design or design-type thinking. Because design is a cognitive and social process, requiring the participant to share a context or situation, it provided rich detail regarding individual qualities associated with design, cognitive and interpersonal processes, and effective and ineffective approaches and outcomes. An abbreviated list of protocol questions intended to facilitate the critical incident discussion is included below:

1. How was this situation different than other situations you encountered in the past?
2. Who (by position) was engaged to begin to wrap your arms around this situation?
3. Did the situation require a lot of interaction or did those involved provide individual contributions?
4. Was there a need or opportunity for someone to serve as a devil's advocate?
5. What was the general climate like amongst those involved in the incident (e.g. tense, collegial)?
6. How did team members demonstrate critical or creative thinking when addressing this situation?
7. What additional thinking processes were demonstrated by you or other team members during this situation (e.g., holistic thinking, systems thinking, considering second and third order effects, questioning assumptions)?
8. When unexpected issues occurred (e.g., new information becoming available, unexpected resistance in the environment) how did the team address the issue?
9. Please describe the process used by the group to agree upon relevant details of the situation and/or the end-product?
10. What product was derived from this situation?
11. Was sufficient time available for this situation?

12. Please describe, if applicable, any re-thinking or re-assessment of the situation that took place after the initial understanding was developed?

In addition to exploring critical incidents, participants were asked to identify and describe specific knowledge/expertise, cognitive/interpersonal skills, or abilities necessary for effective application of design. Potential personal attributes or characteristics that make an individual more effective at design than others were also sought.

Interview Participants

Interviews involved a convenience sample of 26 individuals possessing varied experience with design or design-type thinking. These participants were solicited from three primary sources: the U.S. Army Command and General Staff College's School for Command Preparation and School of Advanced Military Studies and the U.S. Army War College. These sources were intended to provide access to practitioners of design, instructors with curricula involving design, and students receiving direct instruction on applying design. One of the interviews was a focus group conducted with four leaders with recent division-level experience with design. Table 2 depicts the ranks or titles of the 26 interview or focus group participants.

Table 1.
Rank or Title of Interview and Focus Group Participants

	CSM	MAJ	LTC	COL	DA Civilian
U.S. Army War College				2	2
School for Command Preparation	1		1	8	
School of Advanced Military Studies		7			
Other military installation/organization		3	2		

Interview Procedure

The interviews and focus group were approximately 60 to 90 minutes in length. During the discussions, a notetaker transcribed the conversations and they were also audio-recorded. On-site transcription permitted the notetaker to seek immediate clarification on statements and the audio recording permitted later corrections to be made to the transcriptions. Near-verbatim transcription was intended to support the accurate capture of participant experiences and sentiment and to support subsequent detailed analysis. Audio files were destroyed upon completion of transcription.

Analysis of Interview Data

Examination and understanding of the interview data relied on a deductive content analysis approach. This method applies a set of procedures to textual data in order to make inferences from it (Weber, 1990). A central idea to the procedures is to reduce the text into

smaller elements or categories that facilitate understanding of the content. The approach is deductive in nature because the research goal was to identify requisite knowledge, skills, and abilities, and the interview protocol was developed to specifically elicit this information.

Analysis of the 23 transcripts involved establishing an initial analytic framework and identifying and organizing the relevant information into seven primary categories. Six of the categories represented the competencies that were developed and defined through the literature review: holistic thinking, sensemaking, sensegiving, adapting, innovative thinking, and collaborating. A seventh category allowed the capture of social or cognitive processes that facilitate design amongst a commander and/or the design team. The information was further organized into sub-categories according to the specific KSAs associated with each competency. It was expected that some of the interview data may be unique information and not appropriately aligned with the specified KSAs. Therefore, the content analysis allowed for information to be designated to a generic sub-category within each competency rather than attempt to make it conform to the analytic framework. By doing so, this also provided a clear means to view differences between essential KSAs identified within the literature and essential KSAs identified by the interview participants.

Execution of the content analysis occurred in three stages: training, analysis, and re-analysis. Training required the research team members to become familiar with a Microsoft Word macro that would facilitate categorization of the interview data and subsequent examination of the similarity or dissimilarity between individual efforts at categorizing the data. As part of training, team members independently used the macro to analyze two of the interview transcripts. Analysis involved thoroughly reviewing the statements made by the interview participant and identifying comments that were representative of the categories or sub-categories. Then the members compared the similarity of their categorization and reviewed their interpretation and understanding of each KSA statement to ensure that the same analytic approach was applied across all of the transcripts and by each member.

To maintain rigor and reliability in the content analysis, 40% of the transcripts were analyzed by multiple team members. For these transcripts, the team members again reviewed the similarity in their categorization efforts. If discrepancies between team members existed, they were discussed and consensus was reached on how to most appropriately categorize the information.

Once all the transcripts were analyzed, the adequacy of the competency and KSA analytic framework was assessed. In particular, the generic sub-category of each competency was examined to determine if it was actively used to capture information that did not conform to the analytic framework. If the sub-category was used, the information was further analyzed to see whether it represented one or more new knowledge, skills, or abilities. To be considered a new and distinct KSA, it must have been mentioned by at least two participants. When complete, all of the transcripts were re-analyzed using an updated framework that reflected the new KSAs and addressed any remaining anomalies in the analysis.

The set of KSA statements was reviewed a final time to assess the comprehensiveness of the list and to prepare it for the next step of gathering survey data. As a result of the review, the

competencies and list were enhanced with four additional abilities. To support sensemaking, an individual must be able to hold and consider two distinct – and possibly competing – ideas in mind. Additionally, as part of sensegiving, an individual must be able to convey the design concept in practical terms. The Team Leading competency was re-conceptualized to place a greater emphasis on the social interaction required of design team members and was re-defined as Collaborating. Expanding on the interpersonal aspects of collaborating, the ability to listen and the ability to maintain productive discourse without allowing discussion to become completely unbounded were included in the list of KSAs.

KSA Survey

Both the literature review and the interviews shaped the identification of the knowledge, skills, and abilities associated with applying the Army Design Methodology. Neither source, however, provided a comprehensive assessment of how essential a KSA might be to effectively applying design or whether some KSAs may be more critical to effectiveness than others. To gain this information, a survey was developed that solicited these data from interview participants and others knowledgeable about design. The survey results assisted in validating the appropriateness of the KSA statements, confirming the comprehensiveness of the list, and potentially highlighting where specific training recommendations may be needed.

In order to gather this information, the survey asked the participants to complete two primary tasks. For each KSA statement, participants were asked to assess how critical possessing or demonstrating the KSA is to effectively applying design. Responses were given on a 5-point scale to assess criticality:

(1) Unrelated - Possession of this KSA has no impact on success of design effort
(2) Relevant - Possession of this KSA has minimal impact on success of design effort
(3) Beneficial - Possession of this KSA is helpful, but not required for success of design effort
(4) Critical - Possession of this KSA significantly contributes to design team success
(5) Very Critical - Absence of this KSA will result in design team failure.

In addition, participants were asked to rank order the six competencies - holistic thinking, sensemaking, sensegiving, adapting, innovative thinking, and collaborating - in terms of their importance to effectively applying design. The survey also permitted respondents to provide any comments regarding the completeness of the list of KSAs, suggest additions or omissions, or specify where KSA statements may need clarification.

Survey Participants

To ensure that the list of KSA statements received an appropriate level of scrutiny as well as to ensure a sufficient response rate, the survey was sent via e-mail to the 26 interview or focus group participants and also 33 leaders associated with either the U.S. Army Combined Arms Center (CAC) or the U.S. Strategic Command. This broadened approach exposed the KSA list to stakeholders in the development of the Army Design Methodology, additional instructors of design, and a senior command design team. The survey achieved a 39% response rate, with 23 of the 59 prospective participants responding. Of those respondents, 26% were interview

participants, 35% were from the U.S. Strategic Command, and 39% were associated with the Combined Arms Center.

Analysis of Survey Data

The data were examined for outliers or distinct response patterns that would influence analysis and none were found. Descriptive statistics for the survey data were then computed. This included identifying the frequency with which the six competencies were rank ordered and computing the mean and standard deviation for each of the KSA statements. A KSA with a higher mean would suggest that possession or demonstration of that specific knowledge, skill, or ability is more critical to the success of the design effort.

Results

Content Analysis Findings

The content analysis of the interviews produced new information that enhanced the final list of KSAs. When the six generic sub-categories were analyzed, four new KSA statements emerged. Three of the KSAs referred to sensemaking and having generalist-like knowledge, an ability to deliberately weigh information, and an ability to change and apply different approaches to understanding the environment and/or problem. The fourth KSA statement pertained to adaptability and being open-minded to new sources of information.

- Sensemaking
    - Possession of a diverse knowledge base.
    - Ability to suspend judgment to thoroughly develop understanding.
    - Ability to change and apply different approaches for understanding the environment and problem.

- Adaptability
    - Ability to be receptive to other sources of knowledge/information.

In addition to the six sub-categories related to the KSAs, there was a seventh category related to the social and cognitive processes that help facilitate design. Overall, there was substantial inconsistency among the comments in response to the questions about process, and many comments were not about process at all, indicating that the participants possibly had difficulty articulating the processes used in design. However, two main themes were identified in this category: environmental framing and problem framing. Comments regarding environmental framing included the need to step back and look at the big picture. Some comments mentioned that while looking at the big picture is important, there is also a need to break the environment down into smaller, more manageable pieces. Other comments stressed thinking about how the environment changes and not just focusing on the current state. Comments regarding problem framing included the need to define the problem explicitly and not assume that everyone has a shared understanding. It was mentioned that problem framing often gets the least attention because it is assumed that everyone knows what the problem is, yet it was viewed as important to successfully applying design methodology.

Survey Findings

Participants rank ordered the six competencies in terms of their importance to effectively applying design. The range for each competency ranking was either 4 or 5 with only six placement options. That means that on four of the six competencies, participants used all six placement options and on the remaining two competencies, they used all but one placement option. Despite the wide variety of rankings, holistic thinking was most frequently ranked as the most important competency (43% ranked it first), while collaborating was most often ranked as the least important (43% ranked it last). Overall, the general rank order of the competencies was: holistic thinking, sensemaking, innovative thinking, adapting, sensegiving, and collaborating.

The wide range of the rankings suggests that the 23 participants viewed the competencies as highly interdependent, non-linearly related, or equally important. Hence caution should be used in attempting to determine an order or priority of the competencies. Indeed, examination of the comments provided by participants and follow up conversations with several interview participants suggested they were uncomfortable ranking the competencies and cautioned against using the ranking results to prioritize training.

Participants also assessed how critical each specific KSA was to engage in design. Given a five-point rating scale, 22 of the 43 (51%) KSAs received a mean rating of 4.0 or higher, indicating that possessing or demonstrating them is critical to effective design. Much of the remaining items (19) were considered to be beneficial to design and would help the effort. Only two KSAs had a mean rating less than 3.0, suggesting that they are relevant to design but have minimal impact on design success. Because there was limited evidence to suggest that any of the KSAs were clearly unrelated to design, all 43 were retained as part of the model. The following list includes the competencies, their definitions and associated KSA statements.

- **Holistic Thinking**: Conceptualizing and understanding adaptive relationships and interactions amongst varied entities or variables; involves the application of both critical thinking and systems thinking to develop hypotheses and formulate inferences regarding the problem space and its surrounding environment.
    - Ability to understand complex and adaptive relationships among events and actors.
    - Skill in thinking critically about situations or events.
    - Ability to develop a frame with incomplete information.
    - Ability to reflect on past actions or events.
    - Ability to identify constraints and factors that influence the feasibility and desirability of alternatives.
    - Ability to build mental models that hypothesize the possible consequences of various courses of action.

- **Sensemaking**: Ongoing synthesis of information from the surrounding environment into a meaningful understanding (i.e., frame or mental model) of the environment; this understanding or frame must be continually maintained and enhanced.
    - Ability to synthesize information to create new meaning or structure (frame).

- Ability to use iterative assessment to understand the environment and develop frame.
- Ability to use personal experience to select and encode relevant information.
- Ability to organize information by creating heuristics to suit the context.
- Ability to seek evidence that does not conform to the current frame.
- Ability to suspend judgment to thoroughly develop understanding.
- Ability to change and apply different approaches for understanding the environment and problem.
- Ability to hold and consider two distinct, and possibly competing, ideas in mind.
- Possession of a diverse knowledge base.
- Ability to incorporate doctrine and regulations into thought processes.
- Knowledge of historical information and events relevant to the situation.
- Knowledge of and an accurate awareness of the operational environment.
- Skill in recognizing social networks.
- Ability to identify the perspectives of others in social situations.

- **Sensegiving**: Ongoing social communicative process of maintaining and enhancing others' shared understanding of environmental and problem frames; involves continually assessing others' understanding (via questioning and active listening) and providing additional translation of ideas and concepts as required to ensure continual alignment of shared understanding.
  - Ability to use evocative language, metaphors, written narrative, and drawing to represent abstract concepts.
  - Ability to achieve a common understanding and shared vision.
  - Knowledge or awareness of one's own assumptions and how they affect interpretation and transmission of ideas.
  - Ability to take tacit information and give it explicit meaning to develop shared understanding.
  - Ability to use group discussion to produce shared understanding.
  - Ability to convey the design concept in practical terms.

- **Adapting**: Adjusting effectively to new information, requirements, conditions, or constraints; involves maintaining an awareness of gaps in knowledge, skills, and tendencies (in self and others).
  - Ability to adapt past knowledge to current situations.
  - Self-awareness of what one knows and what one needs to know.
  - Ability to recognize and adapt to changes in the environment as they occur.
  - Ability to adapt one's frame and approach in response to new information.
  - Ability to be receptive to other sources of knowledge/information.

- **Innovative Thinking**: Thinking creatively in order to address problems from a new perspective; identifying one or more novel approaches to a problem; includes fostering a culture of originality within the design team.
  - Ability to question key assumptions, knowledge, or established ways of thinking.
  - Ability to acknowledge and accept complexity.

    - Ability to use analogical reasoning to compare and contrast knowledge and understanding.
    - Ability to see problems in new ways and avoid linear thinking.

- **Collaborating**: Communicating with and engaging others to apply design concepts in a productive environment; Involves management of group interaction and discourse, team development, and guidance.
    - Ability to contribute to an environment where different views are encouraged and shared.
    - Ability to reconcile diverse perspectives.
    - Ability to listen.
    - Ability to maintain productive discourse without allowing discussion to become completely unbounded.
    - Ability to form collaborative networks to enhance team capabilities or knowledge.
    - Skill in identifying and accessing relevant expertise.
    - Skill in defining the design team's mission.
    - Skill in establishing roles, expectations, and goals.

Appendices A and B provide the descriptive statistics for all 43 KSAs. Appendix A shows the mean rating of criticality, the standard deviation, and the range of responses for each KSA. Appendix B shows the frequency by which each response option was chosen for each KSA. The following sections describe the 22 KSAs deemed critical to design success (mean rating of 4.0 or higher). KSA criticality ratings were made on a 5 point scale (1=Unrelated, 2=Relevant, 3=Beneficial, 4=Critical, 5=Very Critical). The percentage of participants who identified the KSA as either critical or very critical is displayed for each KSA. The KSAs are organized by competency and discussed in descending order based on their mean rating of criticality within the competency. The criticality rank for a KSA within its competency is discussed. That rank is based on the criticality mean for each KSA in a competency and describes the criticality of the KSA statement in relation to other KSAs within the same competency. Lastly, the overall criticality rank of each KSA is discussed. That rank describes the criticality of the KSA in relation to all other KSAs that were measured in the survey. In addition to discussing the criticality of each KSA, exemplary statements, if available, from the interviews are also included. The statements help illustrate and further define the KSA being discussed.

Holistic Thinking

The ability to understand complex and adaptive relationships among events and actors was identified as very important to design (M=4.52, SD=0.67). This ability was rated the most critical KSA for the Holistic Thinking competency and the second most critical KSA overall. Over ninety-one percent of the survey participants indicated that this ability was either critical or very critical to design. One participant aptly described this as an "ability to see more than is there; see broadly; to understand the connections between the things; to be able to divine the relationships between the factors that matter." The participant further explained that "understanding the linkages is the key to be able to say, 'here are the things that matter and here is *how* they matter to each other.'"

Skill in thinking critically about situations or events was also identified as very important to design (M=4.43, SD=0.73). Nearly ninety-six percent of the participants indicated that this skill was either critical or very critical to design. One participant expressed the importance of being able to think critically in multiple contexts: "The ability to use analytical skills in any context. If we are talking lethal or nonlethal, understanding political, social, economic, from that perspective, that would be very helpful."

The ability to develop a frame with incomplete information was the third most important KSA within the Holistic Thinking competency (M=4.22, SD=0.80). Slightly over seventy-eight percent of survey participants indicated that this ability was either critical or very critical to design. To describe this KSA, one participant posed the question, "How do you see complexity? How are you able to view a complex environment and see through the smoke, noise, and separate the wheat from the chaff? The ability of your mind to see what is important and what is not in a complex environment - that helps a lot." Another participant described the difficulty that constraints, such as time, have on design and specifically how time affects the examination of information. "It can lead you to dismiss things you don't want to dismiss. It's about choices. Strategy is about choices when you are making a plan and you are constrained. If one of those constraints is time, the choice you make is where you 'deep dive' and where you don't. What design does for you, in my mind, is framing the problem [which] allows you to make a better judgment on where you can 'deep dive' and where you can take a short cut."

Sensemaking

The ability to synthesize information to create new meaning or structure (frame) was identified as important to design (M=4.39, SD=0.66). This ability was rated the most critical KSA for the Sensemaking competency. Slightly more than ninety-one percent of the participants indicated that this ability was either critical or very critical to design. One participant described how synthesis took place,

> when the teams divided to do their 'deep dive' they had found rocks in the forest and found stuff we didn't because we were going a different direction. We didn't say 'you are fools because you didn't consider the body of evidence.' What we did say was 'When I was looking at this I found this factoid; if that is true does that change what you are looking at?' We were trying to bring these challenges forward to ask if they were important or made a difference. 'Why isn't it important? Under what conditions may this/that be true?' Some of the critiques were 'slideology,' grammar, word choices, cosmetics, and packaging. Some were quite substantive. 'How is that going to work out?' Much of it was trying to think forward in time to consider how things might work out in execution.

Next, the ability to change and apply different approaches for understanding the environment and problem was identified as important to design (M=4.35, SD=0.71). Eighty-seven percent of participants indicated that this ability was either critical or very critical. Participants identified many examples of why it is important to use different approaches for understanding the environment and problem. These examples show how different approaches aid in the design process by avoiding intellectual rigidity. Also, the various approaches can be used together to yield results that have been more well thought out. One participant said, "It's about

divergent and convergent thinking. It's like the mind needs an actuator to go back and forth." Another stated, "For knowledge, you have to approach things uniquely. If you always use systems thinking or complexity theory or emergence or one epistemological viewpoint, if you use one thing, you will fail. You have to use a mixture of them in your unique problem and when it doesn't work, switch gears. That is the best knowledge slice you could have. Don't become comfortable in a complex environment."

A number of abilities clustered together with regard to their perceived importance. The ability to seek evidence that does not conform to the current frame was identified as important to design (M=4.13, SD=0.76) with 78.3% indicating that this ability was either critical or very critical. Similarly, the ability to use iterative assessment to understand the environment and develop a frame was seen as essential to design (M=4.09, SD=0.67). For this ability, 82.6% of participants indicated that this ability was either critical or very critical. The ability to use iterative assessment to understand the environment was considered valuable because designers must think about the effects of decisions made in the environmental and problem frames with regard to solutions. One participant said, "We had a continual process of looking at the problem and redefining and coming up with solutions. It was iterative and evolutionary. It wasn't like we sat down to write a battalion operations order." Finally, the ability to hold and consider two distinct, and possibly competing, ideas in mind was identified as important to design (M=4.00, SD=1.04) and 69.6% indicated that this ability was either critical or very critical.

Innovative Thinking

The ability to question key assumptions, knowledge, or established ways of thinking was identified as very important to design (M=4.57, SD=0.59). That ability was rated the most critical KSA of the 43 identified, and for the Innovative Thinking competency. Nearly ninety-six percent of participants indicated that it was either critical or very critical to design.
In general, challenging assumptions was seen as essential to various aspects of design. One participant described the pitfalls of not questioning key assumptions, knowledge, or established ways of thinking. "Be careful if you become too careful with your assumptions. When you get a list of assumptions, you want to embrace it because it takes time and is hard to reframe your environment. Once you think you have it figured out, it is human nature that you want to keep going down that path. It is easier." Participants indicated that questioning key assumptions, knowledge, or established ways of thinking includes the senior leader's assumptions. One participant said, "(You) can't be afraid to engage and challenge senior leaders or be afraid to say, 'Why do you believe that?'" This ability also concerned those who are perceived to be experts in their field. "Sometimes it's a little confrontational. When you bring in SMEs, you have to be able to challenge what they are saying …'Tell me why I have to believe you.' Discourse is difficult."

In addition, the ability to see problems in new ways and avoid linear thinking was identified as important to design (M=4.22, SD=1.00). Nearly eighty-three percent indicated that this ability was either critical or very critical. In describing the difficulty for linear thinkers to do design, one participant stated, "If you are directive in nature or a linear thinker, it will be more difficult for you - you are working by steps. Well there aren't any steps in the flow of design. I make my own steps along the way."

Third, the ability to acknowledge and accept complexity was seen as necessary for design (M=4.17, SD=0.72). Nearly eighty-three percent of the participants indicated that this ability was either critical or very critical. Several participants mentioned the importance of acknowledging and accepting complexity. One individual described the importance of accepting complexity, "A willingness to want to solve complex problems. If you look at it as a chore and something you want to get to your 'Outbox' as fast as possible, you probably won't be as good at it as someone who is willing to take on complexity and realize this thing is bigger than you. You can't get your whole mind around it. You need help; it's a team effort. One person can't do design very well."

Adapting

The ability to adapt one's frame and approach in response to new information was identified as very important to design (M=4.48, SD=0.51). This ability was rated the most critical KSA for the Adapting competency and was the third highest-rated KSA overall. Notably, 100% of the survey participants indicated that this ability was either critical or very critical to design. This KSA was ranked third overall because participants used the very critical response option more often for two other KSAs, thus, their means were higher. One participant described the importance of this KSA, "If you aren't looking for measures of ineffectiveness, you may miss certain elements that tell you that you are going the wrong direction. We don't spend a lot of time thinking about what will tell us we are going in the wrong direction as we do thinking about how to tell we are going the right way."

Similarly, the ability to be receptive to other sources of knowledge/information was identified as important to design (M=4.39, SD=0.66). With regard to the participants, 91.3% identified that this ability was either critical or very critical to design. Several participants mentioned humility and the ability to ask questions as an important aspect to having the ability to be receptive to other sources of knowledge/information. In addition, the ability to recognize and adapt to changes in the environment as they occur was identified as important to design (M=4.35, SD=0.65) and 91.3% indicated that this ability was either critical or very critical. Participants indicated that design does not happen in a vacuum and that the actions resulting from design will change the environment, creating the need to continually re-evaluate the environment. One participant said, "In the real world, everything we do has a different cause and effect that changes what we planned yesterday. The good commanders keep that in mind and execute and adjust based on that." Another participant said, "It is about the ability to keep that aperture open and understand the changing environment because your daily actions change the environment. It is the co-creation of context." A third stated that, "Design is built on the concept that you accept that the environment will change from the very beginning. You're watching for the environment to change. You're not saying 'I'm following *this plan*.' You say, 'The environment is changing, therefore I should start doing *these* things.'"

Sensegiving

The ability to convey the design concept in practical terms was identified as important to design (M=4.30, SD=0.76). This ability was rated the most critical KSA for the Sensegiving competency. Nearly eighty-three percent of participants indicated that this ability was either critical or very critical to design.

The ability to use group discussion to produce shared understanding was also identified as essential to design (M=4.22, SD=0.90). A smaller percentage (69.6%) identified that this KSA was either critical or very critical to design. One participant clarified that, "It is 'shared understanding' – not consensus. Everyone may not agree." Another pointed out, "How do you think about that from their perspective? You put it in their logic so it makes sense. If all you think is, 'that's irrational,' you're missing an opportunity to understand your enemy." Knowledge or awareness of one's own assumptions and how they affect interpretation and transmission of ideas was identified as important to design (M=4.17, SD=0.65) and 87% indicated that this knowledge was either critical or very critical to design. Those who are effective at design "understanding how they make decisions, their biases, and how they can learn to account for their biases…They don't try to deny but they account for it. They know where it is and have control over their heuristics." Finally, the ability to achieve a common understanding and shared vision was also identified as a necessity for design (M=4.13, SD=0.76). Over seventy-eight percent indicated that this ability was either critical or very critical. One participant described the best way to achieve shared vision, "The 'Holy Grail' is to figure out how to make people think it was their idea."

Collaborating

The ability to listen was identified as very important to design (M=4.43, SD=0.59). This ability was rated the most critical KSA for the Collaborating competency and fifth highest rated KSA overall. Nearly ninety-six percent of the survey participants indicated that this ability was either critical or very critical to design. Supportive to listening, the ability to contribute to an environment where different views are encouraged and shared was identified as important to design (M=4.22, SD=0.8). This ability was rated as either critical or very critical by 78.3% of the participants. Several participants mentioned the importance of facilitating discussion and managing conflict in discourse as ways to contribute to an environment where different views are encouraged and shared. One participant said, "Brainstorming can come to a halt because you don't have someone who can work with people and go both ways." Another participant said, "One of the basic premises - you have to allow everyone to be heard. Whether or not what they say is accepted or rejected. There has to be an honest commitment to hear their voice…If you have an atmosphere and conditions to express your point of view, that would keep the group moving." In addition, the ability to maintain productive discourse without allowing discussion to become completely unbounded was considered essential to design (M=4.14, SD=0.77). 77.3% indicated that this ability was either critical or very critical.

Finally, skill in defining the design team's mission was seen as a necessity for design (M=4.00, SD=0.85) with 65.2% of the participants indicating that this skill was either critical or very critical. Several participants identified the importance of defining the design team's mission. One participant said, "It starts with the commander giving good guidance. If it is ambiguous or the commander doesn't know what his end state is, then that can be frustrating for the staff regardless of the model that they apply." Another participant also described the problem that occurs from not having anyone with the ability to define the design team's mission. "Because they didn't know where they were going, they couldn't produce a plan. They just continued to consider and develop charts and concepts and ideas and relationships but they couldn't move forward."

Discussion

Overall, the research findings supported a KSA model including six competencies — Holistic Thinking, Sensemaking, Innovative Thinking, Adapting, Sensegiving, and Collaborating — and 43 KSAs required for design. Using existing research and literature as an initial framework for exploring design, the present research aimed to understand the requirements for applying design. The KSA model grew and evolved through discussions with design practitioners. When the general model was later proposed for review and confirmation, the specified knowledge, skills, and abilities found support from a broad array of Army leaders.

Leaders were also asked about the social and cognitive processes related to design. Responses to the questions about process were varied and many were not about process at all, a possible indication that participants had difficulty articulating the processes used in design. This is perhaps not surprising, given that design is creative and iterative; every experience using design is unique and does not follow a sequence of steps or a well-defined process. Because the process is not well-defined, the competencies and KSAs are even more important: team members need to possess (or be able to develop) the requisite competencies and KSAs so that they have the tools for whatever process is used.

Based on the assessments made by the Army leaders, it could be generally concluded that all six competencies are important to design. However, the competencies can be divided into two groups based on their characteristics: cognitive and social-communication. With understanding at the forefront of design, the competencies primarily involving cognition – holistic thinking, sensemaking, innovative thinking, and adaptation – could constitute one group. Important to a team-based process of building shared understanding, the competencies that are social-communicative in nature – sensegiving and collaborating – could constitute the second group. Discussing the competencies and KSAs using these two concepts – cognition and social-communication – may be an appropriate mechanism for considering the implications for education, development, and a commander's goal to utilize a design team.

Design is an inherently cognitive activity. The findings of this research clearly convey that to engage in design-thinking one must think holistically when attempting to understand complex, related, and changing systems. One must also be capable of synthesizing information into new frames for understanding the existing environment and problem. Throughout, the individual must be actively questioning existing information and current understanding, while actively considering and testing new sources of information and approaches to determine whether they improve the existing frame of an environment and problem that can constantly change.

Design is also an inherently collaborative activity. Banach notes that design must make an "inherently individual activity" into a "collective pursuit of understanding" (2009). Both sensegiving and collaborating contribute to this pursuit. The research findings emphasize both the ability to listen and the ability to convey the design concept in practical terms as critical elements of design. This requires being able to contribute to an environment where different views are encouraged and group discussion facilitates shared understanding.

Social-communicative competencies and KSAs often involve behaviors that are observable through interpersonal and team activities. Therefore, interventions that enhance cognitive skills might enhance social-communication skills if they are developed in a collaborative setting. Although, social-communication competencies may develop in a more passive manner than those that focus on cognitive skills, there is value to dedicating attention to them in order to expedite their development and ensure that they are appropriately applied when needed. Salas, Burke, and Cannon-Bowers (2000), note that an inability to effectively communicate is the second most cited cause for team failure and accidents, hence focused attention on social-communicative KSAs is warranted.

Recommendations for Enhancing the Development and Application of Design Competencies and KSAs

In order to build a larger cadre of officers who are proficient in design competencies and KSAs a three-pronged system is required. First, officers must be screened and selected based on important KSAs, especially those that are difficult to train. Then those who have demonstrated propensity to display design competencies and KSAs should be encouraged to develop skills and be provided opportunities to exercise those skills early in their careers before the expression of those skills is necessary. Finally, those who demonstrate competence on critical design KSAs should be rewarded and reinforced through promotions, assignments, and awards.

The first step to enhancing the development and application of design KSAs is to identify individuals who have the propensity to demonstrate those skills. Cognitive and interpersonal skills vary among people and those differences will lead to varying degrees of success performing activities that involve those skills. Although specific cognitive abilities can be improved, differences in abilities will exist between individuals and improvement requires time. Additionally, training and development improvements in "soft skills" like interpersonal skills tend to be modest (Hunt & Baruch, 2003). Thus it is important to screen and select individuals who can demonstrate proficiency with the KSAs important for design. Those who have the innate abilities for design need to be identified early and given access to the necessary training and developmental experiences that will make them even better.

One framework that combines the benefits of screening for propensity to display design competencies and providing developmental opportunities was described by Wong and Gerras (2013) as a model for developing strategic thinking skills over an officer's career. While the competencies for successful strategic thinking and design are not identical, many of the cognitive components of design and strategic thinking skills identified by Wong and Gerras (2013) are similar (e.g., conceptual skills, frame of reference development, and enterprise understanding). Indeed, some military educators argue that the skills needed to execute both design and strategic thinking are "for all intents and purposes, the same" (Waters, 2011, p. 118). Thus the developmental model proposed by Wong and Gerras is useful to consider when determining how to develop design competencies. The developmental model has three main tenets. First, screening is a critical component prior to selection at multiple points across an officer's career. Second, not all competencies are emphasized at each level of development. Finally, the developmental model recognizes the considerable impact that experience outside the classroom has on an officer's development. Figure 1 is an example of how Wong and Gerras's (2013)

developmental model might be applied to design competencies. Adapting and innovative thinking are competencies that are appropriate to develop throughout an officer's career. Self awareness, the ability to adjust to a changing environment, and the ability to creatively problem solve are skills that are relevant for all officers. Holistic thinking, sensemaking, and sensegiving on the other hand, involve KSAs that are not as critical for platoon level leaders. While, critical and reflective thinking, ongoing synthesis of information, and communicating understanding are important throughout a career, other elements of the competencies (e.g.. systems thinking, in-depth and iterative assessment of the environment, and communicating a shared vision) become more relevant as an officer moves from tactical to strategic leadership positions. Similarly, while working together to solve problems is important for all levels of Army leaders, many of the KSAs involved with collaborating are not always appropriate at tactical levels (e.g., encouraging discourse and forming collaborative networks). In order to build conceptual thinking skills later in an officer's career, it is important to expose them to strategic concepts early in their career (Easterby-Smith & Davis, 1983).

Design Competency	Selection	Basic Officer Leader Course	Lieutenant Time	Captain Career Course	Captain Time	Intermediate Level Education	Major and Lieutenant Colonel Time	Selection	Senior Service College	Colonel Time	Selection	Army Strategic Leader Program	General Officer Time
Adapting	Screen	Develop	Exercise	Develop	Exercise	Develop	Model			Model			Model
Innovative Thinking	Screen	Develop	Exercise	Develop	Exercise	Develop	Model			Model			Model
Holistic Thinking				Develop	Exercise	Develop	Exercise	Screen	Develop	Model			Model
Sensegiving				Develop	Exercise	Develop	Exercise	Screen	Develop	Model			Model
Sensemaking				Develop	Exercise	Develop	Exercise	Screen	Develop	Model			Model
Collaborating				Develop	Exercise	Develop	Exercise	Screen	Develop	Model			Model

Figure 1. Possible framework for development of design competencies (adapted from Wong and Gerras's 2013 model for developing strategic thinking in Army officers)

Once officers have been screened as having a potential to display KSAs related to design, those officers require development and the opportunity to demonstrate/practice their skills. An important component of design KSA development is experiential learning that is augmented with building a knowledge base of relevant theory and practical methodologies to enhance holistic and innovative thinking, sensemaking, and adapting. The institutional Army has existing instruction in place at various points within the education system. Allen and Gerras (2009) note a general sequence – such as the Basic Officer Leadership Course, Intermediate Level Education, and the Army War College – in which creative thinking and critical thinking are taught. There is, however, significant room for improvement and Allen and Gerras (2009) recommend using a multi-disciplinary approach that incorporates skill-based practice guided by a skilled leader and promotes regular application of the learned skills.

A primary purpose for using a multi-disciplinary approach is to offer different perspectives to thinking. As an example, Allen and Gerras (2009) point out that philosophy supports logic and reasoning, whereas education and psychology can support questioning and self-reflection. Exposure to multiple disciplines also assists in expanding general knowledge which can improve critical assessment, synthesis of information, idea generation, and the use of analogical reasoning and metaphors for understanding complex and ill-structured issues.

With respect to practical application, Halpern (2004) states that pedagogy will not promote in-depth understanding. Instead, experiential learning, where critical and creative thinking is required and practiced, is necessary. However, this experiential learning must be guided. Guided learning is necessary to ensure that relevant events and information are recognized and interpreted. It also challenges an individual to explain their understanding and the process by which they developed that understanding (Halpern, 2004). This can improve recognition of one's own assumptions, foster the development of other approaches for building understanding, and deepen comprehension. Further, a leader or instructor that can facilitate effective dialogue within these practical experiences can promote more innovative thinking by allowing for assumptions to be openly challenged and for alternatives to be developed or explored. In addition to structured practical applications, on the job learning is a powerful mechanism for skill development especially if it is accompanied by coaching and mentoring (Easterby-Smith & Davis, 1983).

To support effective sensegiving and collaboration, the importance of communicating through dialogue cannot be understated. Senge et al. (1994) conveys that leaders must understand that dialogue requires "the free and creative exploration of complex and subtle issues, a deep 'listening' to one another and suspending of one's own views" (p. 220). This should be actively practiced with facilitation by senior leaders or instructors in any setting. Fastabend and Simpson (2004) add that learning organizations use dialogue with critics as a means to check logic and/or reinforce arguments. Engaging and exploring a conflict of ideas may advance understanding.

Dialogue also requires a balance of inquiry and advocacy. Inquiry involves listening to what another individual is saying and attempting to fully understand it, while advocacy attempts to explain or convince a personal idea or action to another individual. (Ross & Roberts, 1994). An imbalance between these may impair or end dialogue; therefore, leaders must have a clear

awareness of how they engage others. If they lack this knowledge and skill, it can influence whether or not they successfully achieve shared understanding.

The leader development model in the Adaptive Leaders Course (ALC) is a good reflection of incorporating practical application (Vandergriff, 2007). The ALC espouses cognitive development through experiential learning and Vandergriff points out that it can be applied at any level of the education system. The program of instruction is described as being reflective of war – a complex and open environment. The curriculum involves case studies, decision games, free-play exercises, and feedback. To support experiential learning, instructors serve to provide guidance only to facilitate and encourage holistic, creative, and adaptive thinking. Students wrestle with problems without being provided approaches to address them; they are challenged to consider their approach and other viable solutions; and later provided with specific theory to assist in problem-solving.

Increasing the focus on developing design competencies in a group of officers with the ability to excel requires a culture change whereby the Army fully supports and encourages the main tenets of design. Commanders/leaders/instructors at all levels must create the conditions for innovative and adaptive thinking – to include collegiality, honest dialogue, and opportunity to learn from failure. One of the Army's preeminent decision making processes (MDMP) is incredibly familiar and widely accepted within the force. However, MDMP requires analytical thinking, but does not encourage innovative or adaptive thinking. Though MDMP and design address fundamentally different questions (e.g. MDMP is well suited to answer "what action will our unit take?" while design is well suited to answer "what environment is our unit operating in?"), the widespread adoption of MDMP might be hindering the acceptance of design – a fundamentally adaptive decision making tool. Further, a hierarchical rank structure commonly can discourage challenges to existing thinking, and yet challenging one's thought process is necessary for creativity. Robert Sternberg, a prominent scientist of creative intelligence, notes that a supporting and rewarding environment is a critical facet to creativity: "One could have all of the internal resources needed in order to think creatively, but without some environmental support (such as a forum for proposing those ideas), the creativity that a person has within him or her might never be displayed" (2006, p. 7).

Institutional change can be difficult, but necessary. To create a culture of innovation, Fastabend and Simpson (2004) stressed that behavior must change. This includes "product behavior" and "experimentation behavior." Rather than being an organization that focuses on *processes*, the Army could shift toward a focus on outcome or *product*. Emphasizing the end product would permit the generation of multiple alternative processes. Adaptive processes may improve and expedite the development of the product. This focus on the product would promote greater experimentation whereby more hypotheses and approaches can be tested. It will also create the potential for more failure. It is a failure-averse, "zero-defects" mentality that the Army must move away from and Vandergriff (2007) notes that failure can be a learning experience that produces a more adaptive leader. In a non-threat environment (institution or training), there must be a culture that permits innovative thought and action where failure is not met with negative repercussions. This is an understandably difficult recommendation because widespread organizational change is inherently risky, as it disrupts the status quo, and in the operational environment that many military design teams work in failure can have life and death

consequences. However, in the recommended environment, the abilities associated with innovative thinking and adapting will likely grow and that will have positive impacts on the system as a whole.

Once officers with the demonstrated skills to engage in design thinking have been selected and developed they must be rewarded and reinforced for engaging in design thinking. In order to effectively execute design, leaders must encourage subordinates to engage in behaviors that facilitate design (Waters, 2011). The Army, as an institution, must reward those who pursue non-traditional developmental opportunities (Salmoni, Hart, McPherson, and Winn, 2010). There are several ways that the Army can reward and reinforce officers for engaging in design thinking. For example, the Army can provide challenging and rewarding assignments for design thinkers to use their skills (Eifler, 2012) and then include those assignments favorably in performance evaluations (Goldman and Casey, 2010). It is also important to publically recognize individuals and teams who excel at design and one way the Army does this is through promotion. U.S. Army Reserve Colonel Thomas Williams insightfully notes that "rank is a reward for articulating what is acceptable" (2009, p. 61). He discussed this as a mechanism for proliferating the ideas of conventional wisdom; however, the same argument can be made for encouraging design thinking. If officers are rewarded for engaging in design, then it will likely encourage others to pursue developmental opportunities and assignments that enhance their design capabilities. This cyclical pattern will create a larger contingent of Army leaders with the KSAs to successfully apply design thinking.

Future Research

Although the present research established the competencies and KSAs associated with applying design, future research could explore whether some KSAs may be more foundational to design. If possible, making a clearer distinction between the KSAs that all design team members must possess and the KSAs that only some must possess would extend the Army's understanding of the competencies and better inform development and selection recommendations. Further, it would be useful to better understand how the possession of different KSAs by team members may complement each other and support the interdependent nature of design.

Similarly, because it is likely that a commander will not have a staff that sufficiently possesses the requisite design competencies, and possession and demonstration within the team need not be equal, selecting appropriate individuals to be a part of the team may frequently be necessary. Future research could not only research strategies and best practices for selection, but also develop tools to support selection. Having these tools at the commander's disposal would expedite the process of creating a team and rapidly attempting to understand the environment and problem before them.

Conclusion

The research found support for a model of six competencies and 43 KSAs required for effectively applying the Army Design Methodology. Broadly, these competencies and KSAs can be organized into two groups – one that focuses on the cognitive aspects of design and one that focuses on the social and communicative aspects of design. In order to enhance the development

and application of design competencies broadly throughout the force, the Army needs to identify and select leaders with a propensity to demonstrate the KSAs, provide them additional developmental opportunities (both inside and outside the classroom), and finally reward them for engaging in design thinking.

References

Abrahamson, E., & Fomburn, C. (1994). Macro cultures: Determinants and consequences. *Academy of Management Review, 19,* 728-755.

Allen, C. D., & Gerras, S. J. (2009). Developing creative and critical thinkers, *Military Review, 89*(6), 77-83.

Banach, S. J. (2009). Educating by design: Preparing leaders for a complex world. *Military Review, 89*(2), 97-104.

Banach, S. J., & Ryan, A. (2009). The Art of Design: A design methodology. *Military Review, 89*(2), 105-115.

Baran, B. E., & Scott, C. W. (2010). Organizing Ambiguity: A Grounded Theory of Leadership and Sensemaking Within Dangerous Contexts. *Military Psychology, 22*, 42-69.

Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: A meta-analysis. *Personnel Psychology, 44*, 1-26.

Browning, L., & Boudes, T. (2005). The use of narrative to understand and respond to complexity: A comparative analysis of the Cynefin and Weickian models. *Emergence: Complexity & Organization, 7*(3-4), 32-39.

Burnett, M., Wooding, P., & Prekop, P. (2004) *Sense making – Underpinning concepts and relation to military decision-making.* Command and Control Research Symposium, San Diego, CA.

Chi, M. T. H., Glaser, R., & Rees, E. (1982). Expertise in problem solving. In R. J. Sternberg (Ed.), *Advances in the Psychology of Human Intelligence* (Vol. 1, pp. 1-75). Hillsdale, NJ: Lawrence Erlbaum Associates.

Conger, J., & Kanungo, R. (1992). Perceived behavioral attributes of charismatic leadership. *Canadian Journal of Behavioral Science, 24*, 86-102.

Cooke, N. J. (1994). Varieties of knowledge elicitation techniques. *International Journal of Human-Computer Studies, 41,* 801-849.

Easterby-Smith, M.M., & Davis, J. (1983). Developing strategic thinking. *Long Range Planning, 16*(4), 39-48.

Eifler, B.S. (2012). Developing strategic thinking leaders in the U.S. Army. (Strategy Research Project). Carlisle, PA: U.S. Army War College.

Eisenhardt, K. (1992). Speed and strategic choice: Accelerating decision making. *Planning Review, 20* (5), 30-34.

Ericsson, K. A., & Lehmann, A. C. (1996). Expert and exceptional performance: Evidence of maximal adaptation to task constraints. *Annual Review of Psychology, 47*, 273-305.

Fastabend, D. A., & Simpson, R.H. (2004). *Adapt or die: The imperative for a culture of innovation in the United States Army*. Retrieved from http://www.au.af.mil/au/awc/awcgate/army/culture_of_innovation.pdf

Festinger, L. (1957). *A theory of cognitive dissonance.* Stanford, CA: Stanford University Press.

Flanagan, J. C. (1954). The critical incidents technique. *Psychological Bulletin, 51*, 327-358.

Frensch, P.A., & Sternberg, R.J. (1989). Expertise and intelligent thinking: When is it worse to know better? In R.J. Sternberg (Ed.), *Advances in the psychology of human intelligence* (Vol. 5, pp. 157-188). Hillsdale, NJ: Lawrence Erlbaum Associates.

Garstka, J. (2003). *Network centric operations conceptual framework. Version 1.0.* Retrieved from www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA457620

Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal, 12*, 433-448.

Gioia, D. A., Corley, K. G., & Fabbri, T. (2002). Revising the past (while thinking in the future perfect tense). *Journal of Organizational Change Management, 15*, 622-634.

Goldman, E.F. & Casey, A. (2010). Building a culture that encourages strategic thinking. *Journal of Leadership and Organizational Studies, 17*, 119-128.

Grigsby, W. W., Gorman, S., Marr, J., McLamb, J., Stewart, M., & Schifferle, P. (2011). Integrated Planning: The operations process, design, and the military decision making process. *Military Review, 91*(1), 28-35.

Grothe, G. K. (2009). *Innovation Versus Adaptability: Seizing the Initiative Through Creative Thinking Versus Reacting to the Enemy.* Fort Leavenworth, KS: U.S. Army Combined Arms Center.

Guthrie, T. (2012). Mission Command: Do we have the stomach for what is really required? *Army, 62*(6), 26-28.

Halpern, D. (2004). The development of adult cognition: Understanding constancy and change in adult learning. In D. V. Day, S. J , Zaccaro, & S. M. Halpin, (Eds.), *Leader development*

for transforming organizations: Growing leaders for tomorrow (pp. 125-152). Mahwah, NJ: Lawrence Erlbaum Associates.

Hammerstrom, M. (2010). *Size matters: How big should a military design team be?* Fort Leavenworth, KS: School of Advanced Military Studies.

Hill, R. C., & Levenhagen, M. (1995). Metaphors and mental models: Sensemaking and sensegiving in innovative and entrepreneurial activities. *Journal of Management, 21*, 1057-1074.

Hunt, J.W., & Baruch, Y. (2003). Developing top managers: The impact of interpersonal skills training. *The Journal of Management Development, 22*, 729.

Hunt, R. R., & Ellis, H. C. (2004). *Fundamentals of cognitive psychology* (7th ed.). New York: McGraw-Hill.

Janis, I. L. (1972). *Victims of groupthink.* Boston: Houghton-Mifflin.

Kasser, J. (2010). *Holistic thinking and how it can produce innovative solutions to difficult problems.* Paper presented at the 7th bi-annual European Engineering Conference, Stockholm, Sweden.

Kelly, G. (1955). *The psychology of personal constructs*. New York: Norton.

Klein, G., Calderwood, R., & Clinton-Cirocco, A. (2010). Rapid decision making on the fire ground: The original study plus a postscript. *Journal of Cognitive Engineering and Decision Making, 4*, 186.

Kurtz, C. F., & Snowden, D. J. (2003). The new dynamics of strategy: Sense-making in a complex and complicated world. *IBM Systems Journal, 42*, 462-483.

Laroche, H. (1995). From decision to action in organizations: Decision-making as a social representation. *Organizational Science, 6*, 62-75.

Latham, V. M. (1987). Task type and group motivation: Implications for a behavioral approach to leadership in small groups. *Small Group Behavior, 18*, 56-71.

Leventhal, G. S. (1980). What should be done with equity theory? In K.J. Gergen, M.S. Greenberg, & R. H. Willis (Eds.), *Social exchange: Advances in theory and research* (pp. 27-55). New York: Plenum.

Lindsay, D. R., Day, D. V., & Halpin, S. M. (2011). Shared leadership in the military: Reality, possibility, or pipedream? *Military Psychology, 23*, 528-549.

Madjar, N., Greenberg, E., & Chen, Z. (2011). Factors for radical creativity, incremental creativity, and routine, noncreative performance. *Journal of Applied Psychology, 96,* 730-743.

Maitlis, S., & Lawrence, T. B. (2007). Triggers and enablers of sensegiving in organizations. *Academy of Management Journal, 50*, 57-84.

Mandler, G. (1984). *Mind and body: Psychology of emotion and stress*. New York: Norton.

Matthews, M. M. (2008). *We were caught unprepared: The 2006 Hezbollah-Israeli War, The long war series occasional paper 26.* Fort Leavenworth, Ks: Combat Studies Institute Press.

Mattis, J. N. (2008). *MEMORANDUM FOR U.S. JOINT FORCES COMMAND, Subject: Assessment of Effects Based Operations.* Norfolk, VA: U.S. Joint Forces Command.

McNulty, T., & Pettigrew, A. M. (1999). Strategists on the board. *Organization Studies, 20,* 47-74.

Mills, J. (2003). *Making sense of organizational change*. London: Routledge.

Morgeson, F. P., DeRue, D. S., & Karam, E. P. (2010). Leadership in teams: A functional approach to understanding leadership structures and processes. *Journal of Management, 36*, 5-39.

Mumford, M., Costanza, D., Threlfell, K., Baughman, W., & Reiter-Palmon, R. (1993). Personality variables and problem construction activities: An exploratory investigation. *Creativity Research Journal, 6*, 365-389.

Ntuen, C. A., & Leedom, D. (2007). *Deductive Sensemaking Principles Using Personal Constructs of the Field Commanders.* Paper presented at the 12th International Command & Control Research and Technology Symposium, Newport, Rhode Island.

Orasanu, J. (1990, October). *Shared mental models and crew performance.* Paper presented at the annual meeting of the Human Factors Society, Orlando, FL.

Ortony, A. (1975). Why metaphors are necessary and not just nice. *Educational Theory, 25*, 45–53.

Pearce, C. L., & Sims, H. P. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational, and empowering leader behaviors. *Group Dynamics: Theory, Research, and Practice, 6*, 172-197.

Perez, J. C. (2011). A practical guide to design: A way to think about it, and a way to do it. *Military Review, 91*(2), 41-51.

Randall, K. R., Resick, C. J., & DeChurch, L. A. (2011). Building team adaptive capacity: The roles of sensegiving and team composition. *Journal of Applied Psychology, 96*, 525.

Ross, R. & Roberts, C. (1994). "Balancing Inquiry and Advocacy," In *The Fifth Discipline Fieldbook*, by Senge, P., Kleiner, A., Roberts, C., Ross, R., & Smith, B. New York: Doubleday.

Ryan, A. (2011) *Introduction to the Army Design Methodology.* Fort Leavenworth, KS: U.S. Army School of Advanced Military Studies. [PowerPoint slide presentation].

Salas, E., Burke, C., & Cannon-Bowers, J. (2000). What we know about designing and delivering team training: Tips and guidelines. In K. Kraiger (Ed). *Creating, implementing, and managing effective training and development: State-of-the-art lessons for practice* (pp. 234-259). San Francisco: Jossey-Bass.

Salmoni, B.A., Hart, J., McPherson, R., & Kirby-Winn, A. (2010). Growing strategic leaders for Future Conflict. *Parameters, 40* (1), 72-88.

Senge, P., Kleiner, A., Roberts, C., Ross, R., & Smith, B. (1994) *The Fifth Discipline Fieldbook*. New York: Doubleday.

Sieck, W. R., Klein, G., Peluso, D. A., Smith, J. L., & Harris-Thompson, D. (2007). *FOCUS: A model of sensemaking.* Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Snowden, D. J. (2003). Managing for serendipity or why we should lay off 'best practices' in KM. *Knowledge Management, 6*(8). Retrieved from http://www.cynefin.net/kbase.php

Sorrells, W., Downing, G., Blakesley, P., Pendall, D., & Walk, J. (2005). *Systemic Operational Design: An introduction.* Fort Leavenworth, KS: U.S. Army School for Advanced Military Studies.

Sternberg, R.J. (1985). *Beyond IQ: A triarchic theory of human intelligence*. New York: Cambridge University Press.

Sternberg, R. J. (2006). Creating a vision of creativity: The first 25 years. *Psychology of Aesthetics, Creativity, and the Arts, S*(1), 2-12.

Taylor, J., & Van Every, E. (2000). *The emergent organization: Communication as its site and surface.* Mahwah, NJ: Lawrence Erlbaum Associates.

Tversky, A., & Kahneman, D. (1974). Judgments under uncertainty: Heuristics and biases. *Science, 185,* 1124-1131.

U.S. Department of the Army. (2006a). *Field Manual 3-24, Counterinsurgency*. Washington, DC: Headquarters, U.S. Department of the Army.

U.S. Department of the Army. (2006b). *Army Leadership: Competent, confident, and agile,* (Field Manual 6-22). Washington, D.C.: Author.

U.S. Department of the Army. (2008). *The U.S. Army Commander's Appreciation and Campaign Design,* (TRADOC Pamphlet 525-5-500). Washington, DC: Author.

U.S. Department of the Army. (2010). *The Operations Process*, (Field Manual 5-0). Washington, DC: Author.

U.S. Department of the Army. (2011a). *The Operations Process,* (Field Manual 5-0 C1). Washington, DC: Author.

U.S. Department of the Army. (2011b). *Mission Command,* (Field Manual 6-0). Washington, DC: Author.

Vandergriff, D. E. (2007). Adaptive Leader Course: Old dogs teaching new tricks. *Army, 57*(11), 59-66.

Waters, D.E. (2011, 4th Quarter). Understanding strategic thinking and developing strategic thinkers. *Joint Forces Quarterly, 63,* 113-119.

Weber, R.P. (1990). *Basic content analysis*. Newburry Park, CA: Sage Publications.

Weick, K. E. (1988). Enacted sensemaking in crisis situations. *Journal of Management Studies, 25*, 305-317.

Weick, K. E. (1993). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly, 38,* 628-652.

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

Weick, K. E.,& Sutcliffe, K. M. (2001). *Managing the unexpected: Assuring high performance in an age of complexity.* San Francisco: Jossey-Bass.

Weick, K., Sutcliffe, K., & Obstfeld, D. (2005). Organizing and the process of sensemaking. *Organization Science, 16,* 409-421.

Williams, T.M. (2009). Understanding innovation, *Military Review, 89* (4), 59-67.

Wong, L. & Gerras, S.J. (2013). Developing Army strategic thinkers. In H.M.K. Wolters, A.P. Grome, & R.M. Hinds (Eds.*), Exploring strategic thinking: Insights to assess, develop, and retain strategic thinkers.* (Research Product 2013-01). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Wright, A. (2004). *The use of scenarios in social construction of sense*. West Midlands, UK: University of Wolverhampton. Retrieved from http://www.wlv.ac.uk/PDF/uwbs_04%20WP001-04%20Wright.pdf

Appendix A

KSA Survey Results: Descriptive Statistics for KSAs

Table A1.

Descriptive Statistics of KSAs

KSA Statement	*n*	Range	*M*	*SD*
Ability to question key assumptions, knowledge, or established ways of thinking. (Innovative Thinking)	23	2	4.57	.590
Ability to understand complex and adaptive relationships among events and actors. (Holistic Thinking)	23	2	4.52	.665
Ability to adapt one's frame and approach in response to new information. (Adapting)	23	1	4.48	.511
Skill in thinking critically about situations or events. (Holistic Thinking)	23	3	4.43	.728
Ability to listen. (Collaborating)	23	2	4.43	.590
Ability to synthesize information to create new meaning or structure (frame). (Sensemaking)	23	2	4.39	.656
Ability to be receptive to other sources of knowledge/information. (Adapting)	23	2	4.39	.656
Ability to change and apply different approaches for understanding the environment and problem. (Sensemaking)	23	2	4.35	.714
Ability to recognize and adapt to changes in the environment as they occur. (Adapting)	23	2	4.35	.647
Ability to convey the design concept in practical terms. (Sensegiving)	23	2	4.30	.765
Ability to use group discussion to produce shared understanding. (Sensegiving)	23	2	4.22	.902
Ability to see problems in new ways and avoid linear thinking. (Innovative Thinking)	23	4	4.22	.998
Ability to contribute to an environment where different views are encouraged and shared. (Collaborating)	23	2	4.22	.795

Note. The competency that the KSA is related to is identified in parentheses following the KSA statement.

Table A1. (continued)

Descriptive Statistics of KSAs

KSA Statement	*n*	Range	*M*	*SD*
Ability to acknowledge and accept complexity. (Innovative Thinking)	23	2	4.17	.717
Ability to maintain productive discourse without allowing discussion to become completely unbounded. (Collaborating)	22	2	4.14	.774
Ability to achieve a common understanding and shared vision. (Sensegiving)	23	2	4.13	.757
Ability to seek evidence that does not conform to current frame. (Sensemaking)	23	2	4.13	.757
Ability to use iterative assessment to understand the environment and develop frame. (Sensemaking)	23	2	4.09	.668
Ability to hold and consider two distinct, and possibly competing, ideas in mind. (Sensemaking)	23	4	4.00	1.044
Skill in defining the design team's mission. (Collaborating)	23	2	4.00	.853
Ability to build mental models that hypothesize the possible consequences of various courses of action. (Holistic Thinking)	23	3	3.91	.848
Ability to suspend judgment to thoroughly develop understanding. (Sensemaking)	23	4	3.91	1.083
Knowledge of and an accurate awareness of the operational environment. (Sensemaking)	23	3	3.87	.815
Self-awareness of what one knows and what one needs to know. (Adapting)	23	3	3.83	.778
Ability to identify constraints and factors that influence the feasibility and desirability of alternatives. (Holistic Thinking)	23	3	3.78	.600
Ability to identify the perspectives of others in social situation. (Sensemaking)	23	3	3.78	.902

Note. The competency that each KSA is related to is in parentheses following the KSA statement.

Table A1. (continued)

Descriptive Statistics of KSAs

KSA Statement	*n*	Range	*M*	*SD*
Ability to reflect on past actions or events. (Holistic Thinking)	23	4	3.61	.839
Ability to take tacit information and give it explicit meaning to develop shared understanding. (Sensegiving)	23	4	3.61	.839
Skill in identifying and accessing relevant expertise. (Collaborating)	23	3	3.57	.728
Knowledge of historical information and events relevant to the situation. (Sensemaking)	23	3	3.57	.728
Ability to use evocative language, metaphors, written narrative, and drawing to represent abstract concepts. (Sensegiving)	23	4	3.57	1.037
Ability to organize information by creating heuristics to suit the context. (Sensemaking)	23	4	3.43	1.037
Ability to form collaborative networks to enhance team capabilities or knowledge. (Collaborating)	23	2	3.43	.662
Ability to use analogical reasoning to compare and contrast knowledge and understanding. (Innovative Thinking)	23	3	3.39	.656
Possession of a diverse knowledge base. (Sensemaking)	23	3	3.35	.775
Ability to adapt past knowledge to current situations. (Adapting)	23	3	3.35	.775
Skill in recognizing social networks. (Sensemaking)	23	3	3.30	.765
Ability to use personal experience to select and encode relevant information. (Sensemaking)	23	3	2.78	.795
Ability to incorporate doctrine and regulations into thought processes. (Sensemaking)	23	3	2.61	.783

Note. The competency that each KSA is related to is identified in parentheses following the KSA statement.

Appendix B

KSA Criticality Survey Results by Competency

Table B1.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Holistic Thinking KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to understand complex and adaptive relationships among events and actors.			8.7	30.4	60.9
Skill in thinking critically about situations or events.		4.3		43.5	52.2
Ability to develop a frame with incomplete information.			21.7	34.8	43.5
Ability to build mental models that hypothesize the possible consequences of various courses of action.		4.3	26.1	43.5	26.1
Ability to identify constraints and factors that influence the feasibility and desirability of alternatives.		4.3	17.4	73.9	4.3
Ability to reflect on past actions or events.	4.3		34.8	52.2	8.7

Table B2.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Sensemaking KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to synthesize information to create new meaning or structure (frame).			8.7	43.5	47.8
Ability to change and apply different approaches for understanding the environment and problem.			13.0	39.1	47.8
Ability to seek evidence that does not conform to current frame.			21.7	43.5	34.8
Ability to use iterative assessment to understand the environment and develop frame.			17.4	56.5	26.1
Ability to hold and consider two distinct, and possibly competing, ideas in mind.	4.3		26.1	30.4	39.1
Ability to suspend judgment to thoroughly develop understanding.	4.3	4.3	21.7	34.8	34.8
Knowledge of and an accurate awareness of the operational environment.		4.3	26.1	47.8	21.7
Ability to identify the perspectives of others in social situation.		8.7	26.1	43.5	21.7
Knowledge of historical information and events relevant to the situation.		4.3	43.5	43.5	8.7
Ability to organize information by creating heuristics to suit the context.	4.3	13.0	30.4	39.1	13.0

Table B2. (continued)

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Sensemaking KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Possession of a diverse knowledge base.		8.7	56.5	26.1	8.7
Skill in recognizing social networks.		13.0	47.8	34.8	4.3
Ability to use personal experience to select and encode relevant information.	4.3	30.4	47.8	17.4	
Ability to incorporate doctrine and regulations into thought processes.	4.3	43.5	39.1	13.0	

Table B3.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Sensegiving KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to convey the design concept in practical terms.			17.4	34.8	47.8
Ability to use group discussion to produce shared understanding.			30.4	17.4	52.2
Knowledge or awareness of one's own assumptions and how they affect interpretation and transmission of ideas.			13.0	56.5	30.4
Ability to achieve a common understanding and shared vision.			21.7	43.5	34.8
Ability to take tacit information and give it explicit meaning to develop shared understanding.	4.3		34.8	52.2	8.7
Ability to use evocative language, metaphors, written narrative, and drawing to represent abstract concepts	4.3	4.3	43.5	26.1	21.7

Table B4.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Adapting KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to adapt one's frame and approach in response to new information.				52.2	47.8
Ability to be receptive to other sources of knowledge/information.			8.7	43.5	47.8
Ability to recognize and adapt to changes in the environment as they occur.			8.7	47.8	43.5
Self-awareness of what one knows and what one needs to know.		8.7	13.0	65.2	13.0
Ability to adapt past knowledge to current situations.		13.0	43.5	39.1	4.3

Table B5.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Innovative Thinking KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to question key assumptions, knowledge, or established ways of thinking.			4.3	34.8	60.9
Ability to see problems in new ways and avoid linear thinking.	4.3		13.0	34.8	47.8
Ability to acknowledge and accept complexity.			17.4	47.8	34.8
Ability to use analogical reasoning to compare and contrast knowledge and understanding.		4.3	56.5	34.8	4.3

Table B6.

KSA Criticality Survey Results by Competency: Response Frequencies Displayed as Percentages for Collaborating KSAs

KSA	Unrelated	Relevant	Beneficial	Critical	Very Critical
Ability to listen.			4.3	47.8	47.8
Ability to contribute to an environment where different views are encouraged and shared.			21.7	34.8	43.5
Ability to maintain productive discourse without allowing discussion to become completely unbounded.			22.7	40.9	36.4
Skill in defining the design team's mission.			34.8	30.4	34.8
Skill in establishing roles, expectations, and goals.		4.3	39.1	39.1	17.4
Ability to reconcile diverse perspectives.			47.8	39.1	13.0
Skill in identifying and accessing relevant expertise.		4.3	43.5	43.5	8.7
Ability to form collaborative networks to enhance team capabilities or knowledge.			65.2	26.1	8.7