Technical Report 1349

Best Practices in Military Design Teams

Anna Grome
Beth Crandall
Applied Research Associates
Cognitive Solutions Division

Kimberly A. Metcalf
U.S. Army Research Institute

Dawn Laufersweiler
Robert Strouse
Applied Research Associates
Cognitive Solutions Division

March 2015

**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:

**MICHELLE SAMS, Ph.D.
Director**

Research accomplished under contract
for the Department of the Army by

Applied Research Associates Incorporated,
Cognitive Solutions Division

Technical Review by

Heather M.K. Wolters, U.S. Army Research Institute
Anna Sackett, U.S. Army Research Institute

NOTICES

DISTRIBUTION: This Technical Report has been submitted to the Defense Information Technical Center (DTIC). Address correspondence concerning ARI reports to: U.S. Army Research Institute for the Behavioral and Social Sciences, Attn: DAPE-ARI-ZXM, 6000 6th Street Building 1464 / Mail Stop: 5610), Fort Belvoir, VA 22060-5610.

FINAL DISPOSITION: Destroy his 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

1. REPORT DATE (dd-mm-yy) March 2015	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) May 2012 - August 2013

4. TITLE AND SUBTITLE Best Practices in Military Design Teams	5a. CONTRACT OR GRANT NUMBER W5J9CQ-12-C-0032
	5b. PROGRAM ELEMENT NUMBER 622785

6. AUTHOR(S) Anna Grome, Beth Crandall; Kimberly A. Metcalf; Dawn Lauferseiler, Robert Strouse	5c. PROJECT NUMBER A790
	5d. TASK NUMBER 405
	5e. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Applied Research Associates Incorporated Cognitive Solutions Division 1750 Commerce Center Blvd. North Fairborn, OH 45324-6333	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. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Technical Report 1349

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

13. SUPPLEMENTARY NOTES
Subject Matter POC and Contracting Officer's Representative: Dr. Kimberly A. Metcalf

14. ABSTRACT (Maximum 200 words): This research report offers an integrative view of key challenges that military design teams encounter, and describes lessons, strategies, and approaches used by military leaders to optimize the performance of design teams in operational contexts. Topics include assembling design teams, managing intergroup dynamics, fostering cognitive flexibility, integrating non-military SMEs into the team, capturing the team's evolving understanding, and conveying insights to stakeholders. The report presents findings from previous research on teams as well as insights from interviews and a survey with those who have worked in design teams in operational settings.

15. SUBJECT TERMS
Teams, Army Design Methodology, Best practices, Teams - Design

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON Dorothy Young 703-545-2316
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited Unclassified	110	

i

Technical Report 1349

Best Practices in Military Design Teams

Anna Grome
Beth Crandall
Applied Research Associates
Cognitive Solutions Division

Kimberly A. Metcalf
U.S. Army Research Institute

Dawn Lauferweiler
Robert Strouse
Applied Research Associates
Cognitive Solutions Division

ACKNOWLEDGEMENTS

BEST PRACTICES IN MILITARY DESIGN TEAMS

EXECUTIVE SUMMARY

Research Requirement:

The increasingly connected and dynamic - current and future - operational environment is challenging U.S. and Allied Forces in new and unfamiliar ways. As commanders and planning staffs try to make sense of the complex problems facing the operational environment - and determine ways to address them - they must attend to a range of factors (e.g., military, social, geo-political, cultural, and economic) that interact and influence each other in unpredictable ways. Senior leaders have argued that traditional, analytic, and highly-structured approaches to operational planning are insufficient for understanding and determining effective responses to the dynamic and interactively complex problems that our nation faces (e.g., Joint Staff, 2011; Mattis, 2009; Schmitt, 2006; TRADOC, 2008). The need for the military to be agile and innovative in these complex settings has focused increased interest and attention within the Army and across Services on the value of design-type methods and approaches, such as the Army Design Methodology (ADM; U.S. Department of the Army, 2010). Design approaches emphasize systems thinking, critical and creative thinking, visualization, and open discourse across ranks for improving understanding (or appreciation) of complex and unfamiliar problems, and for developing approaches to address them (Wass de Czege, 2009). Although design activities are virtually always conducted by teams of planners, there has been little research or guidance offered to address the team component.

The primary goal of the research reported here was to examine "design team"[1] activity, to describe and document key challenges that design teams face along with lessons, strategies, and practices that team leaders and team members have found useful when applying design principles and approaches in operational contexts. A secondary goal was to document and disseminate those lessons and actionable strategies in a practical resource to support and optimize the performance of design teams in the field. Specific research objectives were to uncover the
- factors considered and strategies used when creating and assembling design teams;
- strategies used to manage intergroup dynamics, foster trust, and promote effective discourse;
- practices for fostering different ways of thinking (e.g., creative thinking, holistic thinking) and deepening insights across the team;
- strategies for identifying and integrating non-Army subject matter experts (SMEs) into the team; and
- strategies for capturing the team's evolving understanding and conveying insights to those who have a stake in the team's outcomes.

---

[1] Though some of the research participants used the term design team, other terms used to refer to the collections of individuals who engage in design-type activity included planning teams, problem-framing teams, and strategic planning teams. Further, though design team was the choice term at the beginning of the research, recent doctrine (e.g., ADRP 5-0) has shifted to the term planning team to describe teams that conduct design activities (U.S. Department of the Army, 2012) therefore the research team decided to use the terms design team and planning team interchangeably throughout the report.

This report presents findings from previous research on teams as well as insights from those who have worked in design teams in operational settings. It offers an integrative view of key challenges that design teams encounter, and describes lessons, strategies, and approaches used by design team leaders and members to optimize the performance of design teams in operational contexts.

Procedure:

The research team conducted three main tasks to identify and capture strategies and lessons-learned related to design team functioning. The first task was a review of previous team literature to extract principles and practices that have relevance to military design team performance. The second task was data collection (i.e., in-depth interviews, observation, and a follow-up survey) with those who have led and/or participated in design teams in operational contexts, as well as those who have led design and strategic planning teams in business settings. The third task consisted of analysis and synthesis of the data, and development of a job aid containing tips, strategies, and relevant tools and resources to support design team performance in field settings.

Findings:

Analysis of the literature and data set revealed a number of challenges to design team performance, along with a range of strategies and practices that design team leaders and members have found helpful for managing them. The findings were organized around McGrath's (1964) well-established Input-Process-Output framework and covered the following topics

- **Assembling the Team** which included issues related to member diversity, uniformity, recruitment and selection, and team size;
- **Preparing the Team** which included setting the team's expectations, creating an atmosphere of trust, establishing a shared team identity, fostering cognitive flexibility, and preparing the team's physical workspace;
- **Managing Team Dynamics** which included issues related to managing personalities and engaging the full team in the discourse, managing the pace and flow of work, and integrating non-military partners/SMEs into the team; and
- **Capturing and Conveying Team Insights** which included capturing the team's shared understanding, and conveying insights to stakeholders.

In addition, we identified a set of overarching themes that threaded through the detailed findings. One particularly prominent theme was the role of the organizational culture, and the need for design team leaders to be attuned to which aspects of design activity the military culture will (or will not) support. Another prominent theme was the importance of cognitive flexibility and the role that visual thinking and visual tools can play in fostering adaptive thought and in helping teams to achieve new insights. A final overarching theme is that there is no "standard play" for design. It takes different forms, follows different approaches, and manifests differently depending on a variety of factors – including the personnel involved, the echelon at which it is taking place, the timeframe in which it occurs, and the culture of the organization in which it is being enacted. Despite considerable variability across the teams studied, the research uncovered

consistent challenges that design teams face, as well as common strategies and lessons-learned that can be useful to future design team efforts.

Utilization of Findings:

The findings of this research can benefit a variety of stakeholders, including commanders and planning staff who are leading or working within design teams in operational settings. It can also be useful for leaders who are educating Forces on the concept of design and its application to real-world problems. Certain aspects of the findings may be helpful to doctrine authors who will be evolving the concept of design and ADM in future iterations of doctrine. Finally, the findings may also be useful for those seeking insight into future research needs.

BEST PRACTICES IN MILITARY DESIGN TEAMS

CONTENTS

CONTENTS (continued)

Best Practices in Military Design Teams

Today's dynamic and volatile operating environments are challenging U.S. and Allied Forces in new and unfamiliar ways. The types of operational- and strategic-level problems facing our military forces are typically not resolvable through traditional military force alone (Joint Staff, 2011). Leaders at all levels face novel and highly complex problem situations that they must resolve. Commanders and their planning staffs must work together with international, interagency, and nongovernmental (NGO) partners to develop actionable, effective approaches and solutions that are based on a holistic understanding of key interdependencies in the operating environment. To do so, they must consider and account for a range of interconnected social, geo-political, military, and cultural factors as they plan and conduct operations.

The Army's traditional approaches to planning - involving analysis and standardized procedures (e.g., Military Decision Making Process (MDMP), Joint Operational Planning Process (JOPP), and Troop Leading Procedures (TLP)) - have proven useful for resolving a variety of problems in our military's history. However, senior leaders have argued that highly-structured approaches to planning are not sufficient for identifying effective responses to the novel, dynamic, and interactively complex problems that typify contemporary operational environments (e.g., Joint Staff, 2011; Mattis, 2009; Schmitt, 2006; TRADOC, 2008). The need to be agile and adaptive within these environments has focused attention on methods and approaches derived from architectural design to improve understanding of complex and unfamiliar problems, and to develop approaches for solving them (Wass de Czege, 2009). These design-type methods emphasize inquiry, critical and creative thinking, innovation, systems thinking, synthesis, and visualization. Though some argue that successful commanders and their staffs have been engaging in design for decades (Grome, Crandall, Rasmussen, & Wolters, 2012), dialogue, education, and the application of design principles and the associated Army Design Methodology (ADM) have become increasingly prominent in recent years. Design officially became part of Army doctrine in 2010 (see FM 5-0, Headquarters; U.S. Department of the Army, 2010),[2] and design-type activities have been gaining traction across services and within the joint environment. The individuals who engage in this activity have been labeled collectively as the "design team.[3]"

Design teams serve a crucial role in the integrated planning process, yet the nature of these teams poses a number of challenges. Some challenges are common to many types of teams; others are unique to the work that design teams conduct. Most fundamentally, these teams are faced with carrying out a highly complex cognitive task that requires making sense of dynamic, ill-structured, and unfamiliar problems. Not only must the members engage in sensemaking

---

[2] The specific design approach codified in doctrine is known as Army Design Methodology (ADM). ADM is a tool for conceptual planning that harnesses critical thinking, innovation, and collaborative discourse (U.S. Department of the Army, 2010). Within this report, we use the terms design and ADM interchangeably, as our focus is on the team, rather than the specific process of applying design principles.

[3] Although design team was the term of choice at the start of this research, in more recent doctrinal publications (e.g., ADRP 5-0) terminology has shifted to use of the term "planning team" to describe teams that conduct design activities (Department of the Army, 2012). Throughout this report, we use the term design team and planning team interchangeably.

activities as a team, they must also engage in "sensegiving" (Gioia & Chittipeddi, 1991) in order to convey that understanding to others in ways that are meaningful and actionable.

Research Objectives

Design and ADM have received considerable attention over the past several years, with numerous articles in professional military journals (e.g., Banach & Ryan, 2009; Grigsby et al., 2011; Kem, 2009; Paparone, 2011; USJFCOM, 2010; Wass de Czege, 2009; Zweibelson, 2011) and a number of research efforts devoted to understanding and supporting the design process (Poeppelman et al., in press; Wolters et al., in press). Nonetheless, the growing literature on ADM and associated topics (e.g., design thinking, conceptual planning, and strategic thinking) has tended to focus on the individual planner and/or the concepts and principles that surround ADM. Although design activities are virtually always conducted by teams of planners, there has been little research or guidance offered to address the collective team component.

The primary goal of the present research was to examine design activity at the level of the team, to describe and document key challenges that design teams face, and to elicit and capture lessons, strategies, and effective practices from team leaders and team members who have applied design principles and approaches in operational contexts. A secondary goal was to document and disseminate those lessons and actionable strategies in a practical resource to support and optimize the performance of planning teams engaged in design activities in the field. Specific research objectives were to uncover
- the factors considered, and strategies used, in assembling planning teams engaged in design;
- the strategies used to manage intergroup dynamics, foster trust, and promote effective discourse within a team;
- the practices for fostering critical, creative, systemic thinking and deep insights;
- the strategies for identifying and integrating non-Army subject matter experts (SMEs) into the team; and
- the strategies for capturing shared understanding and conveying insights to those external to the team.

This report presents findings from previous research on team performance, as well as insights from those who have worked in planning teams engaged in design in operational settings. It offers an integrative view of key challenges that planning teams encounter, and describes lessons, strategies, and approaches used by planning team leaders and members to optimize the performance of design activities in operational contexts.

Importantly, the focus of this report is not on ADM. Rather, the focus is on teams who are involved in conceptual planning activities that require a design approach (and that may apply ADM as one approach) to make sense of complex and unfamiliar problems. In addition, the report is intended to be descriptive, rather than prescriptive. We do not attempt to provide a blueprint for how to operate in a planning team involved in design activities. Taking such an approach would be antithetical to what design is intended to be. Nonetheless, the investigation did provide a number of suggestions, strategies, and considerations that planning teams may find helpful. These are presented in detail in a separate resource ("Making sense of complex

problems: A resource for teams") developed as part of the project reported here, and are summarized at the end of each major section of the results.

Organization of the Report

The report is organized around three major sections including a
1. **Methods** section which describes the data collection methods, participant sample, and data analysis;
2. **Results** section which describes the key challenges in functioning and performance for teams engaged in design type activities and practices that team leaders and members have found effective for managing those teams; and
3. **Conclusions** section which summarizes the report and offers a set of recommendations for future research and application.

Methods

Our research approach involved three major activities: a review of the team performance literature, data collection (in-depth interviews, observation, and follow-up survey) with individuals experienced in applying design-type activities both in the military and in the civilian context, and data analysis. Each of these activities is described in turn.

Literature Review

There is a wealth of literature on teamwork and high-functioning teams (e.g., Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; Cianniolo, LaVoie, Foltz, & Pierce, 2009; Cooke et al., 2003; Ross et al., 2009; Salas, Cooke, & Rosen, 2008) that offered the potential for providing principles and mediating factors applicable to the processes and performance of design teams. As a result we relied heavily on review articles and meta-analyses, and sought primary research articles when the topic appeared to have particular relevance to planning teams. The research team also paid particular attention to topics central to planning teams that engage in ADM, such as harnessing diverse expertise and perspectives, and fostering a sense of trust and psychological safety. However, many of the findings and principles from the literature review were either too abstract to be actionable, or were highly context-dependent (i.e., dependent upon the team's organizational context). Nonetheless, a number of findings were identified with applicability to planning teams. (For documentation of the literature review, see Appendix A.)

Data Collection

Though the review of the research literature provided general principles and practices that have been identified in previous team performance research, it was also apparent that planning teams who engage in ADM have unique characteristics that may require distinct strategies and behaviors in order to achieve optimal performance. In order to move beyond the more general (and often abstract) principles captured in the team literature, data was collected from individuals who have worked on planning teams engaged in design in operational settings. A combination of incident-based interview methods, observation, and a survey was employed to capture specific

behaviors, factors considered, and practices that commanders and planning team leaders use to facilitate effective team functioning in real-world contexts.

Participants. The interview sample included 20 participants, all of whom had either led or participated as a core member of a planning team engaged in design-type activities. Participants were identified in one of three ways: 1) through existing connections based on previous military planning and design research, 2) based on recommendations from our ARI research partners, or 3) from SME recommendations. We sought and included participants who had recent operational experience as a member or leader of a planning/design team.[4]

Participants included both active and retired commanders and planning staffs from the U.S. Army, U.S. Marine Corps, and U.S. Air Force with recent planning experience in utilizing design for managing challenges ranging from surge recovery and troop drawdowns in Afghanistan, unified response following the Haiti earthquake, determining the nature of Afghanistan's future security force, and Combatant Command strategy development. Six participants were part of an intact planning team at one of the Unified Combatant Commands. Six participants were former School of Advanced Military Studies (SAMS) or School of Advanced Warfighting (SAWs) students who had been formally educated in design, and four participants were individuals with substantial experience leading design teams in commercial design organizations. Given the parallels between design teams and strategic planning teams, we also included two SMEs from the business sector who have used design approaches to explore the complex problems within the context of strategic planning activities.

Procedure. We used an incident-based interview method adapted from the Critical Decision Method (CDM) (see Crandall, Klein, & Hoffman, 2006; Hoffman, 1998; Klein, Calderwood, & MacGregor, 1989) that was organized around the participant's experiences working on design teams within an operational setting.

Following the participants' consent to participate, interviews lasted approximately 1.5 to 2 hours. Interviews were conducted either in-person or via telephone. Topics covered in the interview included the participant's background, overview of the participant's planning team experiences, team selection and formation, managing intergroup processes and social dynamics, creating an atmosphere conducive to design, engaging the commander, fostering the cognitive activities associated with design, integrating non-military SMEs, and knowledge capture and sharing (see Appendix B for the interview protocol).

The interviews were audio recorded after receiving permission to record the session from the participant. The interview teams consisted of one primary interviewer, one primary note taker, and typically at least one additional participant and note taker. The interview notes were compiled and integrated into a single data record for each interview. The team returned to the audio recordings to fill gaps and/or address discrepancies in the notes. One audio recording was destroyed immediately at the participant's request.

---

[4] Though not all participants had referred to their team as a design team, all military participants had participated in conceptual planning teams that employed design-type activities.

Observation. During a data collection visit, we had the opportunity to observe a planning team engage in a discourse session. The discourse session lasted for approximately two hours, and then a group interview was conducted with the team. Given that the activity took place in a secure facility, we were unable to audio record the discourse session or the group interview.

All of the interview and observation data were captured in text files and were scrubbed for any personal identifying information. A quality review process was employed to ensure the files accurately and adequately reflected the interviews and observations. Since the text files were scrubbed of identifying information and to protect the anonymity of the responding participants each resulting interview record was identified with a code that could only be matched in a separate file to the participants' identity.

Follow-on survey. Our initial analysis of the interview data (described next) yielded a set of topics for which we wanted additional information and/or had follow-up research questions. To address those additional questions, a questionnaire was crafted to elicit further information from a sub-sample of the original participants. An invitation to participate in the survey was sent to all the interview participants (see script and survey in Appendix C). Seven participants responded with interest to complete the survey; and a total of six interview participants returned completed surveys.

Analysis

The research team's approach to analysis of qualitative data followed an iterative process of data review and data structuring. Our analytic procedures rely on a systematic examination of individual data records so that findings and conclusions are clearly linked to specific data elements (for a detailed explanation of analysis see Crandall, et al., 2006). In this effort, the research team conducted a thematic analysis organized around three iterative phases: 1) initial data review, 2) category coding and data extraction, and 3) synthesis and integration. Each of these phases will be described in turn.

Initial data review. The analysis effort began with each research team member reviewing the full data record. Following independent review, the team held a two-day working session to discuss and characterize the major themes emerging across the data set. The outcome of this working session was a set of major categories to explore systematically across the data set, initial documentation of inter-relationships among those categories, and documentation of gaps and remaining research questions. The team also used this session to develop preliminary ideas for the eventual multimedia resource to support planning teams. For example, the session was used to document initial ideas for the multimedia resource including goals, anticipated audience, and topics. The set of categories identified during this data review phase provided the coding structure for the research team as it moved into the next phase of analysis.

Category coding and data extraction. The second major phase of analysis involved conducting a systematic review and coding of the dataset. Using the set of categories and their descriptions captured in the initial data review, four team members examined the complete data set for the presence of material relevant to those categories. Therefore the team coded and extracted excerpts from the dataset that corresponded to each category identified in the initial review. However since the categories were not mutually exclusive, a given excerpt from the

dataset could be assigned to multiple categories. The categorizing and data extraction was conducted in Microsoft Word. The survey data were synthesized into the text file containing the qualitative data derived from the interviews and observations so that survey data could be included in the analysis.

Synthesis and integration. The final major phase of analysis involved reviewing the full set of extracted data excerpts to identify a set of key takeaways for each category. Following independent work, the research team held a working synthesis meeting to discuss key themes and capture their inter-relationships. In some cases, this discussion of connections and inter-relationships (and the consideration of survey data) led to refinement and some rethinking of major categories.

<div align="center">

Results

</div>

Analysis of the data revealed a number of challenges to the functioning of planning teams, along with practices and strategies that team leaders and team members have found effective for managing challenges. In addition, several overarching themes were identified that threaded through the detailed findings. Those overarching themes are presented in the section immediately below, followed by description of the detailed findings.

First, the organizational culture that surrounds a planning team strongly determines how the team approaches its work, including: what design actually looks like in practice, what role the commander has within the team, who the "stakeholders," "clients," or "customers" are, how products from planning teams are used, and the value ascribed to those products. Planning teams do not exist in a vacuum; the team exists within a particular organizational context and set of norms for interacting and conducting business. To be successful and to provide value, the planning team needs to be well-attuned to the surrounding organizational context.

Second, team composition matters. Some planning teams have used rigorous, carefully crafted selection processes. Others have little control over selection of team members and must make the most of the personnel assigned to their teams. While both types of situations can be successful, many interviewees commented that the effectiveness of the design team hinges largely on the individuals they have at the table and their depth of knowledge and experience. As one participant noted, "Best practices are all going to revolve around picking the right people…" (U.S. Army LTC). In other words, the effectiveness of the team is a function of who is on the team.

Third, the commander and team leader play pivotal roles. Although every member of the team has an impact on how the team functions and the outcomes it achieves, the team leader has a distinct and critical role. Some of the areas in which the commander and/or team leader's role is particularly important include
- assembling the team;
- defining the team's mission, establishing goals, and setting expectations;
- setting the climate for open and honest discourse;
- building (and maintaining) interpersonal trust and a sense of team cohesion;
- managing personalities and associated team dynamics;
- minimizing unproductive (personal) conflict, while optimizing productive conflict;

- organizing the work of the team;
- managing the team's pace and workflow;
- encouraging and guiding team members in exchanging, discussing, and integrating information; and
- maintaining awareness of the organizational context in which they are working, including the commander's and other stakeholders' needs and preferences.

Fourth, there continues to be a stigma associated with the concept of design both within the Army and across services. In line with findings from a previous investigation into the barriers to ADM (Grome et al., 2012), interviewees in the current project reported their perceptions that an air of elitism surrounds design and ADM. Some reported that they have to be somewhat subversive in their application of design - i.e., "doing design" without telling others they are doing design. Because of the continuing misperceptions surrounding design activity, most planning team leaders have adopted alternative language to describe the activity to their teams.

Fifth, most of the interviewees had not employed ADM, specifically. Although some participants had been educated in ADM (or its USMC variant) at SAMS or SAWs, most adapted ADM or are employing variations that reflect its primary underlying principles and characteristics rather than the components or steps of ADM described in doctrine - i.e., framing the operational environment, framing the problem, and developing an operational approach to solve the problem.

Sixth, *visual thinking* and *cognitive flexibility* are key components to successful design team activity. Design team members must be mentally agile in order to think through complex problems in new ways and to develop innovative approaches for addressing those problems. One approach that holds significant promise for promoting cognitive flexibility is the use of visual tools to explore and understand the problem space. Although some military design teams use visual tools toward the end of their efforts to convey insights to others, using a "visual language" (a combination of words, images, shapes, etc) can also be a powerful mechanism for inquiry and exploring the problem space as at team.

Finally, there is no standard format for design. Design team activity takes different forms, follows different approaches, and manifests differently depending on a variety of factors. These factors include the culture of the organization in which it is being enacted, the personnel involved, the echelon at which the design activity takes place, and the timeframe in which it occurs. In some cases the teams are semi-permanent, and the design activity is each team member's regular assignment - essentially the person's full-time job. In other cases, teams are ad hoc and membership in the team is a temporary assignment. Because of the considerable variability in planning teams, one experienced team leader we interviewed cautioned that "there is a danger in thinking our approaches/practices could apply to other contexts..." (U.S. Army LTC). Another participant similarly noted that "there is no such thing as "best practices" because what is best for one organization or one context is unusable in another. I think of best practices as being circumstance agnostic" (U.S. Army LTC).

While the research team noted this caution and understands the perspective and connotation that is often associated with the term best practice, the data did contain evidence of

commonalities across the varied circumstances and contexts that participants described. Participants identified consistent challenges that were present across very different types of teams, such as assembling and preparing the team, facilitating discourse and managing team dynamics, capturing learning, and conveying insights outside the team. Participants also identified and used strategies to manage these aspects of the activity. The best practices described in the sections that follow reflect the common themes, strategies, and lessons-learned from the research. The findings were organized around the well-established input-process-output (IPO) framework described by McGrath (1964) and are presented in Figure 1.

Input	Process	Output

• Assembling the team
• Preparing the team
   o Setting the team's expectations
   o Developing an atmosphere of trust
   o Establishing a shared team identity
   o Preparing the team's mental workspace
   o Preparing the team's physical workspace, tools, and resources
	• Managing intergroup dynamics
	   o Managing personalities and facilitating inclusive discourse
	   o Managing team conflict
	   o Integrating temporary team members/non-military subject-matter experts
	   o Managing team pace and workflow
		• Capturing team insights
		• Conveying insights to stakeholders

Figure 1. Organization of findings according to McGrath's (1964) Input, Process, and Output (IPO) Framework.

Input: Assembling the Team

One of the tasks a commander or team leader faces early in a design initiative is to identify and bring together the individuals who will serve on the team. Although commanders and team leaders may have the opportunity to screen and select the team, interview participants described many instances in which this was not the case. Whatever the level of involvement in forming the team, team leaders must figure out how to organize and bring together a disparate collection of individuals into a well-functioning planning team.

To meet the goal of identifying and recruiting individuals who have the potential to form a high-functioning conceptual planning team, team leaders must grapple with a number of challenges and issues, including

- identifying the process by which team members will be recruited and/or selected;
- understanding the personality attributes, skills, knowledge, and cognitive and problem-solving styles that can help or hinder the team problem solving process;
- identifying/assessing the attributes and styles of candidate team members;
- determining the optimal balance among attributes, skills, and so forth that will allow the team to function well; and
- determining the characteristics for which diversity among team members is best and those where consistency is preferable.

In the following sections, these challenges are discussed, along with the strategies and approaches team leaders have found useful in the initial phases of forming a team.

Identifying knowledge, skills, and abilities of team members. A key component of team performance is the alignment between the knowledge, skills, abilities (KSAs), work styles, and personality characteristics reflected in the team's composition and the KSAs the task will require. One of the challenges for team leaders is the nature of the problems planning teams confront. Given an unfamiliar, complex problem set, identifying a particular collection of KSAs ahead of time that would be optimal for dealing with a specific problem set is difficult at best. Instead, experienced team leaders and team members described skills, work styles, and aspects of team composition that are likely to contribute to a successful team, regardless of the specific problem they face.

Diversity. Many of the team leaders interviewed for this project identified diversity as a critical attribute of military planning teams. Teams comprised of people with widely varying backgrounds, experiences, and work styles are seen as having a greater variety of perspectives to draw on, once they begin their work. The research literature also indicates that diversity is advantageous for team performance. Teams that are more diverse tend to be more creative, to engage in higher-quality discourse, and to develop more innovative solutions. Diversity within the team allows for more open-mindedness, more active pursuit of diverging arguments, and the ability to see a wider range of possibilities in the problem solving and planning process (e.g., Nijstad & de Dreu, 2002). In his interview, one team leader noted "the greater the diversity, the increased chances that members do not subscribe to the organizational paradigm or at least question some aspects of it. This is key to critical reflection" (U.S. Army MAJ).

Experienced team leaders also reported that creating a military planning team with a significant degree of diversity can be a challenge. Military planning teams are primarily comprised of career military personnel whose values, language, and perspectives are largely shared, and whose backgrounds, education, and deployment histories may be remarkably similar. The team performance literature also notes challenges associated with diversity and describes diversity as a double-edged sword (e.g., Kravitz, 2006). While diversity within the team can offer several benefits, teams with strongly divergent perspectives may suffer from a lack of team cohesion and experience team process challenges (Jackson, 1992; Kearney, Gebert, & Voelpel, 2009).

Interestingly, the subset of participants who completed the follow-up survey painted a fairly nuanced picture of team diversity. The participants identified two different types of

diversity (e.g., one which represented maximum variability of certain traits across the team members and another which represented selected variability of certain traits across the team members) which are seen as important for design team performance. There are some components where maximum variability is the goal, based on the view that the team as a whole benefits when the individuals on the team come from a rich mix of

- backgrounds, education, training, credentials/qualifications, rank,[5] work experience;
- assignments, deployments, career history, areas of expertise;
- functional areas (e.g., planner, intelligence, logistics, special ops);
- genders;
- personality characteristics[6] (e.g., Myers Briggs Type Indicator (MBTI) types[7]); and
- approaches to solving problems.

In general, the team performance literature supports this view. For example, Schultz-Hardt et al. (2002) argue that diversity in functional and educational background is particularly beneficial for stimulating divergent viewpoints in a team. Further, in Williams and O'Reilly's (1998) review, they found that diversity on functional and educational background is the one demographic variable consistently demonstrated as having a positive impact on team process and performance.

In addition to the characteristics for which survey participants seek maximal diversity, there are also features that survey respondents described as highly desirable to have as part of the mix of skill and talent on the team. These are skills and talents that someone on the team should have, but where maximum variability across the team is not necessarily the point. From the survey participants' perspective, successful planning teams engaging in design are likely to include at least some members who are

- voracious readers, and able to digest and synthesize large amounts of information;
- efficient, effective writers, and able to communicate ideas verbally and in text; and
- able to think visually, and can communicate ideas visually, as well as can create effective graphics.

Similarly, participants reported that it is advantageous when the team has a good mix of thinking styles and preferences. Conceptual planning teams were seen as working best when at least some team members are big picture thinkers, some are detailed thinkers, and some think in abstractions. Likewise, participants noted it can be helpful to have some people on the team who are historical thinkers, and think in terms of the historical, geo-political roots of problems and issues; people who are adept at thinking forward in time and constructing in-depth mental simulations of how a situation or potential solutions is likely to play out; and people who are

_____

[5] However, too wide a dispersion of rank may mean that junior-level members may not have the breadth of experience to draw on, and may defer to high-ranking members.

[6] Although personality characteristics were identified as a component where variability across the team is desirable, team leaders and members also described certain personality attributes that are simply not helpful on conceptual planning team. For example, individuals with high needs for control, who are unable to tolerate points of view different from their own, who are unable to manage uncertainty and ambiguity, or who demand to be the center of attention are often disruptive and/or unable to perform well in conceptual planning teams.

[7] While many of the teams discussed using the MBTI, the research authors are not making any claims about the scientific validity or reliability of this assessment.

metacognitive thinkers, and can reflect and comment on how the team is thinking about a particular topic.

These findings are generally consistent with previous literature that has addressed the patterns of team member characteristics and their impact on team effectiveness (Klein & Kozlowski, 2000; Stewart & Barrick, 2004). In some cases, researchers have found that *more* of a particular characteristic (such as general intelligence or emotional stability) may generally be better for team effectiveness. But with certain characteristics, a *balanced* pattern may be optimal. For example, Stewart and Barrick (2004) suggest that a balance across members on personality characteristics such as extroversion, agreeableness, and conscientiousness may be better than similarity along those dimensions.

Uniformity. How experienced team leaders think about team composition goes well beyond a simple desire for substantial diversity on the team. In the interviews and the survey, team leaders also described a set of attributes that they value for *all* team members. These are dimensions where commonality among team members - rather than diversity - tends to be desirable. Team leaders reported in the interviews that design teams benefit when all members of the team are
- eager to learn, naturally curious, and enjoy learning for learning's sake;
- task-oriented, with a strong work ethic;
- able to think deeply and in a sustained way about a topic;
- open-minded, adaptable and willing to consider points of view that differ from their own;
- disciplined, critical thinkers, adept at following a line of reasoning and evaluating it for its value, efficacy, and relevance;
- able to break complex ideas into simple words and phrases;
- willing to speak up, to share their thinking and points of view with the rest of the team, and to work collaboratively;
- unafraid of having their ideas critiqued by others on the team;
- able to accept a less-than-perfect solution;
- comfortable with ambiguity; and
- aware of how the sponsoring organization thinks, and its typical approach to problems.

In addition to these characteristics, the team performance literature has pointed to the importance of interpersonal skills to team effectiveness (Paris, Salas, & Cannon-Bowers, 2000). Mohrman & Cohen (1995) for example, noted that several interpersonal types of skills increase in their level of importance when individuals work within a team. For example, "an individual needs to be able to communicate with others, listen to others, influence others and so forth" (Mohrman & Cohen, 1995; p. 384). Collectively, Morgeson et al. (2005) refers to this set of skills as "social skills." This skill set encompasses skills such as coordination, negotiation, social perceptiveness, persuasion, instructing, and helping others (Mumford, Peterson, & Childs, 1999).

There are a number of commonalities between the KSAs and cognitive style dimensions identified in the current dataset and those identified in an investigation of the KSAs for design conducted by Wolters et al. (in press). At a team level, however, the two efforts provide quite different pictures. The Wolters et al. (in press) research suggests an approach to selection and team formation that emphasizes KSA consistency and commonality across members of the team.

Methodology in that research emphasized desired and critical KSAs of the *individuals* involved in design activities. When experienced team leaders and commanders were asked about the design *team*, as a collective group, as in the research presented here, a more-nuanced picture of the optimal configuration for a conceptual planning team emerged.

Overall, the impacts of diversity on team performance are complex and empirical findings have been mixed. There is a need for more research into the complex configuration of KSAs (including which KSAs all design team members need versus those that only some members need to possess) and how different KSA configurations differentially impact team performance (Kozlowski & Ilgen, 2006).

Recruiting and selecting team members. Individuals become members of a planning team in a number of different ways. Interview participants indicated that although the team leader may have a significant say in who ends up on the team, in many cases he or she may have very little input. Moreover, having decision authority over who serves on the team is not the only requisite to putting together a high functioning team. Planning team leaders described teams whose members had come to the team effort in a variety of ways. Team members may be recruited by the team leader or commander; members may apply to be part of the team through some formal selection process; members may hear about a problem solving effort informally (e.g., group "FYI" emails or word of mouth) and volunteer to be on the team; or, members may be selected by someone else in the command structure who nominates or assigns them to the team.

In one example, co-leaders of a planning team employed a thorough and intentional selection process that included assessment instruments, several interviews, and a writing assignment. The co-leads had an explicit set of criteria that reflected the characteristics and skills they considered important for a successful design team. The candidates were evaluated in terms of that set of criteria. In a second design effort the co-leads refined the criteria and selection process further. The co-leads saw the selection process they had developed as critical to the high quality of the team's process and work products. As one of the co-leaders noted:

One key thing I felt was important about a designer is not only that they fit into the team, but do they have the cognitive skills and tools to engage in this thing called design - do they have the expertise and intellectual power and willingness to learn.

We crafted about two dozen questions based on the personality assessment [we had given them earlier], questions to highlight and understand particular strengths, and the way somebody would interact with the environment around them. If someone showed up as intuition/thinking individual, how did they do that? . . .

I was trying to develop a culture of humility within the team, so … [I] try to get a sense of person's humility when they talk… [We also considered their] ability to use a whiteboard. Creative and visual thinking are important. We had several questions that

forced people to use a whiteboard. Some didn't want to touch it at all, some were very natural with it. (U.S. Army LTC)

In another example, the commander notified directors in selected areas that they needed to identify one person to be assigned to a six-month problem solving effort. Informally, the commander conveyed his criteria as "candidates for the team need to be some of your smartest, most capable people. If it doesn't hurt to lose them for an extended period, you're sending the wrong person" (USMC MajGen). This distributed selection process also worked well, and both the commander and team leader were pleased and impressed with the high quality personnel assigned to the team.

In a third example, team members were selected by the commander and assigned to the team, in accordance with his notions of what the team would need to function well. The commander knew the individuals and their skills, and selected them accordingly. In all three examples, these planning teams engaged in design activities provided important and valued products to their commanders, and their team efforts were considered successful. Rather than there being a particular best practice for creating a problem solving team, what seems to matter is how the team leader works with the people who come to the team.

Getting an initial view of the team. Whatever the process is that brings individuals onto the team, one of the team leader's tasks is to figure out how to mesh the group of individuals into a functional work team. Doing so requires figuring out who the prospective team members are and their strengths and weaknesses. In our interviews, team leaders described both formal and informal assessment strategies for gaining an initial view of individual members, and of the overall team configuration. In some cases, these assessment strategies are used as part of the recruitment and selection process; in other cases, these strategies are used once the team is already established. Some of the assessment strategies that teams have used included the following:

- Inventories and assessment tools for identifying talents, work style and interaction preferences, and aspects of personality. Some examples that teams reported finding useful include the Myers-Briggs Type Indicator (MBTI), StrengthsFinder, and the Kirton Adaption-Innovation Inventory.
- Writing samples and other examples of work products that provide insight into individual communication styles and proficiencies.
- Interviews used during the selection and/or orientation process. Interview processes ranged from structured interview protocols to informal conversations. Regardless of the format, the opportunity to talk with team members individually was consistently identified as a useful source of information. By the mid-career level, which is typical for personnel entering these teams, military personnel typically have a good sense of their strengths, skills, and work style preferences and can describe them reasonably well. Team leaders reported that questions related to how well team members manage loosely-structured tasks, reading and writing ability, and whether they are visual thinkers or skilled at creating compelling graphics were all useful for conducting initial evaluation of team KSAs.

Determining team size. The review of relevant research literature suggests advantages and disadvantages to both small and large teams and no clear empirical support for a link between team size and productivity (e.g., Hackman, 1987; Hammerstrom, 2010; Klimoski & Jones, 1995). For example, larger teams have more cognitive resources upon which to draw (e.g., Halebian & Finkelstein, 1993); yet a larger team size may also have detrimental effects on performance due to heightened coordination needs (e.g., Gladstein, 1984; Hammerstrom, 2010; Sundstrom, DeMeuse, & Futrell, 1990). Findings from our interview data also suggest that there is no "right size" for a planning team. Participants reported their own team varying in size from two to 25 people. Teams of five to nine persons were typical, and larger teams often managed their work by dividing into smaller sub-teams to complete certain tasks (e.g., independent research) and then reconvening for discourse. Obviously, larger teams require more resources, including larger workspaces. However, space and resource requirements are not the only costs associated with larger team sizes. Large teams also involve significant coordination among members, including the time and resources involved in sharing information and insights across a large team, and keeping sub-teams in sync (Mathieu, Rapp, & Gilson, 2008). One team leader noted:

> I have worked with teams from two to 25. Two is simply too small. Three is a big jump, but still too small. Four to six are sizes that have worked the best. Large teams can get more work done, but have difficulty reaching consensus. Small groups are great for decision making, but not great for getting a lot of work done. Almost always, I subdivide large (seven+ members) into subteams of four to six. (Commercial team leader)

A summary of strategies, suggestions and key considerations for assembling the planning team identified by interview participants and the team performance literature are included in Table 1.

Table 1

Assembling the Team: Summary of Strategies and Key Considerations

---

- Recognize both the advantages and disadvantages associated with team member diversity. For example, more diverse teams have a wider range of perspectives on which to draw, but may experience more discord.

- Seek to maximize diversity on traits such as educational background, functional area of expertise, and problem-solving approach. Seek to maximize uniformity on characteristics such as open-mindedness, adaptability, curiosity, and critical thinking skill.

- When the opportunity exists to select members of the planning team, consider using tools and approaches for assessing an individual's relevant skills and characteristics (e.g., interviews, writing samples, personality tests, and visual thinking exercises).

- When selecting team members is not a possibility, consider using tools and inventories for assessing characteristics of the team members you have once the team is in place.

- Recognize that there is no right size for a planning team, but there are advantages and disadvantages related to team size. For example, larger teams may mean more perspectives on which to draw, but might yield larger coordination costs. Smaller teams may yield fewer perspectives, but perhaps more efficient coordination and increased cohesiveness.

Preparing the Team: Creating an Atmosphere Conducive to Design

There are several activities involved in preparing a design team to grapple with the problems they have been asked to address. One activity involves orienting team members to what the team is there to accomplish, along with figuring out how the team will work together, and the processes and work sequences the team will adopt. Another aspect of preparation involves lining up resources and tools, and configuring the team's physical workspace. Finally, getting the team ready to work involves helping team members loosen up their thinking and preparing their "mental workspace" for conceptual planning. The activities involved in conceptual planning and solving unfamiliar problems require team members to think holistically, visually, critically, creatively, abstractly, and from multiple vantage points. Some team members may be familiar with working and thinking in these ways, but others may require help acclimating to a different and unfamiliar approach to planning. The participants reported that bringing team members together around a common set of processes and ways of thinking is an important aspect of getting them ready to work.

Setting the team's expectations. The commander and team leader have key roles in orienting the team to the task they are undertaking, and there are several factors that may make the task of orienting the planning team challenging. One is the need to provide the team with some direction about how to engage in sensemaking and problem solving activities, and how the team's activities are likely to unfold. At the same time, commanders and team leaders' also viewed it as important to refrain from being overly prescriptive, or dictating what the process

should be. Finding a balance between providing a process and allowing the team's activities to naturally unfold was a challenge for some team leaders.

Similarly, it is important the team recognize the practical considerations that will impact their work. For example, what the team produces has to meet certain schedules and deadlines, and those are typically linked to the commander's needs and desires. The team will also likely operate with limited resources of time, personnel, materials, equipment, and information access. Furthermore, what the team ultimately produces has to be useful to people outside the team. It is not enough for solution concepts and work products to make sense to the team. The products must provide value and utility to key stakeholders (e.g., the commander and other senior leaders). Recognizing and managing these various constraints, and balancing these constraints against the team's need for space and time to think deeply about the problem the team is to address, is a challenge for team leaders.

Finally, there is the challenge of figuring out what terminology to use to describe the team's activity. There has been significant consternation within the Army and across Services about design and/or Army Design Methodology (ADM). For a variety of reasons, many members of the Army and Joint services have negative impressions of ADM as elitist and/or simply confusing. Therefore using the terms design or ADM may have an unintended consequence and create resistance among some team members and stakeholders. As an interviewee explained "talking about design strictly still has stigma associated with it… You can get away with saying we're going to do problem framing. I don't put a 'hey, we're going to have a design session,' on a calendar invite" (USMC LtCol).

Another noted:

I avoid using the term design in all but the friendliest of design environments… to avoid the threats, negative comments, and fear that being a design practitioner generates. I now have learned to mask my approach; I use specific but very simple terms. I employ many metaphors; I avoid complex words; I make my drawings on whiteboard but then translate them into simpler, refined deliverables that appear to be merely MDMP done clearly and tastefully. I slip in small design approaches and layer doctrinal terms to disguise them; I even repeat things leaders say that weave into design concepts so that they are hearing words they knew they said- but now those words support a deeper, explanatory approach. (U.S. Army MAJ)

Strategies for setting the team's expectations. Interview and survey participants noted a number of strategies for dealing with the aforementioned challenges. For example, given the stigma associated with design and ADM, the majority of participants described using alternative labels for the activity. Leaders of planning teams in operational contexts have framed their teams' activities using a variety of terms, including: conceptual planning, problem definition, complex problem solving, framing activity, framing session, getting our arms around the

problem, visioning, thinking critically and creatively, concept development, framework creation, big picture thinking, problem framing, collective sensemaking, and questioning fundamental assumptions.

Another strategy leaders have found useful for setting the team's expectations has been to provide the team with a high-level goal statement. Interview participants consistently remarked about the ambiguity and uncertainty surrounding the design activity, and that providing some statement of objective can help members better manage the uncertainty team members will be facing in the activity itself. For example, one interviewee noted "there will be plenty of uncertainty to manage . . . Most of the team enjoyed the certainty I provided for them by explaining what we were doing, and what I needed them to accomplish" (U.S. Army MAJ).

The point of the commanders and team leaders providing a goal statement is not to specify a set of steps, but to provide the team with some general guidance. Previous research has also suggested that goal-setting is a helpful activity for team functioning (Klein et al., 2009). From our interviews, some of the ways that team leaders articulated the team's goal included phrases such as:
- We need to learn about [fill in the blank];
- We need to provide senior leadership with different lenses for viewing the problem;
- We need to answer a specific question. For example
  - What are we going to do about [insert region]?
  - How did [insert] happen?
- We need to provide the commander with alternative realities that he can use to examine the area of operations; and
- We need to orient the commander to the environment, provide the team's assessment of environment, and the team's recommendations in order to allow the commander to move to a decision more quickly.

One interviewee described embedding the goal statement in a "charter," which is an orientation document used to promote shared understanding between the convening authority (i.e., the commander) and the planning team. He described using a charter that has several components including the
- Background or the history that generated the need for the team (i.e., the condition or situation requiring attention, and current trends that affect or will affect the situation);
- Project statement that includes a succinct and operationally worded outline of what the team's effort is intended to achieve;
- Goals that reflect the general intent of the team and the existing goals to be supported;
- Resources that include the physical resources to be employed during the effort, and the human resources that can be called upon;
- Schedule for the team effort, including phases, milestones, and gateways (gateways are go/no-go reviews by the commander);
- Methodology for the planning processes, including methods or tools to be used; and
- Issues that reflect a starter set of topics believed to be important to the effort, and questions for consideration for each topic. As the SME noted, "identifying issues and developing positions on them can get a team going immediately."

Some experienced team leaders also found it valuable to describe the *"anti-goals"* of the activity, and what the activity is *not*. The nature of design activity means that in some cases, articulating the anti-goal can actually be easier than articulating the goal(s). As noted by a team leader, "All I could articulate was what we weren't going to do, not what we were going to do" (USMC MajGen). Based on the interviews, team leaders found it effective to differentiate the activity of the team from traditional methods of planning and problem solving. On many teams, there were some members who had been exposed to (or trained in) non-linear approaches to problem-framing and problem-solving, and other team members who were more accustomed to using traditional analytic tools and procedures. Contrasting the team's task with linear planning procedures such as MDMP or JOPP, and explicitly noting that it is a different way of thinking about the problem, can be helpful in preparing the team and setting expectations for the work to come. One participant eloquently described one of the anti-goals of design activity and its associated challenge:

> Comfort and structure are the enemy of design-based problem solving. By far, my greatest challenge as team leader was getting the team to work in an atmosphere that felt disorganized and chaotic and to resist efforts to organize away creative thinking. (U.S. Army COL)

Another strategy that team leaders reported involves priming team members by providing them with examples and descriptions of the process the team will engage in, including the sense of confusion and disorientation that can occur in the process of moving from one way of seeing the problem to another. Reframing and restructuring is a common part of the process, but also often a stumbling block. As a leader of an innovation and strategic design consulting firm described it:

> [It is] common to think as time passes and as we know more, things get better in a proportional type of way. But that's not what happens. As we begin to learn more about our subject, we begin to conclude our problem is different than what we're trying to solve, that the problem needs to be reframed. That leads to the first moment of challenge. Everyone has met and agreed that we're going to address problem x, but the real problem is different or much more complex… Best thing you can do is inform everyone ahead of time that that point is coming. I won't say it's unavoidable. But there's a high likelihood that there will be moments like that. You have to tell them that day is coming, so don't be surprised when it does. It's important that people recognize that moments of confusion are informative, not negative. (Commercial design team leader)

In a similar vein, another team leader noted in an interview:

> If I were going to do this again, I'd be prepared to articulate and show examples of chaos, disorganization, of confusion and say: 'we're going to go through a period of chaos and confusion'...That would've set things up a lot better. (U.S. Army LTC)

Other strategies reported by participants for setting expectations and preparing the team for working together include: Developing a set of ground rules for team interaction and discourse; facilitating a discussion to help team members define and understand their own and other's roles in the team; providing a reading list that exposes the team to key practices, work processes, and problem-solving approaches that the commander and/or team leader hope to encourage within the team.

Developing an atmosphere of trust. Creating an environment in which members feel comfortable to freely engage in the exchange of ideas is a foundational component for design teams. While trust is vital in any team (Han & Harms, 2010; Ilgen, Hollenbeeck, Johnson, & Jundt, 2005), its importance is amplified in an environment in which people are expected to think creatively, share information openly, and engage in frank and energetic discourse. To coalesce around the challenging work the team is embarking upon, team members need a sense of psychological safety (Edmondson, 1999). Team members need to know that they can share their ideas and viewpoints, and critique others' ideas and viewpoints, without fear of reprimand, negative consequences or concern about making mistakes. As one team leader noted:

> A team must become a trust group in order for members to freely express their incomplete ideas, working hypotheses and emerging ideas. Creative productivity is greatest when team members can build on each other's thinking without concern for making mistakes. (U.S. Army CIV)

Another team leader noted:

> When you are first coming to grips with the essence of the problem or trying to generate a solution…you need everyone's mind and heart open (not to be too fuzzy). Once the mind or heart closes, or someone's feelings are hurt, they will no longer help solve the problem. (USMC LtCol)

The commander and the team leader have key roles in building and maintaining trust. Senior leaders have the ability to set the conditions for trust by creating an environment that is safe for critical thought and discourse, and they have the ability to dampen and jeopardize trust, though perhaps unintentionally. However it is important to recognize that responsibility for making the team work and play well together does not reside only with the commander or team leader. In highly functioning teams, team members develop a shared sense of ownership for the

team and its products. Everyone on the team is responsible for how the team functions, including the development and maintenance of trust among team members (Zsambok, Klein, Kyne, & Klinger, 1993).

Key challenges. There are several factors that pose obstacles to building and maintaining trust within design teams. A significant issue identified by experienced team leaders is the military culture itself. From the outset of their careers, Soldiers are conditioned to conform to the military's hierarchical command structure. Soldiers have been trained to follow orders rather than to question, and to expect orders to be followed. The military's culture has evolved in this way for good reason, and has served the military and our country well. But it has its costs, and one of those costs may be an endemic lack of trust across ranks in the military (see Kaplan, 2007).

For the team to work effectively together, team members must set aside behaviors that are often encouraged (and sometimes required) in military settings. Despite rank, and the service, agency, background, or nationality team members come from, it is important to establish a team climate in which members share ideas, think critically, question assumptions, and critique one another's thinking. In organizations accustomed to hierarchical decision making, these behaviors may be seen as high risk and inappropriate. Still these behaviors are essential features of effective planning teams engaging in design. If a conceptual planning team operates using standard military modes of interaction, it is likely that more junior members of the team will be at a disadvantage, and experience a greater degree of risk and discomfort during discourse. Junior members may find it extremely difficult to actively question the assumptions and perspectives held by higher-ranking team members.

An additional obstacle to building trust is the time and opportunities for interaction that building trust requires (Taylor, 1989). In some circumstances team members may be working with people they already know and trust. However in many cases, it is likely that team members do not know one another, and are working together for the first time. Having the necessary time and shared experiences for building trust can be particularly challenging when the team is operating under time constraints. This is often the case with ad-hoc teams who convene quickly and are operating in response to crisis events such as natural disasters. In one example, an interview participant described his experience as part of a planning team during Operation Unified Response after the Haiti Earthquake; he had never worked with any of his five teammates, and their work pace provided little downtime. Nevertheless, given that trust within a team is believed to increase team effectiveness, it is important even in these time-pressured situations to find ways to foster trust (see Garven, in press for training on fostering trust in quick forming teams).

Strategies for developing and maintaining trust. Based on the research literature and the interview data, there are a number of strategies and practices that may be helpful for building and preserving trust within design teams. This is not a comprehensive review of the research on trust, as there are previous and ongoing research efforts that have covered this topic in significant depth (e.g., Garven, in prep). Here we report the strategies that were most consistently reported by interviewees.

One strategy is to engage in trust- and team-building activities at the outset of the team's interaction. While empirical evidence on the efficacy of team building is inconsistent and inconclusive, some researchers continue to suggest that team-building interventions have potential in improving team effectiveness (Kozlowski & Ilgen, 2006). The practices that have the greatest potential to be effective are those that focus on clarifying roles, building interpersonal relationships, and setting goals (Klein et al., 2009).

One example reported by participants is the use of personal story-telling exercises that provide a forum for team members to share background information and key skills and experiences with the rest of the team. For example "…the first day we were all in the same office, we went around the table sharing personal histories, why you're on the team, what your strengths and weaknesses are" (U.S. Army LTC). One participant recommended providing a short list of topics that these personal introductions should cover. "If there is no model, usually whatever the first person to speak says becomes the model for all. With a list, team members don't have to worry about saying too little or too much..." (Commercial design team leader).

Another example is a role-clarification exercise that allows team members to describe what each brings to the team (e.g., I have significant background in CBRNE, I am fluent in four languages) and to discuss the combined skill set of the team in light of the team's tasking and goals. This exercise also provides an opportunity to highlight and deconflict areas in which the team leader or other team members may see an individual's role differently, or see a connection between some aspect of their personal history and the team's mission. These activities can be useful at both the outset of working together, and when new team members are being added to the team.

A second strategy described by interview participants for fostering trust is to share the leadership function, by asking other team members to lead group discussions or discourse sessions. The simple act of a team leader sitting down (or letting go of the whiteboard marker) and letting others take over invites a sense of shared ownership of the team, and contributes to building confidence and trust. One interviewee noted "when the leader sits down and allows others to pick up the marker and write on the board - or allows someone else to speak without interruption, condemnation, or condescension - others feel like they can contribute and will" (USMC LtCol).

Another strategy for building trust within the team involves providing opportunities for social interaction. Team leaders and members described in the interviews the importance of social interaction for building trust and enabling team members to get to know one another on a more personal level. Social events can also be useful to help provide a needed reprieve from intense research and discourse sessions. One participant noted the importance of exploiting the team's break times in one interview:

Breaks release tension, but they also allow members to talk about issues informally. Not only do team members recharge, they also get to know each other. I usually suggest that teams break for a cup of coffee about once an hour. (Commercial design team leader)

Another team leader reported "I didn't do a good job of mixing in social things… Like, 'let's go out to lunch.' I think it would help to create a better dynamic in managing tensions… There's no reason we can't have a discourse session over beer" (U.S. Army LTC). Yet one design participant also noted an obstacle to this, as he noted the fine line between trust-building and fraternizing:

> The Army warns against this…[they] call it fraternizing. If you cross the line, if you become too familiar with your subordinates or your peers, then they lose respect for you…You can almost become insubordinate. There's a fine line there you cannot afford to cross. I'll acknowledge that. But I'll also tell you, If you aren't walking on that blade, tipping toeing right off to the left or right of that, and you walk into a conference room and say, 'what are we going to do' and you hear silence, then you're way off target. Then you've got an environment that's beyond stifled. It's fear...You don't want that. You want to break those barriers down. Get everyone in the same location where they feel like they can say what they need to say or want to say without being told [to] sit down. (U.S. Army MAJ)

One of the most compelling actions a team leader can take is to explicitly invite disagreement and alternative points of view from his/her team. While many successful teams appoint a particular individual to serve in the role of devil's advocate, inviting push back from all team members provides an opportunity to get a broader array of countering viewpoints from multiple team member perspectives. For example, a team leader who was viewed as a particularly effective and trusted leader by his team explicitly encouraged push back from his team members by saying or asking:
- "Somebody challenge me on my assertion."
- "Who at the table disagrees with this?"
- "What factors are we missing [in this model]? What do we need to be considering?"
- "Where does the model break down? What other factors need to be considered?" (which invited the team to think critically about the model they had constructed). (U.S. Army LTC)

While attention is often given to trust-building activities, *maintaining* trust or *rebuilding* trust when it has been damaged are equally important considerations. Rebuilding trust once broken is different (and often much more difficult) than building and maintaining it. If trust is damaged (e.g., if a discourse session breaks down into personal attacks), it can take significant effort and time to mend (Fukuyama, 1995; Han & Harms, 2010). Thus attention to maintaining trust is important. Successful team leaders invite members to monitor trust relationships across the entire span of the team's lifecycle and to actively note or engage the issue when breakdowns are imminent.

Establishing a shared team identity. Answering the question "Who are we?" is another critical aspect of preparing a planning team to work together effectively. Team identity refers to the extent to which team members see the team's goals as their own and feel interconnected with the team's fate (Han & Harms, 2010). Previous research has found evidence for a positive relationship between team identity and team performance (Han & Harms, 2010; Lembke & Wilson, 1998; Pratt, 1998). Teams who know one another and strongly identify with the team, its goals, and mission are more motivated to exert effort for the overall team success (Tyler & Blader, 2000).

Creating a shared sense of identity within a planning team involves discussing and determining the team's purpose or mission, its core values, and the team's strengths and limitations. It involves understanding who each team member is as an individual, and the attributes and skill sets each person brings to the team. Developing a shared identity also encompasses a consideration of social norms - that is, what is appropriate and acceptable for engaging with one another, and what is not. Finally, it includes developing a common language, or a shared lexicon, within the team. While the team leader certainly plays a pivotal role in the development of the team's identity, every member of the team has a role in creating the team identity.

In the interviews, participants described the importance of a shared team identity for establishing common ground and a shared sense of purpose across the team. Participants also described the importance of having a shared team identity when communicating with external stakeholders. Specifically, participants discussed maximizing opportunities for positive impact within the organization by having team members who could communicate the team's purpose clearly and consistently to key stakeholders within the larger organization.

Experienced planning teams indicated in the interviews that the team's identity and the culture the team creates are greatly influenced by the organizational context in which the team resides. What the team does, what the activity actually looks like, and what the team can offer depends heavily on what is needed and wanted by others within the organization, along with what the larger organizational culture will support. For example, some team members reported they had learned to never use the term design team when describing themselves or their activities, because the concept of design was perceived so negatively in the larger organization. Therefore, understanding the organizational context is a key aspect of team members figuring out who they are as a team.

Given the impact that the organizational context is likely to have on the team's purpose, team members noted in their interviews the importance of recognizing and discussing as a team "What the market will (or will not) support?" For the team to be effective, it must address issues such as, what processes and outcomes will fit or work within our organizational context? What sorts of work products will be well-received, and what are likely to be dismissed? This perspective was noted most strongly by one interview participant:

As a design team leader, you have to be more adaptive, rather than forcing design as a

rote process. You have to apply it within the culture you are resident in. It's really

situation and personality-dependent. You have to be very cognizant of that as a leader.

(U.S. Army LTC)

The team identity is also based, in a very practical way, on the support the team receives from senior leadership. This includes the support and "cover" the team receives, both in a political sense and in terms of the resources dedicated to the team's efforts. If the planning team remains together for a long time, the team's purpose and mission may evolve significantly over time as organizational leadership changes. Similarly, as the membership of the team itself changes, the team's identity will also evolve.

Strategies for creating a shared team identity. Participants' interviews revealed various considerations and strategies related to fostering a shared team identity. Creating a shared sense of the team's identity depends in part on understanding the unique skills, characteristics, knowledge, and experiences of each individual team member. Some strategies that experienced planners and designers have found useful for uncovering the background and expertise of team members include activities such as providing a biographical sketch of each team member prior to the initial team interaction, or giving team members the opportunity to describe the background, skills, key experiences, and perspectives they bring to the team.

Another approach to developing a team identity is to pose questions about the team to team members. Some examples offered by experienced team members and leaders included questions such as "Who are we?" "What do you think our team is here to do?" "What unique value does our team offer?" "What impact can the team have?" As noted by one team leader "I asked the very first question after the introductions in our three-day course. I asked 'who are we?' And that just set off a fire storm" (U.S. Army COL).

Some teams found it valuable to develop a team mission statement as a reflection of shared team identity, and to document the statement. One team leader discussed creating a team handbook that became a resource that team members could refer to or share with members of the organization who asked about the team and its purpose:

[The team handbook] contains a brief mission statement – why we exist, values of the

team, culture we want to build/have, draft discourse rules, team members and their

particular strengths, how design is different from traditional staff work. Also has some

generic design questions - memory joggers. Ways to ask questions. And a reading list, a

resource list, which I've acquired from multiple sources. Eight to nine pages of books,

videos, web pages. I keyed in on some specific issues people had. The environment can

be confrontational at times, but collaborative at the same time. It did cross my mind that

some people might deal with those better than others. (U.S. Army LTC)

A final strategy is to periodically re-evaluate the team's identity. For a variety of reasons, the team's identity may adapt and evolve over time, particularly if the team remains together through several planning series. Changes in organizational leadership or the addition of new team members are factors that may contribute to the evolution and the need for adaptation. One team we studied described the evolution that occurred when bringing in new team members. New members can disrupt the existing team identity and create moments of confusion, particularly when legacy team members discuss or allude to past shared experiences. New team members generally will not have common ground or a shared language with the rest of the team. Experienced design team members noted that at these points, it can be helpful to revisit what the team discussed and agreed upon early in its lifecycle, with respect to its central purpose and mission and ask "Is this still who we are?" and "How are we different now?" From these types of discussions their team identity will evolve accordingly.

Preparing the team's mental workspace: Fostering cognitive flexibility. For planning teams to thoroughly understand unfamiliar problems - to see important connections and influences and to articulate key nuances - requires team members to think and explore the problem in ways that some team members may not be prepared for. Making sense of the problem is going to require team members to adapt their typical ways of thinking, and to think critically, creatively, holistically, reflectively, visually, and from multiple perspectives. In the same way that an athlete warms up before starting an intense workout, team leaders noted in our interviews that it can be helpful to loosen up the minds of the team members before engaging in design activities.

Key challenges. One of the factors that may make getting mentally prepared challenging is a military culture that encourages its members to use highly analytic processes to plan and solve problems. While linear, analytic, and highly structured modes of thinking are exactly what is needed for many problems, these modes of thinking are not so effective for making sense of highly complex or unfamiliar problems. That means that the cognitive tools that many planners bring to solving complex problems are often not best suited for the task. In addition, the type of thinking required for design activity is not the type of thinking the military culture supports (see Grome et al., 2012). Individuals may perceive thinking in this way as somewhat risky, as it challenges typical military conventions of structured analysis and rapid decision making.

A related challenge for team members is to develop a sense of how they typically think, what perspectives and biases they bring, and how they usually solve problems. For some team members, this kind of metacognitive awareness may be second nature. But for many, this metacognitive awareness may be new and possibly uncomfortable. People can get stuck in their own worldviews and paradigms, and have difficulty breaking away from them and looking at problems from a different viewpoint (Paparone, 2011; Zweibelson, 2011). *Metacognitive reflection* - thinking about one's own thinking - is a skill that requires practice and support (Schraw, 1998).

In addition, thinking in different ways (particularly in a holistic/systemic sense) is a challenge because of the human tendency to oversimplify as we attempt to make sense of the world. Feltovich, Hoffman, Woods, and Roesler (2004) describe the human tendency to reduce complexity to simplistic explanations as the *reductive tendency* (p. 91). People tend to exhibit

this tendency when situations or events are dynamic and emergent (and not governed by principles of cause and effect), when the situation includes multiple context-dependencies, and when key principles are highly abstract and not obvious.

An additional challenge to preparing the team's mental workspace is the presence of team members who are unwilling (or possibly unable) to open their minds to other perspectives, ideas, ways of thinking, and alternative work tools or processes. To optimize the team's interaction and collective sensemaking activity, it is essential that team members offer respect for and consideration of others' ideas and contributions, and be open to at least exploring different tools, approaches, and ways of thinking. The team leader has a central role here, both in modeling these behaviors, and in reinforcing them in the team.

In a sense, cognitive flexibility is what drives design thinking and conceptual planning. The purpose of discourse is not to engage in an academic exercise, but to examine ideas and systems of thought from a variety of perspectives. Discourse is a means to gain insight, depth of understanding, and recognition of the advantages, drawbacks, and the relevance of a given perspective to the problem the team is addressing. The degree to which discourse activity is successful depends on how capable the team is at adopting a variety of perspectives, at least temporarily, in order to appreciate what each might contribute to the overall effort. This adaptive plasticity of thought is often referred to as cognitive flexibility.

The construct of adaptive thought has been addressed by a number of cognitive researchers, using a range of terms and labels. For example, Spiro and colleagues have described a model of cognitive flexibility that addresses the restructuring of knowledge in response to highly dynamic situations (e.g., Spiro, Coulson, Feltovich, & Anderson, 1988). Cognitive developmental researchers use the term *decentering* to describe the ability to view an object (or situation) from multiple perspectives (Piaget & Inhelder, 1969, p. 26). Klein and colleagues describe the adaptive processes of framing and reframing one's situational understanding involved in sensemaking (Klein, Wiggins & Dominguez, 2010). While these various lines of research draw on different terminology and research traditions, these research efforts share a focus on the individual's ability to shift from a current perspective, or habitual approach to a task or problem, and adopt a different one.

The importance of cognitive flexibility was a consistent theme in participants' interviews, and came up in relation to a number of other issues related to team performance, including: team members' awareness of their typical thinking styles and approaches to problem solving, and of their own cognitive biases; the importance of having a range of cognitive styles represented on the team; ways of conveying insights to others (inside and outside the team) that encourage a larger, and more varied perspective on an issue; the role of the "dissenting voice" during discourse as a way to expand and shift the team's perspective on the problem, and the critical role that trust plays in allowing team members to step away from their usual ways of working to try new approaches.

Strategies for fostering cognitive flexibility. Findings from the interviews suggest some members of conceptual planning teams tend to view cognitive flexibility as a matter of individual differences in cognitive style, akin to differences in the ability to think visually. Some people are

cognitively flexible, others are not. Given the importance of cognitive flexibility for planning teams, the best solution to enhancing cognitive flexibility is to select people for the team who have that propensity.

Team leader interviews described strategies for encouraging flexibility, and for helping team members become more adaptive in their thinking. One strategy is to encourage team members to *"think about thinking"* and become more fully aware of their own perspectives and biases. The strategy allows a team to identify information and points of view they may not be considering. As one participant noted "you need them to confront how they think… If they can at least acknowledge their own shortfalls, their own preferences, their own biases, they have a greater chance to recognize when moving down that same road" (U.S. Army MAJ).

This encompasses not solely the individual level, but the organizational level as well. For example, at the organizational level team members can ask "How does our organization tend to approach problems?" During an interview, a team leader described a strategy that he refers to as "de-tacticalization." The team leader used this method to help the team to reflect on their tendency to view the problem from a reductionist worldview. As this participant noted "the critical thinking, the reflective thinking, thinking about how we think, looking inwards at our organization is essential before you move to framing what the problem really is. How do I approach problems" (U.S. Army MAJ).

Another strategy is to push the team to expand and refine a problem frame or solution so it encompasses competing viewpoints. As an example, one team leader we interviewed described her refusal to allow the team to arrive at a current frame to the problem, or a potential solution, by using either compromise or a voting process. Instead, she insisted the team identify a way forward that everyone on the team could agree to and endorse. Doing that forced every person on the team to expand their usual ways of thinking and problem solving. She noted:

> …probably the biggest thing I did was refuse to allow it to become a voting situation,
> which is what the other guys wanted. It's an American cultural thing where best guy
> wins. It is robust ideas put forth, advocated, and best idea wins. I refused to ok ideas
> winning. It had to be a third way that everyone could agree to. Not a compromise where
> you water down an idea or one idea won or lost. That was the most frustrating thing to
> other guys on the team. Win or lose they wanted a decision. But I think we came out with
> a much better product because of that. (USMC Col)

Another interviewee participant referred to this strategy as "having your cake and eating it too." He noted "the planner should avoid having to choose. Seek out the best features of competing choices, and build a new choice with the essences of all" (Commercial design team leader).

Although the topic came up often in participants' interviews, it is the research team's conclusion that military participants' view of how to foster cognitive flexibility is a fairly narrow

one. Cognitive flexibility is discussed in terms of team diversity and team members' metacognitive skills. Approaches employed in other professional fields (e.g., strategic problem solving, design, and innovation) suggest that there are additional approaches to enhancing cognitive flexibility that may be useful for conceptual planning teams and their leaders.

One strategy employed in non-military contexts involves the use of warm up exercises and activities, prior to the team beginning its work. Tools, games, and exercises that focus on divergent thinking, brainstorming, and creative problem solving and "everyday creativity" may be useful for fostering greater confidence in team members' abilities to generate creative, innovative solutions (e.g., Sanders, 2013).

Another strategy for engendering cognitive flexibility involves considering polar concepts, and describing a topic from both ends of the spectrum. For example, one participant noted:

> The polar scale *self – society* captures one of the differences between Americans who value individualism and many Asian cultures that place the group over the individual. A little reflection supplies other scales for stimulation – such as *competition – cooperation* for work style, or *young/energetic – old/wise* for the value of age, or *global-local* for the focus of power. (Commercial design team leader)

A third strategy involves exposing the team to a different set of cognitive modalities to use in exploring ideas during discourse. In particular, the use of a visual language (a combination of words, images, and shapes) can provide another lens with which to examine ideas, interrelationships, and perspectives, and often results in distinctly different insights than using a text-based/verbal modality alone.

In this context, visual language is not just a tool for producing graphical depictions of the team's understanding. Rather, the visual language is another way to develop and enhance the team's understanding of the problem. For example, Horn and Weber (2007) describe the use of visual language to convey meaning. In particular, the authors advocate the use of "mess maps" as a form of visual representation to depict complexity and linkages among concepts. The ability to move adeptly between language-based and image-based modes of thinking requires cognitive flexibility in the same way that shifting from one perspective to another does.

Interview participants noted the importance of having at least a few "visual thinkers" on the team. Many also mentioned that access to a whiteboard was critical for conceptual planning and the collaborative development of ideas. However, the notion of working with a visual language goes beyond the whiteboard-based analysis that many military planners engage in. Professionals in the fields of strategic innovation, creative problem solving, design, organizational and leadership development, often use visual language tools that include images, sketches, graphics, colors and shapes, and other visual tools to help them to explore and think through complex problems. Some have developed toolkits and other aids designed to facilitate the development and exchange of ideas based on visual elements. For example, Sanders' (2013)

make toolkits includes a set of tangible working materials such as images, words, and shapes that teams use to stimulate collective creativity and visualize future scenarios. These toolkits solve a problem noted by Eriksen (2009): while drawing and sketching is critical to design, not everyone is trained to do it, and it can be difficult to do collaboratively. The toolkits can be thought of as "communication catalysts" (Capjon, 2009) and can enable team members to participate directly and simultaneously in configuring the toolkit elements as members develop a shared understanding of the problem space. The resulting visualization serves as a shared reference point for the team (Sanders, 2013).

One interview participant, however, added a cautionary note about using customized toolkits since such "toolkits may add unintended weight or associations just by the graphic qualities of their diagramming elements. These emphases can be valuable, but shouldn't be applied just because the bold red arrow is the next thing in the box" (Commercial design team leader).

This same participant noted:

> A simple vocabulary of forms is probably all that is necessary for most of the project. These could include boundary lines, different types of lines for different kinds of grouping (solid, dashed, dotted, etc.), connection lines for association, arrows for movement and direction, hierarchical arrangements, process boxes and decision diamonds for activities – and other forms as they occur. Everyone will have used them at one time or another; with some discussion as their use comes up, meanings can be readily agreed upon. (Commercial design team leader)

Another example of a visualization tool is the Visual Explorer Toolkit developed by the Center for Creative Leadership (Palus & Horth, 2001). Palus and Horth (2002, p. 146-149) describe six features of image-mediated dialogue that support depth of insight and co-construction of meaning, including the use of images that
- are tangible and exist independently of the dialogue that surrounds them;
- lend themselves to a variety of perspectives, interpretation and meaning;
- support articulation of hunches, intuitive or emotionally-laden thoughts;
- support transformation, synthesis and integration of ideas;
- allow people to set aside skepticism and engage in "as-if" exploration of ideas and perspectives; and
- offer support for managing language, and may provide important avenues for individuals who may be less facile at expressing concepts verbally to express insights.

Participants from commercial design organizations described a fairly broad repertoire of tools and approaches for supporting aspects of cognitive flexibility. These strategies may be useful for adoption or adaptation by military forces. The challenge lies in the extent to which the military would be open to using these tools and approaches, given that some of them are quite different from approaches the military has typically embraced.

Preparing the team's physical workspace, tools, and resources. An important (and often underappreciated) aspect of preparing the team to explore the problem together involves setting up the physical environment. The physical space and the materials within it have the potential to either dampen or spark collective creativity, foster discourse, and facilitate visual thinking (Sanders, 2013). A variety of real-world constraints can impact a planning team's access to needed materials and resources. For example, while some teams may have the luxury of choosing the space in which the team may work, many teams have to make do with the space they are given. Regardless, there are many things the team can do to make the configuration and other characteristics of space more conducive to teamwork, learning, collective sensemaking and complex problem solving as a team.

Participants described several considerations and strategies in our interviews for enhancing the team's physical workspace. One strategy involves determining what the physical space needs to do, and what the space can offer to the team. Human factor psychologists think about this as the notion of "affordances" (Norman, 1999). Experienced planning teams and team leaders have described the goals and requirements of the physical space as needing to support
- independent time for research and quiet reflection;
- group time for discussion and sharing ideas;
- space for visualization and sensemaking - both individually and collectively - and access to shared content (e.g., whiteboards, wall space);
- a workspace where the team can leave up drawings and other artifacts, and add to them over time;
- space for "making a mess"; i.e., using a variety of materials (e.g., LEGOs, foam forms, post-its, collage material, sketchpads);
- reconfigurable space to support different team modes and activities; and
- space and seating configurations conducive to discussion (e.g., horseshoe or circular configurations).

Design researchers have focused most heavily on the importance of a shared visual space. Fruchter and Bosch-Sijtsema's (2011) work, for example, identified the importance of a large physical display surface (such as a wall or whiteboard) for facilitating dynamic participation of individuals within collaborative work environments. Fruchter and Bosch-Sijtema argued that "the wall acts as a mediator for individual reflection-in-action and team reflection-in-interaction…" (as cited in Sanders, 2013, p. 160). Similarly, Pang (2010) described "paper spaces" which are essentially large sheets of paper and sticky notes that cover the walls of a team's meeting space. Paper spaces allow people to move ideas (written on the sticky notes) around and "turn thinking about the future into a shared experience in constructing a common view of the future" (Pang, p. 9). As Sanders (2013) notes, "the co-construction of a visualization of the big picture or shared mental model is essential for collective creativity and this is where the importance of the tools and materials comes into play" (p. 159).

A summary of strategies, suggestions, and key considerations for preparing the planning team identified by interview participants are offered in Table 2.

Table 2

Preparing the Team: Summary of Strategies and Key Considerations

_____

- Recognize the stigma currently associated with design and ADM. Consider using alternative labels and descriptive language when introducing the activity to the team.
- Differentiate the design activity from traditional and analytical planning processes such as MDMP, and describe the anti-goals of the activity (what the activity is intended *not* to be).
- Describe to the team the ambiguity of the task the members will face. Set the team's expectation that they will likely experience periods of significant uncertainty and confusion as the team members attempt to define the problem.
- Emphasize that confusion can be an important impetus for the team's learning and journey toward deeper understanding rather than a sign that the team is failing to make progress.
- Discuss and clarify team member roles and anticipated contributions.
- Engage in activities intended to help team members learn about one another, their backgrounds, and areas of expertise (e.g., personal storytelling).
- Engage in activities that enable team members to reflect upon and become more aware of their (and their organization's) typical ways of thinking and problem-solving.
- Conduct activities that promote the cognitive flexibility of team members and encourage members to think in different ways, such as thinking visually or metaphorically.
- Provide alternatives to text-based tools (e.g., visual tools, shapes, images) to enable team members to explore the problem in different ways.
- Consider and articulate how the team wants to configure and use the physical space, in order to support the team and its activities.
- Discuss the team's purpose, values, and mission, including ways the mission could get off-track. Document these items to capture the team's shared understanding, and to serve as a common point of reference.
- Discuss and reach agreement on the team's norms for interacting. Document the outcome as a common point of reference for team members.

_____

Process: Managing Intergroup Dynamics

A significant facet of a team leader's role is managing the internal workings of the team. Supervising the team's dynamics includes managing the interactions among the team members, as well as managing the pace, energy level, and overall workflow of the team. While all team members can participate in monitoring the team's process and interpersonal dynamics, team leaders are in a unique position to help the team manage their work effectively, maintain a positive and productive climate for discourse and sensemaking, and maintain progress. The participants we interviewed and surveyed emphasized the importance of understanding the personalities, and communication and interaction styles of individual team members. For many team leaders, understanding the array of personalities and communication styles on a team is

central to recognizing when conflict within the team is productive or when it may become counter-productive. In many teams, cohesion and productivity depends on the team leader's ability to anticipate and manage challenging interpersonal dynamics. Our research revealed a variety of challenges and associated strategies team leaders (and members) use to manage interpersonal dynamics. We describe these in the following section.

Facilitating discourse. A common challenge team leaders face is to manage the variety of personalities, experiences and perspectives on the team. While interview participants consistently acknowledge the advantages of diverse teams for sensemaking and complex problem solving, participants also report that diversity can create challenges to team identity, cohesion, and trust. The challenge can be amplified when non-military partners are brought into the team temporarily due to personal agendas, varying views of the military and its mission, and goals that are distinct from the team's mission and objectives.

One strategy team leaders reported in the interviews as helpful for managing interpersonal dynamics is to assess team members early in the team's lifecycle. An earlier section ("Getting an Initial View of the Team") described team leaders' use of both formal and informal assessment strategies for gaining an initial view of individual members, and what each of them brings to a team. These same strategies can be useful for understanding and assessing the personalities of the team members. As noted earlier, these strategies range from use of inventories for identifying talents, work style and interaction preferences, and aspects of personality, to interviews that provide an opportunity to talk with team members individually. In combination with activities such as personal story-telling, participants reported these practices as being helpful for a variety of purposes including
- interpreting actions and behaviors of individual team members;
- matching individuals to tasks that best suit their skill sets;
- negotiating team member roles;
- anticipating barriers to progress;
- understanding and anticipating preferred modes of communicating and interacting with others in the team context;
- understanding different styles of learning and processing information; and
- anticipating, understanding, and managing conflicts among team members if/when they occur.

Regardless of how well team members know one another and are prepared to work together, experienced team leaders noted certain personality types and behaviors that can be particularly troublesome within a planning team. Among the most difficult challenges are individuals who seek to dominate the discussion, have difficulty allowing other members to talk, and are dismissive of other team member's ideas. For example, one participant described:

There was a guy… who was really dominant. He was a brilliant person. [He] had the

ability to dominate discourse very easily. [He had a] very forceful personality, loud,

strong personality. His insights and thoughts were always right on…usually way ahead of

me. But he had a tendency to really dominate with his views. (U. S. Army LTC)

Another participant noted:

> I've had occasions when one team member monopolizes the conversation by stepping on comments of others - taking over the conversation before anyone else can get in a word edgewise. When this happens, the team leader has to step in and call on quiet members for their comments. Left unattended, monopolized conversations lead to dysfunctional team meetings – and resentment on the part of those who could not participate. (Commercial design team leader)

One of the reasons dominant personalities are so problematic in planning teams conducting design is because these personalities can stifle the sharing of *distributed information* (i.e., the unique knowledge and expertise held by each individual member). In order for teams to benefit from the different knowledge and perspectives of individual members, it requires that the distributed knowledge that exists within the team is exchanged, discussed, and integrated. The process for doing so has been coined *information elaboration* (Stasser, 1999; van Knippenberg, de Dreu, & Hoffman, 2004; Wittenbaum & Stasser, 1996). Despite the importance of the information elaboration process to problem-solving teams, researchers have found that teams' informational resources are frequently not fully used; often, distributed information is not adequately exchanged and processed (Gigone & Hastie, 1993; Gruenfeld, Mannix, Williams, & Neale, 1996; Scholten, van Knippenberg, Nijstad, & de Dreu, 2007). Dominant team members who monopolize the discourse have the potential to further suppress information exchange and elaboration across the team.

The team leader has an important role in information elaboration among team members. The leader needs to explain the importance of sharing distributed information, guide the process of information elaboration by instructing the members to exchange, discuss, and integrate information (Scholten et al., 2007), and to actively manage the individuals who either intentionally or unintentionally monopolize the discussion.

Team leaders reported in the interviews a range of approaches for managing individuals who tend to dominate discourse. One is to employ a direct approach and confront the person within the context of the team interaction. Another approach is to have side bar conversations with the team member, and to ask the member to "tone it down" and be more aware of their impact on the team. A strategy one team leader reported using in his interview was to:

> …start sections of the meetings with reminders that we're all about collaborative co-construction here, all about collaboration, open minds, have to be comfortable with notions that lack detail. Need to withhold judgment about this until we get these ideas much further down the road. Doing this, you can kind of call out negative behavior without calling out the person who's doing the negative behavior. (Commercial design team leader)

Another participant with a dominant personality on his team reported:

> The beauty of the leadership role between myself and design chief...he can be very
> dominant too. I'd sometimes have him come in and challenge the strong personality I'm
> describing to balance things out. He can come in and be a counteractive force. He would
> occasionally come in and challenge the strong personalities. That was usually a
> purposeful conversation me and the chief had, [I] would tell him to come in now and
> interject. (U.S. Army LTC)

Another participant favored making sure to give team members the chance to say what's on their
mind to help reduce combativeness or a team member withdrawing. Specifically he noted:

> ...you have to get those guys to say everything that is on their mind and maybe some is
> helpful and pertinent maybe other stuff isn't—but it gives them the opportunity to unload
> all their things and they feel as if they've been heard. (USMC LtCol)

In a single instance, a team leader reported that he removed the difficult team member from the
team, and sought out a replacement who was a better fit for the team's goals and work style.

A related challenge is ensuring that everyone's ideas make their way into the team
dialogue. On teams where a few members do the majority of the talking, access to the full range
of viewpoints and perspectives available to the team is much reduced. It is not unusual to have a
team in which some members are very comfortable speaking up and sharing their views and
ideas, while other team members are naturally quiet and prefer to listen more than talk. Some
team members may be reticent in response to strong, vocal personalities who are in the room.
Team leaders can help foster the team's awareness of this aspect of the team's dynamic. When
team leaders recognize that a team member has not been heard from over a sustained period of
time, team leaders can create opportunities for those individuals to share their ideas. During
interviews, experienced team leaders offered some techniques for ensuring that all team
members had opportunities to contribute. These techniques included the following:

- Developing a set of ground rules for discourse. For example, don't interrupt another person when he/she is speaking; share time so that all members can participate in the discourse.
- Paying attention to who has the marker in his/her hand at any given time. The person standing at the whiteboard holding the marker is the person whose idea will be listened to.
- Paying attention to the person taking notes: Is the note taker noting/typing the ideas as people said them? Or is the note taker filtering/editing others' ideas? Having a designated person who serves as the "recorder" for the group can be helpful but it is important that ideas are recorded as spoken.
- Using brainstorming methods to help pull quieter individual's ideas into the mix.
- Giving everyone some front of the room time where members have an opportunity to share their ideas for a period of time without interruption.

Overall, the interview and survey data suggest that there is not a one size fits all method for managing team dynamics. In addition to the various personalities and agendas that may be present, the organizational culture and external stakeholder pressures may further complicate team interaction.

Managing team conflict. Planning teams engaging in design, in many ways, need to encourage conflict. Conflict is a central aspect of their work as the team is working to make sense of an unfamiliar and seemingly intractable problem. Team members need to exchange ideas, express disagreement, challenge assumptions, and share alternative viewpoints - and conflict is inherent in these various activities. In interviews, team leaders described the goal of guiding the team to engage in productive conflict, while discouraging interpersonal and other sorts of negative conflict. To do that, team leaders need to recognize the difference between the two types of conflict; task conflict and relationship conflict.

Task conflict has been described as tensions between group members related to differences in opinion regarding the nature of the work (i.e., allocation of resources, conflicts in understanding) (de Dreu & Weingart, 2003). The team performance literature has noted both benefits and disadvantages for task conflict in teams. Some evidence suggests that *low levels* of task conflict in a team can be stimulating and assist in preventing group-think. Specifically, teams with differing initial perspectives tend to share information more extensively (Parks & Nelson, 1999), and develop better solutions in problem-solving (Wanous & Young, 1986) than teams with similar initial perspectives (Schultz-Hardt et al., 2002). Tjosvold, Johnson, & Lerner (1981) found that teams with members who hold conflicting positions tend to be more open-minded during the team discussion. Teams with members of differing points of view also tend to actively seek diverging arguments and then integrate those different perspectives into their view of the problem (Schultz-Hardt et al., 2002). Some have argued that disagreement about the task enhances creativity in teams by leading to increased information exchange, re-evaluation of the status quo, and adapting goals, strategies, and processes to better fit the team's task (Farh, Lee, & Farh, 2010; Hülsheger, Anderson, & Salgado, 2009; West & Richer, 2008). Finally, research has demonstrated that *genuine dissent* (Schultz-Hardt et al., 2002) - which can result from a diverse team comprised of individuals with differing viewpoints - can lead to decision making processes that are more open-minded (Schultz-Hardt et al., 2002).

However, when task conflict increases too much it can interfere with team information processing by increasing cognitive load and diverting attention - and therefore impeding team performance (de Dreu & West, 2001; Kozlowski & Ilgen, 2006). Too much task conflict can impede team member's ability to perceive, process, and evaluate information; team members may also become frustrated by lack of progress in the task completion as a result (de Dreu, 2006). Thus, there is a curvilinear relationship (inverted U-shape) between task conflict and team effectiveness (de Dreu, 2006; Gardner, 2006).

Relationship conflict is described as tensions between group members related to differences in opinion regarding personal preferences or interpersonal styles and values (de Dreu & Weingart, 2003). Relationship conflict has been shown to hinder team performance and does not focus on the task to be completed but rather, the personalities of the team members (de Dreu & Weingart, 2003). Team leaders need to encourage and promote productive conflict among team members, while minimizing destructive conflict (personal attacks) that can break down trust and collaborative work processes.

One strategy interview participants reported as helpful for managing conflict within the team is to facilitate a discussion in the early stages of the team's lifecycle to collectively consider the atmosphere or climate the team members' desire within the team. The dissenting opinions that are needed for effective design will be more likely to be expressed if the climate of the team is one that supports and encourages *positive deviance* (Packer, 2008). Lencioni (2005) suggests that teams ask themselves "What is the dynamic we want in this team? And how can we foster it?" During these discussions, it can be helpful for the team to consider the following questions, which can inform ground rules for discourse:

- Does the team want an atmosphere where conflict is not only acceptable, but desirable and expected?
- Should team members call one another out if they seem to always agree with others' views?
- Is it acceptable for discussions to become heated and contentious at times?
- What types of conflict are not ok (e.g., personal insults)?

These team discussions are also an opportunity for the team leader to convey his/her expectations about conflict within the team. Interview participants also described finding it useful to explicitly set an expectation for lively debate, energetic exchange and the critique of ideas, in order to gain deeper understanding. One team leader noted:

One of the best ways we've learned to deal with tension is that we're not conflicting or challenging individuals personally. Looking at this as learning, not attacking. It's the ideas, the theories. [It's] important to say: "We're doing this to learn," [which] has made it helpful to keep things at a manageable level. (U.S. Army LTC)

Although the leader has an important role in managing conflict, high-functioning teams also learn to monitor and manage conflict together, as a team. In some cases this may be easier

when the team is smaller in size. For example, "because we got so small with just six people, it was almost like being a family. We were able to call somebody out. There was a lot of self-policing" (U.S. Army COL).

Another strategy that interviewees reported involves monitoring and reflecting on the team's dynamics. In interviews, team leaders described the importance of reminding the team of the atmosphere they wanted to create. For example, these team leaders would ask team members "Are we achieving the climate the team members sought to achieve? If not, what is getting in the way of achieving this climate?" These discussions can help the team leader and team members recognize common triggers for destructive conflict, identify and note any common factors that tend to trigger unproductive (i.e., interpersonal) conflict, and discuss how those triggers can be avoided or minimized.

Finally, a relevant strategy described by Prince (1970) in his classic book *The Practice of Creativity* is to implement a "spectrum policy." The spectrum policy acknowledges that every idea offered in a team discussion has a spectrum ranging from good aspects to bad aspects. Regardless of how much bad there might be in an idea, there will always be some good aspects. In addition, early in problem-solving efforts, it can be difficult to know what will ultimately be good or bad ideas. So instead of responding with "that idea won't work because…" or "that doesn't make sense because…," it can be useful for the team to look at the idea as a spectrum and pick out the good parts of it and build on those parts constructively.

Integrating temporary team members/non-military subject-matter experts. Managing the team dynamics not only involves managing the core planning team members, but also managing the dynamics that result from inviting others to participate in the discourse and sense-making on a temporary basis. The types of non-military SMEs design teams have brought into their teams range from members of non-governmental organizations (NGOs), to host nation officials, to academics, to foreign tribal or religious leaders, to technical experts in very specific areas. Integrating temporary team members introduces a different set of challenges, as it can involve non-military individuals who may have diverse views of the military and different norms for interacting and conducting business. In some cases, the temporary team members are also stakeholders, with their own goals, agendas, and priorities. All of this can pose challenges to team dynamics that the team leader and team members need to anticipate and be prepared to manage.

As described in the research, the reason temporary team members are invited to the team is to fill a perceived gap in the team's expertise and to help deepen the team's knowledge. Another benefit is that those temporary team members (i.e., subject matter experts) can help the team to think differently about the problem the team members are trying to understand and to expand the discourse. For example, one interview participant noted the value of bringing in theoreticians as a way to bring in "externality" or a way to become more aware of the team's current way of thinking and deepen learning:

[the design team needs]… access to multiple theoreticians and opportunities to interact with them. It's a way to gain externality. If you don't have an external viewpoint of yourself, you never have real learning. The outside externality gives you reflection you can't get as an individual. Very few people can pull themselves out of where they are…that access to theoreticians is important to have an external view on yourself. (U.S. Army LTC)

Interview participants described engaging external SMEs in a variety of ways that range in the level of formality and extent of interaction. In some cases planning teams elicit knowledge and expertise from external SMEs via informal conversations. In other cases, the teams invite temporary team members to give mini-lectures to the team and engage in discourse sessions; in other cases the design teams conduct semi-structured interviews. As one interviewee noted:

Sometimes it's very informal just picking their brain over lunch. Sometimes it's a more formal sit-down in a commander's office. It's not necessarily a briefing, but rather I'd call it an interactive session with an expert. I tell them what we'd like to get out of it, but also emphasize being free to take tangents as the discourse evolves. (U.S. Army LTC)

While temporary team members can provide the team with the necessary perspective and differing lenses through which to view a problem, there are also some challenges inherent in integrating external SMEs into the team. One of the difficulties is for the team to recognize *when* they need to bring in SMEs. In many cases "you don't know what you don't know." One interview participant noted that simply not having the answers to questions that arose during discourse sessions served as a clue to the team that additional expertise was needed. Another participant described a rule of thumb he uses to determine when to pull in external SMEs to his design team efforts:

... there are basically three places where subject matter experts can play important roles: where the team is exploring context to find and understand problems, where the team is generating concepts and needs help developing nascent ideas, and where the team is solidifying concepts and needs critical evaluation based on knowledge of the contextual problems. I classify them as "finders" and "makers."

Finders are usually scientists or scholars and are interested in understanding. They enjoy discovery and are very helpful in asking and answering critical questions - useful in context exploration, and useful later on in critiquing potential proposals. They are not very helpful when the problem is concept generation - they easily fall back on the position that more information is needed.

Makers, on the other hand, are usually engineers, architects or designers and are interested in construction (in the general sense). They enjoy invention and putting together new arrangements, compositions, systems, devices, etc. They are very helpful when the problem is synthesizing ideas and building solutions. They are not very helpful when the problem is understanding - they want to get on with developing the concept.

Taking advantage of these insights, I have tried to bring in appropriate SMEs according to the nature of the tasks at hand, using the finders most extensively early on and at the end of a project, using the makers when solution concepts are being generated. (Commercial design team leader)

Another challenge is identifying *who* the team actually needs to bring in. In certain cases the nature of the problem is so ill-defined, that identifying the appropriate person or persons who have the needed expertise can be a challenge. In addition, because the problems planning teams wrestle with have so many interconnected facets, it can be difficult to figure out where to draw the line because everything appears to be connected. One simple practice an interview participant described is the "empty chair exercise" which asks the team to imagine that there is an empty chair at the table, and to ask themselves "Who should be in that chair?" This is a simple way to engage the team in reflecting upon and discussing which perspective or perspectives are most needed within the team.

Another participant noted that, as team leader, he would actively seek out someone who had a bias, and who was not the bona fide expert on a given topic. As he explained in his interview:

There's a tendency to bring in the bona fide expert for the exact problem they're looking at. There's also a tendency to bring in the bona fide expert who is Western or American. …The very best experts publish…We were able to do a huge amount of research [from the internet]. But what I tried to find was one-level-down type of guys who had been out there working for all these experts and can tell you their biased opinions on what works and what doesn't and what the politics are from their lower level point of view. We were looking for people (like people at the Pentagon, at the embassies, at NGOs, at State) who weren't the top level guys but one or two steps down so we could get their opinion of what it was that they saw. I looked for people with a bias. And looked for people with a different bias [than ours] because we're always trying to look for absolute truth with no bias in it and it doesn't really exist. (U.S. Army COL)

One interview participant described a strategy he has used to help his teams explore the problem space and identify needed SMEs. This strategy involves having the team members think of all the questions that come to mind for them when they consider the problem set and documenting those questions. Conducting this type of exercise can be helpful in not only identifying needed expertise, but it can also serve as a means to determine an initial set of questions for the SMEs. As explained by an interviewee, "I'd have everyone around a room start listing questions on a whiteboard until they start to seem redundant… doing this helps to define the problem space and determine who needs to be around the table" (Commercial strategic planning team leader).

A final challenge that interviewees described was associated with language and communication style. As the core design team works together, the team develops a shared language and understanding that becomes tacit. Though this shared language makes sense to the team members, it can be difficult for members to recognize they are using it, and that the language possibly may not resonate with others. Thus, design team participants noted in their interviews the importance of being aware of this tendency and for needing to adapt their language and communication style to effectively communicate and elicit information from external SMEs. As one design team leader noted:

> So when we Army officers were engaging with police officers, we always recognized
>
> they were coming from a different environment, so a lot of the acronyms and terms we
>
> sprinkle in our Army conversations, we needed to be more conscious of not to use those.
>
> This is good because the entire design team needs to develop a cohesive, collaborative,
>
> shared language. Different from your standard military organizational language.
>
> Acronym heavy, field manual heavy, doctrine heavy within our own products. (U.S.
>
> Army MAJ)

Managing team pace and workflow. Based on interview findings, team leaders consider attentiveness to and management of a team's workflow a crucial activity for productive planning teams engaging in design activities. Managing the team's workflow involves monitoring the team's timeline and progress toward the team's goals and deliverables, and also monitoring and managing the team's energy level and general climate. In most design activities, a typical workflow involves iterative cycles of independent reading, research, and reflection. Team members come together for discourse, to hear what members have learned, to discuss and build upon team member's understanding of the problem, and to identify knowledge gaps. Then, team members will likely return to more independent or small group research and reflection. Interview participants expressed the need for the team leader to maintain awareness of a range of conditions throughout this work cycle including: the team's "battle rhythm" - when is the rhythm so intense that it is actually counterproductive? At what point does discourse need to end so that the team can pursue independent reading and reflection? Does everyone simply need a break from the intensity of thinking and learning?

A challenge identified by interview participants is recognizing when to push the team's level of effort and task engagement and when to lessen the intensity of the team's efforts. These judgments require knowing the individuals on the team and how the members tend to work best, understanding the personality of the team as a collective unit, and gauging when members need to be challenged versus when the team needs a break or change in task.

Team leaders we interviewed talked about being able to read their team and having the ability to recognize when members need a break (e.g., are team members frustrated, unfocused, mentally fatigued). Team leaders described looking for cues that indicated the team needed to restructure or alter its activity. Some of the obvious cues exhibited by team members that might indicate it is time to shift activities include: low energy, lots of yawning, glazed eyes, and fidgeting. Other not so obvious cues might include: when the team seems to be restating the same ideas rather than generating new ones or circular discussions. Additional signs that team members are fatigued or disengaged include significant lulls in the discussion, tangential or sidebar conversations, disagreements about relatively insignificant issues, and individuals withdrawing from the discussion. In interviews, participants described the importance of team leaders being attuned to these cues in order to recognize when the team needs a break, a change in activity or work setting. As noted by on interviewee "there were times I'd just end discourse. I'd say 'we're done, go home' when you could just tell by body language there was no energy left. We were done, go home, we'll come back next the day" (U.S. Army LTC).

Monitoring the team can be particularly difficult for team leaders because they are "participant-leaders" who are also extensively engaged in the design activity itself. The team leader must participate in the research and the discourse while simultaneously tracking and maintaining a big picture view of the state of the team and its individual members. Some team leaders manage those dual roles by taking periodic time-outs, when they would consciously step back and remove themselves from the discussion or discourse in order to assess the overall climate and the team's energy level.

During interviews, experienced designers also described the challenge of keeping track of multiple aspects of the team's workflow and productivity. For example, in addition to tracking and managing the workflow that occurs during a team meeting or specific interaction, leaders also report tracking the general flow of work activities such as independent research, thinking, collective discourse and problem framing. Knowing when and how to move the team from one type of activity to another can vary based on the team and the individuals comprising the team. One team member in an interview noted an approach his team leader used for managing the workflow:

… [Our lead] tried to map out cycles - days for research, days for discourse - and tried to manage and adjust that. My personal opinion is that's a dynamic thing. We came up with a schedule that was three days of discourse. There was a default schedule: morning or afternoon discourses session (three-four hours of discourse), then blocks for independent research. I want to say it involved four discourse sessions [per week?] but then it went down to three. (U.S. Army CIV)

Finally, team leaders must figure out how to manage the external timelines and stakeholder pressure to produce actionable insight, while also providing the team with the time and support the team needs to do its work well - i.e., time to research, time to mentally explore the problem, time to discuss, and time to let ideas develop. The ebb and flow of the project will vary depending on a variety of factors, including external organizational pressures, the criticality of the problem, team dynamics, and the ever-changing political and social climates. One approach participants suggested for managing these intersecting factors is to conduct a stakeholder analysis focused on internal and external stakeholders. This stakeholder analysis can help identify those individuals or groups that need to be managed closely (communicated with often) vs. stakeholders who may just want to be informed of the final solution the team will offer. Having an understanding of stakeholder requirements early in the project lifecycle can help teams effectively plan for and manage external timelines and alleviate some external organizational pressures.

A summary of strategies, suggestions, and key considerations for managing team dynamics identified by interview and survey participants and the team performance literature are provided in Table 3.

Table 3

Managing Team Dynamics: Summary of Strategies and Key Considerations

---

- Use the outcome of assessment tools and exercises to identify team members' talents, work style, personality characteristics, and interaction preferences and to help team members learn about one another.
- Reflect on the constellation of individual characteristics that exists on the team as a way to anticipate and prepare for potential challenges to discourse and team dynamics.
- Agree on a set of ground rules for discourse and for interacting with one another more generally. Document them in a place that serves as a reminder to the team.
- Collectively discuss the climate desired within the team.
- Convey expectations about conflict within the team and differentiate between productive and non-productive conflict.
- Actively monitor and reflect upon the dynamics of the team: Is the team achieving the atmosphere it agreed to create? If not, what is getting in the way?
- Use unanswered questions as a cue for when it may be helpful for the team to bring in non-military SMEs.
- Adapt language and communication style to effectively communicate and elicit information from non-military SMEs.
- Be vigilant about the team's climate, energy level, and general mental state and adjust the team's activity, pace, and workflow accordingly.

Output: Capturing Team Insights

A significant challenge for planning teams is documenting the knowledge and insights that develop over the course of the team's design work. In part, dealing with knowledge capture is a resource issue: how much time to spend in discourse and reflection, and how much to spend documenting the developing insights and discussion. Participant interviews indicated that the issues surrounding how to track and document developing knowledge and insights are well-recognized. Nonetheless, the strategies that participants identified in the interviews were highly variable. In the interviews, some individuals reported specific processes for knowledge capture which the team used early in its formation and refined over the course of the team's work. Other teams were far less deliberate, despite their recognition that capturing evolving understanding would be critical, as the team worked toward its final products.

How to capture insights, questions, issues and developing logic that emerges from discourse and other collaborative work sessions is a team issue. What to capture, at what level of detail, in what form and format, and how to make the team's work products accessible are all key questions of planning teams. One of the issues identified by the participants is the role and function of a knowledge manager. Team leaders and members addressed concerns in our interviews with the best solutions to issues such as

- whether or not to designate a note taker or to enlist team members to take turns documenting the team's work; and
- whether the team supports collaborative knowledge capture, or instead leaves it up to individual team members to keep track of what seems important to them.

As one team leader noted in an interview:

> We need some type of recorder to really capture the discourse. Sometimes it's very
> informal and we'll dub someone to capture the discourse. But then they can't really add
> to the discourse, so you're losing that person's intellectual power. So as a team resource,
> that's really important. (U.S. Army LTC)

The team members we interviewed described a range of processes and techniques they had used to capture learning over the course of their projects. Some examples included:

- One team member working in real time to create a series of PowerPoint slides based on the discourse and discussion. The team would then review and edit the slide content at the end of each day.
- The team using butcher paper to create timelines and other work artifacts; the timelines became a record the team used over the course of the project to examine where members had been and how their thinking had evolved.
- The team photographing the whiteboard session. Photos would then become embedded into a written documentation of work sessions to link them with other work products.
- The team using a team note taker during discourse sessions.
- The team using a team "visualizer" who sat in the background during discourse sessions, making notes and drawing pictures in order to capture what was going on. In this example, team members took turns filling the visualizer role.
- The team including documentation sessions as part of the team's workflow in which certain days would have the goal of summarizing and capturing the previous week's discourse sessions and key insights.
- The team using pre-made forms (i.e., templates) for capturing issues, insights, and ideas the team has discussed.
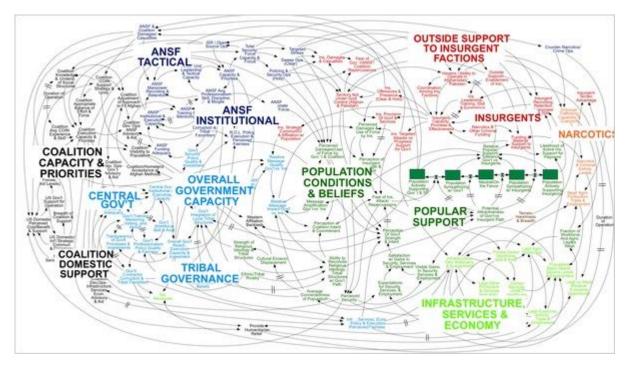
In the interviews, team members pointed to a number of important products and processes that knowledge capture serves. For example, capturing insights from team meetings and discourse sessions provides an audit trail and common point of reference for the team as their work progresses. Participants' interviews emphasized the importance of using a multimedia approach to knowledge capture that combined text-based documents with sketches, timelines, and graphics. Doing so allowed the team to create and retain a richer, more varied set of insights than occurs with text alone. Graphics are particularly useful for understanding and depicting linkages and key interdependencies across a developing system of concepts.

A consistent topic identified in the interviews was the question of *when*, *how*, and in *what* ways to share the knowledge products being created. It can be helpful to think of the team's work products as spanning a continuum, from those that are internal to the team to those that are created to represent insights and solutions to people outside of the team. Participants described the challenges involved in traversing that continuum. Over the course of working together, teams must shift their focus from communicating insights and learning within the team to communicating concepts, insights, and potential solutions to external stakeholders. At the point that teams begin creating products and representations for external stakeholders, it can be enormously helpful to have access to interim representations products, along with an audit trail of the team's evolving concepts and rationale.

Conveying insights to stakeholders. A final aspect of a planning team's effectiveness is the exchange that occurs between the team and those external to the team who rely on the insights and products the team develops (e.g., detailed planners, commanders and other senior leaders, interagency and inter-service partners, and other unified action partners). Though the team itself may achieve significant depth of insight and shared understanding about the problem it is grappling with, the team must effectively convey its understanding of the problem to key decision makers and other users of the information. As noted by one participant in an interview

"it doesn't matter how good a design product we have, if it doesn't resonate with someone it doesn't matter" (U.S. Army LTC).

The process by which individuals and teams articulate their understanding or mental models in order to influence the sensemaking process of stakeholders has been referred to as sensegiving (Gioia & Chittipeddi, 1991; Maitlis & Lawrence, 2007; Weick, Sutcliffe, & Obstfeld, 2005; Wolters et al., in press). When dealing with complex and abstract issues, it can be particularly difficult to articulate one's tacit understanding to others (Weick et al., 2005). Interview participants noted the challenge involved in recognizing the possibility that interim products which may be well understood within the team may not necessarily be readily absorbed and understood by those who have not been directly involved in making sense of the problem. Graphics, drawings, and complex language that are clear and straightforward to those within the team can be entirely incomprehensible to those outside the team (Zweibelson, 2012d).

Furthermore, when teams invest significant time and effort into the development of products, the team can become enamored with those products and be blinded to the possibility that the product may not make sense to others. Although the interim analysis products and visual representations may hold significant meaning for the team in framing the problem, those internal working products may not be appropriate for an external audience. A recent and well-known example of this problem published in the New York Times on April 27, 2010 was the U.S. military's plan for Afghanistan stability and security – otherwise known as the "spaghetti slide."

As General McChrystal famously remarked at the time "when we understand that slide, we'll have won the war" (Bumiller, 2010). This example illustrates a crucial delineation that needs to be made between knowledge representations that are used for internal team sensemaking purposes, and those that are used to convey ideas and insights to others.

Specifically, final products need to stand alone and make sense to key stakeholders. As Zweibelson (2012d) noted:

> Perhaps one of the most damaging things that design practitioners do…is to present emergent products as the results of design work. I use the term "emergent products" to describe the many complex, often engrossing drawings, white-board sessions, and PowerPoint slides that planning teams build during their journey to understand and appreciate a complex problem. These design products usually contain language, concepts, and graphics that resonate for the planning team, but… The products are also often impossible for the larger audience and the decision maker to understand… (p. 86)

An additional factor that creates challenges for communicating with external stakeholders is the level of commander engagement with the team. While the planning team's activity is always done at the behest of the commander, participants described considerable variability in how involved their commanders were in the actual design activity. As a participant noted in an interview:

> Within our culture it's very difficult to get a regular session with the commander…You don't go see the commander unless you have something substantive to talk to him about. You can't just say "we want to pick your brain on something we're struggling with and get your thoughts." That's not supported in our environment. We have to be pretty refined about what we take to him. (U.S. Army LTC)

Because of this, the commander is unlikely to be exposed to the evolution of logic underlying the team's insights and recommendations. In these situations, planning teams need alternative strategies for keeping the commander apprised of their evolving understanding. Some options include communicating to him or her through senior leaders or through various information-sharing media and products.

Strategies for conveying insights. Interview participants described a variety of lessons and strategies related to conveying insights outside the planning team. First, a key aspect of communicating outside the team is maintaining awareness of the larger organizational culture and sensitivity to the audience. As Zweibelson (2012c) noted:

Sensitivity to socio-politics and your audience are critical for successful design

efforts….If the vast majority of our organization clearly understands a linear execution

checklist, but only an insignificant minority is familiar with non-linear approaches fusing

general systems theory and swarm theory, it would be self-destructive to develop a final

planning deliverable that used the latter instead of the former.

Hammerstrom's (2010) monograph on military design teams supports this finding. He urges design teams to have an X-team structure (as described by Ancona & Bresman, 2007) that is externally-focused so that their products and concepts meet the customer's (i.e., commander's) and the larger organization's needs.

In addition, team members find it helpful to remind themselves that simple does not equal simplistic. As noted by Zweibelson (2012c) "simplicity is perhaps the greatest challenge in communicating novel concepts and innovative thinking to the larger organization, yet it is essential to the delicate transition from abstract thought to detailed execution" (p. 8). Therefore effective communication with external stakeholders and others in the larger organization requires simplifying language and visual representations.

As noted earlier, teams often struggle with abandoning the complex concepts and terminology they have used to explore the problem. But if the team does not find ways to translate their work into more streamlined, simpler products they risk having their work dismissed as incomprehensible or esoteric by their audience. Interview participants noted the importance of explaining the essence of the team's insights and recommendations using standard organizational terms and language. As one author described it, work products need to be in a "form that is both familiar and palatable to the larger institution…" (Zweibelson, 2012c, p.10). The extent to which the team can simplify the essence of the concepts using language the organization is accustomed to using will increase the likelihood that it is understood and acted upon by stakeholders. At the same time that simplicity is important, there is a delicate balance that should be acknowledged. Making the products too simple can risk losing or obscuring some of the meaning the team is trying to convey.

Participants also noted the importance of explicitly identifying the team's key stakeholders and discussing their goals and perspectives. For example, the team might work together to address such issues as:
- Who are the key stakeholders?
- What is the team's understanding of the stakeholder's goals and needs?
- What decisions will our products be informing?
- How might needs of diverse stakeholders align or be in conflict with one another?
- What does that mean for the product we ultimately provide them?

In addition, effectively conveying the understanding and recommendations the team has developed requires that the team learn about stakeholders' needs, styles, and preferences for consuming information. Different stakeholders have different preferences for receiving and absorbing information. Some stakeholders want face-to-face updates, some favor narrative

descriptions, while others prefer a visual representation. Some teams are able to figure this out fairly effortlessly based on regular interactions with key decision makers. But others have found the need to actively elicit needs and preferences. Getting to know the audience allows the team to tailor the information and communication media in ways that best fit the preferences of key stakeholders. As one team leader noted in an interview:

> We have found that [our commander is] a voracious reader. So if we can't get something on his calendar, we'll use written narrative with accompanying visualizations. Then he'll provide comments or come talk about it when he's available. He'll usually give some handwritten notes that provide good insights. With others it varies, it's personality-dependent. Some want a briefing. Some want to read a paper. Some want both. (U.S. Army LTC)

One interview participant noted that there will likely be different needs for amount of context and detail across different stakeholder groups. For example, while the commander may need less context and might prefer more direct, to-the-point advice from the team on possible actions, other stakeholders may need support material and deeper explanation as they may be less aware of the history and context that led to the insights.

In some cases, participants reported directly asking the stakeholder their preference for consuming information. For example, if possible the team members would have a conversation with key stakeholders and ask the stakeholders what they want and need, the stakeholder's goals, and how they will use the insights and products the team develops. Another strategy is to use a dual leadership arrangement to help communicate with external stakeholders. One team we studied found it valuable to have co-leaders, who had very different functions. One co-leader focused on the day-to-day internal workings of the team (i.e., the "down and in" guy). The other co-leader served as a link between the team and the external organization (the "up and out" guy). The up and out guy was someone who knew the organization very well and understood its culture and politics. He regularly conveyed information back to the team about the commander's and other stakeholders' needs and preferences, and also provided a check on whether insights and products developed by the team were well-aligned with stakeholders' needs and preferences. As the interviewee noted "I'm the one who gets to go in [to the design team] and say… 'This is great, but it doesn't speak to anybody. They (the audience) are not going to care about this right now'…" (U.S. Army LTC).

Planning teams have also found it effective to socialize ideas with stakeholders. Rather than waiting until the product is completed, the teams we interviewed provided interim updates to key stakeholders as their understanding and ideas evolved. This provides an opportunity for team members to get "outside their own heads," to expose stakeholders to their logic, and to get feedback to help them refine their thinking. These exchanges provide opportunities for the client or user of the products to ask clarifying questions, elaborate on ideas, and seek additional information. In some cases, there may be built-in continuity (i.e., someone involved in the conceptual planning/problem framing phase may also be involved in the detailed planning).

However this is not always the case. One major concern that was expressed by team members is that designers'/conceptual planners' recommendations are simply "thrown over the fence" for detailed planners to implement. To smooth the transfer of ideas and insights to those who need to act on them, conceptual planning teams have actively built in opportunities for this important exchange and continual iteration of ideas to occur. In some cases, these updates occur verbally; but some teams have found it effective to provide written updates such as ½-1 page narratives for stakeholders to mark up with feedback. For example:

> I would write emails to the commander. It would help me articulate the ideas (there's the adage: if you haven't written about something then you haven't thought about it). I would write a concise thing to the G3 and try to boil the thing down into the plainest language as possible (where we're at and where we're going) then he could provide feedback or follow-up with me asynchronously, then I could bring that feedback into the next OPT meeting. Sometimes feedback was delete this, or delete that, or ask questions. The G3 was sensitive to the politics and personalities at the upper levels and was able to guide the team that way. (U.S. Army MAJ)

Seeking external feedback on the team's products was also reported as valuable. Some teams discussed bringing in someone outside their team to provide a sanity check on their final products. This person might work within the organization or he/she might be someone they trust outside their immediate organization (depending on classification level of the products). In one team, the person who filled this role was the up and out guy described earlier. This person helped the team evaluate questions such as "Does this make sense to someone outside our team? Does it communicate what we're trying to have it communicate? Does it involve a lot of explanation? Or can it stand alone?"

Another strategy reported by participants was to consider alternative means of packaging the information. Though PowerPoint is a common tool for packaging and communicating information within the military, it has its drawbacks (see Tufte, 2003; Zweibelson, 2012b). Different ways reported by planning teams in our interviews, to communicate their insights and recommendations (other than a slide deck), include ½-1 page "stakeholder narratives" that provide a non-bulleted text-based description of the ideas and recommendations, visual representations that model ideas and recommendations using graphical media, or some combination thereof. As described by one interviewee:

> The stakeholder narrative is typically about a half page. First half they read and then put all their comments on the bottom half. Most stakeholders are high ranking, and don't have a lot of time. They need the bottom line up front in a clear and concise manner… (USMC LtCol)

One team leader described packaging his team's insights into what he referred to as "alternative realities." These alternative realities were different perspectives on the area of operations, based on quite different, but entirely plausible, assumptions. Describing the stakeholder narrative, a participant reported:

> We decided we needed to offer three lenses to look through… [so] we used a concept of alternative realities in order to accelerate the decision making of the commander's…
>
> "If those things are true and this reality is this … It could look like this. It doesn't have to, but it could." In this [second] reality we assume these things to be true. We don't have to agree with it. But when we assume this reality, then these things are true. And then, why we thought those things could be true based on facts, supporting intel, etc.
>
> [We then] went through that process for each of the alternative realities: none of these [realities] are right, but they're not wrong… when you go out there, you can confirm or deny some of these things. [This] gave the commander something to measure what he's looking at on the ground against… . (USMC LtCol)

When possible and appropriate, planning teams have leveraged existing communication mechanisms to share their evolving understanding and recommendations. One participant, for example, described the utility of using Command Post of the Future (CPOF) as an alternative to static PowerPoint slides to communicate the planning teams' evolution of understanding within the dynamic operational environment:

> These last two units use CPOF as a way to present data and information and knowledge to the commander for battle updates…The nice thing about CPOF is it updates itself. You can't do that in PowerPoint. They got used to using CPOF as a way to transfer info and knowledge to the commander. The commander started trusting his staff for giving the information he needed to make decisions. CPOF…updates continuously. He sees where changes are, so he's constantly in tune to his operational environment. You can't work that way with PowerPoint. It's too static. Only a snapshot in time. (U.S. Army CIV)

Finally, interview participants described considerable variability in the commander's level of involvement with the planning team. While the commander commissions the team, most commanders simply do not have the bandwidth to be involved in the day-to-day workings and dialogue of the team. Therefore, the team needs to be strategic about when to seek the commander's guidance and how to best use the (sometimes) limited opportunities for interaction with him/her. Experienced team leaders have described key triggers that alert them to the need to engage the commander. Examples provided by interview participants included:

- When there was a decision point and the team needed the commander's perspective.
- When the team needed a more explicit statement of objective or intent.
- When the team was stuck and was having difficulty figuring out a productive way forward.
- When the team reached a point where members needed to significantly reframe their understanding.
- When the team needed assistance identifying or recruiting a new team member or SME.
- When a particular team member was not gelling with the rest of the team or otherwise aligning with the team's mission and values.
- When the team had completed its final product(s) and they needed the commander's final stamp of approval.

As one participant described in our interviews:

> We don't have much interaction with the commander, so we deal with his senior leaders. We have senior leader discussions that represent the commander (various staff elements). But direct interactions with the commander as described by doctrine on ADM are not really resident in our experience right now.
>
> [The extent of the interaction with the commander] depends on the design effort. We usually have one or two iterative sessions with him. Will typically meet when there's a decision point we need him to weigh in on. Or when we hit a point of reframing. And we have to tell him why we can't get from A to B without backing up and reframing. And, he is part of the final iterations, final polishing. Providing his fingerprint on final thoughts at end. (U.S. Army LTC)

An appropriate summary for communicating with external stakeholders is offered by Zweibelson (2012c) as "although there are no 'rules' the final design deliverables should be concise, informative, yet simplistic for wide organizational consumption and application" (p. 6).

A summary of strategies, suggestions, and key considerations for conveying team insights identified by interview and survey participants and the team performance literature are provided in Table 4.

Table 4

Conveying Team Insights: Summary of Strategies and Key Considerations

---

- Early in the team's lifecycle, consider and discuss how the team is going to capture its discourse. Reflect on how the approach is working at various points during the project, and adapt process and tools as needed.
- Recognize that knowledge products span a continuum from those intended for internal team use to those that are created for people outside of the team, and evolve as the team becomes closer to product delivery. Products developed to support the team's development of understanding are not what should be delivered to external stakeholders.
- Study and discuss the team's stakeholders and the stakeholder's goals, needs, and preferences for consuming information.
- Review ideas and products with stakeholders. Build in opportunities for discussion and exchange with stakeholders.
- Recognize (and resist) the tendency to become enamored with internal team products and representations.
- Simplify complex language and representations; recognize that simple does not equal simplistic.
- Seek external feedback on products and explore: Does this make sense to someone outside the team? Does it communicate what the team is trying to convey?
- Consider strengths and limitations of different communication modes, and whether alternatives to PowerPoint might do a better job at conveying your message.
- Leverage existing communication tools and technology, where appropriate, if part of stakeholders' typical information flow.
- Seek the commander's review and input at key decision points.

Conclusions

As the U.S. Army continues to encounter unfamiliar and highly complex challenges, teams whose charter is to define complex problems and figure out innovative approaches for addressing them will likely become increasingly prevalent. The task of collective sensemaking is a highly complex one, and can be further complicated by issues associated with interpersonal dynamics. Military leaders need support in managing these challenges. Using insights collected from planners who have participated in planning teams in real-world operational settings, we have captured a wide array of practices that can be helpful to those leading teams in future operational contexts.

Experienced planners have adopted practices that allow them to identify and mesh a group of disparate individuals together into a cohesive unit, to prepare the team and set expectations about the team's activity, to manage diverse personalities, engage in inclusive dialogue, think about problems holistically, and to capture and convey insights to those with a stake in the team's outcomes. At the heart of all of these practices is the recognized need to

understand the organizational culture and context in which the team resides and what the culture will support.

Although commanders and planners have developed successful strategies for a number of team challenges, there are some challenges with which these leaders continue to struggle. In some cases, team leaders have not yet found or developed effective ways to manage certain challenges, or have indicated the need for a wider set of strategies. These topics represent areas where additional research seems warranted. For example, while metacognition, holistic thinking, creative thinking, and cognitive flexibility are central to team performance in design type activities, planners seem to have a fairly limited set of strategies for cultivating these cognitive activities in their team members. Planning team leaders would benefit from innovative tools and approaches they can use to foster these activities among team members. While strategies have been developed and used successfully outside the military (such as using tangible working materials to explore problem sets), some approaches and tools may be viewed as trite or trivial by military personnel because they are so different from what the military culture has typically embraced. Similarly, trust and psychological safety are recognized as crucial to effective design team interaction; yet research participants lamented the continual challenge of getting team members to truly dissent and express alternative points of view - particularly to those of higher rank.

As the Army continues to evolve its culture toward one that is more adaptive, agile, and learning-oriented it may be productive to explore the tools and approaches that have been effective for other organizations who have been successful in cultivating cognitive flexibility, innovation, strategic thinking, and a sense of psychological safety. It would also be helpful to examine how some of the non-traditional tools and approaches (or adaptations of them) identified outside the military might gradually become integrated and accepted within the military culture. In parallel, the Army should explore cultural barriers and ways to evolve the culture in a way that is more accepting of the types of tools and practices that may be currently viewed as counter-cultural.

Summary

This research effort sought to identify and capture best practices for military planning teams engaging in design. Although the term best practice suggests context-independence, a key finding from this work was that team activities are largely context-dependent. Yet, despite the variability in how the teams function, the research reported here illuminated many practices and strategies that team leaders and members have found effective in dealing with core aspects of team functioning in operational contexts. We uncovered a range of practices and useful strategies surrounding topics such as assembling the team, preparing the team and setting expectations, fostering cognitive flexibility, managing team dynamics, and capturing and conveying evolving understanding and insights. These findings can be helpful to those who are leading or participating in planning teams engaging in design activities as they struggle to manage these challenges and seek to optimize design team functioning and outcomes.

References

Ancona, D. G., & Bresman, H. (2007). *X-Teams: How to build teams that lead, innovate, and succeed*. Boston, MA: Harvard Business School Press.

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

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

Bumiller, E. (2010, April 27). We have met the enemy and he is PowerPoint. *The New York Times*. Retrieved from http://www.nytimes.com/2010/04/27/world/27powerpoint.html?_r=0

Burke, S. C., Stagle, K. C., Klein, C., Goodwin, G. F., Salas, E., & Halpin, S. M. (2006). What type of leadership behaviors are functional in teams? A meta-analysis. *The Leadership Quarterly, 17*, 288-307.

Cannon-Bowers, J. A., Tannenbaum, S. I., Salas, E., & Volpe, C. E. (1995). Defining team competencies and establishing team training requirements. In R. A. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 333-380). San Francisco: Jossey-Bass.

Capjon, J. (2009). *Engaged collaborative ideation supported through material catalysation.* Paper presented at the Nordic Design Research Conferences, North America.

Cianniolo, A. T., LaVoie, N., Foltz, P., & Pierce, L. G. (2009). *Augmented performance environment for enhancing interagency coordination in stability, security, transition, and reconstruction (STTR) operations*. Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Clark, T. (2013). The genome doodle of strategic thinking: Times, epistemologies, and narratives. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 231-247): Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Cooke, N. J., Kiekel, P. A., Salas, E., Stout, R. J., Bowers, C., & Cannon-Bowers, J. (2003). Measuring team knowledge: A window to the cognitive underpinnings of team performance. *Group Dynamics: Theory, Research and Practice, 7*, 179-199.

Cooke, N. J., Salas, E., Cannon-Bowers, J. A., & Stout, R. J. (2000). Measuring team knowledge. *Human Factors, 42*, 151-173.

Covey, S. (2006). *The speed of trust: The one thing that changes everything*. New York: Free Press.

Crandall, B., Klein, G., & Hoffman, R. (2006). Chapter 7: Analysis and representation *Working Minds: A practitioner's guide to Cognitive Task Analysis*. Cambridge, MA: The MIT Press.

Crandall, B., Klein, G., & Hoffman, R. R. (2006). *Working minds: A practitioner's guide to Cognitive Task Analysis*. Cambridge, MA: The MIT Press.

De Cremer, D., & van Knippenberg, D. (2002). How do leaders promote cooperation? The effects of charisma and procedural fairness. *Journal of Applied Psychology, 87*, 858-866.

de Dreu, C. K. W. (2006). When too little or too much hurts: Evidence for a curvilinear relationship between task conflict and innovation in teams. *Journal of Management, 32*, 83-107.

de Dreu, C. K. W., Nijstad, B. A., & van Knippenberg, D. (2008). Motivated information processing in group judgement and decision making. *Personality and Social Psychology Review, 12*, 22-49.

de Dreu, C. K. W., & Weingart, L. R. (2003). Task verus relationship conflict, team performance and team member satisfaction: A meta-analysis. *Journal of Applied Psychology, 88*, 741-749.

de Dreu, C. K. W., & West, M. A. (2001). Minority dissent and team innovation: The importance of participation in decision making. *Journal of Applied Psychology, 86*, 1191-1201.

Druskat, V. U., & Wolff, S. B. (1999). Effects and timing of developmental peer appraisals in self-managing work groups. *Jornal of Applied Psychology, 84*, 58-74.

Edmondson, A. C. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly, 44*, 350-383.

Entin, E. E., & Serfaty, D. (1999). Adaptive team coordination. *Human Factors, 41*, 312-325.

Eriksen, M. (2009). Engaging design materials, formats and framings in specific, situated co-designing - A micro-material perspective. In Online Proceedings of the Third Nordic Design Research Conference, Oslo, Norway.

Esser, J. K. (1998). Alive and well after 25 years: A review of groupthink research. *Organizational Behavior & Human Decision Processes, 73*, 5-24.

Farh, J. L., Lee, C., & Farh, C. I. C. (2010). Task conflict and team creativity: A question of how much and when. *Journal of Applied Psychology, 95*, 1173-1180.

Feltovich, P., Hoffman, R., Woods, D., & Roesler, A. (2004). Keeping it too simple: How the reductive tendency affects cognitive engineering. *IEEE Intelligent Systems, 19*, 90-94.

Fletcher, K. (1990). *Mapping strategic thought*. New York: John Wiley and Sons.

Fruchter, R., & Bosch-Sijtsema, P. (2011). The WALL: Participatory design workspace in support of creativity, collaboration, and socialization. *Al Sociology, 26*, 221-232.

Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity*: Free Press.

Gardner, H. (2006). *Five minds for the future*. Cambridge, MA: Harvard Business School Press.

Garven, S. (in preparation). *Trust development in Quickly Performing Teams*. (Research Product) Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Gigone, D., & Hastie, R. (1993). The common knowledge effect: Information sharing and group judgment. *Journal of Personality & Social Psychology, 65*, 959-974.

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

Gladstein, D. L. (1984). Groups in context: A model of task group effectiveness. *Administrative Science Quarterly, 29*, 499-517.

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

Grome, A. P., Crandall, B. W., Rasmussen, L., & Wolters, H. M. K. (2012). *Incorporating Army design methodology into Army operations: Barriers and recommendations for facilitating integration* (Research Report 1954). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Gruenfeld, D., Mannix, A., Williams, K., & Neale, M. (1996). Group composition and decision making: How member familiarity and information distribution affect process and performance. *Organizational Behavior & Human Decision Processes, 67*, 1-15.

Guzzo, R. A., Yost, P. R., Campbell, R. J., & Shea, G. P. (1993). Potency in groups: Articulating a construct. *British Journal of Social Psychology, 32*, 87-106.

Hackman, J. R. (1987). The design of work teams. In *Handbook of organizational behavior* (J. Lorsch ed.). Englewood Cliffs, NJ: Prentice-Hall.

Hackman, R. J. (1986). The psychology of self-management in organizations. In M.S. Pollack & R. O. Perloff (Eds.), *Psychology and Work: Productivity, Change, and Employment*. Washington, DC: American Psychological Association.

Halebian, J., & Finkelstein, S. (1993). Top management team size, CEO dominance, and firm performance: The moderating roles of environmental turbulence and discretion. *Academy of Management Journal, 36*, 844-863.

Hambrick, D., Cho, T., & Chen, M. (1996). The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly, 41*, 659-684.

Hammerstrom, M. (2010). *Size matters: How big should a military design team be? Monograph*. Fort Leavenwork, KS: United Sates Army Command and General Staff College. School of Advanced Military Studies.

Han, G., & Harms, P. (2010). Team identification, trust and conflict: A mediation model. *International Journal of Conflict Management, 21*, 20-43.

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

Hodson, G., & Sorrentino, R. M. (1997). Groupthink and uncertainty orientation: Personality differences in reactivity to the group situation. *Group Dynamics: Theory, Research and Practice, 1*, 144-155.

Hoever, I. J., van Knippenberg, D., van Ginkel, W. P., & Barkema, H. G. (2012). Fostering team creativity: Perspective taking as key to unlocking diversity's potential. *Journal of Applied Psychology, 97*, 982-996.

Hoffman, R. R. (1998). How can expertise be defined?: Implications of research from cognitive psychology. In W. F. R. Williams, J. Fleck (Ed.), *Exploring expertise* (pp. 81-100). New York: MacMillan.

Horn, R., & Weber, R. (2007). *New tools for resolving wicked problems: Mess mapping and resolution mapping processes*. Watertown, MA: Strategy Kinetics, LLC.

Horwitz, S. K., & Horwitz, I. B. (2007). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of Management, 33*, 987-1015.

Hülsheger, U. R., Anderson, N. H., & Salgado, J. F. (2009). Team-level predictors of innovation at work: A meta-analysis spanning three decades of research. *Journal of Applied Psychology, 94*, 1128-1145.

Ilgen, D. R., Hollenbeeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI Models. *Annual Reveiw of Psychology, 56*, 517-543.

Jackson, S. E. (1992). Team composition in organizational settings: Issues in managing an increasingly diverse workforce. In S. Worchel, W. Wood & J. A. Simpson (Eds.), *Group processes and productivity* (pp. 138-173). Newbury Park, CA: Sage.

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

Janis, I. L. (1982). *Groupthink: Psychological studies of policy decisions and fiascoes* (Second ed.). New York: Houghton Mifflin.

Jehn, K. A. (1995). A multi-method examination of the benefits and detriments of intragroup conflict. *Administrative Science Quarterly, 40*, 256-282.

Jehn, K. A. (1997). A qualitative analysis of conflict types and dimensions in organizational groups. *Administrative Science Quarterly, 42*, 530-557.

Jehn, K. A., & Mannix, E. A. (2001). The dynamic nature of conflict: A longitudinal study of intragroup conflict and group performance. *Academy of Management Journal, 44*, 238-251.

Joint Staff. (2011). *Planners handbook for operational design*. Suffolk, VA.

Kaplan, F. (August 26, 2007). Challenging the generals, *New York Sunday Times Magazine*. Retrieved from http://www.nytimes.com/2007/08/26/magazine/26military-t.html

Kearney, E., Gebert, D., & Voelpel, S. (2009). When and how diversity benefits teams: The importance of team members' need for cognition. *Academy of Management Journal, 52*, 581-598.

Kem, J. (2009). Design: Tools of the trade. Ft. Leavenworth, KS: U.S. Army Command and General Staff College, U.S. Army Combined Arms Center.

Klein, C., Diazgranados, D., Salas, E., Le, H., Burke, C. S., Lyons, R., & Goodwin, G. F. (2009). Does team building work? *Small Group Research, 40*, 188-222.

Klein, G., Wiggins, S. L., & Dominguez, C. O. (2010). Team sensemaking. *Theoretical Issues in Ergonomic Science, 11*, 304-320.

Klein, G. A., Calderwood, R., & MacGregor, D. (1989). Critical decision method for eliciting knowledge. *IEEE Transactions on Systems, Man, and Cybernetics, 19*, 462-472.

Klein, K. J., & Kozlowski, S. W. J. (2000). *A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes*. San Francisco, CA: Jossey-Bass.

Klimoski, R., & Jones, R. G. (1995). Staffing for effective group decision-making: Key issues in matching people and teams. In R. A. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations* (pp. 291-3332). San Francisco: Jossey-Bass.

Kozlowski, S. W., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7*, 77-124.

Kravitz, D. A. (2006). Diversity in teams. A two-edged sword requires careful handling. *Psychological Science in the Public Interest, 6*(2), i-ii.

Langan-Fox, J., Code, S., & Langfield-Smith, K. (2000). Team mental models: Techniques, methods and analytic approaches. *Human Factors, 42*, 1-30.

Larson, J. R., Christensen, C., Abbott, A. S., & Franz, T. M. (1996). Diagnosing groups: Charting the flow of information in medical decision-making teams. *Journal of Personality and Social Psychology, 71*, 315-330.

Lembke, S., & Wilson, M. G. (1998). Putting the "team" into teamwork: alternative theoretical contributions for contemporary management practice. *Human Relations, 51*, 927-944.

Lenconi, P. (2005). *Overcoming the five dysfunctions of a team*. San Francisco: Jossey-Bass.

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

Mannix, E., & Neale, M. (2005). What differences make a difference? The promise of reality of diverse teams in organizations. *Psychological Science in the Public Interest, 6*, 31-55.

Mathieu, J. M., M., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007: A review of recent advancements and a glimpse into the future. *Journal of Management, 34*, 410-476.

Mattis, J. N. (2009). *Vision for a joint approach to operational design* (pp. 1-10). Norfolk, VA: U.S. Joint Forces Command.

McGrath, J. E. (1964). *Social psychology: A brief introduction*. New York: Holt, Rinehart and Winston.

Mohrman, S., & Cohen, S. (1995). When people get out of the box: New relationships, new systems. In A. Howard (Ed.), *The changing nature of work* (pp. 355-410). San Francisco: Jossey-Bass.

Moon, B. M., Hoffman, R. R., Novak, J. D., & Cañas, A. J. (2011). *Applied concept mapping: Capturing, analyzing, and organizing knowledge*. Boca Raton, FL: CRC Press, Taylor & Francis Group.

Morgeson, F. P., Reider, M. H., & Campion, M. A. (2005). Selecting individuals in team settings: The importance of social skills, personality characteristics, and teamwork knowledge. *Personnel Psychology, 58*, 583-611.

Mumford, M. D., Peterson, N. G., & Childs, R. A. (1999). Basic and cross-functional skills. In N. G. Peterson, M. D. Mumford, W. C. Borman, P. R. Jeanneret & E. A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O'NET* (pp. 49-69). Washington, DC: APA.

Naumann, S., & Bennett, N. (2000). A case for procedural justice climate: Development and test of a multilevel model. *Academy of Management, 43*, 881-889.

Nijstad, B. A., & de Dreu, C. K. W. (2002). Creativity and group innovation. *Applied Psychology, 51*, 400-406.

Norman, D. (1999). Affordance, conventions and design. *Interactions, 6*, 38-43.

Novak, J. D., & Cañas, A. J. (2008). The theory underlying concept maps and how to construct them. Pensacola, FL: Institute for Human and Machine Cognition.

Owen, C. (2013). Strategic thinking: A design contribution. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 173-201). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Packer, D. J. (2008). On being both with us and against us: A normative model of dissent in social groups. *Personality and social psychology review, 12*, 50-72.

Palus, C. J., & Horth, D. M. (2001). *Visual explorer: Picturing approaches to complex challenges*. Greensboro, NC: Center for Creative Leadership.

Palus, C. J., & Horth, D. M. (2002). *The leader's edge: Six creative competencies for navigating complex challenges*. San Francisco: Jossey Bass.

Pang, A. S.-K. (2010). Paper spaces: Visualizing the future. *World Future Review, 31*, 1-19.

Paparone, C. (2011). Design and the prospects of a design ethic. *Small Wars Journal*. Retrieved from http://smallwarsjournal.com/jrnl/art/to-design-or-not-to-design

Paparone, C. (2013). The sociology of STRATEGY: Romancing the image. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 81-101). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Paris, C. A., Salas, E., & Cannon-Bowers, J. A. (2000). Teamwork in multi-person systems: A review and analysis. *Ergonomics, 43*, 1052-1075.

Parks, C. D., & Nelson, N. L. (1999). Discussion and decision: the interrelationship between initial preference distribution and group discussion content. *Organizational Behavior & Human Decision Processes, 80*, 87-101.

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

Perron, B., & Stearns, A. (2010). A review of a presentation technology: Prezi. *Research of social work practice*.

Piaget, J., & Inhelder, B. (1969). The psychology of the child. New York: Basic Books.

Poeppelman, T. R., Beaubien, J. M., Metcalf, K. A., Pritchett, C. S., Henderson, J., Vick Jr. R. S., Domeshek, E., & Weyhrauch, W. S. (in preparation). Developing metrics of performance for the Army Design Methodology (Technical Report). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Pratt, M. G. (1998). To be or not to be: Central questions in organizational identification. In D. A. Whetten & P. C. Godfrey (Eds.), *Identity in organizations* (pp. 171-207). Thousand Oaks, CA: Sage.

Prince, G. M. (1970). *The practice of creativity; a manual for dynamic group problem solving*. New York: Harper & Row.

Roam, D. (2008). *The back of the napkin*. New York: Portfolio.

Ross, K., Grome, A., Arrastia, M., Schaab, B., Ong, J., & Spangler, J. (2009). *Development and validation of training themes for joint, interagency, intergovernmental and multinational (JIIM) operations.* Paper presented at the Proceedings of the Interservice/Industry Training, Simulation & Education Conference (I/ITSEC), Orlando FL.

Salas, E., Cooke, N., & Rosen, M. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human Factors, 50*, 540-547.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. *The Journal of the Human Factors and Ergonomics Society, 50*, 540-547.

Salas, E., Rozell, D., Mullen, B., & Driskell, J. E. (1999). The effect of team building on performance: An integration. *Small Group Research, 30*, 309-329.

Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "Big Five" in teamwork? *Small Group Research, 36*, 555-599.

Salas, E., Stagl, K. C., Burke, C. S., & Goodwin, G. F. (2007). *Fostering team effectiveness in organizations: Toward an integrative theoretical framework of team performance.* Paper presented at the Nebraska Symposium on Motivation, Lincoln.

Sanders, E. (2013). Creativity in strategic thinking. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 150-172). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Sanders, E., & Stappers, P. (2013). *Convivial toolbox: Generative research for the front end of design*. Amsterdam: BIS Publishers.

Sanders, E. B.-N., Brandt, E., & Binder, T. (2010). *A framework for organizing the tools and techniques of participatory design.* Paper presented at the Proceedings of the 11th Bienneial Participatory Design Conference.

Schmidt, M. (2013). A science of context: The qualitative approach as fundamental to strategic thought. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 220-230). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Schmitt, J. F. (2006). A systemic concept for operational design Vol. 2010. Retrieved from http://www.au.af.mil/au/awc/awcgate/usmc/mcwl_schmitt_op_design.pdf

Scholten, L., van Knippenberg, D., Nijstad, B. A., & de Dreu, C. K. W. (2007). Motivated information processing and group decision-making: Effects of process accountability on information processing and decision quality. *Journal of Experimental Social Psychology, 43*, 539-552.

Schraw, G. (1998). Promoting general metacognitive awareness. *Instructional Science, 26*, 113-125.

Schultz-Hardt, S., Jochims, M., & Frey, D. (2002). Productive conflict in group decision making: Genuine and contrived dissent as strageies to counteract biased information seeking. *Organizational Behavior & Human Decision Processes, 88*, 563-586.

Schweiger, D. M., Sandberg, W. R., & Rechner, P. L. (1989). Experiential effects of dialectical inquiry, devil's advocacy, and consensus approaches to strategic decision making. *Academy of Management Journal, 32*, 745-772.

Schwenk, C. R., & Valacich, J. S. (1994). Effects of devil's advocacy and dialectical inquiry on individuals versus groups. *Organizational Behavior & Human Decision Processes, 49*, 210-222.

Sitkin, S. B., & Hackman, J. R. (2011). Developing team leadership: An interview with coach Mike Krzyzewski. *Academy of Management Learning and Education, 10*, 494-501.

Smith, K. G., Carroll, S., & Ashford, S. J. (1995). Intra- and interorganizational cooperation: Toward a research agenda. *Academy of Management Journal, 38*, 7-22.

Sniezek, J. A. (1992). Groups under uncertainty: An examination of confidence in group decision making. *Organizational Behavior & Human Decision Processes, 59*, 210-222.

Sniezek, J. A., & Henry, R. A. (1989). Accuracy and confidence in group judgment. *Organizational Behavior and Human Decision Processes, 43*, 1-28.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., & Anderson, D. K. (1988). Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains. In V. Patel (Ed.), *Tenth Annual Conference of the Cognitive Science Society* (pp. 375-383). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Stahl, G., Maznevski, M., Voigt, A., & Jonsen, K. (2010). Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups. *Journal of International Business Studies, 41*, 690-709.

Stasser, G. (1992). Information salience and the discovery of hidden profiles by decision-making groups: A thought experiment. *Organizational Behavior & Human Decision Processes, 52*, 156-181.

Stasser, G. (1999). The uncertain role of unshared information in collective choice. In L. L. Thompson, J. M. Levine & D. M. Messick (Eds.), *Shared cognition in organizations: The management of knowledge* (pp. 49-69). Mahwah, NJ: Erlbaum.

Stewart, G. L., & Barrick, M. R. (2004). Four lessons learned from the person-situation debate: A review and research agenda. In B. Smith & B. Schneider (Eds.), *Personality and organizations* (pp. 61-87). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Stout, R. J., Cannon-Bowers, J. A., Salas, E., & Milanovich, D. M. (1999). Planning, shared mental models, and coordinated performance: An empirical link is established. *Human Factors, 41*, 61-71.

Sundstrom, E., DeMeuse, K. P., & Futrell, D. (1990). Work teams: Applications and effectiveness. *American Psychologist, 45*, 120-133.

Tannenbaum, S. I., Beard, R. L., & Salas, E. (1992). Team building and its influence on team effectiveness: An examination of conceptual and empirical developments. In K. Kelley (Ed.), *Issues, theory and research in industrial/organizational psychology* (pp. 117-153). Amsterdam: Elsevier.

Taylor, R. G. (1989). The role of trust in labor-management relations. *Organization Development Journal, 7*, 85-89.

Tjosvold, D. (2008). The conflict-positive organization: It depends on us. *Journal of Organizational Behavior, 29*, 19-28.

Tjosvold, D., Johnson, D. W., & Lerner, J. (1981). The effects of affirmation and acceptance on incorporation of an opposing opinion in problem solving. *Journal of Social Psychology, 114*, 103-110.

TRADOC. (2008). Commander's appreciation and campaign design, v1, Pamphlet 525-5-500.

Tufte, E. (2003). *The cognitive style of PowerPoint*. Cheshire, CT: Graphics Press.

Tufte, E. (2006). *The cognitive style of PowerPoint: Pitching out corrupts within* (2nd ed.). Cheshire, CT: Graphics Press.

Tufte, E. R. (1997). *Visual and statistical thinking: Displays of evidence for decision making*. Cheshire, CT: Graphics.

Tyler, T. R., & Blader, S. L. (2000). *Cooperation in groups: Procedural justice, social identity, and behavioral engagement*. Philadelphia: Psychology Press.

U.S. Department of the Army. (2012). *ADRP 5-0, The Operations Process*. Washington, DC.

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

U.S. Joint Forces Command. (2010). *Design in military operations: A primer for joint warfighters.* (The Joint Warfighting Center Joint Doctrine Series, Pamphlet 10). Washington, DC: Author.

Valacich, J. S., & Schwenk, C. R. (1995). Devil's advocacy and dialectical inquiry effects on face-to-face and computer-mediated group decision making. *Organizational Behavior & Human Decision Processes, 63*, 158-173.

van Ginkel, W. P., & van Knippenberg, D. (2009). Knowledge about the distribution of information and group decision making: When and why does it work? *Organizational Behavior & Human Decision Processes, 108*, 218-229.

van Ginkel, W. P., & van Knippenberg, D. (2012). Group leadership and shared task representations in decision making groups. *The Leadership Quarterly, 23*, 94-106.

van Knippenberg, B., van Knippenberg, D., De Cremer, D., & Hogg, M. A. (2005). Research in leadership, self and identity: A sample of the present and a glimpse of the future. *The Leadership Quarterly, 16*, 495-499.

van Knippenberg, D., de Dreu, C. K. W., & Hoffman, A. C. (2004). Work group diversity and group performance: An integrative model and research agenda. *Journal of Applied Psychology, 89*, 1008-1022.

van Riper, P. (2013). The identification and education of U.S. Army strategic thinkers. In H. M. Wolters, A. P. Grome & R. Hinds (Eds.), *Enhancing the Army's strategic thinking capability: Insights to assess, develop and retain strategic thinkers* (Research Product 2013-01, pp. 10-31). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Wanous, J. P., & Young, M. A. (1986). Solution diversity and the quality of group decisions. *Academy of Management journal, 29*, 149-159.

Wass de Czege, H. (Jan-Feb 2009). Systemic operational design: Learning and adapting in complex missions. *Military Review,* 2-12.

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

West, M. A., & Richer, A. W. (2008). Climate and cultures for innovation and creativity at work. *Handbook of Organizational Creativity*, 211-236.

White, S. E., Dittrich, J. E., & Lang, J. R. (1980). The effects of group decision making procedures and problem situation complexity on implementation attempts. *Administrative Science Quarterly, 25*, 428-440.

Wildman, J. L., Thayer, A. L., Pavlas, D., Salas, E., Stewart, J. E., & Howse, W. R. (2012). Team knowledge research: Emerging trends and critical needs. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 54*, 84-111.

Williams, K. Y., & O'Reilly, C. A. (1998). Demography and diversity in organizations: A review of 40 years of research. In B. Staw & R. Sutton (Eds.), *Research in organizational behavior* (Vol. 20, pp. 77-140). Greenwich, CT: JAI Press.

Wilson, K. A., Salas, E., Priest, H. A., & Andrews, D. (2007). Errors in the heat of battle: Taking a closer look at shared cognition breakdowns through teamwork. *Human Factors, 49*, 243-256.

Wittenbaum, G. M., & Stasser, G. (1996). Management of information in small groups. In J. L. Nye & A. R. Brower (Eds.), *What's social about social task representations? Research on socially shared task representations in small groups* (pp. 3-28). Thousand Oaks, CA: Sage.

Wolters, H., Conrad, T., Riches, C., Brusso, R., Nicely, K., Morath, R., & Keller-Glaze, H. (2014). *Identification of the requisite knowledge, skills and abilities for design* (Technical Report 1339). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Xiao, Y., Hunter, W. A., Mackenzie, C. F., Jefferies, N. J., & Horst, R. L. (1996). Task complexity in emergency medical care and its implications for team coordination. *Human Factors, 38*, 636-645.

Yukl, G., Gordon, A., & Taber, T. (2002). A hierachical taxonomy of leadership behavior: Integrating a half century of behavior research. *Journal of Leadership and Organizational Studies, 9*, 15-32.

Zsambok, C. E., Klein, G., Kyne, M., & Klinger, D. W. (1993). How teams excel: A model of advanced team decision making *Performance Technology-1993, Selected Proceedings of the 31st NSPI Conference* (pp. 19-27). Chicago, IL: NSPI.

Zweibelson, B. (2011). To design or not design. *Small Wars Journal*. Retrieved from http://smallwarsjournal.com/jrnl/art/to-design-or-not-to-design

Zweibelson, B. (2012a). Does design help or hurt military planning: How NTM-A designed a plausible Afghan security force in an uncertain future, part I. *Small Wars Journal,* (July 9). Retrieved from http://smallwarsjournal.com/jrnl/art/does-design-help-or-hurt-military-planning-how-ntm-a-designed-a-plausible-afghan-security-f

Zweibelson, B. (2012b). How PowerPoint stifles understanding, creativity, and innovation within your organization. *Small Wars Journal,* (Septermber 4). Retrieved from

http://smallwarsjournal.com/jrnl/art/how-powerpoint-stifles-understanding-creativity-and-innovation-within-your-organization

Zweibelson, B. (2012c). Military design in practice: A case from NATO training mission-Afghanistan in 2012. Why military decision making requires a blend of theory, doctrine, and politics. *Small Wars Journal*. Retrieved from http://smallwarsjournal.com/jrnl/art/military-design-in-practice-a-case-from-nato-training-mission-afghanistan-in-2012

Zweibelson, B. (Nov-Dec 2012d). Seven design theory considerations: An approach to ill-structured problems. *Military Review,* 80-89.

**Appendix A
Team Performance Literature Review**

Introduction

The work performed by military design teams (i.e., planning teams engaged in problem-framing and problem-solving activities) is vital to contemporary military planning operations. As design teams continue to play an important role in military operations into the foreseeable future, it is important to identify and understand the factors that may contribute to their effectiveness. Design teams face several challenges that are common to teamwork in general – such as building and maintaining trust, creating a sense of cohesion, and managing conflict. But, design teams also face unique challenges due to the context in which they operate and the type of tasks they conduct. Design teams engage in highly complex cognitive activities that require making sense of dynamic, ill-structured, and unfamiliar problems and determining potential ways to resolve them. Yet not only must design teams engage in sensemaking, they must also engage in "sensegiving" in order to convey their understanding to others in ways that are meaningful and actionable. Given the types of problem sets design teams are tackling in today's operational environments, these teams' work is clearly non-trivial and important to better understand and support.

A great deal of the literature on teamwork and high-functioning teams that can be brought to bear on the challenges of planning teams engaged in design (Cannon-Bowers et al., 1995; Cianniolo et al., 2009; Cooke et al., 2003; Ross et al., 2009; Salas et al., 2008). We examined the existing team literature in order to extract principles that have potential applicability for design teams. The review drew upon on literature from organizational psychology, management, social psychology, human factors psychology, and the military domain that addresses practices for effective teamwork. The two primary goals were to extract:
- Factors that researchers have identified as important for effective team performance/collaboration in general.
- Best practices for teams, generally, that may be applicable to design teams.

In order to scope the search through the vast team performance literature, we focused heavily on recent review articles (e.g., Kozlowski & Ilgen, 2006; Salas, Stagl, Burke, & Goodwin, 2007) and meta-analyses (e.g., Klein et al., 2009), as they provide summative accounts of what has been established with respect to practices that influence team effectiveness.

The findings from the literature review begin with an overview of team performance and effectiveness. We then present findings reflecting a set of topics relevant to design teams. We use the well-established input-process-output (IPO) framework (McGrath, 1964) as an organizing structure for the findings. The topics addressed in the review include:
- *Input* - Team composition, team diversity, team size, organizational context, team development, and team building, team cohesion, team efficacy, team identity, leadership, and trust.
- *Process* - Developing trust, managing conflict, team cognition - i.e., developing a shared understanding, team sensemaking, metacognition, holistic thinking, avoidance of groupthink, team decision making with distributed information, creative thinking, and visual thinking.

- *Ouput* - Sharing insights with stakeholders outside the team, and use of visual representations for complex ideas.

We summarize each section with a *key takeaway* for design teams. We have interwoven many of the findings from this literature review into the main body of the research report to augment the interview, observation, and survey findings. However, this literature review can also serve as a stand-alone piece useful for other team performance related research efforts.

Team Performance and Effectiveness: Overview

Given the centrality and importance of teams in a wide array of work settings, there has been a vast amount of research conducted on teamwork and team effectiveness in recent decades. Salas, Cooke, and Rosen (2008) referred to the recent decades as a "golden age" of team research. Researchers have identified a host of factors that impact team performance – ranging from personality factors, cognitive ability, cultural factors, motivation, to team structure and norms, to task characteristics – such as task type and workload (Salas et al., 2008). Paris, Salas, and Cannon-Bowers provide a taxonomy of variables that influence team effectiveness that includes: contextual factors, structural factors, team design factors, process factors, and contingency factors. Researchers have also identified a host of competencies required for effective teamwork (Paris et al., 2000).

The challenge in identifying best practices for design teams is that most of the findings about factors that impact team performance are highly context-dependent. In many cases, the answer to the question "What matters?" is "It depends." A variety of factors mediate the relationship between input or process variables and their impact on team performance – including type of task, timeline, and elements of the organizational context in which the team functions. Thus, in some regard, the notion of "best practice" is a misnomer given how highly context-dependent team effectiveness can be. Nonetheless, we have summarized key aspects of the team performance literature and have captured takeaways that are relevant to design teams.

Team Performance Models and Taxonomies

Team performance scholars have developed numerous models, theories, and/or taxonomies of team performance and effectiveness. While a detailed description of these is beyond the scope of this effort, it is important to note their existence, as it illustrates the complexity of the domain and the amount of research that has been dedicated to it. Salas, Stagl, Burke, & Goodwin's (2007) review of the literature identified over 130 models and frameworks for team performance that range in level of specificity. While some models are generalizable and parsimonious, such as Salas, Sim's, and Burke's (2005) "Big Five" of teamwork, other models are much more task-or context-specific (for example Xiao, Hunter, Mackenzie, Jefferies, & Horst, 1996). Other models focus on specific team functions or processes (Salas et al., 2008).

A common thread that weaves through many of the existing team performance models is the way in which the variables are accounted for. Most of the team performance models have followed the input-process-output (I-P-O) logic developed by McGrath (1964). Although this framework has been criticized for taking a static perspective on teamwork (and therefore may hold limited value as a casual model), it has proven to be useful as an organizing framework when describing the factors that make a difference for team performance (Ilgen et al., 2005; Kozlowski & Ilgen, 2006). Thus,

for the remainder of this literature review, we will organize the findings according to the I-P-O framework[8]. Following each major topic area, we provide a summary of key takeaways relevant to design teams.

Input

Team Composition

Important questions for military design teams are "Who should be on the team" and "How should the team be structured?" A team's composition and mixture of member knowledge, skills, and abilities needed to actually perform the task has been established as a critical contributor to team performance. (Mathieu et al., 2008; Morgeson et al., 2005; Stewart & Barrick, 2004).

Kozlowski and Klein (2000) and Stewart and Barrick (2004) address the patterns of team member characteristics and their impact on team effectiveness. In some cases, they found that *more* of a particular characteristic (such as general intelligence or emotional stability) may generally be better for team effectiveness. But with certain characteristics, a *balanced* pattern may be optimal. For example, Stewart and Barrick (2004) suggest that a balance across members on personality characteristics such as extroversion, agreeableness, and conscientiousness may be better than similarity along those dimensions. However, Mathieu et al. (2008) also notes that team member personality characteristics may impact team performance differently depending on the task in which the team is engaged.

The team's performance not only depends on team members' KSAO's required for *individual* task performance, but also on KSAOs required for effective *team* functioning (Paris, Salas, & Cannon-Bowers, 2000). Given that individuals working in teams must be able to work effectively with other people, Morgeson, Reider, and Campion (2005) argue that the KSAOs required for effective team performance may be different than those required for individually-oriented tasks. For example, there is evidence supporting the importance of individual team members' social skills to team performance (Morgeson et al., 2005). Mohrman and Cohen (1995) similarly noted that several interpersonal types of skills increase in their level of importance when individuals work within a team. For example, "an individual needs to be able to communicate with others, listen to others, influence others and so forth" (Cohen, 1995; p. 384). Skills such as coordination, negotiation, social perceptiveness, persuasion, instructing, and helping others increase in importance when working in teams (Mumford et al., 1999).

Morgeson et al. (2005) conducted a study to examine the relationships between social skills, personality characteristics (including extraversion, agreeableness, emotional stability, and conscientiousness), teamwork knowledge, and contextual performance. The authors found that each of these variables is positively related to contextual performance in a team setting. Thus, Morgeson et al. (2005) posit that when selecting individuals for teams is an option, such skills should be given

---

[8] The I-P-O framework has evolved in the past decade as researchers have recognized that teams are complex, adaptive systems that exist within a particular context and evolve and adapt over time. For example, Ilgen, Hollenbeck, Johnston and Junt (2005) proposed the input-mediator-output-input (IMOI) framework to address the IPO framework's deficiencies and better account for the complex phenomena involved in teamwork.

consideration and suggest options for testing/screening on these constructs for selection, including structured interviews and a situational judgment test.

Specifically within the context of design teams, Owen (2013) describes characteristics important for design thinkers. These characteristics include: ability to visualize, a bias for adaptively, systemic vision, ability to use language as a tool, a generalist view, facility for avoiding the necessity of choice, ability to work systematically with qualitative information, human-centered focus, conditioned inventiveness, environment-centered concern, self-governing practicality, and an affinity for teamwork (see Owen, 2013 for more detail). Specifically regarding an affinity for teamwork, Owen notes that designers routinely work in a collaborative and multi-disciplinary fashion. Thus, good interpersonal skills and learning to be a good team member are of paramount importance. He also notes that learning to be a good team member comes primarily from real-lived experience working as part of team. Furthermore, it is often through the dysfunctional team experiences where individuals tend to learn the most about themselves and team dynamics (Owen, 2013).

A research investigation specific to military design activity was conducted by Wolters et al. (2014) to identify the specific KSAs needed for design activity. The investigators created a framework of six competencies and 43 KSAs that are associated with the cognitive and the social-communication aspects of design. The general model included the following competencies: holistic thinking, sensemaking, innovative thinking, adapting, sensegiving, and collaborating. The authors argue that in some cases, a commander's best option for ensuring an effective design team composition is to select individuals who possess these competencies. They recommend that strategies and best practices of selection be identified, and that tools to support commanders in selecting design team members should be identified and/or developed. The authors also recommend that additional research is needed to distinguish between KSAs that *all* design team members need versus those that only *some* design team members need to possess.

Wolters et al.'s (2014) recommendation is consistent with Kozlowski and Ilgen (2006) conclusion that the research in the area of team composition is still fairly young. There is a need for more research into complex configuration of KSAOs (such as sharedness or diversity along dimensions such as ability, personality, cultural, and other demographic characteristics) and how they differentially impact team performance.

Key takeaway. Although research has identified particular types of KSAOs that are important for effective teamwork in general, and for design activity in particular, there is currently no empirical evidence that points to an optimal configuration of KSAOs across a design team. Given the existing research, commanders and design team leaders do have a strong place to start in identifying the types of skills and characteristics of team members that are likely to contribute positively to the team's performance (e.g., social/interpersonal and communication skills, collaboration skills, holistic thinking skills, etc.).

Team Diversity: Advantages and Drawbacks

Previous research has argued for the importance of diversity in military design teams (Hammerstrom, 2010; Zweibelson, 2012a). A significant amount of research has been conducted exploring the role of diversity in team performance that can be brought to bear on military design teams (e.g., Horwitz & Horwitz, 2007; Jackson, 1992; Kearney et al., 2009; Mannix & Neale, 2005;

Stahl, Maznevski, Voigt, & Jonsen, 2010). Team diversity has been tied to multiple performance advantages. For example, research has demonstrated that *genuine dissent* (Schultz-Hardt et al., 2002) - which can result from a diverse team comprised of individuals with differing viewpoints - can lead to decision making processes that are more open-minded (Schultz-Hardt et al., 2002; D. Tjosvold et al., 1981). Another potential advantage to diversity is that teams comprised of individuals with different preferences or judgments before starting the group discussion tend to show less overconfidence (Sniezek, 1992), reach more accurate judgments (Sniezek & Henry, 1989), share information more extensively (Parks & Nelson, 1999), and develop better solutions in problem-solving (Wanous & Young, 1986) than teams with similar initial perspectives (Schultz-Hardt et al., 2002). Schultz-Hardt et al. (2002) also found evidence that teams whose members hold conflicting positions tend to actively seek diverging arguments and then integrate those different perspectives into their view of the problem. Finally, in their meta-analysis, Stahl et al. (2010) found that cultural diversity contributes to team process benefits through increases in creativity and satisfaction.

Yet, despite the apparent benefits of diversity to teams, there is also a preponderance of evidence that diversity has several potential drawbacks and can negatively impact team performance (Mannix & Neale, 2005; Mathieu et al., 2008). David Kravitz (2006) refers to this apparent paradox as the two-edged sword. Teams with strongly divergent perspectives may suffer from a lack of team cohesion (Jackson, 1992; Kearney et al., 2009; Mannix & Neale, 2005). Teams with diversity on variables such as age or tenure tend to decrease individuals' social integration, and can lead to higher turnover (Williams & O'Reilly, 1998). In their meta-analysis, Stahl et al. (2009) found that cultural diversity contributes to team process losses through task conflict and decreased social integration. Groups that are diverse also tend to be slower in implementing decisions than groups who are homogenous (Hambrick, Cho, & Chen, 1996; White, Dittrich, & Lang, 1980). Further, although Zweibelson (2012a) argues for diversity within design teams, he also notes that it helps to share a common language and understanding of the environment, which may be more common in teams with that are more homogenous in composition.

In an attempt to account for the apparent diversity paradox, Mannix and Neale (2005) concluded that differences such as age, gender, and ethnicity or race tend to have more negative impacts on team performance overall; while differences in education, functional background, or personality tend to be associated more positively with team performance, as these characteristics may facilitate creativity and group problem solving. Within the context of military design teams, specifically, Hammerstrom (2010) concluded that military design teams should have a cross-functional (i.e., multi-disciplinary) team structure – with diverse disciplinary backgrounds, and with a variety of perspectives and theoretical frameworks represented.

Overall, the impacts of diversity on team performance are complex and empirical findings have been mixed. No overall *main effect* of diversity on team performance has been found (Horwitz & Horwitz, 2007; Kravitz, 2006; Mannix & Neale, 2005). Instead, the research has indicated that the impact of diversity on team performance is mediated by team processes and moderated by various contextual factors (Kravitz, 2006; Mannix & Neale, 2005).

Key takeaway. Design team leaders should recognize the "double-edged sword" of diversity and understand that there can be benefits to diversity, but potential drawbacks as well. Some team leaders discussed creating "team handbooks" which described the team values, team culture, and discourse rules as a potential way to provide inclusion for ideas since effective design

teams are likely to have members who are diverse on certain characteristics (such as education and functional background) and yet needed to be able to have a safe environment in which to share those ideas.

Team Size

In addition to determining who should be on the team, military design teams are also likely to face the question of "How many people should be on the team?" Research indicates that there is a balance involved in this determination. Too few team members might lead to undue stress on those team members; but too many members can mean wasted resources (Klimoski & Jones, 1995). The existing empirical evidence suggests that there is not a direct linear relationship between team size and productivity. Larger teams tend to have a larger pool of cognitive resources (e.g., Halebian & Finkelstein, 1993). However, larger teams can also have performance detriments, largely due to the heightened coordination needs (Gladstein, 1984; Sundstrom et al., 1990). Larger teams may also be at greater risk for group-think (Klein et al., 2009). The general rule suggested in the empirical literature is that teams should be staffed to the lowest number needed to do the work (Hackman, 1987; Sundstrom et al., 1990).

In his SAMS monograph, Hammerstrom (2010) specifically addressed the topic of military design team size. Following his review of the literature, he concluded that the optimal size for a design team is approximately five-six people in the core group. However this core group can be aided by other stakeholders at various points throughout the design process. Hammerstrom (2010) also explained some of the factors that degrade the effectiveness of larger teams. For example - the number of transaction (communication) channels required in larger teams creates burdens and inefficiencies. As the size of the team expands, the amount of time and energy necessary to communicate and maintain relationships can divert attention away from the team's primary tasks. In addition, limits on short-term memory can mean that larger teams can make it difficult for an individual to retain the information and various perspectives offered by the other team members and integrate those into their understanding (Hammerstrom, 2010).

Finally, Zweibelson (2012c), who describes his experience working in a military design team as an operational-level planner in NATO training Mission-Afghanistan (NTM-A), described how the team may actually change in size as the planning effort evolves. He described starting design with a small planning cell. The size of the team can then gradually increase as it moves from the conceptual to the detailed planning phase.

Key takeaway. There is no "right size" for a military design team. Team leaders should keep in mind the advantages and disadvantages associated with both small and larger teams (for example, smaller teams may be more cohesive and communicate more efficiently; yet smaller teams may not have as large a pool of cognitive resources upon which to draw). Generally speaking, a rule of thumb for the core design team may be somewhere between five to nine members, with other team members brought into the team as needed.

Organizational Context

Military design teams will always exist as part of a larger organizational context that can either engender or inhibit the team's functioning and effectiveness. Hackman's (1992) normative model of team design suggests the larger organizational context − and its support of the team − is

one of the major factors for consideration in any team's design. The organization should provide the necessary information, education, and rewards. Even with an effective team composition and processes, the lack of material resources necessary to accomplish the goals to the necessary standard and timeframe will contribute to lower levels of team performance (Hackman, 1992).

Mathieu et al. (2008) also discusses the role of organizational context on team performance. The authors note that overall, little research has examined the impact of organizational context on team performance, despite the fact that organizational context has been long recognized as an important contributor to team performance. One of the variables that Mathieu et al. (2008) discusses is an *openness climate*. Research has found some support between an organizational climate of openness and team empowerment and positive team outcomes (Mathieu et al. 2008). Zweibelson (2012c) alludes to a related aspect of organizational context and its role in team performance. He describes the role of the larger organization in providing a design team with both the resources and the freedom to do design activity. Specifically, he notes that "Providing a specialized team the ability and resources to appreciate complex environments without shackling them to the inhibiting elements that maintain organizational uniformity, repetitiveness, and hierarchical control nurtures critical and creative thinking" (p. 2).

Key takeaway. There is little empirical research that has directly examined the impact of organizational context on team performance. Nonetheless, organizational context has often been described as having a significant impact on team performance. Military design teams should recognize the role that organizational context may have on the team's work. The team leader, in particular, should stay attuned to what the organizational culture is, what its leadership will or will not support, and adapt accordingly.

Team Development: Team Training and Team Building

Part of design team formation is preparing the team for working together. There is considerable evidence that team training and development can promote team effectiveness and enhance team performance (Salas et al., 2008). Specifically, cross-training techniques that improve team members' awareness and understanding one another's roles can improve coordination. Klein et al. (2007) conducted a meta-analysis on training methods and found that team training accounted for approximately 20% of the variance on critical outcome variables (knowledge, affective, behavioral, and performance outcomes). The specific types of training that have been linked to improved team performance include cross-training, adaptability-coordination-CRM training, and simulation-based training (Kozlowski & Ilgen, 2006). Despite the positive outcomes of team training, given our understanding of how design teams often function within real-world operational contexts, it is unclear whether training would be an option for most design teams. However, other team development activities, such as team building could be.

Klein et al. (2009) distinguish *team training* from *team building*. Team training focuses on skill development, and is typically formal and systematic. Team building, however, is not systematic, does not focus on development of skill-based competencies, and typically happens in settings other than the actual performance environment. Klein et al. (2009) define team building as interventions that focus on improving social relations, clarifying roles, and solving task and interpersonal problems that affect team functioning. The authors also describe four different models of team building: goal setting, developing interpersonal relations, clarifying roles, and creating additional capacity for problem solving.

Klein et al. (2009) conducted a meta-analysis to examine the efficacy of team-building. The authors note that although team building is one of the most commonly used interventions in today's organizations, there is uncertainty concerning how and why these interventions work. In fact, it is unclear as to whether these interventions work at all. Empirical evidence on the efficacy of team building has been inconsistent and inconclusive (e.g., Salas, Rozell, Mullen, & Driskell, 1999; Tannenbaum, Beard, & Salas, 1992). However, some researchers have suggested that these interventions have important potential on shaping team development and improving team effectiveness (Kozlowski & Ilgen, 2006).

In their meta-analysis, Klein et al. (2009) found that team building has positive effects on team process and affective outcomes in teams. Furthermore, while all four components of team building – role clarification, goal setting, interpersonal relations, and problem solving – had moderate effects on team outcomes, the goal setting and role-clarification aspects had the largest effect. The authors also found that while all teams seem to benefit from team building, larger teams seem to benefit the most (Klein et al., 2009; Salas, Rozell, & Mullen, 1999).

Key takeaway. There is considerable evidence surrounding the efficacy of team training for team performance outcomes. Yet, military design teams may not always have the opportunity to engage in team training. When team training is not possible, team building activities are an option for design teams. Although the empirical evidence on the efficacy of team building is mixed, evidence does suggest that setting goals and being clear about team member roles may be particularly valuable for team effectiveness.

Team Cohesion, Efficacy, and Potency

Design teams in real-world operational contexts are likely to have varied levels of team cohesion, team efficacy, and team potency. Team cohesion has been defined in numerous ways (e.g., Carron, 1982; Evans and Jarvis, 1980; Beal, Cohen, Burke, & McLendon, 2003), but generally reflects a group's tendency to be united as a group toward a common goal. Team efficacy has been defined as "a shared belief in a group's collective capability to organize and execute courses of action required to produce given levels of goal attainment" (Kozlowski & Ilgen, 2006, p. 90). Team potency has been defined as the team's collective belief that they can be effective (Guzzo, Yost, Campbell, & Shea, 1993). Although the constructs of team efficacy and group potency are similar, team efficacy is *task-specific* and potency refers to a belief about the team's *general effectiveness*.

Kozlowski and Ilgen (2006) noted that these three factors have substantial empirical evidence for promoting team effectiveness. However, the research is fairly sparse on the precursors or antecedents to these processes and emergent states, or techniques that can be used to promote them in practical contexts. For example, while there is substantial evidence that team cohesion strengthens team effectiveness, there is little evidence on the antecedents and techniques for enhancing team cohesion (Kowslowski & Ilgen, 2006). On the other hand, Kozloski and Ilgen note that research at the individual level may provide insight into techniques for fostering team level states. For example, the authors argue that development of self-efficacy can be modified to development of team level efficacy and potency.

Key takeaway. Team cohesion, efficacy, and potency are associated with positive team effectiveness outcomes. However, there is limited evidence as to how to promote these attitudes

within a team. Given this, in order to promote team efficacy and potency in military design teams, it may be valuable to turn to strategies and practices for promoting individual level self-efficacy.

Team Identity

Team identity stems from the construct of organizational identity and refers to the question of "Who are we as a group?" (Pratt, 1998). Team identity refers to the extent to which a team member sees the team's goals as their own and feels interconnected with the team's fate (Han & Harms, 2010). Previous research has found a positive relationship between team identity and team performance (Han & Harms, 2010; Lembke & Wilson, 1998), and the importance of cultivating a sense of "we" (as opposed to "I") in a team setting. The theory is that individuals who are strongly identified with the team will be more motivated to exert effort given that the team's success is their own success (Han & Harms, 2010; Tyler & Blader, 2000).

Han and Harms (2010) studied team member attitude as an antecedent to team conflict. The authors found evidence that trust in peers mediates the relationship between team identity and team conflict. Han and Harms found that team identity predicted lower levels of conflict (both task and relationship conflict) but these relationships were mediated by team members' trust in their teammates.

Key takeaway. Given the importance of team identity to team performance, and the important mediating relationship of trust, commanders and leaders of design teams should facilitate processes that foster the development of a strong team identity (as well as trust) among team members.

Leadership

All military design teams will have a leader − whether it is the commander, a team leader appointed by the commander, or an emergent, informal leader. Kem (2009) describes the importance of the commander (i.e., the leader) in design teams. He discusses the commander's role in establishing a collaborative environment in which dialogue and debate occurs with those at all levels (subordinates, peers, and those from other services, agencies, and nationalities).

Theoretical and empirical research strongly supports the critical role of leadership on team effectiveness (e.g., Klimoski & Jones, 1995; Kozlowski & Ilgen, 2006; Sitkin & Hackman, 2011). Qualities of the leader influence performance of all teams (Klimoski and Jones, 1995). Kozlowski and Ilgen (2006) note that team leaders can affect team performance by affecting the three critical processes for effective team functioning including team cognition, motivation/ affect, and behavior. A recent meta-analysis by Burke et al. (2006) found consistent evidence that leadership is crucial to team performance - particularly in the leader's influence on the way team members work on their tasks and the leader's influence on social-emotional factors. The authors adopted a functional view of team leadership, arguing that leaders of teams should focus on leadership in two major areas: 1) task-focused leadership and 2) team member development. Finally, De Dreu et al. (2008) argue that transformational leadership (inspiring vision and intellectual stimulation of group members) enhances creativity and incites group members to contribute ideas (B. van Knippenberg, van Knippenberg, De Cremer, & Hogg, 2005). By contrast, autocratic (highly directive) leadership undermines independent and deliberative thought among group members (see also Yukl, Gordon, & Taber, 2002).

Despite the strong evidence of the importance of a leader to team performance, Kozlowski and Ilgen (2006) caution that most of the research evidence regarding the impact of leadership on team effectiveness is indirect, rather than direct. Further, very little empirical work has been conducted on leadership in military design teams, specifically. One investigation that did address military design team leadership is Wolters et al.'s (in press) work on design KSAOs. This research highlighted the importance of the leader in composing the design team, defining the mission of the team, establishing goals, setting expectations, and organizing the work of the team. Specifically, Wolters et al. (in press) found that the skill of defining the team's mission was of critical importance to design teams. The authors also note the importance of the leader in effectively communicating with and influencing others on the team (Wolters et al., in press).

Key takeaway. Little empirical research has examined leadership in the context of military design teams. However, the existing evidence from the empirical research on design teams does provide a helpful starting point for the tasks of a design team leader and the KSAOs a military design team leader should possess to effectively lead his/her team. In particular, military design team leaders play an important role in defining and communicating the team's mission to the team.

Trust

Closely related to the topic of leadership is the topic of trust, as the leader has an important role in the development of trust within teams. It has been argued that the presence of trust is a cornerstone of effective teamwork and has been established as a key predictor of cooperation in teams (Han & Harms, 2010; Ilgen et al., 2005; Smith, Carroll, & Ashford, 1995). Creating an atmosphere of trust, where people feel comfortable expressing divergent points of view (even when it conflicts with their commander's view), is crucial in design teams.

Research has found that trust can develop quite slowly in a work setting (Taylor, 1989). Trust can also be quite difficult to restore once it is destroyed (Fukuyama, 1995; Han & Harms, 2010). Yet although it can take time to develop, once developed it can increase the speed and productivity significantly (Covey, 2006). This reflects a notion of "going slow to go fast" (i.e., invest more time upfront to save time later).

Edmondson (1999) studied the related construct of *psychological safety* – "a shared belief that the team is safe for interpersonal risk tasking" (p. 354). In her study of healthcare teams, she found that for hospitals low in psychological safety the individuals were less likely to engage in risk taking and exhibited behaviors consistent with status quo. Creating an atmosphere of trust in which members feel comfortable critiquing the ideas of those of higher ranks or of more experience can be particularly challenging within an organization in which there may be an endemic lack of trust. Kaplan (2007) argued that there is a growing trust deficit across ranks in the military. Junior level officers may have less confidence in senior commanders due to the direct and recent experience of those at a more junior level (see Kaplan, 2007).

Key takeaway. Trust among team members, the team leader, and the commander is vital for effective military design teamwork. Investing in trust building and maintenance activities is important, particularly with a focus on creating a climate of psychological safety within the team. In a climate that is psychologically safe, members can feel comfortable challenging others' ideas and sharing their own ideas without fear of reprimand or ridicule.

Process

Managing Conflict in Teams

The potential for conflict exists in military design teams where individual team members may have different personalities, see the world through different frames of reference, and express divergent points of view. This may be the case particularly when non-military SMEs are brought into the design team at various stages throughout the design team activity.

There has been a considerable amount of research into team conflict and its impact on effectiveness (de Dreu & Weingart, 2003; Han & Harms, 2010; Jehn, 1995, 1997; Tjosvold, 2008). Some evidence suggests that low levels of conflict can be advantageous in a team. Low levels of conflict can be stimulating and can assist in preventing group-think. However, conflict can impede team performance when it interferes with team information processing by increasing cognitive load and diverting attention (Jehn & Mannix, 2001; Kozlowski & Ilgen, 2006). Too much conflict can impede team members' ability to perceive, process, and evaluate information; members can also become frustrated by a lack of progress (de Dreu, 2006). Thus, there is a curvilinear relationship (inverted U-shape) between conflict and team effectiveness (de Dreu, 2006; Gardner, 2006).

Researchers have distinguished between task conflict and social/relationship conflict. Task conflict has been described as "conflicts about the distribution of resources, procedures and policies, and judgments and interpretation of facts" (de Dreu & Weingart, 2003, p. 741). Some research has noted positive effects of task conflict on team performance. Specifically, de Dreu (2006) found evidence that *moderate* effects of task conflict are related to increased levels of team performance. Task conflict has also been argued to enhance creativity; some research has shown that disagreement about the task enhances creativity in teams by leading to increased information exchange, re-evaluation of the status quo, and adapting goals, strategies, and processes to better fit the team's task (Farh et al., 2010; Hülsheger et al., 2009).

Despite research evidence that task conflict can be productive for teams, some empirical studies have painted a more bleak picture of both relationship *and* task conflict (e.g., De Dreu and Weingart, 2003; Ilgen et al., 2005). De Dreu & Weingart's (2003) meta-analysis examined the relationships between relationship conflict, task conflict, team performance, and team member satisfaction. Not surprisingly, the author's found that relationship conflict was negatively and significantly correlated with team performance and member satisfaction. However, task conflict was also negatively correlated with team performance and member satisfaction, which is inconsistent with what has been suggested in previous academic research. The authors theorized that this may be due, in part, to high levels of task conflict and disagreements leading to relationship conflict. Thus, de Dreu & Weingart (2003) conclude that leaders should intervene in a conflict management role to minimize the possibility of task conflict from becoming destructive.

Farh, Lee, & Farh (2010) explored the relationship of task conflict and team creativity within a specific context (the phase of the team's lifecycle). Similar to de Dreu & Weingart (2003), they found evidence of a curvilinear relationship between tension and team effectiveness, and that moderate levels of task conflict lead to the highest levels of team creativity. Farh et al. (2010) also found that the u-shaped effect of task conflict on team creativity only held for teams in the early phase of their lifecycle. The authors suggest that unique ideas raised at early points in the team's lifecycle are more likely to be valued and incorporated into the team's outcomes (Farh et al., 2010).

Research has also examined how unproductive social conflict among team members might be minimized. It is both the leader's role and the individual team member's role to manage conflict and to promote productive conflict, while minimizing unproductive social conflict. Druskat and Wolff (1999) found that developmental face-to-face feedback from peers can drastically reduce conflict. This is particularly the case when the feedback is delivered at the project's midpoint. The leader has a clear role in minimizing conflict as well. Specifically, Naumann and Bennett (2000) and De Cremer and van Knippenberg (2002) found that leaders who apply rules consistently can minimize relationship conflict in teams.

Despite important strides in team conflict research, Kowslowski and Ilgen (2006) caution that the research foundation on conflict in teams is not well-established enough to develop practical recommendations. Yet, the authors do suggest that team members should have the interpersonal skills necessary to build trust, and to minimize and manage conflicts when they arise in teams. Others have argued that there *are* practical takeaways that can be considered. Specifically, team leaders who want to enhance their team's creativity should encourage some level of task conflict within the team, especially at early phases of the team's lifecycle (Farh, Lee, & Farh, 2010). Leaders should also foster a climate that is psychologically safe (Edmonson, 1999) so that members of the team feel safe raising ideas that might be counter to the majority view.

Key takeaway. Although efforts should be taken to minimize *interpersonal* conflict among team members, moderate levels of *task* conflict may contribute to effective team performance outcomes. The positive effects of task conflict are more likely if efforts are taken to cultivate a strong sense of team identity and trust among design team members.

Team Cognition

Given that the tasks of design teams are largely cognitive in nature − including the task of making sense of ill-defined, complex, and unfamiliar problems − investigation into the team cognition literature is highly relevant for identifying practices for promoting design team effectiveness. Design teams must share information, make sense of complex problems, think creatively, and ultimately develop a shared understanding of the problem and an approach for solving it. As will be apparent in the following sections, while team cognition is a central component of design team activity, very few practical strategies are provided in the literature for promoting team cognition.

Shared understanding. One of the goals of design teams is to ultimately converge upon a shared understanding of the problem, along with an operational approach to solving it. In their review article, Salas, Cooke, and Rosen (2008) note that shared cognition is a critical factor in team performance. Evidence has been accumulating on the importance of shared team cognition for team adaptation under varying conditions, similar interpretation of environmental cues, and coordinated action. Similarly, research has demonstrated how breakdowns in shared cognition can lead to errors and inferior performance (e.g., Stout, Cannon-Bowers, Salas, & Milanovich, 1999; Wilson, Salas, Priest, & Andrews, 2007).

In a review of the team cognition literature by Wildman et al. (2012), the authors noted that the literature has focused primarily on emergent team knowledge structures (i.e., shared mental models) with minimal focus on the *processes* involved in team cognition. In the literature that has

focused on shared mental models, evidence has been gathered showing a relationship between shared mental models and team effectiveness (Wildman et al., 2012). Wildman et al. (2012) noted four different content areas that characterize the team-level knowledge representations: task related, team related, process related, and goal related knowledge structures.

Research has also provided evidence that team training focused on building shared mental models of the situation, task environment, and team member interactions can increase team's performance under high-stress conditions (Entin & Serfaty, 1999). Furthermore, there is evidence that shared cognition in teams is measurable (e.g., Cooke, Salas, Cannon-Bowers, & Stout, 2000; Langan-Fox, Code, & Langfield-Smith, 2000).

In Kozlowski and Ilgen's (2006) review, they discuss shared team member mental models as a potential leverage point for fostering effective teams. The authors argue that factors such as leadership, training, and common experience are opportunities for developing shared mental models to impact team effectiveness. Wildman et al. (2012), however, note that the limitation of existing research in the area of shared mental models is that they are typically approached as crystallized knowledge structures, rather than as dynamic understanding that changes over time and experience (Wildman et al, 2012). Thus, there is a need for further research to understand how dynamic team-level mental representations are developed.

Team sensemaking. In their review of team cognition literature, Wildman et al. (2012) note that one line of research that addresses the existing gap in the *process* approach to team cognition is the team sensemaking literature. Team sensemaking is "the process by which a team manages and coordinates its efforts to explain the current situation and to anticipate future situations, typically under uncertain or ambiguous conditions" (Klein et al., 2010, p. 304). Conceptually, design is a team sensemaking process and this team sensemaking includes activities such as selecting a frame, questioning a frame, and re-framing. The outcome of a successful team sensemaking process is a shared understanding of a situation. At that point, the appropriate course of action is apparent (Klein et al., 2010). Klein et al. (2010) also describes the emergent requirements for team sensemaking – including seeking and synthesizing data, monitoring the data quality and interpretation quality, resolving disputes, and managing coordination costs across these activities. In particular, Klein et al. describe the difficultly of data synthesis in team sensemaking because relevant information resides with different team members. Teams that are particularly effective are skilled at pushing the right information to the right people at the appropriate time (Klein et al., 2010).

Visual representation plays an important role in supporting team sensemaking, as they can be used to reflect complex ideas, interdependencies, and connections. Horn and Weber (2007) describe the use of a "visual language" (i.e., a blending of words, images, and shapes) to convey meaning, and they describe "mess maps" that are a form of visual representation to depict complexity and linkages among concepts. Mess maps portray "chunks of information and their relationship with other "chunks." (Horn and Weber, 2007, p. 9). (Visual representations are described more in the section entitled "The role of visual thinking in developing insights.")

Metacognition. Metacognition is a key activity in design. It involves self-reflection and awareness of one's own thought processes and associated limitations (e.g., Clark, 2013; Paparone, 2013; Schmidt, 2013). Strategies for fostering metacognitive thinking can support design team performance and effectiveness. For example, Zweibelson (2012a) describes "de-tacticalization" as a strategy for getting the team to reflect on their typical way of thinking. Specifically, he used this strategy to help the design team reflect on their tendency to view the problem from a reductionist worldview. He introduced concepts from post-modern philosophy (including a metaphor of a tornado) to encourage the team to challenge the way they think. However, overall, the current research team found very few practical strategies in the literature that can be used to foster metacognition.

Holistic/Systemic thinking. Holistic thinking is another central cognitive activity in design. As noted by Van Riper (2013) "interactively complex systems do not lend themselves to analytical methods of study and decision making; one must consider them holistically. In addition, nonlinear systems usually lose meaning when deconstructed" (p. 27). Strategies for helping design teams to think more holistically will support their effectiveness.

Feltovich, Hoffman, Woods, and Roesler (2004) note the human tendency to reduce complexity to simplistic explanations. For example, humans tend to over-simplify their explanations under the following conditions noted in Feltovich et al., (2004, p. 91):
- Events are dynamic, simultaneous and parallel, and organic (evolving, emergent) rather than governed by simple cause and effect principles.
- Event parameters are continuous and highly interactive.
- Events involve heterogeneous components or explanatory principles, nonlinear dynamics, and multiple context-dependencies.
- Events can be understood by multiple representations.
- Cases show asymmetries and irregularities.
- Key principles are abstract and not obvious.

In such cases, learners and practitioners tend to interpret situations as though they were characterized by simpler alternatives; their understandings tend to be reductive—that is, they tend to simplify; and they tend to try to defend their simple understandings when confronted with facts that suggest that the situation is more complex than what they suppose. (Feltovich et al., 2004, p. 91)

The challenge is, to the research team's knowledge, that there is little empirical evidence for how to overcome this reductive tendency.

Team decision making with distributed information. Research in team decision making has invested significant effort into understanding teams' use of distributed information (i.e., unique information that resides with different individuals). This is a particularly relevant line of research for design teams who must share and integrate information possessed by different team members in order to develop a shared and holistic understanding of the problem.

Theoretically, the value of distributed information for team decision making is obvious (i.e., "two heads are better than one"). However, research suggests that a team's informational resources are frequently not fully used; distributed information is often not adequately exchanged and processed (see Gigone & Hastie, 1993; Gruenfeld et al., 1996; Scholten et al., 2007). Stasser (1992) and Wittenbaum & Stasser (1996) demonstrated that teams primarily discuss and make use of shared information that was available to all team members prior to the discussion. Teams tend to not exchange and discuss important unique information that was previously available to just one individual member (and therefore new to the others). Relying solely on commonly shared information among team members is strongly associated with poor decision making in teams (Schultz-Hardt et al., 2002). Instead of sharing unique, distributed information, teams tend to be more concerned with reaching agreement or common ground (Schultz-Hardt et al., 2002; van Knippenberg et al., 2004).

Van Ginkel & van Knippenberg (2009) found that groups with distributed information perform better when group members are aware of their co-members' knowledge and competencies (i.e., members are aware that a team member has unique knowledge). Similarly Kozlowski and Ilgen (2006) discuss the related construct of *transactive memory* which refers to awareness of how knowledge and expertise is distributed across team members (e.g., who holds what unique knowledge?). Kozlowski and Ilgen (2006) suggest that strategies for accessing team member's knowledge would be particularly useful for improving team effectiveness.

Not only do members need to know who holds what unique knowledge, but in order for teams to benefit from the different knowledge and perspectives of group members, the distributed knowledge that exists within the team must be exchanged, discussed, and integrated within the team's collective knowledge. The process for doing so has been coined *information elaboration*. Despite the importance of this process in teams, researchers have found it happens to only a modest degree in decision making teams where knowledge is distributed (see Van Knippenberg, de Dreu, & Hoffman, 2004; Stasser, 1999; Wittenbaum & Stasser, 1996).

The team leader has an important role in information elaboration. Van Ginkel and van Knippenberg (2012) studied how group leaders can shape team members' understanding about the role of information elaboration in team decision making performance. Van Ginkel and van Knippenberg note that one way for leaders to foster an emphasis on information elaboration is by explaining the importance of it to the team, and actively guiding the process of information elaboration by instructing the members to exchange, discuss, and integrate information. Leaders can also influence this in a team by role-modeling these behaviors and engaging in exchange and discussion of information, repeating information, and soliciting information and clarification from team members (e.g., Larson, Christensen, Abbott, & Franz, 1996).

Avoidance of groupthink: Fostering dissent and critical thinking. A well-known construct, groupthink (Janis, 1972, 1982) has been defined as "the deterioration of mental efficiency, reality testing, and moral judgment that results from in-group pressures" (Janis, 1982, p.9); and an "unconscious process where pressures toward group unity take precedence over rational decision-making" (Hodson & Sorrentino, 1997, p.1). Groupthink occurs under conditions of high group cohesion, group insularity, social-ideological homogeneity, inadequate procedural norms, and high stress/low confidence (Hodson & Sorrentino, 1997). Esser (1998) describes how pressure for conformity and the desire to preserve harmony within a team can inhibit the critical appraisal of relevant facts, thereby leading to poor decisions. Packer (2008) studied the relevant concept of *positive deviance*. Packer found that dissenting opinions may be more likely expressed if the culture/identity of the group dictates that such deviance is approved of *and* if dissenting individuals identify strongly with the group.

Some research has found that inclusion of a "devil's advocate" role on a team - one who attempts to identify weaknesses in solutions and generate counterarguments - can improve the quality of team decisions (e.g., Schweiger, Sandberg, & Rechner, 1989; Schwenk & Valacich, 1994; Valacich & Schwenk, 1995). Schultz-Hardt et al. (2002), however, did not find a strong short-term positive effect of having a devil's advocate. The authors did suggest, however, that having a devil's advocate role might have stronger effects over time by creating a culture of conflict in and reducing barriers to expressing genuine dissent. In a similar vein, Schultz-Hardt et al. (2002) found evidence suggesting that biased information seeking in teams can be reduced or altogether prevented when at least one dissenting opinion is presented at the beginning of the team's information search. (Schultz-Hardt et al., 2002).

One recommendation Schultz-Hardt et al. (2002) made following their review is to create teams with a diverse range of characteristics (e.g., especially on particular demographic variables) increasing the likelihood that the team will include divergent viewpoints. The authors argue that diversity in functional and educational background is particularly beneficial for this purpose. A second recommendation offered by Schultz-Hardt et al. (2002) is that team members express their different viewpoints during the group discussion, rather than withholding them. If the team wants to actually benefit from their diversity, the team should encourage members to express their dissenting views and doubts. Schultz-Hardt (2002) also echo Janis's (1982) groupthink theory and note that a team leader who withholds his/her own viewpoint and explicitly asks for divergent views can be particularly beneficial.

Creative thinking. Creative thinking – particularly as a collective activity – is a key aspect of design activity. Sanders (2013) addressed collective creativity and its role in strategic thinking, noting that one of the defining features of *collective creativity* is when all the individuals in a group "contribute simultaneously to a big picture or mental model that emerges from a shared mind and body space" (p. 150). Given the role of creative thinking in design, practices for fostering creative thinking in design teams should be given due attention to facilitate effective performance.

Sanders (2013) argues that the factors contributing to individual creativity apply also to collective creativity. However, Sanders also noted a variety of factors that are unique to collective creativity. These are summarized in Table A-1.

Table A-1

Factors Unique to Collective Creativity (Sanders, 2013, p. 162)

_____

Collective Creativity in the Socio-Cultural Space

- Diversity of participants
- Trust among participants
- Mutual respect between participants
- Sense of ownership in the collective vision
- No executive control
- Breakdowns (e.g., Schon, 1983) that offer opportunities for reflection and learning
- Participants who have good social skills
- Principles of interaction
- Group methods with facilitation
- Support for a wide variety of behaviors including quite reflection, relaxation, active collaboration, making a mess, etc…
- Support for a range of moods including playful, serious, stimulating, informal, formal, etc.

Collective Creativity in the Physical Space

- Wall where materials can be posted for all to see and act upon
- Round tables
- Furniture that can be easily rearranged
- Support for both individuals and groups of varying size working face-to-face
- Comfortable and dedicated spaces of collaboration, for retreat, for fun, etc.
- Enough space for collaborative physical construction of prototypes and artifacts
- Enough space to support collaborative enactments

Collective Creativity in the Space of Tools, Techniques, and Materials

- Access to shared content
- A common language to support a shared mind and body space
- Collaborative visualization capabilities
- Physical construction via prototypes (full scale is best)

_____

Some scholars have addressed the relationship between team composition and collective creativity. Diversity in teams, including differences in perspectives and knowledge, is often argued to stimulate higher levels of team creativity (e.g., Hoever et al., 2012; Jackson, 1992; West, 2002; Nijstad & DeDrue, 2002). As Sanders (2013) noted, bringing together individuals with different ways of thinking and decision making can increase the chance that connections and new insights

Hoever et al. (2012) built upon previous research to consider the role of perspective-taking in enhancing collective creativity in diverse teams. The researchers found that when diverse teams engaged in perspective-taking (attempting to understand the thoughts, motives, and feelings of another team member and why they think/feel that way), they performed more creatively than

homogenous teams. The authors argue that perspective taking "helps teams to capitalize on their diversity on creative tasks by fostering the sharing, discussion, and integration of diverse viewpoints and information" (Hoever, 2012, p. 984). In terms of practical implications, the researchers contend that when attempting to enhance creativity in teams where members have diverse approaches to the task, fostering perspective taking within the team may be beneficial.

Researchers have also addressed the role of the physical space and materials in fostering collective creativity. Accumulating evidence suggests that the physical environment in which design teams work, and the materials that they have to work with, can both have an important impact on team functioning and performance (e.g., Fruchter & Bosch-Sijtsema, 2011; Pang, 2010; Sanders, 2013; Sanders & Stappers, 2013). Providing design teams with the space and materials needed to foster design thinking is important to their ability to perform effectively.

For example, Fruchter and Bosch-Sijtsema (2011) specifically describe the importance of a large physical display surface (such as a wall or whiteboard) for facilitating dynamic participation of individuals within collaborative work environments. Fruchter and Bosch-Sijtsema (2011) argued that "the wall acts as a mediator for individual reflection-in-action and team reflection-in-interaction…" (p. 221). Similarly, Pang (2010) described "paper spaces," which are essentially large sheets of paper and sticky notes that cover the walls of a team's meeting space. Paper spaces allow people to move ideas (written on the sticky notes) around and "turn thinking about the future into a shared experience in constructing a common view of the future" (Pang, p. 9). Sanders (2013) also noted, "The co-construction of a visualization of the big picture or shared mental model is essential for collective creativity and this is where the importance of the tools and materials comes into play" (p. 159).

While some researchers have described the benefits of particular materials, tools, and technology to collective creativity, other scholars have described barriers that certain tools can create to collective creativity. For example, Zweibelson (2012b) argues how certain information-sharing materials can impede creativity. Specifically, he describes how the military's deeply institutionalized use of PowerPoint can stifle critical thinking, creativity, and understanding in teams and organizations. PowerPoint has the potential to push the military toward less productive ways of thinking and the capacity to *explain* (rather than simply *describe*) complex and dynamic problems. "If descriptive thinking blinds your organization to critical and creative thinking, then PowerPoint is the drug of choice for continuing the reductionist and highly tacticized mentality across an organization that fears uncertainty" (p. 2). He argues for consideration of different information-sharing alternatives.

Zweibelson's (2012b) argument echoes Edward Tufte's view of PowerPoint. Tufte (2006) vehemently argues about the ills of PowerPoint for presenting complex ideas in an impactful way. He suggests that PowerPoint promotes an inherently linear way of organizing and presenting information, and can promote overly-simplistic thinking or can mislead the audience as complex concepts are broken down into disparate bullet points. Further, due to the inherent hierarchical structure, PowerPoint can relegate critical items to the bottom of the hierarchy and potentially misinform the audience and negatively impact decision-making (Tufte, 2006). The author argues that many of the ideas for which PowerPoint is used would be presented better in brief 5-10 minute narratives. The remainder of the interaction between presenter and audience should involve discussion of those concepts (Tufte, 2006). One potential alternative to PowerPoint is Prezi, which is inherently nonlinear in how it organizes and presents content (Perron & Stearns, 2010). The tool

allows the user to organize content - ranging from images, to video, to text - on a blank canvas - and enables the user to present information in either a linear or nonlinear fashion by zooming around the canvas.

Visual thinking. Design teams in the military are taught to use visual representations to depict complex ideas and communicate them to each other and to external stakeholders (see "Art of Design" textbook for School of Advanced Military Studies). Yet there is another use for visual representations; visual representations can be used to support thinking, to explore the problem space, and to develop shared team insights that may not be achievable through discourse and text-based representations alone. As noted in ADRP 5-0, "A graphic can often point to hidden relationships that were not considered through conversation alone" (Headquarters, Department of the Army, 2012, pp. 2-5). In other words, visualizations can help people to see and know differently.

Eriksen (2009) describes the importance of sketching and drawing to design and the development of shared understanding. But importantly, he also notes that not everyone is trained to sketch and draw, and further that this activity is particularly difficult to do collaboratively. As an alternative, he describes the role of "tangible working materials" in design in helping teams to explore problems collaboratively. Eriksen lists a variety of different types of design materials (basic, pre-designed, and field/project specific) that can be used and combined to explore problems collaboratively. These tangible working materials serve as a shared reference point for group members from diverse disciplines (Eriksen, 2009). These working materials have been described as "things to think with" (as cited in Eriksen, 2009), and "communication catalysts" (Capjon, 2009).

The ideas posited by Eriksen (2009) are similar to those of Roam (2008), who explores the role of visual thinking in solving complex problems and provides a set of practical tools to help people address problems using simple drawings. His book focuses on thinking through complex problems in a non-verbal manner, and using images to organize ideas. One of his main points is that one does not need to have artistic talent to be able to think and represent complex ideas visually.

In a similar manner, Sanders, Brandt, and Binder (2010) have offered tools for fostering creative thinking in teams who are grappling with complex problems. These *make toolkits* include a set of elements such as images, words, and shapes for creating visualizations depicting future scenarios. Such a toolkit can enable all members of the team to participate directly and simultaneously in the placement of the toolkit elements. The visualization that is created can serve as a point of a common ground for communication across the team, and can help in the construction of a shared understanding within the team (Sanders, 2013). What Sanders describes points to the importance of a visual language for fostering creative thinking. Design teams can achieve different insights using visual materials, and can use those materials to explore and support their thought process.

Key takeaway. Design teams engage in a variety of complex cognitive activities. The team must make sense of problems as a team, develop a shared and holistic understanding, and think creatively to identify innovative solutions to problems. Teams face a number of challenges as they try to make sense of the problems they face. These challenges include synthesizing data into a holistic understanding when unique and important information resides with different members of the team. There are a variety of tools, techniques, and approaches described in the literature that can help to support the complex cognitive work of design teams. For example,

- use of shared visual representations to support team sensemaking;
- encouraging a culture of dissent, including appointing a devil's advocate;
- encouraging and modeling sharing and elaboration of unique information; and
- using tangible working materials to collectively explore the problem set and think creatively about potential solutions.

Outputs

Sharing Insights

A key task design teams face is to convey their collective insights and understanding to stakeholders outside the team. Design teams typically produce some form of knowledge product that is intended to communicate ideas, insights, and conceptual plans for addressing the problems the team has worked to better understand. In his SAMS monograph, Hammerstrom (2010) strongly recommended that the design team have a significant external focus so that their products and concepts can meet the "customer's" (i.e., commander's) and the larger organization's needs. This requires significant interactions and networking with external stakeholders with functional expertise, ideas, and insights that stretch beyond what is possessed within the core team. As Hammerstrom noted "The military design teams… must be able to reach out across functional, divisional, and organizational boundaries: challenging organizational assumptions; and provide ideas that will help the U.S. Army compete in a complex and dynamic world" (p. 64).

A challenge is for design teams to communicate insights developed over days or weeks with external stakeholders in a way that is concise, but not overly-simplified, and that also retains enough of the underlying logic. The process by which individuals and teams articulate their understanding or mental models in order to influence the sensemaking process of stakeholders is known as sensegiving (Gioia & Chittipeddi, 1991). In the context of design teams, sensegiving is important both within the team itself and as team members communicate their understanding with those outside the team in a way that is both useful and relevant. When dealing with complex and abstract issues, it can be particularly difficult to articulate one's tacit understanding to others. In these cases, some researchers and practitioners have argued that using metaphors, symbols, and narratives can be helpful to convey meaning without oversimplifying (Browning & Boudes, 2005; Hill & Levanhagen, 1995; Perez, 2011).

Zweibelson (2012c) addresses the topic of design team communication with external stakeholders in substantial depth, based on his direct operational experience in design teams. The main themes he discusses include:

1) The importance of the design team being aware of the larger organizational culture in which they are operating, and maintaining sensitivity to the team's audience. As Zweibelson notes, "Sensitivity to socio-politics and your audience are critical for successful design efforts" (Zweibelson, 2012c, p. 10). Specifically, in the transition from conceptual to detailed planning, Zweibelson talks about the need to appreciate the larger organizational context and culture, and the need for it to be in a "form that is both familiar and palatable to the larger institution…" (2012c, p. 10).

2) A second theme Zweibelson (2012b) discusses is the value of packaging deliverables within doctrinal language and within the structure familiar to detailed planners:

If the vast majority of our organization clearly understands a linear execution checklist, but only an insignificant minority is familiar with non-linear approaches fusing general systems theory and swarm theory, it would be self-destructive to develop a final planning deliverable that used the latter instead of the former. (p. 10)

3) A third theme he discusses is the importance (and difficulty) of creating concise and simple representations of complex ideas. He notes, "Simplicity is perhaps the greatest challenge in communicating novel concepts and innovative thinking to the larger organization, yet it is essential to the delicate transition from abstract thought to detailed execution" (p. 8).

4) A final point Zweibelson (2012c) makes is this: Representations that may be useful to developing the team's shared understanding are not necessarily the ones that should be shared outside the team. While the internal work products may hold significant meaning for the team members, these same work products may be confusing or even nonsensical to the intended audience. Zweibelson (2012c) notes that the design team's final product (the design deliverable) should "stand alone, and make sense without the planning team present to walk you through them" (p. 8). He further notes, "Although there are no 'rules' the final design deliverables should be concise, informative, yet simplistic for wide organizational consumption and application" (p. 6).

Key takeaway. Design teams face a challenging task when conveying complex ideas and shared insights to others who have not been part of the development of the understanding. To effectively communicate with external stakeholders, design teams should keep a variety of principles in mind, such as recognizing the difference between internal team products and external deliverables, striving for simplicity, and maintaining awareness of the organizational culture.

Use of Visual Representation for Communicating Insights

Visual representations can play a critical role in the communication of understanding and insights between design teams and key stakeholders. ADRP 5-0 (2012) describes the role of visual modeling in ADM as a way to think through problems, examine abstract constructs, and develop greater understanding. Visual representations can include drawings, pictures, diagrams, charts, maps. These visual tools can be useful both for helping the team think through complex ideas and problem sets, but also for communicating those complex ideas to others. A well-designed visual depiction has the potential to provide a more powerful communication medium than a verbal or text-based description alone (Tufte, 1997). Images can be viewed as metaphors that serve as way to communicate meaning to others (http://cft.vanderbilt.edu/teaching-guides/teaching-activities/visual-thinking/).

A variety of different tools exist for communicating complex concepts. These include tools such as concept mapping (Moon, Hoffman, Novak, & Cañas, 2011), mind-mapping, argument mapping (Fletcher, 1990), and mess mapping (Horn and Weber, 2007). Concept maps, for example, are a form of graphical representations that combine visual and text-based representations to depict relationships between concepts. (Moon et al., 2011; Novak & Cañas, 2008). In concept maps, each concept (represented via a word or phrase) is connected to another word or phrase. Ideas are connected using labeled arrows. Arrows may be labeled with words that describe the relationship between concepts such as "is required by", "contributes to," or "is prohibited by." Concepts maps have been used successfully for knowledge capture and transfer in multiple arenas including to

capture and transfer tacit knowledge from experts, to create and communicate models of expert knowledge, to plan in virtual environments, and to enhance collaborative brainstorming sessions (Moon et al., 2011).

Dan Roam has also addressed the communication of complex concepts in a simple way in his books Drawing on the Back of a Napkin (2008). He explores the role of visual thinking in solving complex problems and provides a set of practical tools to help people address problems using simple drawings. One of his main points is that one does not need to have artistic talent to be able to think and represent complex ideas visually and communicate those ideas in a way that people can readily understand. He talks about four different types of visual representations including:
- Portraits which capture who or what you are dealing with.
- Maps which depict spatial relationships between concepts.
- Charts which address the question of "how much?"
- Timelines which are used to define phases and milestones.

Finally, specific to a military design team concept, Zweibelson (2012a) provides examples of visual representations his NTM-A design team used for communicating both within the team and to external stakeholders. His design team used ways of representing information (breaking away from traditional military doctrine) to represent key tensions for the future Afghan security forces. As mentioned previously, there is an important delineation that design teams need to consider between preliminary and internal design team products and design deliverables that are provided to stakeholders in that:

> …most of the initial design products should not be mistaken for design deliverables. What makes sense within the planning team should not be forwarded to the larger audience and the decision makers as a final deliverable as it will inevitably cause confusion and doubt. (Zweibelson, 2012a, p. 17)

Key takeaway. Visual representations can be a useful tool for conveying the team's shared understanding and insights to external stakeholders. A variety of visual tools and resources exist that military design teams can leverage to help them communicate complex ideas in visual form.

Conclusion

As military planners continue to face complex, unfamiliar, and ill-defined problem sets, they will continue to work collaboratively to make sense of the problems they face and develop potential approaches for resolving them. Due to the nature of the problem sets U.S. forces and their allied partners face, the work of military design teams will play an important role in unified operations into the foreseeable future. Thus, understanding what contributes to the effectiveness of design teams is important to identify, understand, and foster.

Design teams face a number of challenges that are similar to those faced by any team. But, in addition, they encounter challenges that are unique due to the context in which they operate and the complex cognitive tasks in which they engage. The review of the teams literature reflected in this document has uncovered and captured key principles and practices that have relevance to military design teams operating in real-world contexts. In combination with the original data collected from

experienced design team leaders and members as part of this research effort, the body of work provides a solid basis for extracting strategies and practices that design team leaders can use to optimize the functioning and performance of current and future military design teams.

Appendix B
Interview Protocol

OVERVIEW

The Intent of the Interviews is to:

Capture strategies and best practices for managing challenges to design team functioning and optimizing team performance and outcomes. We will focus specifically on practices and strategies for:

- Design team selection and formation (including key decisions, factors considered, processes used)
- Management of social process, including fostering a climate of trust that encourages push-back and discourse; integrating diverse team members and diverse perspectives; and managing members who may dominate discussion or stifle discourse.
- Encouraging cognitive processes central to design – e.g., perspective-taking, critical, creative, and systemic thinking.
- Capturing the learning and shared understanding as it emerges through the team's interactions.**
- Conveying insights, recommendations, and underlying logic to those external to the design team, such as those engaged in detailed planning efforts.**

**Key priorities

Structure of Interview:

The guide incorporates techniques from both incident-based CTA and Team Audit methods, with questions organized around a pre-determined set of topic areas. We will elicit specific examples in which the participant engaged in design team activity, and use those examples as the basis for subsequent questions about team practices and strategies.

As part of conceptual planning activities, SMEs may have participated in teams who engaged in activities analogous to Army Design Methodology (ADM), but that were not referred to as "ADM" or "design." In these cases, we will guide the participants toward describing experiences in which they have worked with others to make sense of complex, ill-defined situations as part of the mission planning process.

The interviews are intended to be semi-structured and conversational in nature. The questions in this guide provide a starting point for each interview segment; the specific questions posed will vary depending on the experiences of the individual. We do not expect that we will ask all the questions in this guide in every interview.

At the start of each interview, the interview team will introduce itself, identify organizational affiliations, and provide an overview of the project (see "Introduction Script" on page 3). We will present each participant with an informed consent document, and ask him/her to read and sign it. We will also advise each participant that s/he is free to terminate the interview at any time, and should not feel constrained to answer any question that s/he prefers not to.

Interview Introduction Script

We are research psychologists from Applied Research Associates, partnering with the U.S. Army Research Institute on a research study to capture best practices for military design teams (or, planning teams, more generally). We are interested in talking with you today about your experiences working as part of a team that dealt with a highly complex and ill-defined situation. The types of situations we are interested in are ones in which the actual problem your team was trying to solve wasn't clearly understood, and you needed to work together to develop a shared understanding of the problem, and visualize ways to solve it, prior to detailed planning.

The format of this interview is semi-structured. We have several topics we want to cover with you; but the exact questions we ask will depend on what your experience is and what you tell us.

The way the interview will unfold is… We will spend the first few minutes talking with you about your background. Then we will ask you to provide us with an overview of your experiences with design and as a leader (or member) of a design team. Even if you do not have direct experience on a design team, per se (or in using Army Design Methodology, specifically), we are interested in hearing about your experience working in a team that engaged in conceptual planning activities analogous to ADM - i.e., where you used creative and critical thinking and collaborative discourse to make sense of an - ill-defined situation during mission planning. We will spend a large portion of the interview talking about a specific experience (or two), and the strategies you and the team used to facilitate the team's functioning and achieve successful outcomes.

In the last part of the interview, we will ask for your thoughts about guidance, tools, and support you believe would be useful for those leading or working in design teams to promote effective design team interaction and outcomes.

This interview will be approximately **2 hours long**. Is that timeframe okay for you?

We'd like to reiterate that **your participation is entirely voluntary**. You can stop the interview at any time, or decline to answer specific questions with no negative repercussions.

This project and these interviews are at an **unclassified level**. We will remind you of this throughout, but we rely on you to refrain from revealing sensitive or classified information.

We will be taking notes throughout the interview, but like to have an audio recording as a backup to our notes. **Can we have your permission to audio record the interview?** You can decline this request without any negative repercussions whatsoever, or you may choose to have the recording stopped at any time during the interview. The audio recordings, transcripts, and raw interview notes will not be shared outside the interview team and the ARI project sponsors. We will delete the audio recordings once the data file has been created.

In order to protect your anonymity on the audio tapes, we will be addressing you as "Sir" or [General, Major, etc.; Insert appropriate rank] and excluding your name. We ask that you do the same and refrain from using specific personal or unit names while describing your experiences. Be assured that even if you do use specific names, we will scrub the audio tapes after the interview to protect confidentiality of those you identify.

Do you have questions before we begin the interview?

Background

- Current position/rank/role[9]
- Overview of background - i.e., training, deployments, roles
- Overview of experience with Army Design Methodology (ADM) (or design, more generally)
    - Did you receive formal training/instruction in ADM?
    - How do you think about design/ADM - what does it mean to you?
    - Overview of design team experience[10]
        - Number of experiences
        - Nature of those experiences
        - Specific examples

[Interviewers will select one of the examples and ask the participant to give us a short overview description. This example will serve as a case account to refer back to throughout the interview to ground subsequent questions.]

Overview of Design Team Example

- When/where?
- What was the purpose of the team; what were you trying to accomplish?
- What was your role? (Leading the team? Core team member? Role in putting the team together? Other?)

Team Selection and Formation

- Team size and composition - Who? How many? What roles?
- Were there other individuals (outside of the immediate design team) who were involved in the team, or who otherwise influenced the design process? (e.g., interagency partners, NGOs, etc.). Describe…
- How were members chosen? Who determined what expertise was needed? What factors were considered?
- What worked well in that process of team selection/formation? What didn't?
- How could it be done more effectively? What factors *should* be considered?
- If you had it to do over, is there anything about the team you'd change (size, composition, roles)?

Social Processes/Intergroup Dynamics

- What made working together as a team - or achieving a successful outcome - challenging? What difficulties did you encounter? What hindered the team's performance?

_____

[9] This guide is geared primarily toward a military design team participant. However, most of the questions will be pertinent to non-military SMEs as well. For those from NGOs or interagency organizations who were brought into design teams temporarily as an SME, there is an additional set of questions at the end of this guide.

[10] It is possible that some participants will not use the words "design", "ADM" or "design teams" to characterize their experience. However, their experience may involve working on a planning (or other) team that engaged in activities akin to ADM. We will guide participants toward describing experiences where they have worked collaboratively to make sense of complex, ill-defined situations and envision potential operational approaches, even if they do not refer to this experience as "design".

[dig into each of the challenges…try to uncover strategies for dealing with them.]
- o What did you (or someone else) do to manage this difficulty? Did that help? If not, why not? What else might have worked?
- o How could that challenge have been avoided?
- What about the team's process and intergroup dynamics worked particularly well? What helped the team work together effectively? (practices, behaviors, processes, tools, etc.)
- How were unhelpful behaviors dealt with? (e.g., team members who may have dominated conversation or stifled discourse) and by whom? Was that an effective means for dealing with an unhelpful behavior? If not, what other approach might have worked?
- Specifically regarding non-military SMEs who were brought into the team…how were they integrated into the team? What was challenging about that? How did you manage those challenges? What strategies would you suggest for other design teams who bring external SMEs into the fold?

Creating an Atmosphere Conducive to Design

- Were you (or the design team leader/commander, or other team members) able to create an atmosphere of trust and openness… so team members felt comfortable pushing back, questioning assumptions, engaging in discourse?
- o If you were, what allowed you to do so? If you were not, what were the barriers to creating?
- o What was most difficult about creating an open and trusting atmosphere?
- o What worked well? What didn't work so well? Examples.

Encouraging the Cognitive Activities Needed for Design

- Were you (or the leader, or other team members) able to effectively facilitate the type of thinking required for effective design – for example, were you able to get team members to think critically? Divergently? Holistically? Take alternative perspectives?
- o If so, how were you able to do this...and maintain it?
- o What was difficult about getting the team to think in these ways?
- o What worked well? What didn't? Examples.
- o What were some of the barriers you encountered?
- How did you know when you needed to reframe or reset your understanding? Did you have any particular strategies for doing so? Cues you relied on?

Engaging the Commander

- [If they aren't the commander] What did the team do to keep the commander engaged in the design activity?
- What sorts of interactions did you (the team) have with the commander? What worked? What didn't?
- What made keeping the commander engaged difficult? What suggestions do you have for other design teams for keeping the commander engaged?

Knowledge Capture and Sharing

[Before interview, we will ask them to bring specific products with them… photos, thumb drive, etc.]

Within the team

- During the design team interaction, how did you capture the iterative learning and understanding as it emerged? What approach, process, strategies, or tools did you use?
- What was it about that approach or those tools that worked well?
- What were the limitations of that approach?

Outside the team

- As you developed an understanding of the nature of the problem, who did you share that learning and understanding with? When? How?
- What was the purpose for sharing at that point in the process?
- What was the final outcome of the team's design process? What products or artifacts did you produce to capture the understanding and insights the team developed?
- What was the intent of those particular products?
- What lead you to choose to develop those particular ones?
- Did you consider them successful? Why/why not?
- How did the team integrate outcomes of design with detailed planning efforts? What strategies did you use?
- How effective was it?
- What challenges did you encounter?

Other:

- Given the example you have been telling us about, how typical is it? Do you have examples from other design team experiences that are markedly different? (Give them a chance to give us a contrasting view and set of experience if they have it).
- If you hadn't taken the time to conduct design, how might things have unfolded differently with respect to planning, decision making, or mission execution? What difference did it make?
- If you could do this over again, what (if anything) would you do differently? And why?
- How is being on a design team different than being on other teams?
- What are the greatest vulnerabilities or pitfalls in design teams?
- Is there anything else you think we should know, or any question we haven't asked that you think is important?

Needs/Multimedia Guide

- What would be helpful to you as a commander/planner/designer in order to facilitate successful functioning and performance of the design team? What do you (or others) need?
- If we were to create a multimedia guide that contained strategies and best practices for design teams, what would you want to see in it?
- How do you see yourself using such a guide?
- What, specifically, do you need to maximize the integration between design outcomes and other planning efforts?
- What would you NOT want as part of the guide?

For non-military SMEs brought in as temporary team members:

- What was the purpose of your involvement in the team? Why were you brought in?
- At what point in the design team's life cycle were you brought in? How long were you involved? Was your involvement all at once, or at different points throughout the design team's interaction?
- Who contacted you about being involved? What information were you given at that time about the purpose of the team's activity and your role in it?
- What was the nature of your initial interaction with the team? How did the nature of your interaction with the team change over time?
- What was the nature of the expertise you provided?
- How was your knowledge and expertise used?
- What was challenging about being folded into the team?
- What did the leader (or other team members do) to help integrate you into the team, if anything? Was that helpful? If not, why not?
- What would have helped you as a temporary team member to make the interaction, and your contribution to the team's goal, more effective?

Appendix C
Follow-on Survey

Introduction: This survey is being distributed to individuals who recently participated in interviews about their Design team experiences. The interviews were conducted by Anna Grome and her team at Applied Research Associates (ARA) and Kim Metcalf of the U.S. Army Institute for the Behavioral and Social Sciences (ARI).

The purpose of the survey is to gain clarity and/or greater detail around topics that emerged from the interviews. There are a total of 18 questions in this survey, most of which are open-ended. We recognize your time is very valuable and appreciate you taking time and effort to complete this survey. Please answer as many of the questions as you have time and inclination to do and return to agrome@ara.com as an attached Word file by March 5, 2013. Once we receive your completed survey, we will download the Word file and delete the email so that your identity is not linked to your responses.

Note: we recognize that some people do not use the terms "Design team," and instead use the terms "planning team" to describe the group of individuals who engage in collective sensemaking and problem framing. But for purposes of this survey, we will be using the term "Design team" to describe planning teams or other types of teams who engage in Design-type activities.

Thank you, as always, for sharing your knowledge and experience.

Background
1. What is your current rank? _____

2. Approximately how many Design teams have you been part of? _____

3. What role have you held in your Design team experiences? (please check all that apply)

> Team member _____
> Team leader _____
> Temporary/Ad-hoc team member _____
> Other _____

Team Composition

4. When discussing team composition, several people we interviewed stressed the importance of diversity within a Design team (e.g., diversity in perspective, diversity in experience). But we also heard about particular characteristics some leaders want their team members to have in common (e.g., curiosity, open-mindedness, etc.).

> In your opinion, for which characteristics is diversity among design team members more beneficial than similarity?

> For which characteristics is similarity among team members more beneficial than diversity? Please explain.

5. Interviewees described several specific attributes or skills they saw as important characteristics to consider when building a Design team. Some of these are listed below. We are interested in which ones you believe are important for all team members to have, and which ones you believe are important for just some members to have for effective Design team interaction and performance. (Please check either "all team members" or "some team members" to indicate your view.)

Skill or Attribute	All team members should possess	Some team members should posses
Big picture thinking ability		
Detailed thinking ability		
Willingness to learn		
Voracious reader		
Good writer		
Curiosity		
Good verbal communicator		
Visual thinking ability		
Forward thinking ability		
Awareness of one's own cognitive biases		
Self-learner		
Ability to communicate ideas visually (in non-text form)		
Historical thinking ability		
Cognitive Flexibility		
Ability to accept a less-than-perfect solution		
Tolerance for ambiguity		
Abstract thinking ability		
Open-mindedness		
Adaptability		
Creative thinking ability		
Critical thinking ability		

Ability to synthesize large quantities of information		
Reflective thinking ability		
Ability to think metacognitively (i.e., awareness of how one thinks, one's biases, what perspective one brings)		
Awareness of how one's organization tends to think (i.e.,"How does the U.S. military tend to see the world and approach problems?")		

Priming the Design Team and Setting Expectations

6. If you do not use the term "Design" to describe Design-like activities to your team, and/or to external stakeholders, what terms or phrases do you use to describe it?

Flattening the Hierarchy

7. Interviewees (and literature on Design teamwork) describe the importance of "flattening the hierarchy" in a Design team in order for effective discourse to happen. But <u>how</u> do you actually do this? What specific strategies do you use (or have you seen used) to emphasize that everyone can share their views regardless of rank (and that there will be no reprisal for doing so)?

Managing Team Dynamics

8. What is the most difficult personality you have had to manage in a design team? What made it difficult? And how did you manage it?

Incorporating external SMEs

9. Interviewees have described tapping into expertise that is external to the team as a strategy for enhancing team learning. Please describe the types of external SMEs you have sought information from in your Design experiences, and the approaches you have used to elicit information from them.

10. If you involved *non-military* SMEs in any of your Design team experiences, what challenges (if any) did you face in incorporating them into your team? And how did you manage those?

11. What specific strategies did you use you build trust with non-military team members?

Packaging information for Stakeholders

12. Commanders and other stakeholders have differing preferences for receiving information from a Design team. For example, some may want a ½ page narrative description, some may want PowerPoint slides, others may prefer face-to-face communication. Other than trial and error, are there certain strategies you have found effective in determining how to 'fit' information to your commander or other stakeholders? Please describe.

Task Interdependence

13. Below are 3 types of tasks that reflect differing levels of task interdependence in a team. Based on your experience in a Design team, which of the following descriptions best characterizes the nature of the *majority* of Design team activities? Please choose one.

    ___*Pooled*: Team members make separate and independent contributions to the group. The team's performance is a sum of each team member's contribution.

    ___*Sequential*: Team members perform tasks in a sequential order. One member's work depends on another's.

    ___*Reciprocal*: Team member's work is dependent on other team members' work. Members of the team share information and work closely together.

Monitoring and Accountability

14. We are interested in how Design Team members monitor one another's performance and hold one another accountable for their work. In your experience, what specific practices have you found useful for monitoring the work of individual team members and/or for holding one another accountable?

Integration with the larger Unit or Command

15. We are interested in the larger organizational structure in which Design Teams reside, and how Design Teams are integrated with the rest of their unit or command.

    For example, in some cases, a commander may decided to have a full-time Design team and full-time planning team that have no overlapping membership. Other times, the Design Team may be a subset of the planning team. There are also additional models distinct from the two described. What was the structure of your Design team relative to the rest of your unit or command?

16. In your view, is there an optimal structure/model?

Supporting Design Team leaders
   17. What are the top 3 challenges for Design team leaders?

   18. What resources, aids, or other support would help with those challenges?

Thank you for your time and input!