Technical Report 1309

Assessing Interpersonal Trust in Networked Teams

Anna T. Cianciolo
Command Performance Research, Inc.

Arwen H. DeCostanza
U.S. Army Research Institute

July 2012

United States Army Research Institute for the Behavioral and Social Sciences

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

Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:

MICHELLE SAMS, Ph.D.
Director

Technical review by:

Sena Garven, U.S. Army Research Institute
Andrew Slaughter, U.S. Army Research Institute

NOTICES

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

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

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

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
July 2012	Interim	April 2009 to April 2011

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Assessing Interpersonal Trust in Networked Teams	W91WAW-09-C-0057
	5b. PROGRAM ELEMENT NUMBER: 622785
6. AUTHOR(S): Anna T. Cianciolo (Command Performance Research, Inc.), and Arwen H. DeCostanza (U.S. Army Research Institute)	5c. PROJECT NUMBER: A790
	5d. TASK NUMBER
	5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Command Performance Research, Inc. 1201 Waverly Dr. Champaign, Il 61821 U.S. Army Research Institute 6000 6th St (Bldg. 1464) Fort Belvoir, VA 22060	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 (Bldg. 1464 / Mail Stop 5610) Fort Belvoir, VA 22060-5610	10. MONITOR ACRONYM: ARI
	11. MONITOR REPORT NUMBER: Technical Report 1309

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

13. SUPPLEMENTARY NOTES
Contracting Officer's Representative: Arwen H. DeCostanza

14. ABSTRACT *(Maximum 200 words)*: Joint, interagency, and multinational (JIM) operations are characterized by persistent disunification of both command and effort, requiring strong interpersonal relationships to accomplish shared objectives. Trust is thought to be one characteristic of these relationships. Improving the effectiveness of Army personnel serving on JIM command and control (C2) teams therefore requires an understanding of how interpersonal trust functions in networked collectives, how it can be measured, and how it can be enhanced through preparation and intervention. The purpose of this 4-year research effort is to develop and test a conceptual model of interpersonal trust in groups conducting technology-mediated work. The model will be applied to identifying behavioral indicators of trust and to designing methods for building trusting relationships. This report documents research focused on theoretical model development conducted within the first 2 years of this project.

15. SUBJECT TERMS
Trust, Command and Control, Network-enabled Operations, Collaboration

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	44	Dorothy Young Librarian 703-545-2316

Technical Report 1309

Assessing Interpersonal Trust in Networked Teams

Anna T. Cianciolo
Command Performance Research, Inc.

Arwen H. DeCostanza
U.S. Army Research Institute

Foundational Science Research Unit
Gerald F. Goodwin, Chief

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

July 2012

Army Project Number
622785A790

Personnel Performance and Training Technology

ACKNOWLEDGEMENT

We gratefully acknowledge the current and former Army personnel whose generosity made it possible to conduct our research in the past year. Data collection was made possible by the Mission Command Battle Lab and facilitated by Ms. Diane Ungvarsky, Mr. Jeff From, Mr. Ralph Reed, Ms. Mary Welborn, and Mr. Matt Fear, to whom we are very thankful. We also thank Mr. David Manning, Mr. David Branscom, and Mr. Mike Tremlett of Dynamics Research Corporation for their support in developing role play exercise scenario materials for our trust experiments. The technical expertise of Ms. Susan Potter, Mrs. Megumi Watt, and Mr. Jordan Schwartz was essential to the development of our trust research platform. Our thinking has benefitted tremendously from the input of Army Research Institute personnel and the scholars they support, especially Dr. Jay Goodwin and the members of the Teams Review Panel (Drs. John Mathieu, Stacey Connaughton, Kurt Kraiger, Joyce Osland, and Joan Rentsch).

ASSESSING INTERPERSONAL TRUST IN NETWORKED TEAMS

EXECUTIVE SUMMARY

Research Requirement:

Joint, interagency, and multinational (JIM) operations are characterized by persistent disunification of both command and effort, requiring strong interpersonal relationships to accomplish shared objectives. Trust is thought to be one characteristic of these relationships. Improving the effectiveness of Army personnel serving on JIM command and control (C2) teams, therefore, requires an understanding of how interpersonal trust functions in networked collectives, how it can be measured, and how it can be appropriately calibrated through preparation and intervention. The purpose of this 4-year research effort is to develop and test a conceptual model of interpersonal trust in groups conducting technology-mediated work. The model will be applied to identifying behavioral indicators of trust and to designing methods for building calibrated trust. This report documents research focused on theoretical model development conducted within the first 2 years of this project.

Procedure:

Year 1 effort produced a conceptual model of trust and a research design for testing the model empirically. In Year 2, these were refined through analysis of data from a division-level C2 exercise and through survey administration to a separate sample of field grade officers with deployed staff experience. Observations of trained analysts attending the C2 exercise were analyzed in concert with questionnaires administered to exercise participants to investigate each component of the trust model. Administration of a questionnaire to a separate sample of field grade officers followed, to provide a broader perspective on the results from the C2 exercise.

Findings:

Consistent with common practice in field research, the data from the C2 exercise and from the questionnaire were integrated to tell a more complete story of trust in networked teams. First, self-reported risk-mitigation strategies adopted in response to untrustworthy individuals differed from observed behavior. Self-reported strategies typically involved reducing social distance from the untrustworthy individual (e.g., providing guidance), but observed behavior generally reflected attempts to increase social distance (e.g., information hoarding). For responding to untrustworthy networked collectives, observed risk-mitigation strategies mirrored self-reported behavior: disengagement from networked communication. Situational conditions, particularly team architecture (i.e., composition, structure, and technology), influenced the selection of risk-mitigation strategies. Second, pilot testing did not produce clear implications for winnowing down the list of behavioral trustworthiness cues for either individuals or networked collectives. Dynamic selection of a small set of cues may be influenced by trustor experience and team architecture. Third, pilot testing of personal characteristics associated with trust suggested

that proximal attitudes (as opposed to general traits), including the trustor's definition of success, may be more useful as predictors of trustworthiness judgments and risk-mitigation behavior.

Utilization and Dissemination of Findings:

This research will be utilized to develop measures of interpersonal trust that can be captured using observer- and systems-based data from C2 exercises in the absence of survey administration and self-reported feelings of trust. Toward this end, the findings reported here will guide the trust experimentation to be conducted in Year 3. High-priority research targets will enhance understanding of how (1) experience and context influence trustors' selection of behavioral trustworthiness cues; (2) team architecture and situational conditions shape risk-mitigation strategies; and (3) proximal attitudes affect trustworthiness judgments, relative to trustee characteristics and behavioral cues. The findings also will be used to design methods for improving the calibration of trust in networked teams. Results suggest that attempts to do so should (1) highlight the behavioral cues of trustworthiness to which experienced personnel are more sensitive; (2) target definitions of success that promote accurate expectations for the contributions of others, especially in diverse teams; and (3) be practice-based in order to promote the adoption of risk-mitigation strategies that reduce social distance and improve collective function.

ASSESSING INTERPERSONAL TRUST IN NETWORKED TEAMS

CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Overview

Joint, interagency, and multinational (JIM) operations are claimed to be both critical to achieving U.S. foreign policy objectives and persistently disunified in both command and effort [e.g., Lamb & Cinnamond, 2009; U.S. House of Representatives Committee on Armed Services (HASC), 2008]. Achieving unity of effort, especially in the absence of hierarchical control measures such as orders and formal performance evaluations, requires "force of personality" and strong interpersonal relationships to achieve cooperation and collaboration (Gronn, 2002; HASC, 2008; Luck & Findlay, 2007). Mutual trust, which promotes information sharing and communication, is one characteristic of such relationships (Avery, Auvine, Streibel, & Weiss, 1981; Kiffin-Petersen & Cordery, 2003; Mathieu, Marks, & Zaccaro, 2001; Salas, Sims, & Burke, 2005; Staples & Webster, 2008). Effective command and control (C2) of JIM operations requires collaborative problem solving by groups of diverse experts whose interaction is voluntary, temporary, cross-cultural, and at least partially mediated by information technology. All of these factors are associated with difficulty establishing and maintaining interpersonal trust (Jarvenpaa & Leidner, 1999). Improving the effectiveness of Army personnel serving on JIM C2 teams, therefore, requires an understanding of how interpersonal trust functions in networked collectives, how it can be measured, and how it can be enhanced through preparation and intervention. Importantly, trust must be measureable *behaviorally,* such that a meaningful impact of trust on team activity can be demonstrated and used as a target for training and assessment.

Project Purpose and Goals

The present, 4-year research effort is part of a larger initiative aimed at enhancing collaboration and decision making in networked C2 (Army Technology Objective R.ARL.2009.05/Tactical Human Integration of Networked Knowledge; THINK ATO). The purpose of the present effort is to develop and test a conceptual model of interpersonal trust in groups conducting technology-mediated work. The model must enable the specification of behavioral indicators of trust in JIM C2 operations and the design of methods for ensuring calibrated trust in working relationships. One goal of this effort is to support the evaluation of future C2 concepts by providing a means to assess the impact of functional, structural, or other changes on the Human Dimension (U.S. Army Training & Doctrine Command, 2008) of JIM C2. A second goal is to enhance the productivity of Army personnel serving on networked JIM C2 teams through interventions that foster unity of effort where there is not a unified chain of command.

This report focuses on the refinement of the conceptual model, documenting research conducted in the second year of this Army Research Institute (ARI) funded work. Details regarding the development of a draft conceptual model in the first year of this research are documented in other published work (see Cianciolo, Evans, DeCostanza, & Pierce, 2011; Evans, Cianciolo, Hunter, & Pierce, 2010). Therefore, initial model development will be summarized briefly, and the report will focus primarily on Year 2 efforts to refine and pilot test the draft conceptual model.

In this research, the following research questions are addressed:

- In networked JIM C2, what do team members do when they have more or less trust in other individuals? In the team as a whole?
- What factors influence people's judgments of other individuals' trustworthiness? Of the trustworthiness of the networked team as a whole?
- What factors influence cooperative/collaborative behavior independently of trustworthiness judgments?
- How can behavior specifically related to trustworthiness judgments be assessed using communications and other behavioral data?

Initial Model of Trust in Networked Teams

In the first year, a draft conceptual model of trust was developed via a combination of literature review, interviews with Army personnel, and observations of C2 training. The literature review was extensive, spanning multiple domains of psychological research (i.e., military, engineering, organizational, social, and personality psychology) and included Army doctrine and reports from Army C2 exercises organized by the Mission Command Battle Laboratory at Fort Leavenworth. The interviews were conducted with eight active duty or recently retired Army personnel who had served either as a commander or as a key staff member of a combined arms command group (battalion- or brigade-level). The observed training comprised two division-level JIM C2 exercises, each conducted by a class of approximately 64 Intermediate Level Education (ILE) students at the Command and General Staff College (CGSC). In addition to observations, opportunities were taken to question students about their actions during the exercise and their previous deployments. For a detailed description of Year 1 research efforts and findings, see Cianciolo et al. (2011).

By the end of the first year, the draft conceptual model of trust depicted in Figure 1 was developed. Consistent with predominant theory of trust in organizations and work teams, trust was defined as a willingness to be vulnerable to the actions of an object of trust (or *trustee*) in the absence of external control or visibility on those actions (see Mayer, Davis, & Schoorman, 1995). However, some departure from this theory was necessary to meet the research program objective of measuring trust via observable behavior.

Measuring trust behaviorally in occupational settings has been avoided because (1) situational conditions can weaken the link between what someone believes and how he or she acts; and (2) behavior on the job may reflect factors other than trust, such as competence (Mayer et al., 1995; Rousseau, Sitkin, Burt, & Camerer, 1998). These researchers typically use self-reported intent to be vulnerable as a measure of trust instead (e.g., Mayer & Davis, 1999).

However, if intent cannot be definitively linked to action—and ultimately to team performance—then measuring trust in C2 future concepts experimentation has limited value, where actual behavior is of primary interest. Therefore, the chief departure from predominant theory in Year 1 was to view "willingness to be vulnerable" as a process whereby a person makes a judgment that an object is trustworthy and then acts consistently with this judgment (see Figure 1).

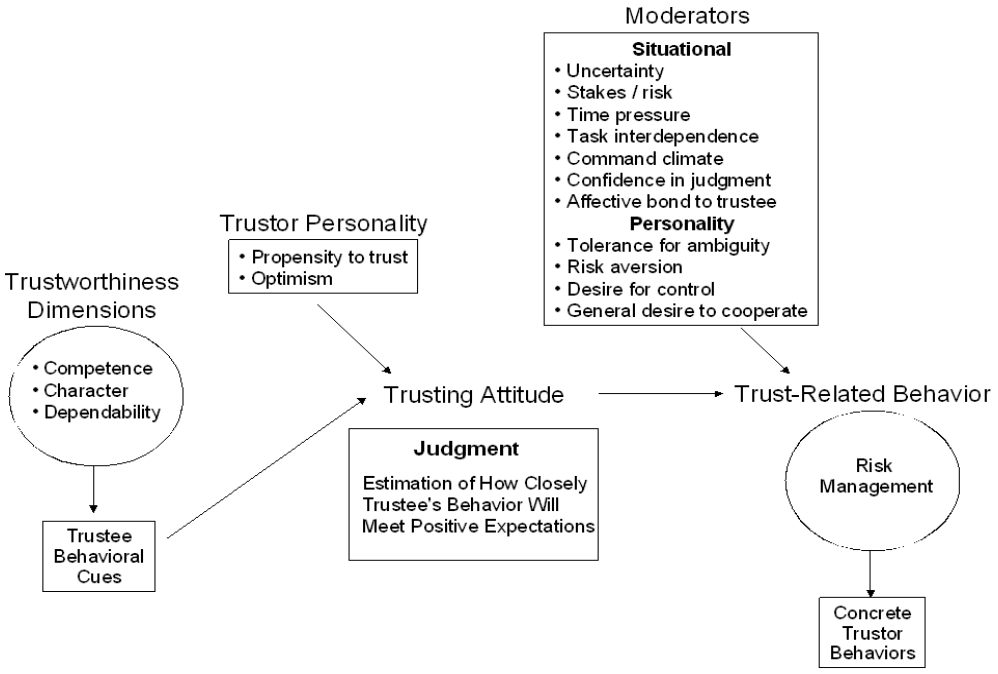

Figure 1. Year 1 conceptual model of trust.

A second, related departure was to avoid building a "universal" model of trust applicable in all conditions. Attempts to build such models have produced numerous types of trust (e.g., affective/cognitive), antecedents of trust (e.g., similarity, familiarity, benevolence), and situational constraints on trust (e.g., risk, control) and countless connections between them. These models cannot be tested statistically in their entirety, and they ultimately fail to account for what people and teams in a given situation actually *do*. In contrast, the present research sought to specify a limited number of high-impact situational and personal factors that moderate the strength of the relationship between judgment and behavior (see Figure 1). As described in more detail below, these factors were used to characterize units of analysis—sets of conditions under which specific, observable behaviors can reliably be used as indicators of trust. The specification of units of analysis is essential to making theoretically justifiable conclusions about trusting affect on the basis of observed behavior.

As shown in Figure 1, a trustworthiness judgment is an estimation of the likelihood that a trustee's actions will meet positive, functionally relevant (i.e., task-related) expectations (Gabarro, 1990). Although positive task-related expectations might be considered confidence, as opposed to trust (Adams, 2005), this estimation was posited to be affective in nature and based on trustee characteristics (i.e., competence, character, and dependability) as well as trustor personality (e.g., propensity to trust). The basis of trustworthiness judgments was theorized to evolve such that trustor personality traits and trustee surface features (e.g., social identity or reputation) initially driving judgment will give way to personal knowledge of the trustee acquired by direct exposure to actual behavior (Gabarro, 1990). Trust-related behavior was defined as acceptance or rejection of the risk associated with continued interaction with a trustee. Acceptance of risk is reflected in information sharing or collaboration with the trustee. Risk mitigation is reflected in attempts to replace, obviate, or monitor the untrustworthy party, or creating rules for the untrustworthy party to follow. The same overarching model was posited to apply to two levels of analysis: trust between individuals and trust between an individual and the networked collective. In the former level of analysis, an individual makes a trustworthiness judgment about another individual and manages the risk associated with engaging that individual. In the latter level of analysis, an individual judges the trustworthiness of a group of people connected via shared information technology and manages the risk associated with participating in collective effort.

The strength of the relationship between trusting attitudes and behaviors was hypothesized to be sensitive to the moderating influence of situational factors (e.g., risk, availability of viable alternatives, uncertainty, perceived interdependence) and personality characteristics of the trustor (e.g., tolerance for ambiguity, risk aversion, desire for control, and cooperation). Situational factors were used to specify team architectural characteristics related to trust, including: composition (diversity), structure (hierarchy vs. separation of powers), and technology (shared/interoperable or separate/non-interoperable), which were used in turn to define the boundaries of units of analysis relevant to measuring trust behaviorally. These characteristics tend to co-vary and collectively influence perceived interdependence, a critical determinant of the strength of the relationship between trust-related affect and behavior (Staples & Webster, 2008). These characteristics also influence the general level of knowledge and confidence that team members have when judging others' trustworthiness, as well as the opportunity to react to their perceptions, all of which affect risk-management strategies.

Within JIM C2 teams, subgroups exist that vary in their architectural characteristics as just described (i.e., composition, structure, and technology). For example, the core problem-solving body within these teams consists of Army personnel who are co-located and share the same information displays. Collaborative problem solving also involves the participation of a multi-echelon Army subgroup (i.e., higher and subordinate command groups) that is organizationally largely homogenous and generally shares technology, but is not co-located. Multinational subgroups comprise all military personnel, but are not co-located and do not share many approaches to work, including technology, terminology, and rules of engagement. Interagency subgroups comprise military and civilian members and also feature contrasting

approaches to work, although their members often are co-located when performing missions. These subgroups were used as representative units of analysis for initial model validation.

Behavioral Indicators of Trust

High-level indicators of both individual and collective trustworthiness (i.e., trustworthiness judgment criteria) were generated based on the literature review, subject matter expert interviews, and data collections throughout the first year of the project (Cianciolo et al., 2011), as summarized in Table 1. Individual trustworthiness indicators represented aspects of competence, dependability, and character most likely to be considered when judging a person's ability to contribute positively to JIM C2 operations in general. Collective trustworthiness indicators represented aspects of group-level competence (i.e., ability independent of communication mode), dependability (i.e., reliability, consistency, and utility of the group's networked communication), and character (i.e., group members' adherence to roles and respect for boundaries) most likely to drive judgments about a collective's ability to conduct networked JIM C2 operations in particular. Separate trustworthiness indicators were specified for judgments made with or without direct exposure to the actual behavior of the trustee. If specified accurately, behavioral indicators of trustworthiness ultimately can be used to develop observer-based measures of individual and collective trustworthiness in a C2 exercise. This trustworthiness data can be used to corroborate observer- and/or systems-based measures of risk mitigation in the absence of survey data.

Table 1

Indicators of Trustworthiness, Individual and Collective Trustees

Exposure	Individual	Collective
No	Professional reputation (from trusted 3rd party) Training and experience (amount and relevance) Social identity (e.g., organizational membership, nationality)	Reputed effectiveness of similar groups (from trusted 3rd party or prior related experience) Group diversity (particularly involvement of out-groups) Group structure (e.g., clearly specified and non-overlapping roles and responsibilities)
Yes	Accuracy, utility, and timeliness of information sharing Understanding of roles and responsibilities Adaptability and initiative taking Problem-solving and visualization skill Inclusiveness in information gathering and decision making Availability and consistency Personal responsibility "Team player" attitude Discretion Compliance	Usability of communications and collaboration technology Breadth of network adoption Frequency/severity of gaps or errors in information sharing Frequency/severity of miscommunications or data loss

Table 2 shows high-level indicators of risk mitigation (i.e., rejection of vulnerability) specified in Year 1 for individual and collective units of analysis. In general, risk-mitigation behavior reflects attempts to create social (if not physical) distance between the trustor and the untrustworthy object, including avoidance or disengagement. However, actions that increase the frequency of interaction, such as monitoring and providing guidance, also were considered. Positive trustworthiness judgments were hypothesized to promote risk-taking, such as accepting a trustworthy individual's input without question or posting sensitive information to a shared workspace.

Table 2

Indicators of Risk-Mitigation in Response to Untrustworthy Individuals and Collectives

Untrustworthy Individual	Untrustworthy Collective
Avoid/ignore/work around untrustworthy individual Double-check the validity of untrustworthy individual's contributions, sources, processes, etc. Monitor untrustworthy individual's actions Guide the untrustworthy individual	Disengage from collective work Avoid/work around networked information sharing (e.g., share information offline) Engage only trusted components of the collective Ignore information posted on the network

Testing the Conceptual Trust Model

Extending progress from the first year, the goals of the second year were to refine the conceptual trust model. It was envisioned that pilot testing in Year 2 would reduce the number of behavioral indicators associated with each aspect of the draft conceptual model, thereby making the model tractable for quantitative analysis. In addition, Year 2 findings were expected to refine the indicators such that the relationship among model components could be reliably specified. For instance, it was necessary to validate which trustworthiness indicators and trustor characteristics influenced self-reported feelings of trust. Also, for the model to be useful for measuring trust behaviorally, it was essential to determine whether the selected boundary conditions for each unit of analysis were associated with the selection of particular risk-mitigation strategies. The conceptual model was refined through pilot testing that included two separate efforts: (1) analysis of the data (surveys and observations) collected from a division-level C2 exercise; and (2) questionnaires administered to a sample of ILE students. These activities and results are described in detail below.

C2 Exercise—Field Testing

Field testing was conducted to identify high-payoff components of the conceptual trust model. Surveys based on Year 1 findings were administered to the participants in a large-scale JIM C2 exercise to explore which indicators of trustworthiness had the strongest influence on role players' judgments and which risk-mitigation actions were most frequently taken in response to low levels of perceived trustworthiness. Situational conditions most likely to have an impact on the relation between trust-related affect and behavior also were explored. Self-report questionnaire data were analyzed in concert with the exercise observations of trained analysts to investigate what trustworthiness and risk-mitigation "looks like" during C2 operations and how situational conditions may influence this picture.

Method

Participants. Participants were role players in a division-level Army C2 simulation exercise conducted across several U.S. and multinational locations by the Mission Command Battle Lab at Fort Leavenworth, Kansas. The purpose of the exercise was to investigate the effect of technological solutions on the interoperability of a U.S. division with a brigade from the United Kingdom (U.K.). In addition, the joint-multinational learning requirements associated with using future C2 technologies were explored. The scope of the exercise was managed by focusing analysis on the critical executive functions of a division command group and those of the subordinate/supporting brigades. Key roles played in the exercise included the Division staff members directly involved in command decision making, members of one subordinate U.S. brigade's command group, and members of a multinational (U.K.) supporting unit's command group. The Division staff was co-located throughout the exercise, while the U.S. and U.K. brigades were distributed. Regardless of location, exercise participants primarily used networked systems for communications. Although other roles were played in the exercise (e.g., State Department representatives and higher command personnel), only key players of military roles participated in the research.

Overall, 94 role players participated in the trust research (N = 49, 25, and 20, respectively, for Division staff, U.S. brigade, and U.K. brigade—nearly all of the C2 exercise military role players) and generally were representative of the personnel who serve in actual division-level JIM operations. The majority of participants (85%) were active duty personnel with 13 years of experience on average. The remaining participants were retired military personnel, with 26 years of experience on average. Eighty-five percent of the participants had command group (i.e., command and/or staff) experience at the battalion level or higher. Twenty-nine percent had staff experience at the division level. On average, participants with command group experience spent 2.5 years in related duty positions. Ninety-three percent had deployment experience and 20% had participated in a prior C2 exercise. The experiential characteristics of these participants represent those of military personnel serving in analogous, operational positions and of role players in other large-scale C2 simulations. Role players for U.S. and U.K. brigades were all active duty military personnel currently serving in intact command groups and

using the simulation exercise in part as a training exercise. Although it was not measured directly, it may be assumed that these personnel all knew each other prior to the simulation exercise and knew relatively few of the Division staff role players. It may also be assumed that there was variability in the interpersonal experience among the Division staff role players.

Materials. Data were collected via questions developed in-house and administered periodically throughout the simulation exercise. Critical incident observations recorded by trained analysts were used to investigate the possible implications of survey responses in greater depth. Participants also responded to additional questions related to analyzing trust in the exercise, such as role-player demographics and participant engagement in the exercise.

Trust questionnaire. The questionnaire used for this field research was exploratory in nature, designed to address aspects of the trust model that were accessible via field study. Specifically, participants were asked to report (1) the perceived trustworthiness of personnel from different groups of role players (e.g., U.K.);[1] (2) the information they used to judge the trustworthiness of individuals and networked collectives; and (3) the risk-mitigation actions they took when perceived trustworthiness of individuals or of networked information sharing was low. The questionnaire also asked about the frequency and nature of problems with networked collaboration.

Perceived trustworthiness of individuals was captured via a single question that asked participants to report the likelihood that individual personnel from four different groups of role players would contribute to mission success during the exercise. The group definitions corresponded roughly to the units of analysis believed to influence risk-mitigation behavior as described above. They were: Division staff, U.S. brigade, U.K. brigade, and non-military agencies. Trustworthiness judgments were provided on a scale of 0–10 (0 = *not at all likely to contribute*; 10 = *almost certain to contribute*). In this context, a person was asked to judge how well individuals from particular groups of role players (including the group the respondent belonged to) would effectively support the conduct of the exercise. Judgments of individuals may therefore have reflected stereotypes of the group to which the rated individual belonged, especially if the rater did not know individual members of the group personally. This condition can be expected to mirror actual JIM C2 operations, where judgments are made about individuals in the absence of an established personal relationship but group identity is known. It should also be noted that, given the exercise environment, judgments were conducted under conditions of relatively little personal or professional risk. Even so, this context may have mirrored actual JIM C2 operations in that individual differences existed in how personally invested role players became in performing well and ensuring that the group succeeded existed.

To capture the determinants of trustworthiness judgments, participants were asked to select from a list of factors (generated in Year 1; see Cianciolo et al., 2011), the five they considered most important when estimating the likelihood that (1) a particular group (i.e., Division staff, U.S. brigade, U.K. brigade, and non-military agencies); and (2) a (notional)

[1]Due to the large number of role-players, questions about the perceived trustworthiness of specific individuals were not administered.

individual from one of these groups would contribute to mission success. Consistent with the conceptual model, the factors that were provided for judging individual trustworthiness differed from the list provided for judging group trustworthiness. However, the factors in each list addressed aspects of competency, character, and dependability. Aspects of the exercise that might influence trustworthiness ratings (e.g., time pressure and information overload) were assessed separately via self-report or direct observation, where possible.

Risk-mitigation in response to untrustworthy individuals was assessed via a single question that asked participants to select, from a list, all of the actions they would take to respond to an individual whose behavior seemed to be reducing the likelihood of success in the mission. Risk-mitigation in response to untrustworthy networked communications also was assessed via a single question. This question asked participants to select, from a list, all of the actions they took to deal with problems they encountered with networked communications in the exercise.

Analyst observations. Analysts—mostly from the Army's Combined Arms Center and Training & Doctrine Command Analysis Center—who are trained in observing C2 exercises conducted observations throughout the exercise. Their purpose was to document, using an open-ended format, noteworthy events related to the exercise's research questions. All analyst observations were reviewed by trust researchers and then selected if they illuminated aspects of the conceptual trust model.

Procedure. The exercise was conducted over 3 work weeks. The first week was a train-up on the various C2 technologies used in the exercise. The second and third weeks were devoted to the C2 exercise. Trust questionnaires were administered online throughout the course of the exercise, as shown in Table 3. These questions were administered alongside questions on other topics of interest to other researchers, including demographics, technology use, and situation awareness.

Table 3

Questionnaire Administration during the Exercise

Survey Topic	Train-Up Week	Simulation Week 1	Simulation Week 2
Trustworthiness Judgments	Once	Daily	Daily
Determinants of Perceived Trustworthiness	Once	Once	Once
Risk-Mitigation Actions	N/A	Once	Once

Results

Consistent with the practice of field research, the results from the C2 exercise are presented as integrated self-report data and analyst observations in order to present a coherent case study of trust in this simulated JIM C2 setting. The discussion begins by quantifying trust-related affect during the exercise, and then presents findings as to the main drivers of trustworthiness judgments. Finally, indicators of risk-mitigation are presented.

Trustworthiness judgments. Data from participants who rated trustworthiness during the train-up and at least once during Weeks 1 and 2 of the exercise were analyzed. Week 1 and Week 2 daily trustworthiness ratings were averaged such that each respondent had one trustworthiness rating for each week of the exercise. Despite the presence of serious technical difficulties (intentionally programmed by administrators as part of the exercise), information management challenges, and personality conflicts, trustworthiness judgments were generally positive, with no group's personnel receiving an average rating lower than 6 on a scale of 0 to 10. However, the perceived trustworthiness of personnel decreased over the course of the exercise [$F(1.31,$[2] $96.91) = 5.39$, $p = .015$]. Decreases occurred at a similar rate, regardless of whose trustworthiness was being judged [i.e., personnel from the Division staff, U.S. brigade, U.K. brigade, or non-military agencies; $F(3.29, 227.95) = 1.26$, ns]. These findings suggest that self-reported trusting attitudes were variable, and thus potentially influenced by factors specified in the conceptual model (i.e., trustee and trustor characteristics and behavior).

Trustworthiness judgment criteria. Although trustworthiness judgments generally were positive, they were not uniformly so. This section summarizes the apparent basis of participants' perceptions of the trustworthiness of personnel from specific groups.

Trustee characteristics. To explore the impact of trustee characteristics on the perceived trustworthiness of personnel from different groups, the effect of trustee group identity was explored. Across time/exposure and trustor group identity, the perceived trustworthiness of personnel coming from non-military agencies was lower than for personnel coming from the other, military groups [$F(1.65, 121.78) = 26.16$, $p = .000$].

Given that the Division staff itself comprised multiple, functional subgroups, the trustworthiness judgments of personnel within subgroups of the Division staff also were explored. Subgroups were defined functionally as Core (i.e., the commander and staff officers central to ground force operations), Intelligence, Civil-Military, Air/Fires, and Support (e.g., personnel, logistics, medical). Within the Division staff, the effect of trustor group identity on ratings was significant [$F(1.58, 66.29) = 24.66$, $p = .000$], with the trustworthiness of non-military participants perceived to be the lowest. Together, these findings suggest that military versus civilian status, and possibly association with lethal versus non-lethal operations (e.g.,

[2] To address violations of the assumption of sphericity, adjusted degrees of freedom are used for all repeated-measures analyses in this section.

governance and infrastructure development), may have a strong impact on trust-related attitudes in networked C2.

Analyst observations revealed a significant lack of knowledge among most role players regarding non-lethal operations and a persistent lack of interest in discovering how non-military agencies and civil-military staff officers could contribute to achieving mission objectives. In addition, aspects of the simulation scenario reduced the level of involvement that some civil-military role players could have in the exercise. Although causality could not be determined from the available data, these observations support the notion that a trustor's definition of success may influence his or her trustworthiness judgments. In the case of this exercise, the definition of mission success on which trustworthiness judgments were based may have excluded the non-lethal component of operations, thus reducing expectations that non-military agencies and civil-military staff officers would have something to contribute. Indeed, one analyst observed that "There has … been a difficult-to-quantify 'feeling' from the [civil affairs] players that much of the staff is really not interested in what they are doing—unless it supports a kinetic action."

To further explore determinants of perceived individual trustworthiness, survey data were analyzed for respondents who selected their five most important trustworthiness cues during the train-up and both weeks of the exercise. Across time/exposure and trustor group identity, the top five cues reportedly used to judge individual trustworthiness were:

1. Provides Accurate, Timely, Useful, and Accessible Information (endorsed by 74% of the sample);
2. Understands and Takes Initiative (53%);
3. Communicates Honestly and Directly (52%);
4. Solves Problems Effectively (49%); and
5. Is a Team Player (47%).

The sixth most frequently endorsed cue (37%) was Knows the Responsibilities of Own Role and That of Others. Knows Responsibilities was among the top five cues when judging the trustworthiness of individuals from non-military agencies, and Solves Problems Effectively was not. This finding suggests that members of the one group in a networked C2 team whose role is not military in nature (the one group likely to be judged as having the lowest trustworthiness to begin with), should understand and behave consistently with role expectations and boundaries, at least initially, in order to convince military personnel of their trustworthiness. This implication is supported by Baba (1999) and was illustrated in analyst observations.

Analyst comments revealed that the Civil Affairs Officer in the Division staff had a wealth of operational experience related to her role in the exercise, that she had a strong personality (i.e., she strongly and directly vocalized concerns), and that she took initiative to fulfill her role requirements by communicating widely with the Division staff, the subordinate units, and the JIM communities, sometimes bypassing the doctrinal channels of communication (e.g., speaking directly to the Division Commander, instead of going through the Chief of Staff). Her efforts and recommendations, however, often contrasted with how staff officers responsible for lethal operations (especially the Operations and Intelligence Officers) wanted to proceed.

One analyst commented that the Civil Affairs Officer "noted a tendency by the staff to leap into the fray… [and] advised caution…" and that she "has been a verbal focal point in pointing out the need to consider 2nd, 3rd, etc. order effects of U.S. military to answer to all." Despite the fact that this role player clearly demonstrated initiative, problem solving, and direct communications, she did not act consistently with how other Division staff officers perceived her role. This also may have reduced perceptions that she was a team player. One analyst observed that with regard to the Civil Affairs Officer's approach, the Operations Officer "was unhappy over the lack of situation awareness as to what meetings were taking place, not so much with the outcome of the meeting and its importance to ongoing operations."

Interestingly, examination of cue rankings suggested that trustor experience level may influence the relative importance of some cues for judging individual trustworthiness. For instance, Is a Team Player was the second most frequently cited cue among survey respondents with less than 1 year of experience on a battalion or brigade staff, whereas this cue was the fourth, fifth, or sixth most frequently cited cue among respondents with 1-3, 3-5, and more than 5 years of experience. A similar pattern was found for the cue Follows Through on Commitments. The reverse pattern was found for the cues Understands and Takes Initiative, which was the second or third most frequently cited trustworthiness cue for respondents with more than 1 year of staff experience and the fifth most frequently cited cue for respondents having less than 1 year of staff experience. These patterns suggest that for individuals with less experience, social factors may play a greater role in judging trustworthiness than functional factors.

Judging group trustworthiness. Data were analyzed for role players who selected their five most important trustworthiness cues for judging groups during the exercise train-up and both weeks of the exercise. Across time/exposure and judged groups (i.e., Division staff, U.S brigade, U.K. brigade, and non-military agencies), the top five cues reportedly used to judge group trustworthiness were:

1. Capability (endorsed by 55% of the sample);
2. Experience (54%);
3. Ability to Communicate Effectively (42%);
4. Ability to Work as a Group (39%); and
5. Consistency of Performance (36%).

The sixth most frequently endorsed cue (30%) was Accessibility via Shared Information Systems. One exception to this pattern was that during the train-up week, Consistency (endorsed by 32% of the sample) was not among the top five cues, but Goals for the Experiment (39%) was. During the train-up week, Consistency also was endorsed less frequently than Accessibility via Shared Information Systems (36%) and Character (36%). This finding suggests that participants adaptively used information to judge group trustworthiness; that is, performance attributes were more frequently used to judge trustworthiness as exposure to groups increased and surface attributes became less frequently used. Unfortunately, there was no way to assess actual group differences on trustworthiness cues to examine their impact on judgment.

Nonparametric analysis was used to explore whether judges' group identity influenced the cues used to judge trustworthiness. Within each group (i.e., Division staff, U.S brigade, and U.K. brigade) and within subgroups of the Division staff (i.e., Core, Intelligence, etc.), the proportion of role players endorsing each trustworthiness cue was calculated and a rank was assigned to each proportion. The most frequently endorsed cue within a particular group was assigned a rank of 1, and so forth. Ties were assigned using standard competition (i.e., "1224") ranking and a Kendall's *W* test was performed on the rankings. Kendall's *W* provides a non-parametric estimate of the correspondence between multiple raters, which varies from 0 (no agreement among raters) to 1 (total agreement among raters).[3] The results indicated that there was substantial agreement among groups [$W = .92$, $X^2(14) = 38.61$, $p = .00$] and Division staff subgroups [$W = .85$, $X^2(14) = 59.34$, $p = .00$]. That is, judge group identity did not influence the information used to judge the trustworthiness of other groups.

Trustor characteristics. To explore the impact of a trustor's personal characteristics on his or her trustworthiness judgments, the impact of trustor group identity (Division staff, U.S brigade, or U.K. brigade) on trustworthiness ratings of personnel from specific groups was explored. It was found to be non-significant [$F(2, 74) = 0.65$, ns], suggesting that neither someone's echelon nor his or her nationality were determinants of expectations for others' contributions. Trustor group identity also did not affect the rate of decline in trustworthiness perceptions over the course of the exercise [$F(2.62, 96.91) = .518$, ns]. Division staff subgroup identity did influence trustworthiness judgments, with Intelligence personnel reporting significantly lower expectations for the successful contributions of others [$F(4, 42) = 4.99$, $p = .002$].

Analyst observations did not illuminate possible explanations for this finding; however, additional background data indicated that where engagement in the exercise was lower, so too was the perceived trustworthiness of others. Specifically, self-reported personal importance of the exercise and willingness to participate were positively associated with overall trustworthiness judgments ($r = .32$ and .24, respectively). Although the sample sizes were too small to draw rigorous conclusions, the Intelligence subgroup reported lower levels of personal importance and willingness than the rest of the Division staff (5.00 vs. 7.65 and 6.88 vs. 8.65 on a scale of 1 to 10 for *personal importance* and *willingness*, respectively). It may be possible that generally negative attitudes toward the exercise simultaneously drove lower levels of engagement and more pessimistic projections regarding the contributions of others to mission success. On average, the Intelligence subgroup members did not differ demographically (e.g., in terms of experience level or number of other role players known personally) from the other subgroups.

Indicators of risk-mitigation. This section summarizes the self-reported and actual actions that C2 exercise participants took to mitigate the risk associated with interacting with an object perceived to be untrustworthy. Ultimately, these actions will serve as behavioral indicators of trust, so analyses sought to uncover the most likely behaviors.

[3] Note that the Kendall's *W* test does not require that a single rater provide rankings on each object. A "rater" may be a variable (see, e.g., LeGendre, 2005). In this analysis, group frequencies were used as a proxy for rankings and thereby groups are treated as a single rater.

Untrustworthy individuals. Data from all role players who listed the risk-mitigation strategies they adopted in response to untrustworthy individuals during both Week 1 and Week 2 of the exercise were analyzed. The top three reported responses to untrustworthy individuals for both Weeks 1 and 2 were to:

1. Increase Guidance (62%);
2. Put Less Weight on Input (50%); and
3. Increase Involvement in Understanding How/Why of Information (42%).

Four other actions (Double Check Information, Speak More Formally, Avoid Their Input, and Avoid Their Opinion) could be considered frequent alternative responses, although they were notably less frequent than the top three (30–35%). These actions varied in importance across weeks of the exercise.

Risk-mitigation actions were illustrated in the breakdown in relations between the lethal and non-lethal components of the Division staff, as documented by analysts. Conflicts between the Civil Affairs Officer and the Operations Officer over the Division's civil-military approach (e.g., establishment of Medical Civic Assistance Programs) devolved into a situation where they ignored each other's input, excluded each other from meetings, hoarded information, and issued directives instead of collaborating. These actions appeared to "snowball" over the course of the exercise until the non-lethal subgroup of the Division staff had formed a functionally separate group from Operations and Intelligence. As noted by one analyst, "There is no apparent attempt by any staff element to synchronize critical information sharing between the Staff and Special Staff." The Intelligence Officer repeatedly refused the Civil-Military Officer's requests for intelligence, surveillance, and reconnaissance assets and apparently felt that "any effort spent on civilians was a waste of time." His list of key information requirements did not "reflect the professional judgment of the [Civil-Military Officer]…" Following a major degradation in communications, one analyst observed that the Operations Officer went into action directing workarounds but that there was "no visible interaction, activity, or integration of the [non-lethal] cells." The members of the non-lethal cells did, however, work closely together and were observed "practicing much interaction and mutual support."

Untrustworthy network. Data were analyzed for role players who listed the risk-mitigation strategies they adopted in response to untrustworthy networked communications (i.e., difficulty finding information, finding inaccurate/untimely information, figuring out where/how to post information, and posting unnoticed/ignored information) during both Week 1 and Week 2 of the exercise. Overall, the most frequently reported risk-mitigation strategy was to Communicate Off the Network More Frequently. This action, reported by 63% of the sample, was the top-ranked action across weeks and respondent group identity. It also was endorsed substantially more than the other actions listed (63% vs. 32% for the next most frequently reported action). Among the *least* frequently reported risk-mitigation actions were Ignore Information From Unknown People and Avoid Posting Very Important Information. Across

weeks and respondent group identity, these behaviors were reportedly adopted by 0-14% of survey respondents, with an average adoption rate of 5% each.

Analyst observations supported these results, indicating that role players generally prioritized sharing information and found ways to do so when networked communications failed. For example, one analyst observed that the Division "commander and staff are very comfortable with FM [communications] and quite possibly any analog [communications] they can rally around when the high-speed digital stuff goes out." Another analyst's observation revealed the leadership role that the Division Commander took in response to untrustworthy information on the network with regard to U.K. brigade assets. The "commander met with the U.K. [Liaison Officer] early in the day to discuss his lack of confidence… [Command Post of the Future] showed U.K. platoons where the commander expected at least companies. [He] requested the Liaison Officer to have the U.K. Commander call him… [The division] commander even went to the effort to get butcher block and write it up near the back of the command post." U.K. role-players, in response to lack of confidence in human-entered data on the network, used email and voice communications to exchange information about significant activity.

Differences in risk-mitigation strategies as a function of respondent group identity also were examined. Across groups (Division staff, U.S brigade, and U.K. brigade), relative ranking of strategies appeared quite consistent [$W = .86$, $X^2(8) = 20.66$, $p = .008$]. Across subgroups of the Division staff, relative ranking appeared less consistent [$W = .67$, $X^2(8) = 26.94$, $p = .001$]; however, the reduction in W may be due to the presence of several more tied rankings among the subgroups. Although Communicate Off the Network More Frequently remained substantially the most frequently reported action, no clear pattern emerged among the remaining risk-mitigation strategies.

Moderators. The exploration of group identity in the analyses described above helped to determine what aspects of trustworthiness judgment could be linked to the generalizable characteristics of group architecture (i.e., composition, structure, and technology). As potential moderators of the relationship between trusting affect and behavior, personal importance of the exercise and willingness to participate were assessed and their relation to risk-mitigation activities was analyzed. A weak correlation was found between personal stakes and the number of risk-mitigation actions that role players reported taking, although it increased slightly between Week 1 ($r = .00$ and .06, for personal importance and willingness, respectively) and Week 2 ($r = .17$ and .14, for personal importance and willingness, respectively). Although the sample size was too small for statistical testing, role players who reported taking at least one risk-mitigation action reported slightly higher personal stakes than those who reported taking no risk-mitigation actions at Week 1 (6.91 vs. 6.69 and 8.02 vs. 7.75, for personal importance and willingness, respectively) and Week 2 (7.07 vs. 5.92 and 8.17 vs. 7.17, for personal importance and willingness, respectively).

Analyst observations indicated that role players differentially treated the exercise like an actual operational situation. The Division Commander and some key staff personnel appeared to identify very closely with their role and to represent it to the best of their ability and experience. However, others were disengaged almost entirely from ongoing activity, and some players

employed fewer risk-mitigation strategies than they might have in the operational environment (e.g., "sitting back and waiting on the techies to fix the system," going on coffee breaks, or "pushing back from the computers instead of pulling up the Battle drill and setting up alternate means of continuing with the mission"). These findings tentatively suggest that, in the context of C2 exercises, situational moderators reflected in the definition of units of analysis may have a greater influence on risk-mitigation behavior than trustor characteristics. In other words, the absence of risk-mitigation behaviors within carefully specified units of analysis in the C2 context may be considered a reliable indicator of positive trustworthiness judgments versus a result of trustor characteristics.

ILE Survey

Survey administration involving a separate sample of research participants and a modified set of survey questions followed field testing and was intended to provide a broader perspective on the results from a single C2 exercise. Specifically, surveys were used to determine whether the indicators refined via field testing were generalizable and whether differences in these indicators across units of analysis should be expected. Survey administration also enabled investigation of trustor personality characteristics related to trust, which could not be assessed in the exercise.

Method

Participants. Survey respondents were 30 Army majors enrolled in ILE, a leadership course administered by CGSC at Fort Leavenworth. The majority of the respondents (70%, N = 21) were in the combat arms or combat support branches and had served as deployed staff officers for more than eight months (83%, N = 25). All but four respondents (87%) had brigade or higher staff experience while deployed. Several respondents reported having worked directly with a variety of Sister Service personnel (53–73%), multinational military personnel (57%), and U.S. government agencies (3–43%) while deployed as staff officers.

Materials. The trust survey consisted of basic demographic questions, questions designed to assess attitudes theoretically related to trust, and questions addressing each aspect of the conceptual model of trust. The survey did not ask for any personally identifying information. Each section of the survey is described briefly below.

Demographics. Demographic questions asked for the respondent's rank, branch, deployed staff experience (location, duration, and echelon), and deployed staff experience working directly with a variety of JIM partners, including Sister Service personnel (i.e., Marines, Air Force, and Navy), a multinational military unit, U.S. government agencies (i.e., State Department, USAID, and Department of Agriculture), host nation government officials, non-government agencies, media, and civilian defense contractors.

Trustor Personality. Two trust-related personality characteristics of the trustor were assessed by the survey: Propensity to Trust [adapted from Rotter's (1967) Interpersonal Trust

Scale, in Robinson, Shaver, & Wrightsman, 1991, pp. 393–396] and Tolerance for Ambiguity (adapted from Budner, 1962). Propensity to Trust was assessed by six items and Tolerance for Ambiguity was assessed by five items. All items involved a Likert scale, which respondents used to indicate the frequency with which they thought the statement presented in each item was true (1= *Always* and 5 = *Never*). To manage the overall length of the survey, items from the original scales were excluded if they did not seem relevant to the topic of the survey (e.g., they asked about trust in politicians or religious institutions or ambiguity related to school assignments). Items also were refined to ensure that they each had a single referent such that level of endorsement would have clear meaning. An example Propensity to Trust item is: "Vigilance is required to prevent someone from taking advantage of you." An example Tolerance for Ambiguity item is: "Clearly specified tasks are preferable to ill-specified ones."

Trustworthiness judgment criteria. Three questions were used to collect information on individual trustworthiness cues, each addressing a different trustworthiness dimension: competence, character, or dependability. Each question asked respondents to rate the frequency with which they would use each item in a list of six cues to judge another person's trustworthiness. Example cues for competence, character, and dependability are "Provides actionable information to the decision making process," "Is a 'team player'," and "Follows through on commitments." One question was used to collect information on networked collective trustworthiness cues. It asked respondents to rate the frequency with which they would use each item in a list of six cues to judge the capability of a networked collective (example cue: "Information management procedures are effective."). For all four questions, rate of cue usage was selected from a 1 to 5 Likert scale, in which "1" represented *Always use this cue* and "5" represented *Never use this cue*. All cues were derived from Year 1 findings and the results of the C2 exercise.

Risk-mitigation. Two questions asked respondents to rate the effectiveness of a variety of risk-mitigation strategies for dealing with untrustworthy others. One question addressed risk-mitigation in response to untrustworthy individuals (e.g., "Do not place weight on this person's input" and "Guide this person"). The other question addressed risk-mitigation in response to untrustworthy networked collectives (e.g., "Communicate off the network" and "Double-check the validity of information on the network"). A Likert scale was used to rate effectiveness (1 = *Very Effective* and 5 = *Very Ineffective*). All risk-mitigation strategies were derived from Year 1 findings and the results of the C2 exercise.

Situational Moderators. Two questions asked respondents to rate how often a list of situational moderators influenced their ability to engage in risk-mitigation strategies (1 = *Always* and 5 = *Never*). Although both questions contained the same list of seven moderators (e.g., "Time Pressure," "Information Overload," "Availability of Alternatives," etc.), one question addressed influences on risk-mitigation in response to untrustworthy individuals and the other question addressed influences on risk-mitigation in response to untrustworthy networked collectives.

Versions. There were four parallel versions of the survey, which differed only in terms of the referent group used in questions addressing trustworthiness cues, risk-mitigation strategies, and situational moderators. These referent groups corresponded to trust-relevant units of analysis and were: a "core group of U.S. Army staff officers," a "networked multi-echelon team of U.S. Army staff officers," a "networked U.S. Army and multinational staff," and a "U.S. Army and U.S. government civilian planning group." In all other respects the versions of the survey were the same. Sample size across versions was as follows: Core (N = 1), Multi-Echelon (N = 10), Multinational (N = 8), and Interagency (N = 11). Because there was only one respondent in the Core referent group, this person's data were not used to explore the influence of referent group on aspects of trust.

Procedure. Participants were invited via an email from the Fort Leavenworth Quality Assurance Office to take the survey. The invitation contained a brief explanation of the research and a link to one of the four versions of the survey, which the respondent clicked on if he or she was interested in participating. Assignment of a survey version to a particular invitee was random, accomplished by dividing the population of 832 ILE students into four roughly equal sized groups (range in N per group = 189–228). The number of students who completed the survey (N = 30) represents a response rate of 4%. This low response rate likely was the result of timing. Delays in the human subjects review process resulted in the survey being administered after the students were well into the course (and after they had already received several other surveys) and just before the Thanksgiving holiday. In addition, a few volunteers (N = 16) did not have deployed staff experience and so were not eligible to complete the survey.

Results

Trustworthiness judgment criteria.

Personal characteristics. Using the data from all 30 respondents, the internal consistency reliability for each scale of trust-related attitudes was assessed using Cronbach's alpha.[4] In both cases, the alpha level was low (.49 and .52 for Propensity to Trust and Tolerance for Ambiguity, respectively). Examination of the inter-item correlations for the Propensity to Trust scale suggested that the scale was measuring two constructs: perceptions of others' honesty or dependability (e.g., r = .56 between "Experts tell the truth about the limits of their knowledge." and "People can be counted on to do what they say they will do.") and need for self-protection (e.g., r = .59 "Caution should be taken with people of unproven trustworthiness." and "Vigilance is required to prevent someone from taking advantage of you."). The correlation between composites of these two item-dyads was –.08, and all other inter-item correlations were low.

Examination of the inter-item correlations for the Tolerance for Ambiguity scale suggested that this scale also assessed two constructs: comfort with ambiguity (i.e., "Clearly specified tasks are preferable to ill-specified ones." "Complicated problems are preferable to simpler ones." and "Familiarity is preferable to uncertainty.") and perceived effectiveness of initiative as a response to ambiguity ("Initiative is a good response to vague guidance."). The

[4] Note that all responses were coded such that a higher value equaled higher levels of the construct assessed.

correlation among the three "comfort with ambiguity" items ranged from .19 to .52, and their internal consistency reliability was .67. The correlation between a composite of these items and the single item relating to initiative was .16. Interestingly, but perhaps not surprisingly given the sample demographic, the average value for the "comfort with ambiguity" composite was lower than the average value for "effectiveness of taking initiative" (2.6 compared to 4.1 out of 5)

Cues of individual trustworthiness. Overall, all 18 cues of individual trustworthiness were rated as being used often (range in average ratings was 1.61 to 2.55 across cues of competence, character, and dependability). There were no statistically significant differences in rate of cue usage across referent groups analyzed (i.e., multi-echelon, multinational, and interagency), which was expected given the small sample size. However, effect sizes also were close to zero.

To explore cue usage further, the average ratings of survey respondents with and without experience with their referent group were examined.[5] Half of the respondents who filled out the multinational version of the survey ($N = 4$) reported having worked directly with a multinational unit while a deployed staff officer. Six (55%) of the respondents who filled out the interagency version of the survey reported having worked directly with representatives of U.S. government agencies or non-government organizations while a deployed staff officer. In general, respondents with referent-group experience rated using nearly all of the trustworthiness cues more often. No effect of experience was found to be statistically significant due to the small sample size, however some large effect sizes were found. Upon examination of the raw data, these effect sizes could not be attributed to an outlier in any of the groups analyzed (e.g., one respondent of four who consistently used one or the other end of the rating scale).

Table 4 shows the trustworthiness cues for which the greatest effect of experience was found. Interestingly, respondents with multinational experience reported using "Operates C2 technology" and "Knows roles and responsibilities" more often than inexperienced respondents when judging competence, however the opposite pattern was true for respondents experienced with civilians from U.S. government agencies and non-government organizations. Acknowledging that average reported rates of cue usage were high regardless, these differences nevertheless may reflect the differing degree to which military versus civilian stakeholders are integrated into Army staff operations. If civilians do not use C2 technology or work on the periphery of ongoing operations, the relative importance of such cues for judging competence could be expected to be weaker.

[5] Note that all respondents who took the multi-echelon version of the survey were assumed to have experience deploying and/or training with multi-echelon Army units.

Table 4

Individual Trustworthiness Cue Ratings Most Influenced by Experience

	Multinational	Interagency
Competence	"Operates C2 technology" (*d* = 2.45) "Knows roles and responsibilities" (*d* = .76) "Solves problems" (*d* = .76)	"Operates C2 technology" (*d* = .81*) "Knows roles and responsibilities" (*d* = .66*)
Character	"Takes responsibility for own errors" (*d* = .83) "Communicates honestly" (*d* = .82)	"Mentors others who are having difficulty" (*d* = .84)
Dependability	"Updates information on the network the same way every time" (*d* = 1.10) "Clearly understands information sharing requirements" (*d* = .97) "Follows through on commitments" (d = .82) "Always maintains the same level of quality" (*d* = .88)	"Always maintains the same level of quality" (*d* = 1.14)

* These cues were reported as used *less* frequently by experienced respondents.

Relative frequency of cue usage across referent groups (multi-echelon, multinational, and interagency) was assessed by correlating the average rating on all six cues within a dimension across referent groups. When the data from only experienced respondents were used, correlations were fairly consistent across referent groups in the dimensions of competence (*r* = .53–.83) and character (*r* = .62–.95). For dependability, relative rates of cue usage between the multi-echelon and multinational referent groups were similar (*r* = .75), but not between these groups and the interagency referent group (*r* = .11–.35). Although there were insufficient data to determine why this pattern emerged, it is possible that differences in nature or integration of military versus civilian duties may influence what dependability cues matter more. For example, the cue of "Always comes to meetings/briefings prepared to contribute" was among the most frequently used dependability cue for multi-echelon and multinational survey respondents and among the least frequently used cue for the interagency survey respondents.

Cues of networked collective trustworthiness. All six cues of networked collective trustworthiness were rated as being used often (range in average ratings was 1.79 to 1.97 across referents). As with cues of individual trustworthiness, there were no statistically significant differences between referent groups on any cue and effect sizes also were close to zero. Experience was shown to influence cue frequency ratings for networked collectives, generally by increasing the reported rate of cue usage. For respondents with multinational experience, there were especially large effect sizes for "Common terminology for communicating mission events is adopted" (*d* = 1.51) and "Information sharing procedures are well understood" (*d* = 1.51), perhaps indicating that experienced personnel understood better the challenges to achieving interoperability. Interestingly, experienced respondents reported a lower frequency of using the

cue "Interpersonal communications techniques are well understood" (d = .82). There were no particularly large effect sizes associated with interagency experience.

Relative frequency of cue usage across referent groups when the data from only experienced respondents was used showed contrasting patterns; that is, the more frequently used cues for one referent group generally were the less frequently used for another (r = –.19 to –.54). These patterns may reflect the different nature of collective work across referent groups. For instance, the most frequently used cue for the multinational referent group was "Common terminology for communicating mission events is adopted," whereas this was the least frequently used cue for the multi-echelon referent group. For the interagency referent group, "C2 technology operations are well understood" and "Communication channels are well understood" were among the least frequently used cues, but were among the most frequently used cues for the multi-echelon referent group.

Indicators of risk-mitigation

Untrustworthy individuals. Most of the risk-mitigation strategies for untrustworthy individuals were rated, on average, as effective (range = 1.79 to 2.83) and ratings did not differ significantly across referent groups. Experience influenced effectiveness ratings, generally by increasing the rated effectiveness of each strategy (although not statistically significantly due to the small sample size). For the multinational referent group, the biggest effect sizes were found for "Guide this person" (d = 1.41) and "Try to understand how/where this person gets their information" (d = .89). For the interagency referent group, the biggest effect sizes were found for "Double-check this person's input before using it" (d = 1.45) and "Do not place weight on this person's input" (d = .72). It was interesting to note that experience with multinational partners was associated with increases in the perceived effectiveness of risk-mitigation strategies aimed towards enhancing collaboration, whereas the opposite was true for experience with interagency partners. However, using data from only experienced survey respondents, the relative rated effectiveness of the risk-mitigation strategies was highly consistent across combinations of referent groups (r = .82–.87).

Untrustworthy networked collectives. In mild contrast to untrustworthy individuals, most risk-mitigation strategies for dealing with untrustworthy networked collectives were rated as neither effective nor ineffective (range = 2.45 to 3.07). Referent group differences in the rated effectiveness of each strategy were not found. An effect of experience was found; however, there was not a general pattern to the effect (increasing or decreasing rated effectiveness). For the multinational referent group, strategies that experienced respondents perceived to be more effective were "Conduct group-level communications" (d = 1.08), "Double-check the validity of information on the network" (d = 1.03), and "Communicate off the network" (d = .83). One strategy was rated less effective: "Act as though the group networks effectively" (d = 1.72). Surprisingly, in the interagency referent group, this same strategy was rated *more* effective by experienced respondents (d = 1.39). "Communicate off the network" also was rated more effective (d = .72). Here too, the findings suggested that experienced multinational respondents placed a greater value (than inexperienced respondents) on mitigating risk through increased

collaboration, but experienced interagency respondents valued the opposite approach. Using data from only experienced survey respondents, the relative rated effectiveness of the risk-mitigation strategies was differentially consistent across combinations of referent groups, with the relative effectiveness of risk-mitigation strategies more similar for the multinational and interagency referent groups (r = .67) than between these groups and the multi-echelon group (r = .28–.42).

Situational moderators. All seven situational moderators were rated, on average, as influencing risk-mitigation strategies often, regardless of referent group or whether the strategies applied to individuals or networked collectives (range = 1.97–2.66). Differences across referent group were not significant and had small effect sizes. Large effect sizes were found for the difference between experienced and inexperienced respondents, with experience generally increasing the reported likelihood that a moderator would affect risk-mitigation. Table 5 shows the situational moderators for which the greatest effect of experience was found in each referent group. Notably, experience influenced the rated frequency of "Time pressure" across referent groups and the object of trust (individual or networked collective).

Table 5

Situational Moderator Ratings Most Influenced by Experience

	Multinational	Interagency
Individual	"Time pressure" (d = 1.28) "Confidence in own judgments of others" (d = 1.21) "Availability of substitutes" (d = 1.15)	"Commander's emphasis on collaboration" (d = 1.53) "Confidence in own judgments of others" (d = 1.35) "Time pressure" (d = .93)
Networked Collective	"Availability of substitutes" (d = 1.62)	"Time pressure" (d = .93) "Personal relationships" (d = .89)

Bearing in mind the range restriction in average frequency ratings, interesting patterns emerged from analyzing the data from only experienced survey respondents. The relative frequency with which situational moderators influenced risk-mitigation was very similar for multinational and interagency referent groups (r = .84 and .76 for individual and networked collective, respectively) but unrelated for these groups and the multi-echelon referent group (r = -.15 to .12 across trust object). Factors such as "Time pressure" and "Availability of substitutes" were rated among the most frequent influences on risk-mitigation in multinational and interagency referent groups and among the least frequent in the multi-echelon group, regardless of trust object. In contrast, the most frequent influences in the multi-echelon group were "Commander's emphasis on collaboration" and "Obligation to interact with others," but these were among the least frequent influences in the other referent groups. This pattern suggests that the structure of the unit of analysis played a role in respondent ratings. Commander's emphasis and obligations perhaps matter more in groups comprised solely of U.S. Army personnel,

whereas in more diverse groups, where there is not a unified command, factors less related to control measures play a greater role.

Refining the Conceptual Trust Model

Based on the results of the Year 2 research described above, in conjunction with previous findings from Year 1, the model of trust in distributed teams was refined slightly. Our primary objectives in Year 2 testing were to reduce the model to only essential elements (necessary for real-world applications), refine measures and behavioral indicators of trust, and to provide initial validation of the model. The refined model is presented in Figure 2, with specific changes described below.

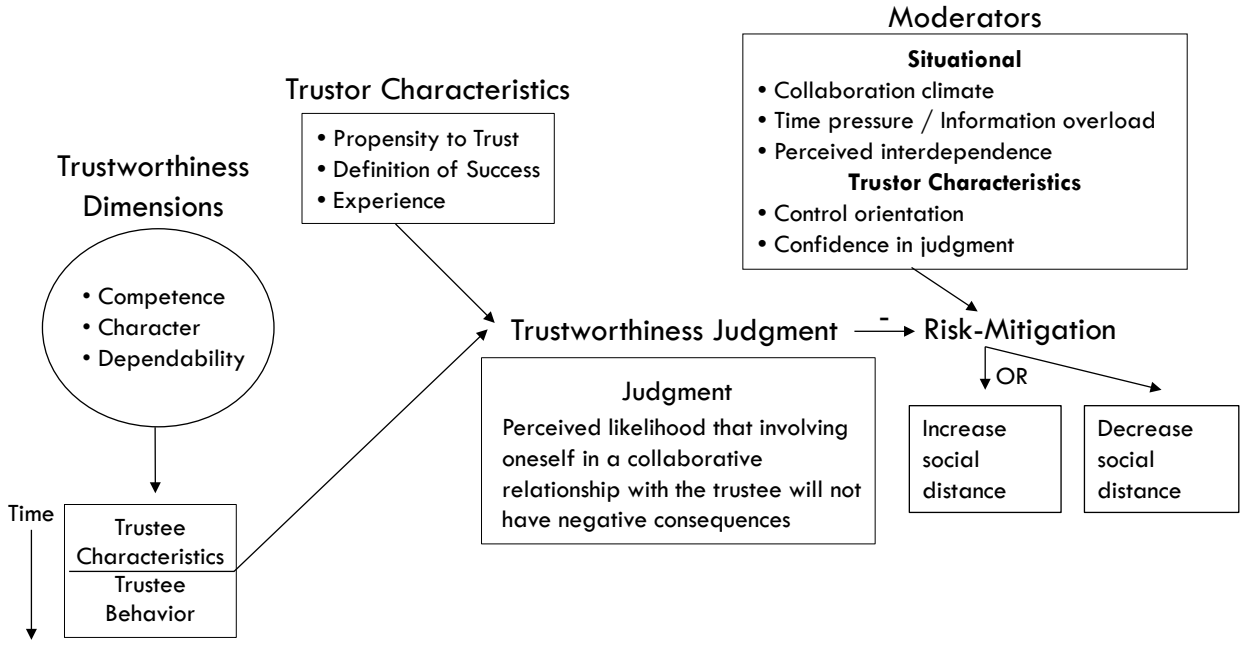

Figure 2. Refined conceptual model of trust.

Personal Characteristics

Trust-Related Personality

The initial attempt to measure extant trust-related personality constructs in Year 2 suggested that a functional approach to exploring such characteristics may be more productive. Increasing the quality of personality measures may require "home-grown" scales whose items all sample a single construct that has a close conceptual relation to risk-mitigation behavior (e.g., perceived effectiveness of various approaches to dealing with ambiguity, rather than comfort with ambiguity) and to the trust objects present in the operational environment to which they will

be applied (e.g., propensity to trust specific referent groups in a JIM C2 team). A construct such as control orientation may reflect a complex combination of trust-related characteristics, including tolerance for ambiguity, risk, and uncertainty. Measures of personality that are proximal to trust-related affect and behavior (as opposed to distal measures of highly general traits), will be less ambiguous to research participants and more likely to serve as useful predictors of self-reported feelings of trust and adopted risk-mitigation strategies.

Other Personal Characteristics

Findings from the exercise suggested that a trustor's definition of success influences his or her perceptions of individual trustworthiness, particularly at the initial stages of a relationship when group identity is among the few trustee characteristics available to consider. In JIM C2 operations, narrow, combat-focused definitions of mission success may influence the trustworthiness of interagency civilians and non-lethal staff officers as perceived by Army personnel. For this reason, one's definition of success was added to the conceptual trust model as a personal characteristic influencing trust-related affect. The act of collaboratively defining success may prove to be a critical, albeit extremely challenging, trust-building activity in JIM C2 teams.

Data from the field study and the ILE survey suggested that experience may influence the selection or weighting of criteria that a trustor uses to judge individual and networked collective trustworthiness. Because a range of experience is represented in actual JIM C2 teams, it will be important to take experience into account when exploring the relations among trust constructs in Year 3. Doing so will elucidate the influence of experience on trustworthiness perceptions and may reveal important learning objectives when designing interventions to calibrate trusting relationships in Year 3.

The field study results also suggested that there was a relationship between personal stakes/risk and trustworthiness judgments, at least initially. Given that the measure of perceived trustworthiness used in the exercise asked respondents to assess the likelihood that personnel would contribute to the success of the exercise mission, it is possible that lower expectations for mission success overall may have reduced expectations for individual contributions. This finding further suggests that accounting for one's definition of success may be important to predicting individual differences in trusting affect. It remains unclear whether personal stakes have their strongest influence on trusting affect or behavior, necessitating further exploration in Year 3.

Trustworthiness Judgment Criteria

Year 2 findings did not have clear implications for winnowing down the list of trustworthiness cues for either individuals or networked collectives. Rather, it appears that trustors may select from a pool of cues in a context-dependent fashion. In Year 3 research, it will be necessary to determine the selection strategies used (and whether they are consistent

across trustors) and to sample actual behavior representing the criteria trustors use to judge others' trustworthiness.

Individuals

For judging the trustworthiness of individuals, the field study data indicated that group identity was a determinant of trustworthiness judgments and provided a working list of behavioral cues for each trustworthiness dimension (competence, character, and dependability) that could be explored further. However, the ILE survey data suggested that all of these cues would be used frequently to make trustworthiness judgments, regardless of trustee group identity. Given the impossibility of simultaneously factoring large numbers of related cues into a single judgment, an implication of this finding may be that single cues are selected from the larger set as the basis for trustworthiness judgments via satisficing algorithms (Gigerenzer & Goldstein, 1996). If this is the case, it will be critical to determine the degree of consensus among Army personnel regarding the rank ordering of cue importance. At least for individual dependability, differing rates of reported cue usage across referent groups and experience levels found in the ILE survey data may provide guidance for further investigation.

Networked Collectives

For judging the trustworthiness of networked collectives, a set of several cues appears to be necessary to reflect changes in cue importance over time and across different types of collectives. In the exercise, there was some evidence that cue usage was adaptive; somewhat greater emphasis was placed on performance attributes (vice surface attributes) as exposure to trustee collectives increased. The ILE survey data indicated that the relative importance of collective trustworthiness cues differed depending on group composition and the consequent nature of cooperative work. For example, in networked collectives involving multinational or civilian partners, cues such as the adoption of shared terminology, common information sharing procedures, and effective interpersonal communication skills were more important than in collectives comprising Army personnel alone. These findings demonstrate the importance of specifying units of analysis when identifying behavioral indicators of collective trustworthiness.

Risk-Mitigation Behavior

Both field study and survey administration indicated that Army personnel prefer taking action to mitigate risk; however, there were differences in reported versus adopted risk-mitigation strategies in response to untrustworthy individuals. Risk-mitigation strategies in response to untrustworthy networked collectives generally involved avoiding the network versus avoiding the individuals connected by it.

Untrustworthy Individual

Data from the field study and the ILE survey suggested that providing guidance and understanding the how/why of untrustworthy individuals' information processing were among the preferred approaches for dealing with untrustworthy individuals. Notably, these approaches act to decrease social distance between individuals by accomplishing shared understanding and coordinated activity. These risk-mitigation strategies represented two of the most frequently endorsed actions by exercise participants and two of the three actions rated most effective by ILE survey respondents. Double-checking also was rated highly by ILE survey respondents and was endorsed by exercise participants with moderate frequency. These risk-mitigation strategies were prioritized for further research in Year 3.

Interestingly, the risk-mitigation behavior observed by exercise analysts did not mirror the strategies most frequently or highly endorsed by the research participants. Rather, untrusting relationships in the C2 exercise were characterized by attempts to increase social distance—for example, by excluding others from decision making and hoarding information. Such risk-mitigation behavior has been widely observed in JIM operations (e.g., HASC, 2008; Luck & Findlay, 2007). The discrepancy between self-reported risk-mitigation strategies and observed behavior suggests that research participants may have been knowledgeable about effective approaches, but knowingly or unknowingly failed to implement them in practice. Especially in the core and multi-echelon units of analysis, rank differences could influence the selection of risk-mitigation strategy, with higher ranking trustors having a greater range of options to increase or decrease social distance. This finding indicates that interventions to develop trusting relationships should be practice-based and may need to take hierarchy into consideration.

Untrustworthy Networked Collective

Across field study and survey administration, the most frequently endorsed or highly rated risk-mitigation strategy for dealing with untrustworthy networked collectives was to communicate off the network. In the exercise, participants appeared to prioritize information sharing and sought alternative ways to do so in the face of difficulty using the network to collaborate. A clear pattern of preference for risk-mitigation strategies other than communicating off the network was not found in either the field study or the ILE survey data; however, the survey data suggested that preferences were more similar for collectives involving multinational or interagency partners than between these collectives and those comprising entirely Army personnel. Until more distinct patterns can be discerned, further research should enable and assess a range of risk-mitigation actions that are afforded in the operational environment for each collective type.

Moderators

Findings from the exercise suggested that there were individual differences in the personal stakes associated with mission success and that personal stakes were associated with slightly greater likelihood of adopting at least one risk-mitigation strategy in response to

untrustworthy individuals or networked collectives. The ILE survey data suggested that the preference for particular risk-mitigation strategies was dependent on the group identity of the untrustworthy individual or the unit of analysis (i.e., group architecture). Preferred risk-mitigation strategies in response to Army personnel or Army-only networked collectives reflected the importance of hierarchy in determining interactions (e.g., commander's emphasis on collaboration, obligation to collaborate). Factors influencing voluntary decisions to collaborate, such as time pressure and availability of substitutes, were more important determinants of risk-mitigation involving multinational or interagency partners or collectives.

Conclusions

Summary

The behavioral research documented in this report was devoted to refining the conceptual model of trust developed in Year 1. Investigation was conducted via analysis of data from a division-level C2 exercise and through survey administration to a separate sample of field grade officers with deployed staff experience, producing several interesting results. First, self-reported risk-mitigation strategies adopted in response to untrustworthy individuals differed from observed behavior. Self-reported strategies typically involved reducing social distance from the untrustworthy individual (e.g., providing guidance) but observed behavior generally reflected attempts to increase social distance (e.g., information hoarding). For responding to untrustworthy networked collectives, observed risk-mitigation strategies mirrored self-reported behavior: disengagement from networked communication. Situational conditions and team architecture influenced the selection of risk-mitigation strategies. Second, pilot testing did not produce clear implications for winnowing down the list of behavioral trustworthiness cues for either individuals or networked collectives. Dynamic selection of a small set of cues may be influenced by trustor experience and team architecture. Third, pilot testing of personal characteristics associated with trust suggested that proximal attitudes (as opposed to general traits), including the trustor's definition of success, may be more useful as predictors of trustworthiness judgments and risk-mitigation behavior.

Large-scale role-play exercises typical of C2 concepts experimentation (i.e., involving hundreds of role players and extending for several days) are not sufficient for empirical research on trust. To statistically test the conceptual model, several groups representing different units of analysis must conduct parallel exercises to validate the direct link between trustworthiness judgments and risk-mitigation behavior. Sustained access to (or replication of) the technology typically used in JIM C2 experimentation, as well as the people who operate it, is not possible in the present effort. Findings suggest, however, that by sampling the ecology of JIM C2 teams, trust research representative of the operational environment can be conducted with small groups of role players involved in relatively brief exchanges (see also Curtis, 2001).

As described previously, subgroups of JIM C2 teams naturally vary along several dimensions that theoretically relate to trust. Accordingly, four units of analysis (JIM C2 subgroups) for exploring the impact of group and situational characteristics on trust were

investigated in Year 2 for their applicability to laboratory research. The Year 2 results suggest that group architecture influences what risk-mitigation to untrustworthy individuals looks like and what other situational factors will moderate the link between trustworthiness judgments and risk-mitigation behavior. In addition, group architecture may influence the cues that determine judgments of collective trustworthiness. Exploring trust separately within each unit of analysis, therefore, should reduce model complexity in a way that is meaningful for supporting JIM C2 teams. Exploring trust across units of analysis will enable the manipulation of multiple conditions that theoretically influence trust at the collective level. Laboratory C2 exercises representing each unit of analysis include core elements of the U.S. Army decision-making body (e.g., Commander, Chief Operations Officer, and Intelligence Cell Chief) and differ with regard to the inclusion of other personnel (i.e., U.S. Army personnel at higher and lower echelons, multinational or Sister Service military personnel, and interagency civilians). The group composition of each exercise is shown in Figure 2.

Future Research

These four units of analysis will be investigated via laboratory experimentation in Years 3 and 4 of this project. A computer-based research platform and exercise scenario for each one has been developed. The format of these scenarios is similar to a "limited objective" C2 exercise as described in Curtis (2001). They are designed to stimulate small-group work and interpersonal interactions representative of those occurring in JIM C2 operations at the brigade combat team (BCT) level. All four exercises require a group of five role players to discuss a course of action in response to a natural disaster in a post-conflict region where U.S. and Coalition troops are operating alongside civilians (e.g., U.S. government representatives and non-government organizations). In each scenario, the BCT Commander has assembled a group of stakeholders to inform his decision making. His course of action development involves choosing among a given set of options associated with each of five issues, which are the same across scenarios. Each stakeholder (including the BCT Commander) has a different perspective on the issues at hand and, thus, contrasting preferences for how best to respond to the natural disaster. The scenarios permit role players 1 hour of discussion to champion their preferred approach. Over the course of the discussion, information is provided to individual role players that updates their understanding of the problem at hand.

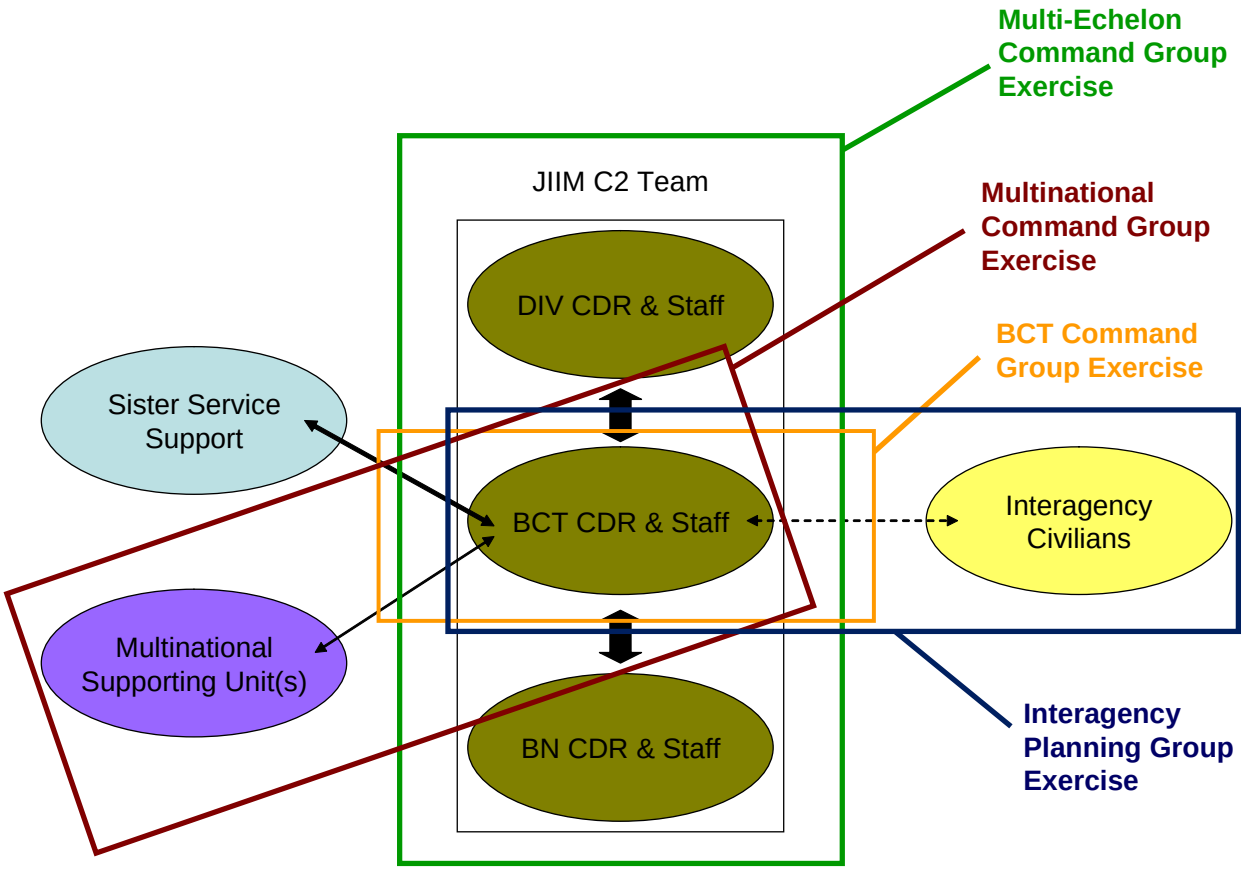

Figure 3. Units of analysis selected for laboratory experimentation.

Implementing the Year 1 research design and Year 2 pilot testing results, the scenarios were designed to manipulate the individual and group differences theorized to affect trustworthiness judgments and the situational conditions theorized to moderate the relation between trust-related affect and behavior. All four scenarios require the same problem to be solved and the same issues to be addressed, but stakeholders and modes of communication differ across the scenarios in a way that represents the naturally occurring, but distinct, units of analysis present in a networked JIM C2 team.

The research platform for implementing the above-described laboratory exercise scenarios was designed in Years 1 and 2 and currently is under development. The Trust in Networked Teams (TiNT) system—an extension of the ARI-funded ICF (see Cianciolo & DeCostanza, 2010)—is a computer-based environment that enables:

- Just-in-time exercise setup;
- Co-located, distributed, and hybrid collaborative problem-solving groups;

- Differential modes of communication that are representative of distinct operational C2 units of analysis;
- Unobtrusive exercise observation by multiple researchers;
- Automated survey administration;
- Automated performance data collection focused on trust metrics;
- Immediate post-exercise access to performance data; and
- Generalizable multiteam systems research.

Detailed documentation of the TiNT research platform will be available in a technical specification document.

In Year 3, experimentation utilizing this research platform and focusing on high-priority behavioral research targets will enhance understanding of how (1) experience and context influence trustors' selection of behavioral trustworthiness cues; (2) group architecture and situational conditions shape risk-mitigation strategies; and (3) proximal attitudes affect trustworthiness judgments, relative to trustee characteristics and behavioral cues. Ultimately, this research will be utilized to develop a training intervention to establish, calibrate, and maintain trust in networked JIM C2 teams. Results reported here suggest that the intervention should (1) highlight the behavioral cues of trustworthiness to which experienced personnel are more sensitive; (2) target definitions of success that promote positive expectations for the contributions of others, especially in diverse teams; and (3) be practice-based to promote the adoption of risk-mitigation strategies that reduce social distance.

REFERENCES

Adams, B. D. (2005). *Trust vs. confidence* (Report No. CR-2005-203). Toronto, Canada: Defence Research and Development Canada—Toronto.

Avery, M., Auvine, B., Streibel, B., & Weiss, L. (1981). *Building united judgment: A handbook for consensus decision making*. Madison, WI: The Center for Conflict Resolution.

Baba, M. L. (1999). Dangerous liaisons: Trust, distrust, and information technology in American work organizations. *Human Organization, 58*(3), 331–346.

Budner, S. (1962). Intolerance of ambiguity as a personality variable. *Journal of Personality, 30*(1), 29–50.

Cianciolo, A. T., & DeCostanza, H. A. (2010). *Augmented performance environment for enhancing interagency coordination in stability, security, transition, and reconstruction (SSTR) operations: Phase II* (Research Report 1934). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Cianciolo, A. T., Evans, K. M., DeCostanza, A. E., & Pierce, L. G. (2011). Trust in distributed military operations. In N. Stanton (Ed.), *Trust in military teams*. Surrey, England: Ashgate Publishing, Ltd.

Curtis, K. P. (2001). *Multinational information sharing and collaborative planning limited objective experiments*. McLean, VA: MITRE Corporation.

Evans, K. M., Cianciolo, A. T., Hunter A. E., & Pierce, L. G. (2010). Modeling interpersonal trust in distributed command and control teams. *Proceedings of the 15th International Command and Control Research & Technology Symposium.* Santa Monica, CA.

Gabarro, J. J. (1990). The development of working relationships. In J. Galegher, R. E. Kraut, & C. Egido (Eds.), *Intellectual teamwork: Social and technological foundations of co-operative work* (pp. 79-110). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. *Psychological Review, 103*(4), 650-669.

Gronn, P. (2002). Distributed leadership as a unit of analysis. *The Leadership Quarterly, 13*, 423-451.

Jarvenpaa, S. L., & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization Science, Special Issue: Communication Processes for Virtual Organizations, 10*(6), 791-815.

Kiffin-Petersen, S. A., & Cordery, J. L. (2003). Trust, individualism, and job characteristics as predictors of employee preference for teamwork. *International Journal of Human Resource Management, 14*(1), 93-116.

Lamb, C. J., & Cinnamond, M. (2009, October). Unity of effort: Key to success in Afghanistan. *Strategic Forum, 248*. Institute for National Strategic Studies, National Defense University. Fort McNair, DC.

LeGendre, P. (2005). Species associations: The Kendall coefficient of concordance revisited. *Journal of Agricultural, Biological, and Environmental Statistics, 10*(2), 226-245.

Luck, G. & Findlay, M. (2007). *Interagency, intergovernmental, and nongovernmental coordination: A joint force operational perspective*. U.S. Joint Forces Command, Joint Warfighting Center. Available at http://jko.cmil.org/file/109/view.

Mathieu, J. E., Marks, M. A., & Zaccaro, S. J . (2001). Multi-team systems. In N. Anderson, D. Ones, H. K., Sinangil, & C. Viswesvaran (Eds.), *International handbook of work and organizational psychology* (pp. 289-313). London: Sage.

Mayer, R. C., & Davis, J. H. (1999) The effect of the performance appraisal system on trust for management: A field quasi-experiment. *Journal of Applied Psychology, 84*(1), 123-136.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of Management Review, 20*(3), 709-734.

Robinson, J. P., Shaver, P. R., & Wrightsman, L. S. (Eds.). (1991). Measures of social psychological attitudes, Vol. 1: *Measures of personality and social psychological attitudes*. San Diego, CA: Academic Press.

Rotter, J. B. (1967). A new scale for the measurement of interpersonal trust. *Journal of Personality, 35*, 651-665.

Rousseau, M. T., Sitkin, S. B., Burt, S. B., & Camerer, C. (1998). Not so different after all: Across-discipline view of trust. *Academy of Management Review, 23*(3): 393-404.

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

Staples, D. S., & Webster, J. (2008). Exploring the effects of trust, task interdependence, and virtualness on knowledge sharing in teams. *Information Systems Journal, 18*(6), 617-640.

U.S. Army Training & Doctrine Command. (2008). Pamphlet 525-3-7: *The U.S. Army Concept for the Human Dimension in Full Spectrum Operations 2015-2024*. Fort Monroe, VA.

U. S. House of Representatives Committee on Armed Services. (2008). *Agency stovepipes vs. strategic agility: Lessons we need to learn from provincial reconstruction teams in Iraq and Afghanistan.* Washington, DC: U. S. Government Printing Office.

Acroynms

ARI	Army Research Institute
ATO	Army Technology Objective
BCT	Brigade combat team
C2	Command and control
CGSC	Command and General Staff College
HASC	U.S. House of Representatives Committee on Armed Services
ILE	Intermediate-Level Education
JIM	Joint, interagency, and multinational
THINK	Tactical Human Integration of Networked Knowledge
TiNT	Trust in Networked Teams
USAID	U.S. Agency for International Development