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Assessing the Impact of Information Channels on the Understanding of Ground Truth

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MONTEREY, CALIFORNIA

THESIS

**ASSESSING THE IMPACT OF INFORMATION
CHANNELS ON THE UNDERSTANDING
OF GROUND TRUTH**

by

Shannon R. Worthan

June 2012

Thesis Advisor:
Second Reader:

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**ASSESSING THE IMPACT OF INFORMATION CHANNELS
ON THE UNDERSTANDING OF GROUND TRUTH**

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Submitted in partial fulfillment of the
requirements for the degree of

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from the

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ABSTRACT

It is important to understand the impact that the proliferation of information displays has on the warfighter's ability to reason about, or make sense of, battlefield information. This research investigates how information sources at a tactical operations center (TOC) workstation affected a battle captain's ability to understand and portray ground truth in a simulated battlefield scenario. Twelve active-duty officers with previous battle-captain experience were randomly assigned to one of four groups. Each group was exposed once to each source condition (two or six sources) and tactical scenario. A replicated pre-network centric warfare (NCW) TOC workstation and modern digitally networked workstation were used for comparison. During each 40-minute battlefield scenario, participants provided situational reports (SITREPs), placed friendly and enemy unit symbols on the battlefield map, and provided perceived mental workload. The results of this research indicate that there is no difference for situational understanding between the modern battle captain workstation (six sources) and the legacy workstation (two sources), when the amount of information from the sources remains the same. Contrary to expectations, perceived mental workload using the two-source workstation is significantly higher than the six-source workstation. Results of this research could have implications for the design of future information system and networked workstations in TOCs.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABCS	Army Battle Command System
ACR	Armored Cavalry Regiment
AFATDS	Advanced Field Artillery Tactical Data System
AMDWS	Army Missile Defense Warning System
ANAM4	Automated Neuropsychological Assessment Metrics
AO	Area of Operations
APA	American Psychological Association
AWE	Advanced Warfighting Experiment
ANOVA	Analysis of Variance
AS3	Assistant Operations Officer
ASAS	All Source Analysis System
ATK	Attack
AVN LNO	Aviation Liaison Officer
BCCS	Battlefield Command and Control System
BCS3	Battle Command Sustainment and Support System
BDA	Battle Damage Assessment
BDE	Brigade
BFT	Blue Force Tracker
BFV	Bradley Fighting Vehicle
BMP	Boyevaya Mashina Pehoti
BN	Battalion
BP	Battle Position
C2	Command and Control
CCA	Close Combat Attack
CCIR	Commanders Critical Information Requirements
CDR	Commander
CCRP	Command and Control Research Program
CF	Coalition Forces

Class III	Petroleum, Oil and Lubricants
ClassIV	Construction Materials
Class V	Ammunition
COP	Common Operating Picture
CPOF	Command Post of the Future
CTC	Combat Training Center
DCGS-A	Distributed Common Ground System- Army
DMSC	Dynamic Model of Situated Cognition
DoD	Department of Defense
DOS	Days of Supply
DP	Decision Point
DSLR	Digital Single Lens Reflex
DTG	Date Time Group
DTSS	Digital Topographic Support System
EEFI	Essential Elements of Friendly Information
ERR	Effective Reading Rate
FBCB2	Force XXI Battle Command Brigade and Below
FFIR	Friendly Forces Information Requirement
FM	Field Manual
FSO	Fire Support Officer
GB	Gigabyte
GCCS-A	Global Command and Control System- Army
GHz	Gigahertz
GPS	Global Positioning System
HD	High Definition
HFE	Human Factors Engineering
HPT	High Payoff Target
HSI	Human Systems Integration
HQ	Headquarters
IDF	Indirect Fire

IED	Improvised Explosive Device
IN	Infantry
INFOSYS	Information System
IRB	Institutional Review Board
ISR	Intelligence, Surveillance and Reconnaissance
KSAO	Knowledge, Skills, Abilities, and Other
LCD	Liquid Crystal Display
M	Mean
MANPRINT	Manpower and Personnel Integration
MDMP	Military Decision-Making Process
METT-TC	Mission, Enemy, Terrain and weather, Troops, Time, Civilian
MOS	Military Occupational Specialty
MP	Military Police
MRE	Mission Readiness Exercise
MRT	Multiple Resource Theory
MSR	Main Supply Route
NASA-TLX	National Aeronautics and Space Administration, Task Load Index
NATO	North Atlantic Treaty Organization
NCO	Noncommissioned Officer
NCOIC	Noncommissioned Officer In Charge
NCW	Network Centric Warfare
O/O	On Order
OBJ	Objective
OODA	Observe, Orient, Decide, Act
OOM	Order of Movement
OP	Observation Position
OPNAV	Office of the Chief of Naval Operations
OPORD	Operations Order
PIR	Priority Information Requirements
PL	Platoon Leader

PSG	Platoon Sergeant
PZ	Pickup Zone
RAM	Random Access Memory
ROE	Rules of Engagement
S-2	Intelligence Officer
S-3	Operations Officer
S-3 AIR	Air Operations Officer
SA	Situational Awareness
SD	Standard Deviation
SIGINT	Signal Intelligence
SIPR	Secure Internet Protocol Router
SITREP	Situation Report
SLANT Report	Abbreviated report to give commander accurate and routine information regarding status of personnel, equipment and situation
Sqdn	Squadron
SVOIP	Secure Voice Over Internet Protocol
TAIS	Tactical Airspace Integration System
TF	Task Force
TIS	Time in Service
TOC	Tactical Operations Center
UAS	Unmanned Aerial System
WPM	Words Per Minute
XO	Executive Officer

EXECUTIVE SUMMARY

Recent developments in satellite communications, global positioning system (GPS) technology, and information networking have revolutionized how battlefield information is shared, developing into a new military doctrine termed Network Centric Warfare (NCW). A battle captain's workstation prior to the first Gulf War had two information sources—radio and telephone. Current workstations have between 6 and 10 information sources: radio, telephone, mirc chat (a form of instant messaging) with multiple chat windows, e-mail, FBCB2 (Force XXI Battle Command Brigade and Below) moving map, and FBCB2 messaging with multiple message areas. As NCW increases, both the information systems linked to the network and the amount of information flowing through it, tactical operations centers (TOCs) are adding more tactical displays. It is important to understand the impact that the proliferation of displays has on the warfighter's ability to reason about, or make sense of, battlefield information. This research investigates how information sources at a TOC workstation affect a battle captain's ability to understand and portray ground truth in a simulated battlefield scenario.

During this research, a laboratory experiment was conducted to assess battle captain sense-making ability while monitoring a simulated battlefield scenario. This research used a 2 x 2 crossover design, comparing the number of sources (two-source and six-source) in two similar tactical scenarios. Twelve active duty Army and Marine Corps officers, with previous battle captain experience, were randomly assigned to one of four groups. Each group was exposed once to each source condition (two or six sources) and tactical scenario. The two-source condition replicated a pre-NCW TOC workstation, while the six-source condition replicated the current networked workstation. During the 40-minute battlefield scenario, participants were required to provide situational reports (SITREPs) approximately every 10 minutes, place friendly and enemy

unit symbols on the battlefield map where they believed them to be located at the end of the scenario, and provide their perceived mental workload every five minutes during each trial.

During the course of this research effort, we found that when a fixed amount of information was presented to a battle captain by a differing number of sources (two and six), the impact on situational understanding was insignificant. Contrary to expectations, the perceived mental workload that battle captains experienced while tracking a simulated battlefield situation was significantly higher for the two-source (analog and legacy) condition than for the six-source (current and digital) condition. Posthoc analysis to determine the influence of initial training and experience on a battle captain's situational understanding and perceived mental workload concluded that digital command and control experience (digital native versus digital immigrant) was not a significant predictor of either situational understanding or mental workload.

Results of this research could have implications for the design of future information systems and networked workstations in TOCs. Simply adding an information source to a TOC workstation may not have the effect of increased situational understanding. All information sources located at each workstation must be reviewed while accounting for information flow rates, presentation methods, type of information, and attention resources required to properly perceive the information.

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I. INTRODUCTION

A. PROBLEM STATEMENT

The digital and information age has modernized the way wars are fought and won. General Eric Shinseki, 34th U.S. Army Chief of Staff, presented his vision of Army transformation in 1999, during the 45th annual meeting of the Association of the United States Army (Gilmore, 1999). Part of his long-term, strategic plan envisioned network-centric combat teams, linked through integrated digital systems, capable of producing a shared, digital common operating picture (COP). This vision set the United States Army on a new path of innovation and technological development that continues today. Shinseki's vision, coupled with recent developments in satellite communications, global positioning system (GPS) technology, and information networking have revolutionized how battlefield information is shared throughout the Army.

Initial development of integrated, digital command and control (C2) information systems (INFOSYS) produced the Army Battle Command System (ABCS) (see Figure 1). Consisting of several C2 systems, ABCS integrates digital systems from strategic to tactical levels, while managing battlefield information across warfighting functions. Operational- and tactical-level personnel interact with ABCS through Force XXI Battle Command Brigade and Below (FBCB2) and Command Post of the Future (CPOF) terminals, located in Tactical Operations Centers (TOCs) and commanders' vehicles on the battlefield. FBCB2 and CPOF terminals provide superiors, peers, and subordinates with the ability to interact and collaborate in real time, while monitoring up-to-date, integrated, battlefield information. The presence of integrated digital systems, in both TOCs and operational commanders' vehicles, provides the means for creating the digital COP that General Shinseki envisioned. To cope with the increased speed of military operations enabled by the information advantage from networked C2 systems, the Department of Defense (DoD) pioneered a new military doctrine termed Network Centric Warfare (NCW).

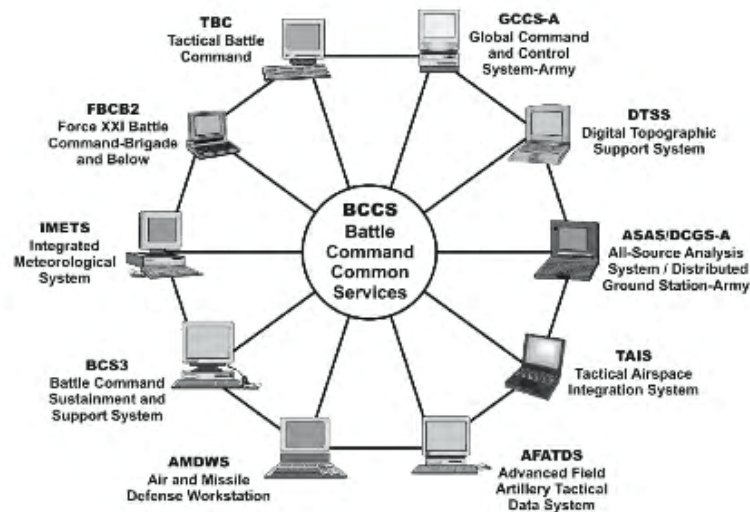


Figure 1. Army Battle Command System
(From: Department of the Army, 2003)

As NCW continues to develop, the supply of detailed, real-time, and accurate battlespace information presented to commanders and their staffs will increase (Thunholm, 2008). Department of the Army's *Mission Command* Field Manual (FM) 6-0 (2003) claims that increasing digitization and information systems will increase the capacity of commanders and their staffs to share information, thus improving their understanding of the battlefield. However, increasing the size of the network creates additional information sources, which increase the amount of information TOC staffs must monitor for relevant information to include in their sensemaking process, which is discussed in detail in Chapter II.

A common myth is that more information leads to better understanding or sensemaking (Klein, Moon, & Hoffman, 2006a). Klein, Moon, and Hoffman (2006b) define sensemaking as the process of making a mental model, where mental models are representations that explain the unfolding events, not isolated stimuli. It is well established that an individual may become overwhelmed with information (Oskamp, 1965; O'Reilly, 1980), thereby degrading a person's decision-making performance. If a staff member, such as a TOC battle captain,

becomes overwhelmed with information presented from the information sources at their workstation, their sensemaking ability degrades. A battle captain is the individual in the TOC responsible for coordinating, planning, resourcing, and battle tracking all units task organized under that command. When sensemaking degrades, the battle captain's situational understanding is reduced and their mental model of battlefield ground truth becomes skewed.

Prior to the first Gulf War, a battle captain's workstation had two information sources—radio and telephone. Current workstations have between 6 and 10 information sources: radio, telephone, mirc chat (a form of instant messaging) with multiple chat windows, e-mail, FBCB2 moving map, and FBCB2 messaging with multiple message areas. In contrast to Oskamp (1965) and O'Reilly (1980), it is not known whether sensemaking would be adversely affected if, rather than being inundated with too much information, a manageable amount of information from a few sources is distributed across many more sources. How does this distribution of information influence the ability to determine what is relevant and irrelevant?

As NCW increases both the information systems linked to the network and the amount of information flowing through it, TOCs are adding many more tactical displays. It is important that we understand the impact of this proliferation of displays on situational understanding. Currently, there is no empirically derived guidance to indicate the number of information systems or sources that an individual operator can attend to at a TOC workstation without degrading the warfighter's situational understanding. Therefore, this research will investigate the impact of the number of information sources in a TOC on the warfighter's ability to reason about, or make sense of, the battlefield.

B. RESEARCH OBJECTIVES

This study investigated how changing the number of information sources at a TOC workstation affected a battle captain's ability to understand and

accurately portray ground truth in a simulated battlefield scenario. The specific objectives of this research effort are:

- Analyzing the accuracy of a battle captain's situational understanding as information sources at a simulated TOC workstation under two conditions: from a pre-Gulf War TOC with two displays and a current, digital age TOC with six or more displays
- Analyzing the accuracy of map tracking in different information source conditions with respect to battlefield ground truth
- Assessing how the number of information sources influences a battle captain's self-reported workload

C. RESEARCH QUESTIONS

The specific research questions addressed by this study are:

- Does the number of sources providing information to a battle captain influence his or her ability to accurately make sense of battlefield reports?
- Is the accuracy of a battle captain's portrayal of ground truth associated with the number of information sources providing him or her information?
- Does adding sources of information increase perceived individual workload?

D. HUMAN SYSTEMS INTEGRATION (HSI)

The U.S. Army was the first multidimensional organization to fully implement and demonstrate the benefits of an HSI approach, by concentrating on the human element (Booher, 2003). This effort started in 1986, when the Army created the Manpower and Personnel Integration (MANPRINT) office, which focused on improving weapons systems and unit performance. By changing the emphasis of weapons system development away from an equipment-only perspective, Army leaders embraced the total system view of

design that includes human performance characteristics, along with equipment performance requirements. This change within the Army acquisition life cycle brought together seven fundamental domains of human and system functionality not previously considered together during system design. While the Navy and Air Force also consider habitability a domain (Air Force 711 Human Performance Wing, 2008; Department of the Navy [OPNAV], 1996), the Army focuses on the following seven domains to guide total system design (Manpower and Personnel Integration [MANPRINT], 2005):

- Manpower
- Personnel Capabilities
- Training
- Human Factors Engineering
- System Safety
- Health Hazards
- Soldier Survivability

Select HSI domains are considered during system design, depending on the scope of the project. Every MANPRINT domain has unique costs associated with potential savings when considered during system design. The trade-off associated with each domain creates a “trade space,” which is considered the range between objective and threshold values for required system attributes (MANPRINT, 2005). Domain trade-offs are at the core of HSI analysis. Balancing human and system requirements within the trade space for system performance creates a balance among system cost, acquisition schedule, and system performance parameters (MANPRINT, 2005). This research focuses on three of the seven HSI domains: human factors engineering, personnel capabilities, and manpower.

Human Factors Engineering (HFE): The goal of HFE within HSI is to maximize the ability of an individual or crew to operate and maintain a system at required levels by eliminating design-induced difficulty and error. Human factors engineers work with systems engineers to design and evaluate human-system

interfaces to ensure they are compatible with the capabilities and limitations of the potential user population (MANPRINT, 2005; Air Force 711 Human Performance Wing, 2008).

Due to the rate of digital system integration into the TOC environment, system designs must account for human limitations. As the availability of digital information to decision makers increases, there is a serious risk that commanders and their staffs will become overwhelmed with information. Future C2 systems must consider the impact of an increase of information sources on an individual's ability to make sense of the battlefield and, ultimately, understand ground truth. This thesis will provide insight into the number of information sources that an individual can monitor without degrading their ability to rapidly and accurately make sense of battlefield information.

Personnel: The personnel domain addresses the requisite cognitive and physical characteristics necessary for warfighters to be successful in their military occupational specialty (MOS). Personnel capabilities are normally reflected as knowledge, skills, abilities, and other characteristics (KSAOs) (MANPRINT, 2005; Air Force 711 Human Performance Wing, 2008). The Army attempts to ensure that a unit's staff has the right mix of experience, knowledge, and training. This balance ensures that the commander has the human resources required to interpret and respond to the battlefield situation.

One personnel characteristic discussed in this thesis is working memory. Specifically, how does an individual's working memory capacity affect their ability to develop an accurate understanding of ground truth as the number of information sources increases? The research literature (McKendrick et al., 2011; Yeh & Wickens, 1988) suggests that individuals with a higher capacity for working memory should be able to develop a deeper and more accurate understanding of a situation when multiple sources or variables are involved.

Manpower: This domain addresses the number of military and civilian personnel required and potentially available to operate, maintain, sustain, and

provide training for systems. Essentially, manpower addresses the number of personnel spaces (authorized positions) and available people (operating strength) (MANPRINT, 2005; Air Force 711 Human Performance Wing, 2008).

The manpower available for units to adequately staff the TOC information systems should be confined to the personnel currently serving in staff positions. However, many units regularly reassign Officers or Noncommissioned Officers (NCOs) from subordinate units to fill TOC manning gaps during deployments so that all systems have someone to monitor them. As discussed by Rhodes and Minami (2007), when digital systems are added to a TOC, more people are required to operate and monitor them. When information sources are added to a TOC without increasing personnel, there is a risk of increasing an operator's workload beyond capacity. By investigating an individual's ability to make sense of the battlefield, this thesis will help determine optimal manning and personnel requirements for digitized C2 centers of the future by gaining a better understanding of how information sources impact individual workload, which influences the sensemaking process and, ultimately, situational understanding.

E. THESIS ORGANIZATION

This thesis is divided into six chapters. Chapter II reviews literature regarding the evolution of information systems, the benefits and challenges of NCW, applicable theories and information models, TOC organization, and decision making. Chapter III outlines the methods used to conduct the experiment and describes the research design and process. Chapter IV reports the results of the experiment, while Chapter V discusses the findings and conclusions, as well as recommendations for follow-on research.

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II. LITERATURE REVIEW

A. BACKGROUND AND LITERATURE REVIEW

1. Evolution of Information Systems in Command and Control (C2)

The information revolution in progress is all about the amount of information richness and reach, and the quality of interactions between and among entities that are possible as a result of advances in technology. (Alberts & Hayes, 2003, p. 74)

Developing and exploiting an information advantage over the enemy has always been important for success in military operations. Methods of military C2 have progressed with technology over time, resulting in information system innovations that fundamentally change the way in which commanders interact with and control units on the battlefield. Such innovations include horseback couriers, signal flags, telegraph, wireless radio, and satellite communications (Office of Force Transformation, 2005). These innovations offer an opportunity to reduce the fog and friction in war, referred to by Carl von Clausewitz (Translated/Edited version, 1976) as early as 1830, by providing field commanders with more timely and accurate information—that is, by accelerating the sensemaking process.

Timely and accurate information reduces a commander's sensemaking cycle, previously referred to as Boyd's Observe, Orient, Decide, Act (OODA) Loop (Brehmer, 2005) (see Figure 2). A sensemaking cycle refers to the continual process in which a commander utilizes information from the cognitive, information, and physical domains to reach and implement decisions. Each of the earlier innovations reduced message transmission time and compressed distances, allowing battlefield information (physical domain) to enter into the commander's cognitive domain sooner. This enables a decision to be communicated to frontline commanders and implemented into the physical domain in a shorter period. As the pace of warfare increases and information

systems evolve, the commander's sensemaking cycles must become faster, while incorporating more information from each domain.

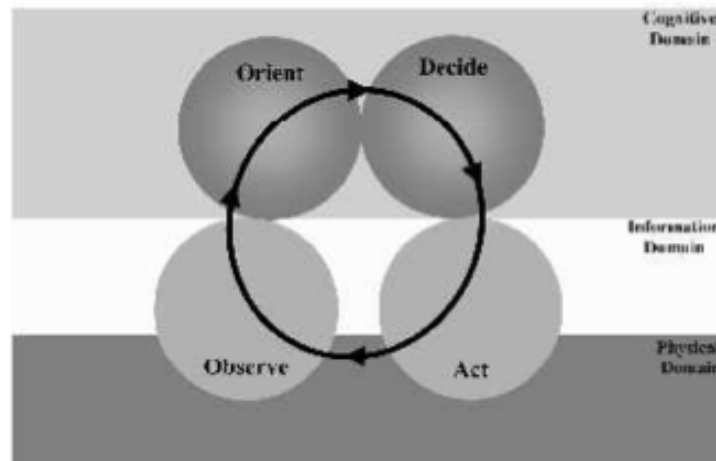


Figure 2. Traditional View of C2: OODA Loop (From: Alberts et al., 2001)

The computer age continues to facilitate advancements in military communication systems through the integration of networks. While past communication innovations reduced the time required to complete a sensemaking cycle, networked systems have produced truly revolutionary changes in C2 (Rhodes & Minami, 2007). Today, many systems—from those worn by the individual Soldier, to our most complex aircraft and ground combat vehicles—incorporate networked information technology in order to leverage real-time battlefield information. This integration vastly increases the ability to collect, process, disseminate, and utilize information (Alberts, Garstka, & Stein, 2000). As a result, military doctrine and C2 processes have been updated to account for new system designs that improve the flow of battlefield information.

Networked digital systems first appeared in ground combat vehicles and Brigade-level TOCs in 1996, during an advanced warfighting experiment (AWE) (General Accounting Office, 1998). The resounding success of the experiment led to the development and implementation of networked C2 functions in Army combat systems. Today, information and decisions travel instantaneously to where they are needed, making the exact location of the recipients largely

irrelevant (Alberts et al., 2000). This technological advancement increases the speed of decision making even more. The traditional sensemaking cycle, which incorporates the cognitive, information, and physical domains (see Figure 2), is replaced with a more integrated process completely supported by the information network (see Figure 3). As a result, the DoD pioneered a new military doctrine called Network Centric Warfare.

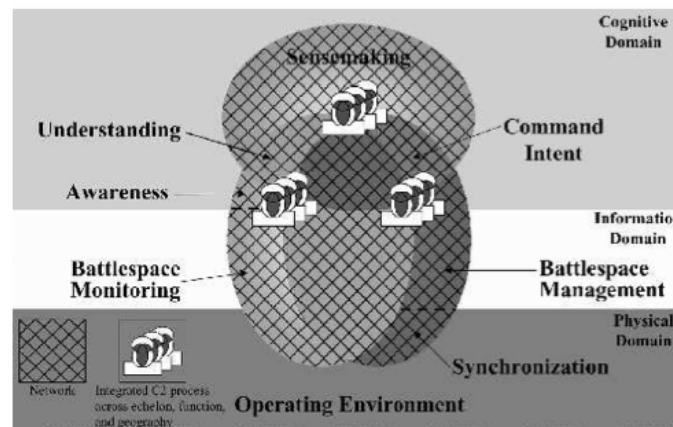


Figure 3. Anticipated Network Integration (From: Alberts et al., 2001)

2. Benefits and Challenges of Network Centric Warfare (NCW)

Alberts, Garstka, and Stein (2000) define NCW as:

An information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, NCW translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace. (p. 2)

NCW, also called network-centric operations, is a change from the traditional way of thinking about military operations. It focuses on combat power generated by linking or networking the warfighting enterprise (Alberts et al., 2000). Network nodes are network connection points for information transfer capable of sending, receiving, or forwarding information over the network. The

term “time lag” (the time delay between information input and information receipt) refers to network lag. The power of NCW is the linking and networking of geographically or hierarchically dispersed nodes and the shortening of lags in the transfer of information.

Nodes may have different forms: TOC workstation, airborne C2 platform, ground combat vehicle, Unmanned Aerial System (UAS), networked sensor, or individual Soldier, to name a few. Each node contributes to, or makes sense of, information on the network. As the number of nodes increases, the effectiveness of collaboration and shared information should also increase. This relationship is characterized by Metcalfe’s Law, which states that as the number of nodes in a network increases linearly, the potential value or effectiveness of the network increases exponentially as the square number of nodes in the network (see Figure 4) (Alberts et al., 2000). Thus, increasing the nodes linked to the network should create significant operational benefits across the force.

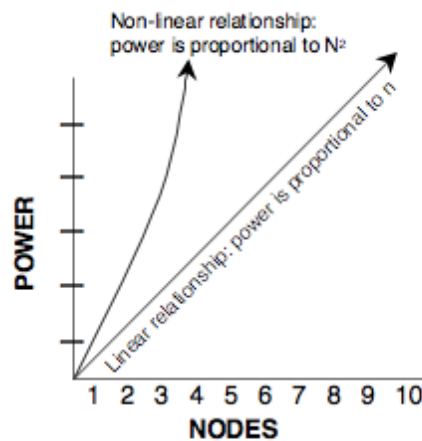


Figure 4. Metcalfe’s Law (From: Alberts et al., 2000)

Alberts et al. (2000) argue that NCW enables collaborators to achieve shared awareness and synchronization across time and space. The C2 network increases operational tempo by reducing commanders’ sensemaking cycles, allowing them to decide and act faster than the enemy by improving

collaboration. The benefits of networking for combat maneuver units include increased planning speed, calls for fire, force lethality, and improved mission outcomes. Inferred improvements include improvements in information quality, information sharing, situational awareness, shared awareness, collaboration, and synchronization (see Figure 5).

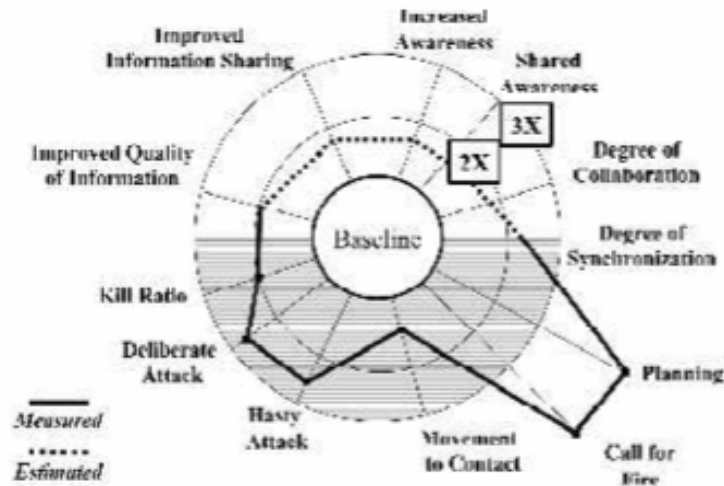


Figure 5. NCW Benefits for Maneuver Units (From: Alberts et al., 2001)

Though the benefits of NCW are numerous, challenges from internal and external factors are present. Internal network factors produce the risk of information overload, difficulty determining relevant from irrelevant information, and commander micromanagement (Wallace, 2005). These internal factors are addressable through proper training of personnel interacting with the network, and system design accounting for human information processing limitations. External factors threatening the success of NCW include network design and training, as well as the network-centric C2 capabilities of our enemies.

As our enemies develop C2 networking capability, the military advantage will go to those best able to rapidly change organizational structures, create new doctrine, and assimilate new technologies in less time (Office of Force Transformation, 2005), thereby gaining information superiority. Information

superiority in military operations is a state derived from the ability to exploit a superior information position (Alberts et al., 2000). Alberts et al. believe that in order to gain and maintain the dominant information position, future C2 networks must convey more accurate and more relevant information in less time than the enemy or competitor (see Figure 6). Absent from this assessment is the human factor that accounts for the input of relevant and accurate information onto the network, enabling timely sensemaking to occur in order to achieve the superior information position.

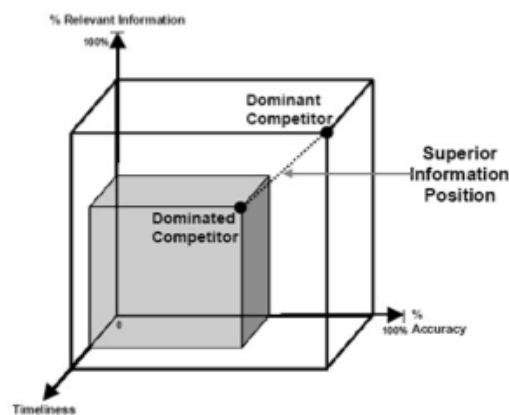


Figure 6. Superior Information Position (From: Alberts et al., 2000)

3. Sensemaking

A knowledge management workshop sponsored by the Command and Control Research Program (CCRP) identified sensemaking as an essential cognitive element of the military decision-making process (MDMP) (Leedom, 2001). Jensen and Brehmer (2005) state that sensemaking is a central task in military decision making and in the collective work of a military staff. While military commanders and their staffs have always engaged in “making sense” of Mission, Enemy, Terrain available, Troops, Time, and Civilian Considerations (METT-TC), there exists a heightened requirement for addressing this process and its contribution to effective C2 (Leedom, 2001). As military doctrine associated with NCW develops, the military requires a deeper understanding of

how sensemaking occurs at both the individual and organizational levels within a C2 system, as well as how sensemaking is shaped by information technology, battle staff training, and organizational design (Leedom, 2001).

Jensen and Brehmer (2005) state that sensemaking is the process of achieving an understanding of the situation in terms of what to do. Klein et al. (2006b) expand this view by adding that sensemaking is the process of making a mental model, where mental models are representations that explain unfolding events, not isolated stimuli. Similar to Klein et al. (2006b), Endsley (1995) discusses integrating information (situational comprehension) by using mental models and frames to solve problems. However, Jensen and Brehmer (2005) and Klein et al. (2006b) refer to sensemaking as a *process* for improving situational understanding with both retrospective analysis and future projection, whereas Endsley employs mental models and frames to reach an improved state within situational awareness to aid problem solving. This author concurs with Jensen and Brehmer (2005) and Klein et al. (2006b) that sensemaking is a continuous process, and further agrees with Klein et al.'s representation of the sensemaking process depicted in the data/frame theory.

In their data/frame theory (see Figure 7), Klein et al. (2006b) use the term “frame” to describe an individual’s perspective or viewpoint, or a mental framework already possessed by the individual. They state that frames define what counts as data and actually shape the data themselves. The current frame, which each individual uniquely possesses in every situation, constitutes his or her determination of information relevance. This creates instances where frames shape and define information relevance, and information mandates that frames change in nontrivial ways (Klein et al., 2006b). They go on to describe an iterative sensemaking process that consists of closed loop transitions between mental model formation and mental simulation. The basic sensemaking act elaborates frames with detail and questions the explanations they provide in order to achieve a “data-frame symbiosis” (Klein et al., 2006b, p. 88).

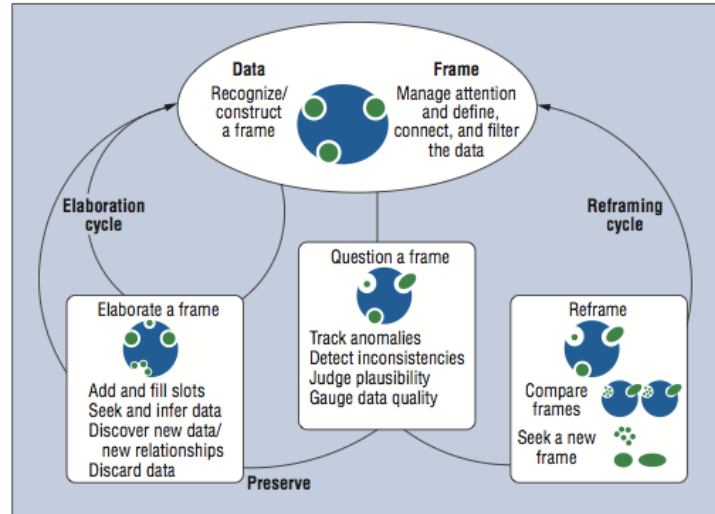


Figure 7. Data/Frame Theory of Sensemaking (From: Klein et al., 2006b)

The data/frame theory of the sensemaking process describes the continuously changing state of situational understanding. In military situations, the constantly changing state of understanding drives a commander’s decision-making process. When applied to the decision-making process within a military TOC, the data/frame theory also describes how a battle captain builds an understanding of battlefield events from abbreviated reports provided by subordinates and adjacent units, as well as information available on the network. The battle captain must assess a constant flow of information, from multiple sources, for relevancy, using his or her current mental model or frame. As digital C2 systems increase the amount of information available to battle captains, it is important to understand the link between sensemaking ability and the number of information sources that an individual can monitor before situational understanding degrades.

4. Applicable Theories and Information Models

Human operators decipher and make sense of a significant amount of information within C2 networks. Of the three factors required for information dominance listed by Alberts et al. (2000), human interaction significantly influences two: information relevance and information accuracy. Information

relevance is a dynamic attribute, which makes it challenging to measure (Alberts et al., 2001). There is no correct or absolute answer as to what constitutes relevant information. Personal experience, education, training, and perspective are tools used to determine information relevance in every battlefield situation (Alberts et al., 2001). Warfighters must also consider the accuracy of information on the network throughout their sensemaking process. Although seemingly straightforward, information accuracy is not always known with certainty. Relevant information is weighed and judged to determine accuracy during the sensemaking process. For example, two individuals observe the same battlefield event, but submit different accounts to the network. Though each report is completely accurate from the individual point of view, a battle captain must make sense of the discrepancy to determine ground truth. As network nodes increase and raw reports conflict, a significant amount of time may be spent determining information accuracy and relevance. Therefore, we require a more thorough understanding of how network factors and design influence an individual's sensemaking process when reasoning about information on the network. There are several theories and concepts that provide insight into how individuals attend to and make sense of information over time.

a. *Workload and Multiple Resource Theory (MRT)*

As networks continue to grow in size and scope, the amount of information available to system operators also increases. Both the amount of information presented to the operator and the manner in which it is presented influences workload. Kramer, Sirevaag, and Braune (1987) define workload as the cost of performing a task in terms of a reduction in the capacity to perform additional tasks that use the same processing resource. Sarno and Wickens (1995) simplify the definition by describing workload as the relationship between resource supply and task demand. When demand for mental resources exceeds the existing supply available for competing tasks, performance will suffer (Dixon

& Wickens, 2003). MRT contributes to understanding mental workload and performance degradation, but only when overload is imposed on the system operator (Wickens, 2008).

MRT was developed, in part, to explain a human operator's performance in high workload, multitask environments (Wickens, 2002), and is not a theory of attention or workload, though workload is closely related. The distinct difference between workload and MRT is that workload relates more to performance potential in high-demand situations, where multiple resources are capacities used that are directly related to actual performance observed (Wickens, 2002). MRT best describes situations where an overloaded individual is required to perform multiple tasks simultaneously across different resources, similar to TOC operators in emergency situations. Wickens (2002) uses the graph in Figure 8 to depict the perceptual modalities (senses), stages (perceptual, cognitive, and response), visual channels (focal and ambient), and processing codes (analogue/spatial and categorical/symbolic) used by an individual when processing information.

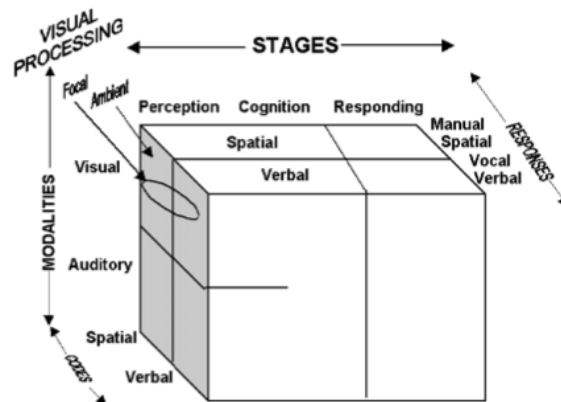


Figure 8. Multiple Resource Model (From: Wickens, 2002)

The model predicts disruption between two or more time-shared tasks. When used as a guide, MRT helps system designers develop controls, input methods, and create displays that reduce or limit resource interference. As

digital networks evolve, leveraging MRT principles can increase productivity and performance for system operators. However, incorrectly designed systems not adhering to MRT principles could overtax modalities, cause conflict, and thus diminish the effectiveness of the overall system due to reduced operator performance.

Wickens' (2002) model and subsequent research (Dixon & Wickens, 2003) suggests that individuals will process multiple information items sequentially if the items use the same resource, or in parallel if they require different resources. Digital C2 systems currently integrated in U.S. Army TOCs rely heavily on the visual and auditory modalities. Reports and information presented on multiple computer screens, UAS feeds displaying real-time battlefield images, wall charts updated by other TOC personnel, and TOC personnel themselves all compete for a warfighter's visual resources. The auditory modality experiences the same competition. Battlefield radio reports, orders or commands issued in the TOC, and auditory cues integrated into digital reporting systems all compete for an individual's auditory modality. MRT supports parallel processing of visual and auditory information; however, information within the same channel or modality is processed in sequence. TOC operators overwhelmed with information may be unable to successfully process everything due to bottlenecks (Broadbent, 1971; Welford, 1967) within individual resources. The prediction of MRT is that operators will miss, disregard, or simply choose not to attend to certain information sources in order to cope with a high volume of information. In this situation, TOC operators are experiencing information overload. Presenting information in a manner that reduces information channel and resource overload increases information processing and reduces information overload.

b. Information Overload

Decision makers tend to seek more information than they require (Driver & Mock, 1975; Schroder, Driver, & Steufert, 1967), leading to information

overload and reduced decision-making accuracy. Information overload can mean several things, such as having more relevant information than one can assimilate (Edmunds & Morris, 2000), or being burdened with a large supply of unsolicited information, some of which may be relevant (Butcher, 1998). Klapp (1986) states that information presented at a rate too high for a receiver to efficiently process without distraction, stress, increasing errors, and other costs acts as noise, making it more difficult to determine relevant from irrelevant information.

As stated previously, military organizations able to achieve information superiority have a significant advantage over their competitors. Lewis (1996) acknowledges this fact when stating that professional and personal survival in modern society clearly depends on our ability to take on board vast amounts of new information. Yet, unless that information can be filtered for relevant information and applied to the COP to achieve a new understanding closer to that of ground truth, the ability to receive vast amounts of information does not improve sensemaking in a military C2 environment. O'Reilly (1980) calls attention to the need to match decision makers' information-processing capacity to the information load encountered. Oskamp (1965) found that with increasing information, a decision maker's performance degrades; yet their decision confidence increases. This finding suggests that as decision makers delay in order to gather more information, their sensemaking may actually degrade. The trade-off here is between making decisions quickly, based on potentially inadequate information, and waiting too long and developing an inaccurate picture of ground truth by mistakenly including information that is irrelevant.

Information overload is akin to workload in that both are related to performance potential in high-demand situations. System operators who self-report low workload indicate they still have information processing capacity in reserve and are not experiencing information overload. The precise amount of information required to induce information overload, thus reducing decision-making performance, changes with each situation and every individual. Of interest to the present research is the impact that the number of information

sources has on an individual's self-reported workload and the impact that those information sources have on information overload.

c. Dynamic Model of Situated Cognition (DMSC)

The DMSC (see Figure 9) (Shattuck & Miller, 2006) illustrates the flow of data from technological systems to an individual decision maker and describes the process by which the decision maker reasons (i.e., perceives, comprehends, and projects) about the battlefield. The DMSC consists of a series of ovals and lenses. The ovals depict information about the environment, with Oval 1 containing all data in the environment, or ground truth. Oval 2 consists of data elements accurately detected by sensors, while Oval 3 depicts the data displayed or presented to an operator or battle captain. There are also three lenses within the DMSC that influence how information is processed or interpreted by an operator. These lenses represent individual operator biases or differences that influence interpretation of the environmental information presented by information sources.

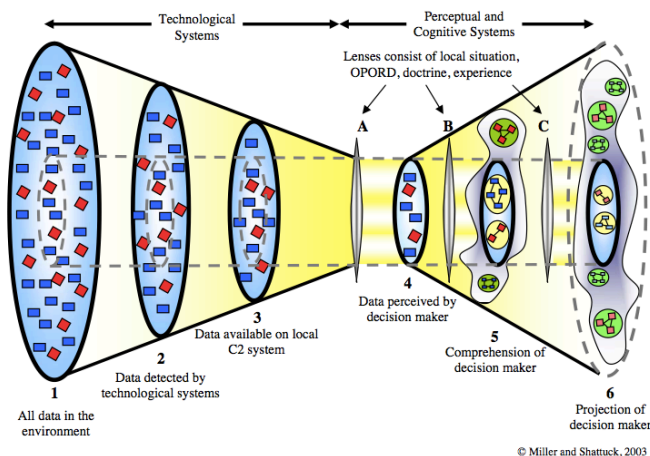


Figure 9. Dynamic Model of Situated Cognition (From: Shattuck & Miller, 2006)

The goals of sensemaking and the DMSC are similar in their attempt to comprehend and make sense of events. The data/frame theory (Klein et al., 2006b) (see Figure 7) explains the cognitive processes within the DMSC

as information propagates through Ovals 4, 5, and 6. Comprehension and sensemaking of battlefield events may stray from ground truth as an individual adjusts his or her mental frame or the data contained within it. In order to ensure decision makers perceive the correct data, comprehend it accurately, and sensemake appropriately, we must improve our understanding of how technological systems influence the sensemaking process.

Shattuck and Miller (2006) explain that distortions in the lens could result in inaccurate perceptions (Oval 4). While the three lenses in the DMSC originally consisted of only the local situation, the military operations order (OPORD), military doctrine, and the experience of the operator (Miller & Shattuck, 2004), they have since been updated. They now include individual traits (e.g., intellect or personality) and temporary states (e.g., fatigue or fear) (Shattuck & Miller, 2006). The model does not specifically account for information presentation methods or information sources as having an impact on the user's perception; the lenses are what direct the decision maker's attention.

Today, networked C2 workstations consist of numerous information sources, all presenting a constant stream of information to the user. Individual factors such as familiarization with individual networked systems, level of training received, or personal preference may also influence perception. Understanding how familiarity with network systems, or digital workspace interaction, influences individual perception in a military C2 environment is critical to ensure that the United States is able to maintain information superiority in the future.

d. Situational Awareness (SA)

The most widely cited definition of SA is Endsley's (1995) human-centric interpretation: "perception of elements in the environment within a volume of time and space (level 1), the comprehension of their meaning (level 2), and the projection of their status in the near future (level-3)" (p. 36) (see Figure 10). Level two of Endsley's model, titled "comprehension of current situation," is equivalent to understanding the current situation. Endsley (1995)

further defines SA “as a state of knowledge, developed from the processes used to achieve that state” (p. 36). The processes Endsley (1995) refers to are those used by individuals to achieve, acquire, or maintain SA.

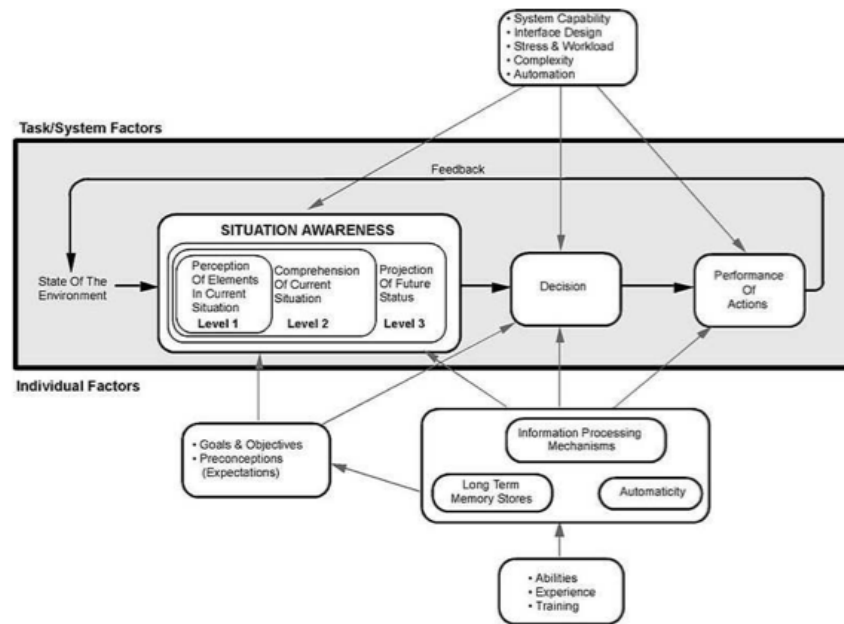


Figure 10. Endsley’s Model of SA (From: Endsley, 1995)

According to the *Mission Command* Field Manual (FM 6-0) (Department of the Army, 2003), by applying judgment to the COP, commanders achieve situational understanding and make decisions (this relationship is presented in Figure 11). The U.S. Army officially defines SA as “the immediate knowledge of the conditions of the operation, constrained geographically and in time” (Department of the Army, 2008, p. 7-11). The *Operations* Field Manual (FM 3-0) defines situational understanding as the “product of applying analysis and judgment to relevant information to determine the relationships among the mission variables to facilitate decision-making” (Department of the Army, 2008, p. 7-11).

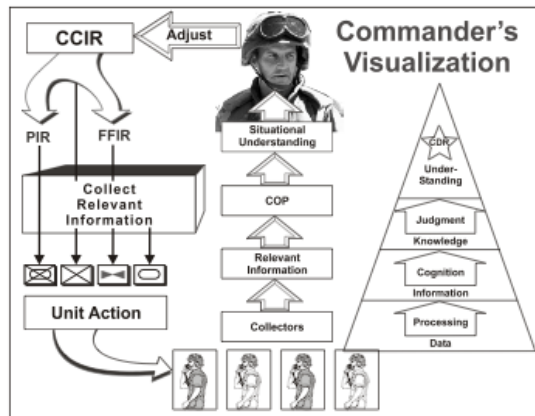


Figure 11. Developing Situational Understanding
(From: Department of the Army, 2003)

Therefore, situational understanding can be thought of as the process used for decision making, by using relevant information to determine the implications of what is happening and what may happen with respect to ground truth, while SA is the product or current state of understanding battlefield relationships. The sensemaking process, using mental models and mental simulation, continually adjusts an individual's frame for determining information relevancy that plausibly links events over time, creating an understanding of the situation that ultimately enables rational decisions, based on an understanding of ground truth.

e. Sensemaking and Situational Awareness (SA)

The objective of the present research effort is to determine how information sources influence an individual's sensemaking (i.e., the knowledge and understanding of the current situation). By applying relevant information to the COP using a sensemaking process, a battle captain improves situational understanding with respect to ground truth. This review of the relevant literature suggests that decisions are made and weighed against the current understanding of the situation arrived at through a continuous sensemaking process. Every battle captain begins the process with an initial frame or perspective of what ground truth is, creating an initial situational understanding

from which decisions are based. Ground truth, however, is a moving target that continuously changes as friendly and enemy units maneuver and engage each other on the battlefield. The manner in which the battle captain is presented, attends to, and processes information from workstation interfaces during sensemaking influences the process itself. The battle captain determines information relevancy based on his or her current frame, which continually updates and changes as information is added to the frame, or the frame changes based on new information. Including relevant information to the battle captain's frame during the sensemaking process should reduce the gap between situational understanding and ground truth. Battlefield decisions are not made with a complete understanding of ground truth; they are made with an imperfect understanding of the situation created by the sensemaking process. This continuous individual sensemaking process is the focus of this thesis; however, the influence of the TOC staff on battle captain sensemaking has not yet been discussed.

Jensen and Brehmer (2005) developed a sensemaking process model representing the process of how battle captains and staffs interact with the real world and new information. Much of their effort focused on shared awareness and the group sensemaking process, seen in their model of sensemaking in military decision making (see Figure 12). Though they recognize that every staff member develops an individual view of the situation, it is the interaction and exchange of these views that creates a shared sense among a military staff. Jensen and Brehmer (2005) state that situational assessment and SA are not components in the sensemaking process, claiming that sensemaking has different roots and represents a different view of human cognitive processes than SA. This view is not fully consistent with the relationship previously stated in this paper that the sensemaking process supports, and is a subcomponent of, situational understanding.

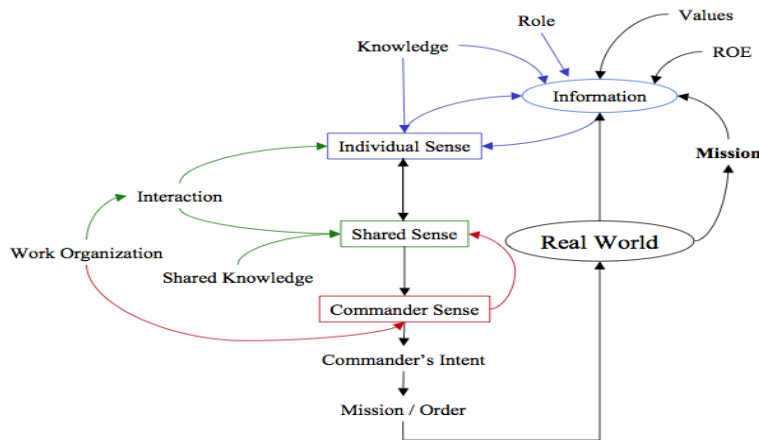


Figure 12. The Model of Sensemaking in Military Decision Making
(From: Jensen & Brehmer, 2005)

The author believes that sensemaking is the most important component of situational understanding, characterized by the continuous synthesis of disjointed information; battle captains make a “motivated effort to understand connections in order to anticipate their trajectories and act effectively” (Klein et al., 2006b, p. 88). The goal of sensemaking is not to achieve a state or level as SA does, but strives to continuously improve individual or group situational understanding, given past events and current future projections with respect to ground truth. A battle captain or collective staff cannot perceive all battlefield information characterizing ground truth during an ongoing operation. Only through detailed retrospective analysis of the situation can a battle captain’s or staff’s complete understanding of the situation be determined; this “state” of knowledge is SA at that particular point in time. Wickens, Gordon, and Liu’s (1998) information-processing model describes the method in which individuals receive information from the environment and act on it to improve situational understanding.

Elements from the models of information processing, SA, and sensemaking can be combined into a holistic, conceptual model that may describe the sensemaking process more accurately and completely. Endsley’s mechanisms of SA diagram (Endsley, 1995), attempts to combine Wickens’

information-processing model with her model of SA. It is this author's belief that SA should not be applied to the information-processing model related to decision making because it is characterized as a state of knowledge captured through retrospective analysis and not an active, forward-projecting process. Building on Wickens' information-processing model and the decision-making and action guidance elements from Endsley's mechanisms of SA model, this thesis proposes a new model (see Figure 13), which depicts Klein et al.'s data/frame sensemaking process as the main component that improves situational understanding, linked to decision making and action guidance.

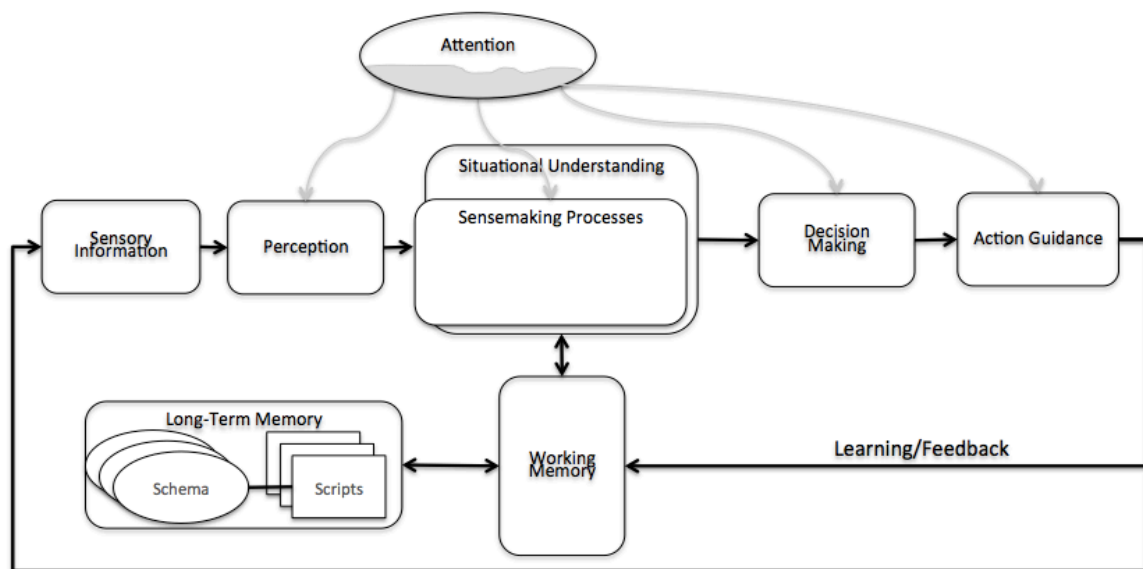


Figure 13. Information Process Model with Sensemaking

Starting at the left side of Figure 13, the information-processing model shows how sensory information is received from the environment by individual senses, perceived by an individual, and given meaning through interaction with long-term and working memory. Individuals (e.g., battle captains) decide to act or not act on the information, by selecting an appropriate response. The author replaces Wickens' "thought decision making" (Wickens et al., 1998, p. 147) block in his original information-processing diagram with the data/frame sensemaking process from Klein et al. (2006b) supporting situational

understanding. The attention provided to each of the main processes is one of the four forms of attention (selective, directed, distraction, or divided) discussed by Wickens et al. (1998). This proposed model informs Wickens' information-processing model by providing further insight into the manner in which perceived information is understood and influences decision making.

In the context of the TOC, a battle captain perceives sensory information and includes it in his or her sensemaking process. The battle captain determines information relevance during the sensemaking process, while information accuracy is also judged, and decisions are made about whether to include this information as data in the current frame or adjust the frames as required, thus improving the battle captain's situational understanding with respect to battlefield ground truth. Situational understanding influences the battle captain's decision making, whether it is a decision requiring action or a decision to not act or present recommendations to the commander. The sensemaking process generates mental models of the current and future situation based on information from the past and his or her current understanding.

B. BATTLE CAPTAIN WORKSTATION

1. Battle Captain Workstation Versus Entire Tactical Operations Center (TOC)

A recent study by Rhodes and Minami (2007) found that since the beginning of the digital C2 shift in the late 1990s, the size of the TOC, the amount of communications and computer equipment, as well as the number of personnel needed to operate this equipment has increased. They also observed that greater amounts and increased types of information are transferred between TOCs, placing greater requirements on the flow of accurate information (Rhodes & Minami, 2007).

Adding information systems or network nodes to a TOC increases the number of personnel required to operate them, creating additional levels to which information must be transferred. This not only adds manpower, but also levels of

bureaucracy or command, thereby slowing information flow as it gets to staff members tasked with determining the relevance of the information to the current situation. This is counter to the goal of flattening the process and eliminating information stovepipes.

System designers and programmers add information systems to warfighters' workstations, thus increasing the number of information sources available to a single operator. Operators should benefit from access to additional sources of information; however, every system added to an individual's workstation becomes another information source that requires monitoring, assessing, and incorporating into the sensemaking cycle.

Currently, there is no doctrinally approved technique for establishing a TOC configuration (Battle Command Training Center, 2006). Thus, there is no doctrinally approved technique for determining what information systems or network nodes must be located at particular workstations. TOC architectures vary depending on each unit commander's preference, the type of organization and mission, and equipment available (Rhodes & Minami, 2007). No matter what configuration is implemented, the following common factors influence the effectiveness of the TOC (Battle Command Training Center, 2006):

- a high degree of organization;
- configured in a manner that facilitates functionality and precludes segregated staff sections; and
- planning areas segregated from briefing and operational areas.

A dedicated and deliberate process for managing information and information flow within a TOC must be developed to ensure that individuals who require the information actually obtain it. A sample message flow diagram highlights the importance of the battle captain in the flow of TOC information (see Figure 14). The battle captain is the primary link to other TOCs and ground forces, while also facilitating the TOC internal information flow. The battle captain position is also critical in influencing staff-level sensemaking.

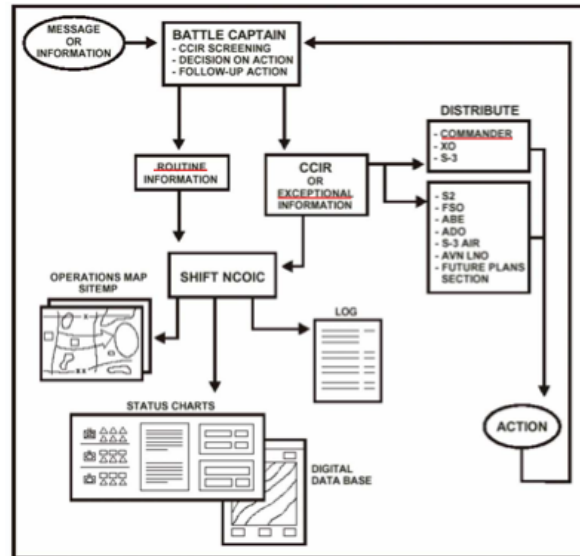


Figure 14. Sample TOC Message Flow
 (From: Battle Command Training Center, 2006)

Each position in the TOC has specific tasks assigned to them in order to facilitate battle tracking and information flow, and assist the commander in the decision-making process. General tasks assigned to the battle captain are (Battle Command Training Center, 2006):

- Keep the Command Group informed
- Supervise TOC information flow
- Ensure that battle staff collects, processes, and disseminates information
- Shield Commander from noncritical information
- Get decisions from the Commander
- Line supervision of battle staff shift
- Quality control of battle tracking
- Battle staff coordination
- Information link to subordinate, higher, supporting, and adjacent units
- Integration of MDMP activities

- Battle staff synchronization during mission execution
- Ensure the TOC can operate continuously while static or mobile

2. Current Battle Captain Workstation

The configuration of the battle captain's workstation and inclusion of information systems must enable the individual to complete the general tasks in the most efficient manner possible. Because the battle captain is a central hub in the determination of relevant battlefield information used for decision making, every aspect of the workstation's design, layout, and available information sources must focus on facilitating that effort.

In 1991, a state-of-the-art battle captain workstation in the 18th Airborne Corps Operations Section consisted of radios, telephones, and analog wall charts to track battlefield information (see Figure 15). Over time, as combat systems integrated networked information, the battle captain's workstation also became more sophisticated in order to harness available information used in the sensemaking and decision-making processes.



Figure 15. XVII Airborne Corps G-3 Workstation (From: Freund, 1991)

Recent pictures (see Figure 16) from a Brigade TOC in Afghanistan (2011) highlights the changes that have occurred over the years. Each workstation includes a computer linked to the secure network, which streams real-time battlefield information across multiple screens. Television screens at the front of the TOC provide real-time video feeds from manned and UASs. Radio, telephone, and even video teleconference communications take place at each individual workstation throughout the network. Though wall charts are still used, they serve as a backup against power or system failure.



Figure 16. Afghanistan TOC 2011

The Brigade Assistant Operations Officer (AS3) from the pictured unit (see Figure 16) reported that the typical information sources that a battle captain is required to monitor at their workstation include (C. Green, personal communication, March 5, 2011):

- CPOF
- Blue Force Tracker (BFT) or FBCB2
- Mirc Chat
- E-mail
- Radio
- Secure Voice Over Internet Protocol (SVOIP) phones
- Analog information kept on wall charts
- Between two and eight video feeds on the wall (depending on the size of the TOC).

According to the AS3, the number of digital systems that a battle captain must monitor may increase when serving with multinational organizations. Due to information and operational security reasons, North Atlantic Treaty Organization (NATO) forces are not granted the same access privileges to U.S. networks. The Brigade AS3 interviewed stated that each TOC maintained both a U.S. Secret Internet Protocol Router (SIPR) and a secure NATO system in order to maintain network connectivity with all NATO forces in their Area of Operations (AO). Each network operates through similar C2 information systems with different levels of security clearance to access particular data. This requires the battle captain to monitor two separate systems providing different versions of the same battlefield. This presents issues not only with increasing workload, but also with conflicting representations of battlefield ground truth.

At baseline (U.S. information systems only), battle captains in modern TOCs currently monitor six or more information sources for relevant information. This information is then included in an individual sensemaking process that facilitates group sensemaking discussions within the TOC. In emergencies, the amount of information streaming over the network may become immense, possibly overwhelming an individual's mental resources. When demand for mental resources exceeds the supply available for competing tasks, performance will suffer (Dixon & Wickens, 2003). Reduced sensemaking performance leads to degraded situational understanding.

As NCW continues to increase both the information systems linked to the network and the amount of information flowing through them, we must consider how the number of information sources may impact a battle captain's sensemaking ability. In order to develop information systems that aid both individual and staff-level situational understanding and decision making, this research investigates the impact on sensemaking by manipulating the number of information sources, while controlling the amount of information presented.

C. HYPOTHESES

The literature review has presented many important issues relating to the advancement of NCW and sensemaking performance of battle captains. As many of the concepts and theories described present many interesting topics relating to sensemaking, decision making, information presentation, and the workload of battle captains in combat battle-tracking situations, the issues have been narrowed to focus on the most relevant pertaining to this study's specific research objectives. The alternative hypotheses generated from the research questions are:

- Ha₁: The modern (six-source) battle captain workstation degrades sensemaking ability and reduces situational understanding when compared to the legacy (two-source) workstation.
- Ha₂: The modern (six-source) battle captain workstation requires more cognitive workload than the legacy (two-source) workstation.

III. METHOD

A. OVERVIEW

A controlled laboratory experiment was used to assess battle captain sense-making ability while monitoring a simulated battlefield scenario. This study was a 2 x 2 crossover design, comparing the number of sources (two-source and six-source) in two similar tactical scenarios (11th Armored Cavalry Regiment [ACR] and 3rd Brigade [BDE]). Participants were randomly assigned to one of four groups. Each group was exposed once to each source condition and tactical scenario. Table 1 illustrates the design for this study.

		NUMBER OF SOURCES	
		TWO SOURCES	SIX SOURCES
SCENARIO	11th ACR	O	X
	3rd BDE	X	O

Table 1. Research Design Example

Table 2 demonstrates how each group corresponds to the source/scenario pairing, and the order in which each pairing was presented to the participants (1st condition, 2nd condition). The source and condition combinations are counterbalanced with this approach to control for any order effect.

PARTICIPANT	11th ACR (TWO SOURCES)	11th ACR (SIX SOURCES)	3rd BDE (TWO SOURCES)	3rd BDE (SIX SOURCES)
A	1st CONDITION			2nd CONDITION
B	2nd CONDITION			1st CONDITION
C		1st CONDITION	2nd CONDITION	
D		2nd CONDITION	1st CONDITION	

Table 2. Groups A-D Source/Pairing and Order

The experiment consisted of a battery of pretests followed by two separate simulated battlefield scenarios, with each scenario lasting approximately 40 minutes. During each scenario, participants monitored simulated battlefield reports presented through various sources. They were tasked with receiving and processing information (both relevant and irrelevant), linking the relevant information together, and reporting their understanding of battlefield ground truth using Situation Reports (SITREPs) and a paper map.

B. PARTICIPANTS

1. Selection

The Naval Postgraduate School Institutional Review Board reviewed and approved the design of this study, in accordance with Department of the Navy and American Psychological Association (APA) standards. All participants were informed of their rights as subjects in the experiment and signed a consent form. They also signed consent forms for video and audio recording during the experimental trials. Participants were solicited through personal contact, e-mail, and flyers. The study used a convenience sample taken from the Naval Postgraduate School.

2. Demographic Makeup

Thirteen participants started the study, with 12 completing both trials (average age = 34.3, standard deviation [SD] = 3.67). One participant withdrew from the research and did not complete the second trial. All participants were male U.S. Army officers from combat arms branches with previous battle captain or battle-tracking experience within a TOC. The ranks of the participants completing the research included 2 Captains, 9 Majors, and 1 Lieutenant Colonel. Participants' time in service (TIS) ranged from 9 to 17 years (average TIS = 11.8, SD = 2.87). Each participant has spent an average of 23.8 months deployed to either Iraq or Afghanistan during their career (average months deployed = 23.8, SD = 7.69), and participated in an average of 2.7 mission

readiness exercises (MREs) at combat training centers (CTCs), where each MRE lasts approximately two to three weeks.

Participant battle captain experiences include both Battalion- and Brigade-level TOC organizations during combat deployments, as well as CTC rotations. Table 3 provides a detailed picture of each participant’s battle captain experience with respect to organization level and time on deployment. Six of the 12 participants reported serving as a battle captain during at least one CTC rotation.

Level of TOC Experience	Months as Battle Captain (Average, SD)	Months as Battle Captain on Deployment (Average, SD)
Battalion	8.25, 4.7	7.67, 5.1
Brigade	4.3, 0.2	5.67, 5.8

Table 3. Participant Battle Captain Experience

Each of the 12 participants in this study had experience with networked TOC workstation equipment (see Table 4).

TOC System	CPOF	FBCB2	Mirc Chat	Tactical E-Mail	Radio
# Participants with Experience	11	12	10	12	12

Table 4. Participant Experience with TOC Systems

C. MATERIALS

1. Equipment

The experiment used four Dell computers; one Apple computer; three flat-panel monitors; computer speakers; a Fort Irwin, California, 1/50,000 terrain map; and a digital, high-definition (HD), video camera to present simulated battlefield transmissions to the participants and capture a video of each trial. One laptop computer ran each of the three main digital TOC workstation components, simulated through Microsoft PowerPoint while the fourth played simulated radio

calls. Each of the three laptop computers were connected to secondary monitors and placed on the TOC workstation desk. An additional computer was connected to the speakers to simulate radio traffic. The equipment list used for this experiment provides detailed specifications:

- 2 x Dell Precision laptops, running Windows XP, Microsoft Office 2003, with Intel Core 2 Duo, 2.49 GHz, 3.5 GB RAM (simulated e-mail and Mirc Chat)
- 1 x Dell Latitude E6500 laptop, running Windows XP, Microsoft Office 2003, with Intel Core 2 Duo, 2.79 Ghz, 1.98 GB RAM (simulated CPOF and tactical message traffic)
- 1 x Dell Latitude D630, running Windows XP, Microsoft Office 2003, with Intel Core 2 Duo, 2.39 GHz, 1 GB RAM (ANAM data collection)
- 1 x Apple Macbook, running Lion OSX, iTunes 10, Garageband audio editing program (recorded and edited radio traffic, radio traffic playback)
- 2 x Dell Ultrasharp 17" LCD flat panel displays (displayed e-mail and Mirc Chat)
- 1 x Dell 20" LCD flat panel display (displayed CPOF and tactical message traffic)
- 1 x Sony Hybrid Plus HD video camera, 4 megapixel (session recording)
- 1 x Fort Irwin Training Facilities map, 1/50,000 relief
- 1 x Polycom sound station speaker phone (collecting SITREPs)
- 1 x Sony a350 DSLR camera, 12 megapixel (capturing participant map rendering)
- *Automated Neuropsychological Assessment Metrics* (ANAM4) computer program for capturing working memory ability
- Reading test
- Stopwatch

2. Simulation

Creating a TOC workstation with actual CPOF, Mirc Chat, and e-mail capability, properly coordinated with radio traffic, would have been a difficult and challenging task, requiring significant financial and technical resources to

execute properly. The use of actual tactical workstations would also require participants to be proficient in specific TOC systems and would introduce the possibility of performance differences based not on their understanding of the battlespace, but on their proficiency with the digital systems. Therefore, a decision was made to use a lower fidelity simulation designed to assess the relevant constructs without requiring expertise on any specific TOC hardware.

Presenting the scenarios in a controlled environment required creating each digital TOC simulation in PowerPoint, using slide transitions to control for timing and information flow rate. Radio calls were coordinated with the PowerPoint slide presentations to ensure that no overlap of information source medium occurred. This approach also eliminated user error from improper screen navigation, or possible free play in the scenario from live simulation. See Appendix E for screenshots of each PowerPoint simulation.

D. VARIABLES

1. Independent Variables

a. *Number of Sources*

The number of sources used to present information to participants varied between two and six source methods. The two-source condition presented information using only radio messages and paper copy TOC notes (see Appendix D). The six-source condition presented information using, radio, e-mail, Mirc Chat (with four chat windows), CPOF-type map, and unit message traffic (with three unit message windows).

b. *Scenario*

Different scenarios were used for each trial in order to minimize any learning effect. Once a participant was exposed to a particular scenario, he would naturally have an understanding of the battlefield events, providing him with an unfair advantage with respect to sensemaking.

The simulated battlefield scenarios were designed to be similar in terms of friendly and enemy unit battle-tracking requirements, level of difficulty, number of storylines to follow, task organization simplification, and duration. The battlefield scenarios and the method in which each message was relayed to the participant are described in Appendix A (Scenario 1) and Appendix B (Scenario 2).

The friendly units in both scenarios are mechanized, brigade-sized forces conducting a search and attack mission against prepared enemy defenses within the Fort Irwin maneuver AO. To limit complexity, the task organization for each scenario utilized only two battalions with four companies each, with one attached scout platoon per battalion. Enemy forces to be tracked in each scenario ranged from 10–16 units of platoon-size or larger. Each scenario contained story lines involving friendly unit battle damage assessment (BDA), enemy unit BDA, enemy indirect fire asset locations, friendly units becoming combat ineffective, friendly units losing radio contact, and the status for three town populations within the AO. Each story line contained a minimum of 3 and a maximum of 10 pieces of information relayed through the various information sources during each trial.

2. Dependent Variables

a. *Situation Report (SITREP) Accuracy*

During each 40-minute scenario, participants provided the commander with four detailed SITREPs using the modified SLANT report format. A percentage score of the participants' understanding of ground truth was calculated by comparing each SITREP with ground truth at each stage of the battle.

b. *Battlefield Ground Truth Map Accuracy*

Participants used the Fort Irwin training area 1/50,000 map at the end of the 40-minute scenario to place friendly and enemy unit symbols where they believed them to be located on the battlefield. The location of each unit

symbol was graded with respect to distance from the actual location, based on battlefield ground truth at the end of the scenario. Unit symbols located between 0 and 1,000 meters received three points; between 1,000 and 3,000 meters received two points; between 3,000 and 5,000 meters received one point; and any unit over 5,000 meters received a score of zero.

c. *Participant Perceived Workload*

Participants provided the researcher with a subjective workload assessment every five minutes during the 40-minute scenario. Participants were asked to estimate their perceived workload as a percentage of their capacity. A participant who believed he was working at half capacity would report his workload was 50%. This method is minimally intrusive and does not require participants to conduct retrospective assessments of their workload such as National Aeronautics and Space Administration-Task Load Index (NASA-TLX).

3. *Covariate Variables*

a. *Working Memory*

Due to the fast-paced nature of military operations, battle captains must attend to, retain, and rapidly recall pertinent information when engaged in sensemaking activities. A test of each participant's working memory was conducted to determine if this factor influenced their sensemaking ability during the trials. Each participant's working memory was assessed using ANAM4 (ANAM4, 2007), a computer program run on a laptop. A customized, three-test battery (including code substitution [learning], memory search [6], and code substitution [delayed]) established a baseline of working memory ability for each participant.

b. *Reading Rate and Effective Reading Rate (ERR)*

Due to the high volume of written material, a determination of each participant's reading rate and ERR was required to determine if this factor influenced their sensemaking ability during the trials. Each participant read

President John F. Kennedy's 1,447-word inaugural address for time. Participants completed five multiple-choice questions to test their comprehension, which was scored as a percentage (Sutz & Weverka, 2011). Each participant's reading rate was determined by dividing the number of words in the passage (1,447) by their time, providing a score in words per minute (WPM). The "effective reading rate" was calculated using the following equation: reading speed (WPM) x comprehension (%) = ERR (Sutz & Weverka, 2011).

E. PROCEDURE

Participants signed up for two 1.5-hour sessions as their schedules allowed. Participants were allowed at least 24 hours between sessions. The researcher randomly assigned participants to one of the four conditions (A-D) within each group.

Participants met the researcher in the Human Systems Integration Laboratory. After completing the informed consent and consent to video and audio recording forms, participants answered a demographic questionnaire (see Appendix F). Participants then completed the covariate tests. The specific covariate test administered depended on the condition assigned to the participant that day. If assigned the two-source condition, he completed the reading test; however, if assigned the six-source condition, he completed the working memory test battery.

Participants then received an orientation and initial training session with the simulated TOC workstation (see Figure 17). Four laptop computers on the other side of the temporary dividers powered the simulation (see Figure 18). The initial training session consisted of a prerecorded audio and PowerPoint demonstration that familiarized participants with the digital simulations used in the TOC workstation (see Appendix E), and SLANT report format (see Appendix C). They also received an abbreviated OPORD (see Appendix G) and shift changeover brief (see Appendix H), which oriented the participants to the current battlefield situation.



Figure 17. Simulated TOC Workstation



Figure 18. Computers Powering the Simulation

A short question-and-answer period followed the orientation to ensure that the participants understood the current battlefield situation and the use of the simulated TOC equipment. Following any questions, all participants viewed a 90-second scenario introduction to orient them to the rate of information

presented during the trial. Participants were not permitted to take notes during this initial familiarization period; however, they were encouraged to consider note-taking or battle-tracking methods that could be used during the actual scenarios. Following the scenario introduction, the researcher answered all remaining questions. Finally, the researcher started the video and audio recordings and the 40-minute experimental trial began.

During the trial, the researcher observed the participant through mirrored glass from a separate room. Every 5 minutes, the researcher called the participant on the telephone and asked for his current perceived mental workload; every 10 minutes, the researcher would call and ask for an updated SITREP. The researcher placed the calls when the participant was not actively conducting a physical task such as moving unit symbols on the map, writing notes, reading messages, or listening to radio calls. After the participants received the final piece of information, the researcher entered the room and the participants had approximately two minutes to complete their final SITREP. Participants were given time to adjust unit symbols to locations they felt accurately represented battlefield ground truth. Once finished, the researcher asked them to brief the current situation. The video recording was stopped following the brief.

After the trial, the researcher discussed the battlefield situation with the participant. General conversation focused on what information may have been missed, or deemed irrelevant, throughout the scenario. The researcher also answered any questions the participant had about the situation. Following the question-and-answer period, participants were released from the study.

IV. RESULTS

The present study collected SITREP report data, map accuracy data, and self-reported workload scores from participants during an observation and information-processing task. Analysis was performed to determine the effect of the number of information sources (two versus six) on SITREP accuracy and map accuracy (situational understanding) to address Hypothesis One. Analysis was also performed to determine the effect of the number of information sources (two versus six) on participants' self-reported cognitive workload to address Hypothesis Two. Data for reading rate, effective reading rate, and working memory ability were also collected on each battle captain. The scoring process for SITREP and map accuracy data for use in the data analysis was provided in Chapter III. An alpha level of 0.05 was used for all statistical tests.

A. SCENARIO SIMILARITY

The two simulated battlefield scenarios were designed to be similar in terms of friendly and enemy unit battle-tracking requirements, level of difficulty, number of storylines to follow, task organization simplification, and duration. Due to the crossover design, scenario similarity had to be established in order for data to be collapsed across the scenarios. If the scenarios are determined to be equivalent, a within-subjects analysis is justified and performance differences could then be attributed to the number of information sources. To confirm scenario similarity, paired t-tests were conducted with the battle captains' average SITREP scores (see Figure 19), map accuracy scores (see Figure 20), and the average self-reported mental workload scores (see Figure 21).

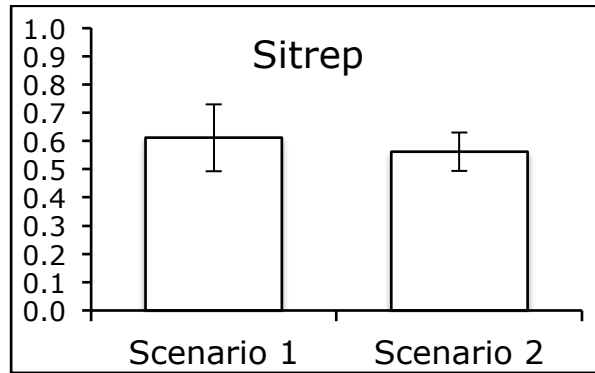


Figure 19. Average SITREP Scores by Scenario

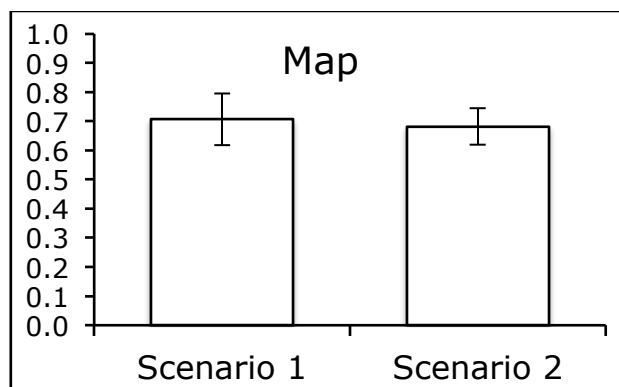


Figure 20. Map Scores by Scenario

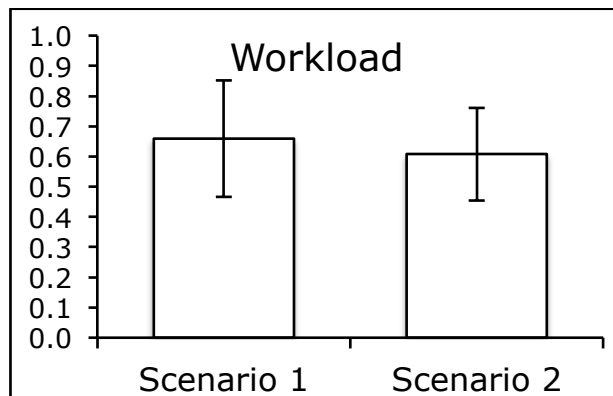


Figure 21. Average Workload Scores by Scenario

A significant difference was not detected between the two scenarios in any of the three dependent variables: average SITREP scores, $t(11) = -1.20$, $p = 0.26$, map scores, $t(11) = -0.866$, $p = 0.41$, and average workload scores,

$t(11) = -0.854$, $p = 0.41$. Therefore, the assumption is made that the scenarios are similar enough to discard the notion that a scenario is a confounding variable in subsequent analysis.

B. SITUATION REPORT (SITREP) ACCURACY

Each participant provided four SITREPs, representing current situational understanding, during each of the two 40-minute scenarios. A percentage score of a battle captain's situational understanding was calculated by comparing each SITREP with ground truth at each stage of the battle. Figure 22 presents the mean scores of all participants for each of the four SITREPs by source. Each source's SITREP scores progress similarly over time, indicating a loss of situational understanding between the 10- (SITREP 1) to 20- (SITREP 2) minute situation reports, then leveling out from SITREPs 2 through 4.

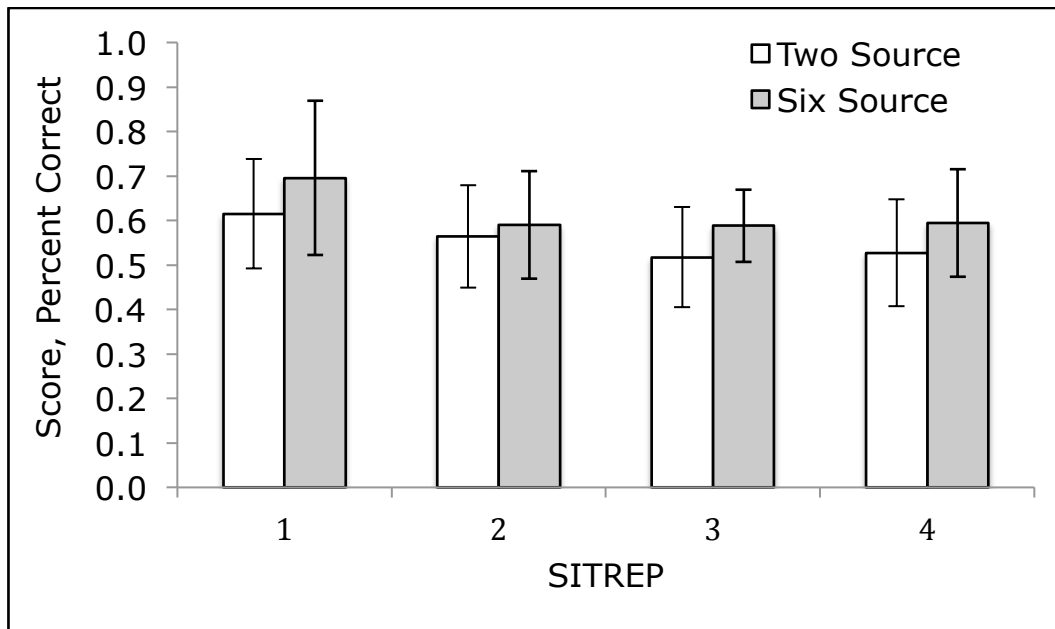


Figure 22. Participants Mean SITREP Scores by Source

To determine the effect of *source* on SITREP accuracy, a paired t-test was conducted using the battle captains' average SITREP scores from each source condition (see Figure 23). A significant difference was not found.

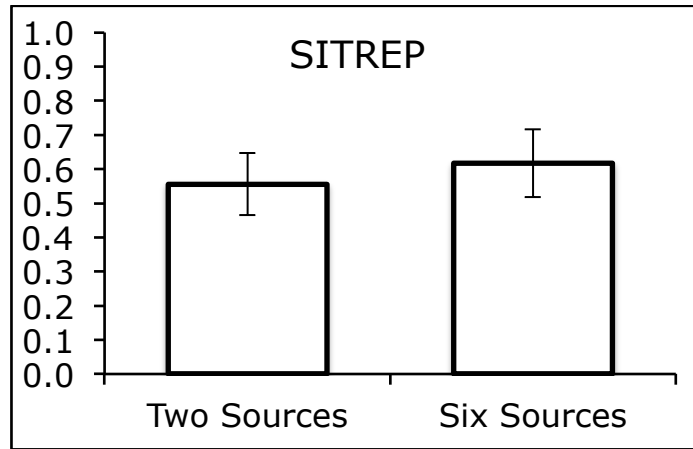


Figure 23. Average SITREP Scores by Source

Acknowledging that each battle captain is different with respect to experience, training, and battle-tracking ability, a 2(source) x 4(SITREP) within subject Analysis of Variance (ANOVA) was also conducted to determine the impact of source on SITREP accuracy over time. The *source* independent variable did not have a significant effect on SITREP reporting accuracy ($F(3,33)= 2.48, p= 0.15$), thus supporting the paired t-test results. There was also not a significant interaction between *source* and *SITREP* ($F(3,33)= 0.31, p= 0.82$). However, results do indicate a significant main effect of SITREP accuracy with respect to ground truth ($F(3, 33)= 10.07, p< 0.001$). Posthoc comparison of the SITREP scores show that SITREP 1 was significantly different than SITREP 3 ($t(46)= 2.73, p= 0.009$) and SITREP 4 ($t(46)= 2.37, p= 0.022$). A complete comparison of p-values is provided in Table 5.

SITREP	1	2	3	4
1		T(46)= 1.998, p= 0.052	T(46)= 2.730, p= 0.009	T(46)= 2.366, p= 0.022
2			T(46)= 0.763, p= 0.449	T(46)= 0.471, p= 0.640
3				T(46)=-0.243, p= 0.809
4				

Table 5. SITREP Score Pairwise Comparisons

C. MAP ACCURACY

The location of each unit symbol was graded with respect to distance from the actual location, based on battlefield ground truth at the end of the scenario.

Figure 24 shows the participants' mean map scores for two sources (M= 0.693, SD= 0.08) and six sources (M= 0.696, SD= 0.08).

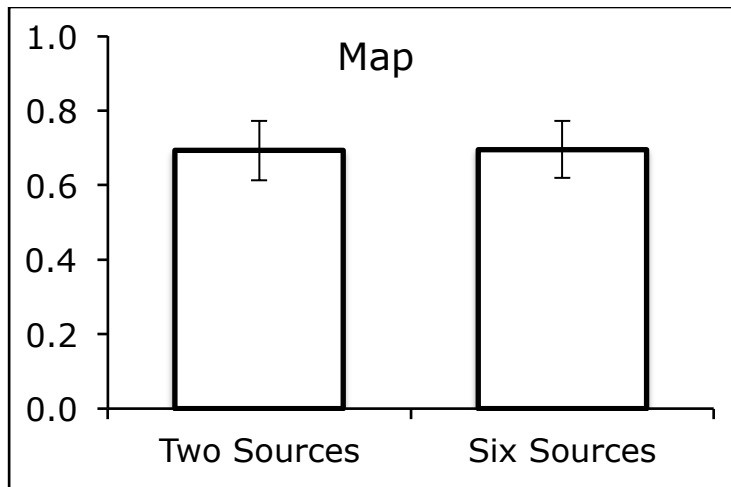


Figure 24. Average Map Scores by Source

A paired t-test was conducted with the battle captains' map scores, indicating that there is not a significant difference between the two- and six-source condition, $t(11)= 0.09$, $p= 0.92$.

D. SELF-REPORTED WORKLOAD

Participants were asked to estimate their perceived workload as a percentage of their capacity. This estimate was recorded every 5 minutes during the 40-minute trial and then averaged to determine each participant's mean perceived workload estimate. Figure 25 shows the participants' mean perceived workload according to source: two sources (M= 0.713, SD= 0.15) and six sources (M= 0.554, SD= 0.16).

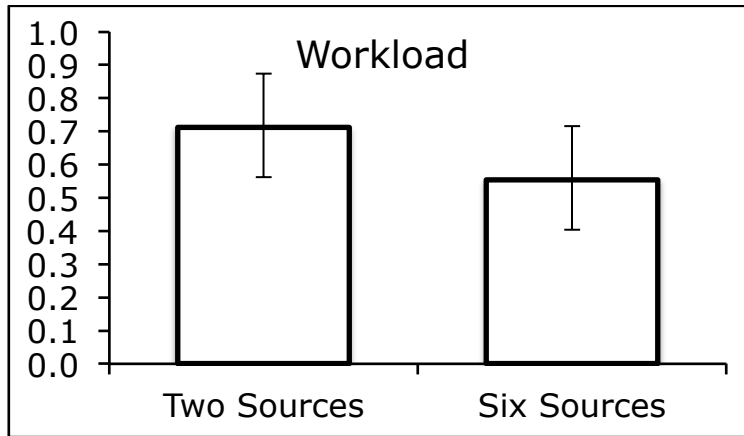


Figure 25. Average Workload by Source

A paired t-test was conducted with the battle captains' average perceived workload scores, indicating that the two-source condition led to a significantly higher perceived workload than the six-source condition ($t(11) = -4.13, p = 0.002$).

E. COVARIANCE

Twelve separate regression analyses for every combination of y and covariates were tested to determine if there was an effect on the dependent variable. We are interested in the p-value of β_1 , the coefficient for source (see equation in Figure 26).

$$\hat{y} = \beta_0 + \beta_1 source + \beta_2 covariate + \beta_3 (source * covariate) + \varepsilon$$

Figure 26. Covariance Equation

The dependent variable \hat{y} is equal to either the average SITREP accuracy, map scores, or average perceived workload scores.

The covariates are equal to either the memory search, delayed memory, reading rate, or effective reading rate.

1. Working Memory

Scores from ANAM4's (ANAM4, 2007) memory search (6), and code substitution (delayed) established a baseline working memory ability for each participant. ANAM4 produced a normalized percentile rank according to the participant's reaction time, correct responses, and throughput for each test. A composite score, found by averaging the three normalized percentiles, was used as a covariate during data analysis to account for participants working memory ability. Table 6 shows the results of the memory search covariate test for each of the three dependent variables. Complete covariance tables are found in Appendix I.

\hat{y}	β_1 Value	SD (β)	t-Score	p-Value
SITREP Accuracy	-0.115	0.104	-0.40	0.714
Map Score	-0.005	0.077	-0.06	0.954
Perceived Workload	-0.067	0.156	-0.43	0.673

Table 6. Covariate Results for Memory Search

The results indicate that the β_1 coefficient for source is not significant for any of the three dependent variables when controlling for the battle captain's memory search ability.

Table 7 shows the results of the delayed memory covariate test for each of the three dependent variables.

\hat{y}	β_1 Value	SD (β)	t-Score	p-Value
SITREP Accuracy	0.026	0.114	0.23	0.824
Map Score	0.065	0.073	0.89	0.386
Perceived Workload	-0.017	0.167	-0.10	0.922

Table 7. Covariate Results for Delayed Memory

The results indicate that the β_1 coefficient for source is not significant for any of the three dependent variables when controlling for the battle captain's delayed memory recall ability.

2. Effective Reading Rate (ERR)

Due to the amount of information participants were required to read during each trial, it was necessary to capture their ability to read and process information. Each participant's reading rate and ERR was determined in order to examine any possible influence on each of the three dependent variables. Table 8 shows the results of the delayed memory covariate test for each of the three dependent variables.

\hat{y}	β_1 Value	SD (β)	t- Score	p- Value
SITREP Accuracy	0.210	0.127	1.65	0.115
Map Score	0.114	0.093	1.22	0.235
Perceived Workload	-0.225	0.210	-1.07	0.298

Table 8. Covariate Results for Reading Rate

The results indicate that the β_1 coefficient for source is not significant for any of the three dependent variables when controlling for the battle captain's reading rate.

Table 9 shows the results of the delayed memory covariate test for each of the three dependent variables.

\hat{y}	β_1 Value	SD (β)	t- Score	p- Value
SITREP Accuracy	0.135	0.097	1.40	0.177
Map Score	0.012	0.071	0.18	0.863
Perceived Workload	-0.331	0.158	-2.09	0.049

Table 9. Covariate Results for Effective Reading Rate

The results indicate that the β_1 coefficient for source is not significant for SITREP accuracy or map score-dependent variables when controlling for the battle captain's reading rate. However, the source β_1 coefficient is significant for perceived workload ($t(11) = -2.09, p = 0.049$). This indicates that even when accounting for the battle captain's ERR, the source independent variable remains significant.

F. DIGITAL C2 EXPERIENCE (NATIVE VERSUS IMMIGRANT)

Discussions with participants after each trial revealed an interesting characteristic—whether the participant was a C2 digital native or C2 digital immigrant. A C2 digital native is an individual whose initial training in C2, or TOC experience in the military, was with the digitally networked systems in use today. Most Soldiers currently serving in the Army, with less than 12 years TIS, should have received initial training on digital systems instead of legacy methods. Digital immigrants are individuals whose initial training in C2 took place before the advent of networked C2 systems. These individuals learned the legacy methods as the primary method of performing battle tracking and immigrated to the digital systems as they were fielded into Army units.

A 2 (C2 digital native or immigrant) x 2 (two-source or six-source) ANOVA was used to test for differences in situational understanding performance. Results indicate that there was not a significant difference between digital C2 experience groups ($F(1, 20) = 0.381, p = 0.54$), or between source ($F(1, 20) = 1.32, p = 0.26$), and the digital C2 experience*source interaction was also insignificant ($F(1, 20) = 0.881, p = 0.36$).

An ANOVA was also completed to determine the influence of digital C2 experience on perceived mental workload. Results indicate that there was not a significant difference between digital C2 experience groups ($F(1, 20) = 0.744, p = 0.398$). There was also not a significant interaction between digital C2 experience and source, ($F(1, 20) = 0.881, p = 0.359$). However, source was significant ($F(1, 20) = 4.25, p = 0.052$) when accounting for the digital native

versus digital immigrant variable. Posthoc comparison of the source (two or six) scores for perceived mental workload show that the two-source ($M= 0.71$, $SD= 0.15$) was significantly higher than the six-source ($M= 0.55$, $SD= 0.16$), $t(22)= 2.43$, $p= 0.021$).

V. DISCUSSION

A. SITUATIONAL UNDERSTANDING (HYPOTHESIS 1)

The hypothesis that the modern battle captain workstation degrades sensemaking ability and reduces situational understanding compared to legacy workstations was not supported. Statistical tests for both SITREPs and map accuracy retained the null hypothesis that there is no difference between the modern battle captain workstation (six sources) and the legacy workstation (two sources) with respect to SITREP reporting and map accuracy. This indicates that when the amount of information presented from the sources remains the same, the number of information sources does not affect the sensemaking process.

1. Results Review

In this research, insight into the sensemaking process was gained by assessing the battle captains' situational understanding throughout each trial and capturing their expectations for unit locations on a map of the battlefield at the end of each scenario. To determine the effect of a source, a paired t-test was conducted on the average SITREP scores and map accuracy data from each source condition. Results showed that the number of sources was not significant for SITREP or map accuracy. Furthermore, a 2(source) x 4(SITREP) within subject ANOVA was also conducted to determine the impact of a source on SITREP accuracy over time. Again, the source independent variable, as well as the interaction between source and SITREP was not significant. The results did indicate a significant main effect of SITREP accuracy with respect to ground truth. A posthoc comparison showed that SITREP 1, recorded 10 minutes into the scenario, was significantly different than SITREPs 3 and 4, recorded 30 and 40 minutes into the scenario, respectively.

2. Relevance of Previous Research to Results

Kramer et al. (1987) indicate that the amount of information presented to participants influences workload. From this study, we would predict that, all other things being equal, battle captains who have more information to process will experience a higher workload than those who have less information to process. Wickens' (2002) MRT model predicts disruption between two or more time-shared tasks. This study would also lead us to expect battle captains to experience bottlenecks when processing information when the modality of the information requires the use of the same cognitive resources. The present study was designed so that there would be no difference in the amount of information processed, regardless of the number of sources, and that information-processing bottlenecks would be minimized. Controlling the rate, type, and method of information presentation across source conditions minimized differences, ensuring that significant findings could be attributed only to the source independent variable. In each trial, battle captains had to switch attention from one information source to another, but they did not have to divide attention between multiple displays, regardless of the number of information sources. This allowed battle captains in each source condition to perceive each piece of information as it was presented, and include it in their sensemaking process (as depicted in the information-processing model with sensemaking, see Figure 12).

The data/frame model proposed by Klein et al. (2006b) requires an initial mental frame that battle captains use to begin making sense of the battlefield scenario. Within the experiment, the OPORD, map orientation, and shift change briefing prior to each trial created an initial mental frame for each battle captain. The battle captains used this foundation to begin building their sensemaking process. Once the scenario started, each battle captain's personal experience, education, training, and perspective influenced his ability to distinguish relevant information from irrelevant information.

According to Klein et al. (2006b), sorting information by relevance is akin to determining how data fits into the current mental frame. If the data do not fit

into the battle captain's mental frame, they may be deemed irrelevant and discarded. In the DMSC (Miller & Shattuck, 2006), the content of the lenses help in determining information relevance. As battle captains included relevant information in their sensemaking frames, they improved their situational understanding with respect to ground truth. The SITREPs provide insight into how the sensemaking process influenced changes in situational understanding with respect to ground truth over time.

The ANOVA results indicate that the battle captains started with a relatively high level of situational understanding following the OPORD and shift changeover briefing. As the simulated battlefield situation progressed, a constant flow of information was provided to them. We expected the battle captains to experience greater difficulty determining relevant information during the six-source condition compared to the two-source condition, because of possible distortions in their lenses (Miller & Shattuck, 2006) caused by the switching "cost" leading to inaccurate perceptions of the information. Due to the lack of significance the number of sources has on situational understanding, the expected distortion of the lenses, as explained by the DMSC (Miller & Shattuck, 2006), must have not occurred.

3. Explaining Nonsignificance of Source

The lack of significance suggests that the number of information sources may not be nearly as important as the amount of information being presented by the sources. The findings indicate that merely increasing the number of information sources, while keeping the amount of information constant, does not affect a battle captain's sensemaking process and, ultimately, his ability to understand the situation. In an operational setting, however, as the number of information sources at a battle captain's workstation increases, the total amount of information presented is unlikely to remain constant. The reason a new network node or information terminal is added to a TOC workstation is to provide more information to the battle captain. An increase in the number of information

sources, with a corresponding increase in information volume, may negatively impact the ability of a battle captain to perceive all of the information due to modality conflict and the introduction of both parallel and serial information processing (Wickens, 2002). This situation may result in information overload, where battle captains are burdened with a large supply of unsolicited information, some of which may be relevant (Butcher, 1998). When there is more information available than capacity to perceive and process the information, the probability of not perceiving relevant information increases. During the sensemaking process, relevant information not perceived reduces the amount of applicable data in a battle captain's current frame. Consequently, when a frame is missing relevant data, a battle captain's situational understanding will degrade, thus increasing the gap with ground truth.

B. COGNITIVE WORKLOAD (HYPOTHESIS 2)

Contrary to expectations, the alternative hypothesis was not supported. In fact, statistical tests indicate that battle captains' perceived mental workload using the two-source workstation is significantly higher than the six-source workstation. This finding shows that when the amount of information is held constant between two source conditions, fewer sources created higher workload. Though this is good for the Army, as current battle captain workstations currently have six or more information sources, it is counterintuitive that this would be the case.

1. Results Review

Participants were asked to estimate their perceived workload, as a percentage of their capacity, every 5 minutes during their 40-minute trial. A paired t-test was conducted, with the battle captains' average perceived workload scores indicating that the two-source condition led to significantly higher perceived workload than the six-source condition.

2. Relevance of Previous Research to Results

Sarno and Wickens (1995) explain that workload is the relationship between resource supply and task demand. Given the fact that the two-source condition creates a significantly higher workload, this definition implies that the battle captain either had fewer resources available, or the battle-tracking task demand during the two-source condition was higher than during the six-source. Since information presentation rate, timing, and method was controlled, we do not suspect the battle captains had fewer resources to attend to incoming information. Therefore, the battle-tracking task for the two-source condition must have been more demanding, resulting in an increase in perceived workload.

Wickens' (2002) distinction between workload and MRT is that workload relates more to performance potential in high-demand situations, where multiple resources are capacities used directly relating to actual performance observed. Under this distinction, battle captains in the two-source condition have less potential to perform at the same level with increasing demand. Because actual performance observed through SITREP reporting and map accuracy was equal between the source conditions, we must assume that the battle captains' available resources were not used beyond capacity. This raises an interesting question as to why performance potential was significantly less in the two-source condition, which was contrary to our expectations. The answer may lie in the roles of working memory, attention, and perception in the sensemaking process.

3. Explaining Workload Significance

Wickens, Gordon and Liu (1998) state that "working memory is the temporary 'workbench' of the mind, where information is transformed and acted on" (p. 155). Only a limited amount of information is perceived and brought into working memory for processing. When discussing attention, Wickens et al. (p. 172) state, "if we devote our resources to one activity, others are likely to suffer." As sensory information is registered, attention directs an individual's focus to particular pieces of information for processing. The types of attention

influencing workload in this case are selective and focused attention. According to Wickens et al. “selective attention may be necessary to choose the displayed information sources necessary for a given task” while focused attention “allows those sources to be perceived without distraction from neighboring sources” (p. 228). The statistical significance of the workload results may reflect the differing requirements for focused attention across experimental conditions. Another possible explanation is the limited capacity of working memory.

Working memory is “relatively transient and limited to holding a small amount of information that may be either rehearsed or ‘worked on’ by other cognitive transformations” (Wickens et al., 1998, p. 156). An individual’s ability to hold information active in working memory depends on the amount of information and time. The well known size of working memory capacity, 7 ± 2 (Miller, 1956) chunks of information, explains the amount of information able to be processed at any given time. Time is also closely linked to working memory capacity. “The strength of information in working memory decays over time unless it is periodically reactivated” by cycling through it (Wickens et al., 1998 p. 158). Wickens et al. also list attention as an additional factor that contributes to working memory decay. Attention is required to cycle through information chunks held in working memory to keep it active. Diverting attention away from information reactivation allows it to decay and eventually be lost from working memory.

A battle captain must employ focused attention while listening to radio calls in the TOC in order to properly perceive the information without distraction. During the two-source condition, the information was divided as follows: 60% radio calls and 40% paper notes. The perishable nature of radio calls required significant focused attention and reactivation in working memory in order to include relevant information in the sensemaking process. The radio calls were not played back or repeated; therefore, if the battle captain did not perceive a piece of information from the sensory register or lost it from working memory due to decay, it could not be used in the sensemaking process. Since the SITREP performance between the source conditions was not significantly different, the

battle captains could have dedicated sufficient attention to the radio calls and working memory information reactivation during the two-source condition to perform as well as they did in the six-source condition. The increased requirement for focused attention during the two source condition to perceive information from the sensory register and maintain information in working memory appears to create a significantly higher perceived workload.

In contrast, the six-source condition had roughly 25% radio reports, with the remaining information spread evenly across the five other information sources. In the six-source condition, the other sources were persistent. In this instance, persistent refers to the fact that the information did not disappear immediately after it was read. Messages remained on the screen until the next message arrived, at which point the previous message moved up the screen until it was eventually pushed off by incoming messages. This created a situation where a significant portion of recently reported information was available across five information sources at any given time, while the radio was the only source requiring focused attention at the time of transmission. The remaining sources could be attended to as needed and were less time critical; therefore, the information did not require as much attention to reactivate the information to maintain it in working memory. Contrary to what we hypothesized, we suspect it is this difference that created significantly higher perceived mental workload in the two-source condition.

4. Sensemaking Process Model (Revision)

The information-processing model with sensemaking presented earlier in Figure 12, did not include attention and incorrectly attributed attention resources solely to cognitive processes. In light of the perceived mental workload results' significance, the model should be revised to account for our findings.

The initial information-processing model with sensemaking (again, see Figure 12) proposed that information followed a linear path, from sensory information through perception, into the sensemaking process. Attention

resources were attributed to perception, sensemaking, decision making, and action guidance. Review of the perceived mental workload results, and the ensuing discussion in Section 3 of this chapter, highlight the role of attention in the early phases of information perception as well as within working memory. Attention directs where and how the individuals focus their cognitive processing resources. Further review of the literature found that the lenses in the DMSC (Miller & Shattuck, 2006) provide a satisfactory explanation as to how attention fits into the sensemaking process model. Shattuck and Miller (2006) describe how the lenses direct attention, therefore, Figure 27 inserts the lenses from DMSC into the original model from Figure 12, which enables us to account for directed and focused attention.

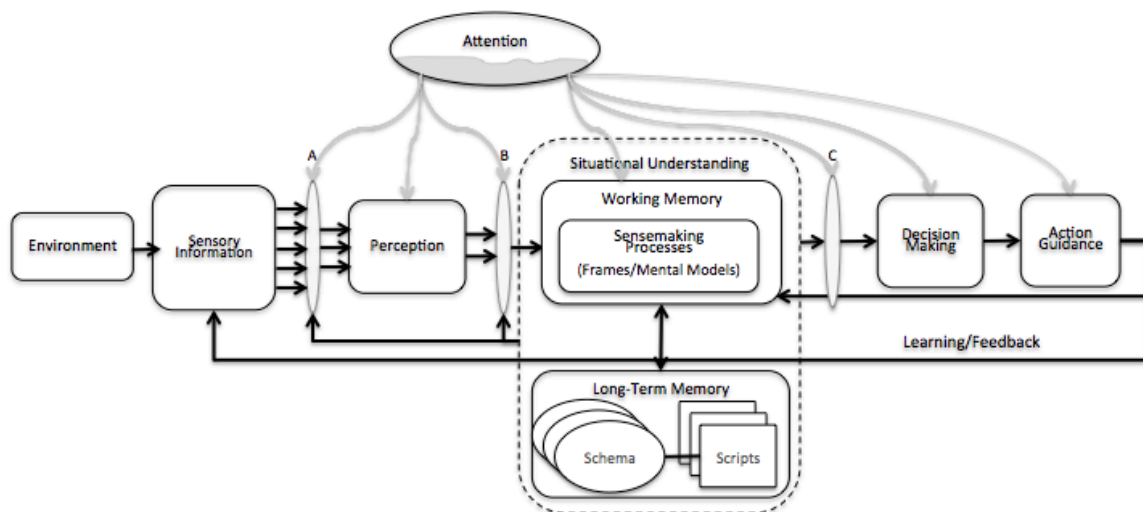


Figure 27. Sensemaking Process Model

The sensemaking process is now depicted within working memory, previously referred to by Wickens et al. (1998) as the “workbench of the mind where information is transformed and acted on” (p. 155), to account for the conscious and active nature of the sensemaking process. The arrow from attention now points to working memory instead of the sensemaking process due to the attention required for information reactivation to reduce information decay over time. In the updated sensemaking processes model, situation understanding

now encompasses both working memory and long term memory, acknowledging the fact that an individual's current understanding of the situation is a product of new information from the environment combined with stored information in long-term memory.

As information sensed from the environment and the action guidance feedback loop propagate through the model, it first encounters Lens A. Lens A filters incoming information based on the current mental frame of the sensemaking process, provided by the situational understanding feedback loop. As a result, the Information passing through Lens A into perception is restricted to sources believed to contain relevant information that must be attended to, based on the current frame in situational understanding.

As perceived information passes through Lens B into working memory, the lens influences how information is organized and fits into the current frame of the sensemaking process in a manner that improves situational understanding with respect to ground truth. This interaction requires focused attention to ensure proper placement of relevant information into the frame. If attention resources are not dedicated to this process, relevant information may be deemed irrelevant due to a perceived lack of fit with the current frame and discarded. This situation explains how overloaded individuals who may perceive relevant information, are unable to properly fit it into the sensemaking frame. Due to the demand on their scarce attention resources (in the two-source condition), they may overlook relevant information in order to process incoming relevant information.

In our original information-processing model with sensemaking, we stated that the battle captain determines information relevance during the sensemaking process. Though the ultimate decision of information relevance is determined during sensemaking within working memory, the objects of a battle captain's selective and focused attention suggest that source relevance is determined by prior iterations of the sensemaking process that guide attention through the feedback loops to Lenses A and B. Attention resources also influence the sensemaking process as information in working memory is reactivated and

maintained until it is either included in the current sensemaking frame, discarded due to irrelevance, or decays from working memory.

The goal of the sensemaking process remains the same—to improve situational understanding with respect to ground truth. As newly developed situational understanding passes through Lens C, the information elements within the lens focus the projections of mental models. The battle captain creates a future prediction of the situation that informs the decision-making process and creates action guidance, based on the interaction of informational elements contained within the lens and situational understanding.

The revised sensemaking process model is able to explain the significantly higher perceived mental workload that battle captains reported in the two-source condition. Information reported over the radio is perishable; therefore, if selective attention resources are not directed to radio reports as they occur, the information may not be perceived or reactivated within working memory. Because the battle captains' situational understanding performance was the same between the two conditions, we can infer that the increase in perceived mental workload can be attributed to attention or the increased need to reactivate perishable information in working memory. Since the scenarios presented information in a strictly serial manner, battle captains were not required to divide attention in order to perceive information. Due to the source conditions and radio report percentage differences (60% for two sources and 25% for six sources), the amount of time that focused attention in Lens A was required to accurately perceive information about the battlefield situation in the two-source condition was higher. This also created a situation where more information required reactivation in working memory due to the perishable nature of the radio reports. This increased attention requirement explains the increased perceived mental workload during this research.

C. DIGITAL NATIVE VERSUS DIGITAL IMMIGRANT

During posthoc interviews with participants, an interesting, and possibly impactful, variable was discovered. Initial comments made by participants following the trials focused around workstation preference. Some stated that they preferred the “old way” of battle tracking, referring to the legacy workstation, while others stated that they felt “back at home” once they sat down at the experiment’s digital workstation. These comments suggested the need to account for their experience and training history with each battle-tracking method. Knowing if they were digital natives or digital immigrants might explain performance results from another perspective—training and experience. A digital native is defined as an individual whose initial military training in C2 or TOC experience was with the digitally networked systems in use today. Digital immigrants are individuals whose initial training in C2 took place before the advent of digital C2 systems.

Post-hoc interviews provided the digital native or digital immigrant information. An ANOVA was used to determine the influence that training or experience may have had on battle captain performance. The results of this research show that neither perceived workload nor situational understanding was impacted by C2 experience (digital versus native). The interactions between the number of sources and digital C2 experience for perceived workload and situational understanding were also insignificant. The lack of significance in both the situational understanding and perceived mental workload results, with respect to digital C2 experience across the number of sources, infers that proper training and system design may mitigate the influence of initial experience.

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VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

During the course of this research effort, we found that when a fixed amount of information is presented to a battle captain by a differing number of sources (two and six), the impact on situational understanding is not significant. Contrary to expectations, the perceived mental workload that battle captain's experienced while tracking a simulated battlefield situation was significantly higher for the two-source (analog, legacy) condition than for the six-source (current, digital) condition. Posthoc analysis to determine the influence of initial training and experience on a battle captain's situational understanding and perceived mental workload concluded that digital C2 experience (digital native versus digital immigrant) was not a significant predictor of either situational understanding or mental workload.

The design of this study controlled the rate, type, and method of information presentation to the battle captain in order to test the impact of the number of information sources on situational understanding and perceived mental workload. Results of this research, where information rate is controlled, allows us to discard the number of sources from the possible variables that influence the sensemaking process and situational understanding. Though we expected to see significant results based on our review of the literature, the fact that we did not implies that the characteristics of the information and the attention resources of the individual must play an even greater role in the sensemaking process and situational understanding than previously thought.

We did find a significant difference in the level of perceived mental workload with respect to the number of information sources. While contrary to our hypothesis, this finding indicates that the method of information presentation influences cognitive workload. Perishable information presented to battle captains through sources that require increased attention in order to perceive

and reactivate that information in working memory may degrade battle-tracking performance in overload situations. Because we controlled the information presentation rate and source type throughout the experiment, the battle captains were never put into a situation where sensory modalities were overloaded. However, the significantly higher perceived mental workload in the two-source condition instead of the six-source shows that the source type (e.g., radio, e-mail, moving map), in conjunction with the attention required to properly perceive the information and keep it active in working memory, may have profound effects on situational understanding performance during battle-tracking tasks.

The initial information process model with sensemaking we proposed in this paper did not properly explain the statistically significant results of perceived mental workload in the two-source condition; therefore, the model was revised. Incorporating the lenses from the Shattuck and Miller (2006) DMSC helped explain the role of attention resources as information propagates through the model. The DMSC was originally created to combine the technological aspects of a system with the human perceptual and cognitive processes (Shattuck & Miller, 2006). When we incorporate the lenses into the revised model we can account for the role of attention in the flow of information. By encompassing the sensemaking process within working memory, the adjusted model more accurately explains the perceived mental workload results and should also predict performance in similar situations in the future. The revised model can be applied to a broad range of scenarios that include the interaction of humans with technological systems.

The computer age continues to facilitate the integration of networks in military communications. In order to develop and exploit an information advantage over the enemy, the method in which information is presented to battle captains and other decision makers must be controlled. According to results of this research, placing another information source, or network node, on a battle captain's workstation will not impact situational understanding *only* if the

information source does not increase the cumulative amount of information presented to the battle captain from all sources currently located on the workstation.

As information sources are added to workstations, the method in which individuals interact or attend to the information sources will become increasingly important to ensure operator mental workload remains below capacity. If a number of information sources at a battle captain's workstation require selective or focused attention, he or she may become overwhelmed with information. Battle captains overwhelmed with information may be unable to successfully process everything (Broadbent, 1971) due to scarce attention resources.

Results of this research could have implications for the design of future information systems and networked workstations in TOCs. Simply adding an information source to a TOC workstation may not have the effect of increased situational understanding. All information sources located at each workstation must be reviewed, while accounting for information flow rates, presentation methods, type of information, and attention resources required to properly perceive the information.

B. RECOMMENDATIONS FOR FOLLOW-ON RESEARCH

There are many opportunities to expand our understanding of the effect that information sources, information flow rates, and attention requirements have on our ability to properly perceive information, make sense of information, and develop an accurate situational understanding with respect to ground truth. In the course of this research, video of each experimental trial was captured, but not analyzed. Reviewing the video footage in order to conduct a task analysis of battle-tracking activities between source conditions may provide additional insight into what information was perceived, missed, or interpreted differently during the trials. Task analysis findings may help strengthen statistical results by providing both qualitative and quantitative descriptions of a battle captain's battle-tracking performance across both source conditions.

The research findings also suggest a need for follow-on studies. A field study should investigate information flow rates in digital TOCs for each information source and consider how flow rates change across TOCs, based on factors such as the number of information sources, echelon of command, and operational tempo. Results of the field study may then be used to design an experiment that incorporates information flow rates representative of the operational environment into an experiment similar to the study reported herein. Participants in a study with operationally relevant flow rates may experience increased mental workload and degraded situational understanding as both the number of sources and the information volume increase.

Future research also should examine the attention requirements for the different information sources monitored by battle captains. Also, determining the cognitive workload required by different information sources may provide insight into how workstations should be arranged, what information sources should be separated because they use the same attentional resources, and how to keep cognitive workload levels below capacity. Findings from these future studies will lead to the development of NCW C2 systems in which information is properly perceived, leading to accurate situational understanding.

Understanding the cognitive processes that play a role in attending to and accurately perceiving information, while conducting sensemaking to improve situational understanding is important to developing future command and control workstations that enable decision makers to close the gap between situational understanding and ground truth. We must re-examine how decisions are made concerning adding information sources to TOC workstations and the unforeseen consequences of these decisions with respect to situational understanding and mental workload. Future research must focus on how to optimize information presentation based on attention resources, information flow rates and perceptual ability.

APPENDIX A. SCENARIO 1, 11TH ARMORED CAVALRY REGIMENT

Scenario 1 development, 11th ACR

Last Updated: 21 Feb @ 13:40

6 Source				2 Source		
Time	Source	Callsign/ channel	Report	Source	Callsign	Report
0:00	radio	Ghost 1-6	Blackhorse X-ray this is Ghost 1-6, current location NV386082, Over.	radio	Ghost 16	Blackhorse X-Ray this is Ghost 1-6, current location NV386082, Over
		Blackhorse X-ray	Blackhorse X-Ray, Roger		Blackhorse X	Blackhorse X-Ray, Roger
0:20	radio	Ghost 2-6	Blackhorse X-ray is Ghost 2-6, Current location approximately 500 from OP location, over	radio	Ghost 2-6	Blackhorse X-ray is Ghost 2-6, Current location approximately 500m from OP location, over
		black horse X	Blackhorse X-Ray, Roger		black horse X	Blackhorse X-Ray, Roger
0:40	CPOF	Easy-6	Easy 6: Just passed through 3-Corners enroute to assault position, just north of airfield, Setting conditions to occupy support by fire position.	Radio	Easy-6	Battle X-Ray, this is Easy-6. Just passed 3-corners enroute to assault position, just north of airfield, Setting conditions to occupy support by fire position, over.
					Battle X-Ray	Battle X-Ray, Roger
1:00	mIRC chat	radio intercept	Radio Intercept: Enemy Battalion commander conversation with commander at airfield. Move your engineer platoon to Battalion headquarters to improve defenses. Confirmed that artillery section will support their withdrawal.	paper copy	radio intercept	Radio Intercept: Enemy Battalion commander conversation with commander at airfield. Move your engineer platoon to Battalion headquarters to improve defenses. Confirmed that artillery section will support their withdrawal.
1:20	radio	Deathdealer-6	Bengal-6 this is Deathdealer-6, we have visual contact with an enemy tank, 2 kilometers to our north, currently unable to engage, over	radio	Deathdealer-6	Bengal X-Ray this is Deathdealer-6, we have visual contact with an enemy tank, 2 kilometers to our north, currently unable to engage, over
		Bengal-xray	this is Bengal-x-ray Roger		Bengal-x-ray	this is Bengal-x-ray Roger
1:40	mIRC chat	Bengal x-ray	ISR: 1st squadron request support to observe enemy force north of Delta Company. Their current grid is: NV390160	paper copy	ISR request	ISR Request from Bengal X-Ray: 1st squadron requesting support to observe enemy force north of Delta Company. Their current grid is: NV390160
2:00	location updates	Delta company	enemy icon north of Delta Company populates: NV395210	Radio	Deathdealer 6	Bengal X-Ray this is Deathdealer 6, current enemy location at NV395210.
					Bengal X-Ray	Bengal- X ray, Roger

1

Scenario 1 development, 11th ACR

Last Updated: 21 Feb @ 13:40

2:20	radio	Delta company	Bengal X-Ray this is Deathdealer 6. Enemy contact vicinity granite pass. Prepare to copy grid..... NV395210 over.	radio	Deathdealer 6	Bengal X-Ray this is Deathdealer 6. Enemy contact vicinity granite pass. Prepare to copy grid..... NV395210 over.
		Bengal x-ray	Deathdealer 6 this is Bengal X-Ray. Roger		Bengal x-ray	Deathdealer 6 this is Bengal X. Roger
2:40	Mirc chat	predator operator	Division predator reports large element moving west towards 1st Squadron from east of Al shark, significant dust obscuring target at this time.	paper copy	Predator operator	Division predator reports large element moving west towards 1st Squadron from east of Al shark, significant dust obscuring target at this time.
3:00	cpof	D company	Deathdealer 6: SALUTE report follows: Size: 2 enemy tanks, activity: appear to be moving in on bounding overwatch, location: grid NV395210 moving south along Main MSR. Unit: unknown, equipment: none. Possibly part of platoon or company size element.	radio	Deathdealer 6	Bengal x-ray this is Deathdealer 6, SALT report follows: 2 enemy tanks, appear to be moving in a bounding over watch formation, grid NV395210 moving south along Main MSR and grant pass, Over
					bengal x-ray	Deathdealer 6, 1 copy Two enemy tanks in a bounding over watch formation moving south from grid NV405210 on Main MSR granite pass, Over
3:20	Location update	Fox Troop	Icon population at location NV308045.	radio	Fox 6	Battle x-ray this is Fox 6, We are currently approximately 500 m from our blocking position on the MSR North of Irwin. Blocking position will be established at NV308045, over
3:40	e-mail	Ghost 1-6	Blackhorse X-Ray: Scout 1 is in position, OP is established. Satcom is up, general reporting will be sent through tactical e-mail, current location, NV388082.	radio	Ghost 1-6	Blackhorse X-Ray This is Ghost 1-6, we are in position, OP is established, current location as follows break, NV388082, over
					Blackhorse x-ray	Ghost 1-6 this is black horse X, Roger, copy NV388082.
4:00	CPOF	Battle-6	guidons, begin assault plan on OBJ Hester	radio	Battle-6	guidons, guidons this is Battle-6. Conditions are set to begin assault plan on Objective Hester, over
					Easy-6	Easy 6 Roger
					Fox-6	Fox 6 Roger
					Golf-6	Gunslinger 6 Roger

2

4:20	Radio	D company Bengals 6	Bengal 6, this is Deathdealer 6, We are fully engaged with enemy platoon near Granite Pass, sustained no damage. Possible company size element. Observed 2 more tanks, over. Deathdealer this is Bengal, Understand fully engaged with the enemy. If company size element is confirmed, report immediately and fall back to defensible blocking position.	Hotel-6 Havoc 6, Roger	Radio	D company Bengals 6	Bengal 6, this is Deathdealer 6, We are fully engaged with enemy platoon near Granite Pass, sustained no damage. Possible company size element. Observed 2 more tanks, over. Deathdealer this is Bengal, Understand fully engaged with the enemy. If company size element is confirmed, report immediately and fall back to defensible blocking position.
4:40	location update	E Troop	icon starts moving from location NV375085.	radio	Easy-6 Battle x-ray		Battle X this is Easy 6, beginning movement forward from assault position into support by fire. Current location NV375085. Over. Easy 6, Battle x-ray, Roger.
5:00	mirr chat	radio intercept	Enemy company commander calling Battalion commander asking if brigade sent a platoon around to the north. Can hear an element engaged in the North, near granite pass.	paper copy	Radio intercepts		Enemy company commander calling Battalion commander asking if brigade sent a platoon around to the north. Can hear an element engaged in the North, near granite pass.
5:20	location update	E Troop	E troop icon continues moving. Currently located at NV372075	radio	Easy 6 Battle x-ray		Battle X this is Easy 6, continuing movement forward to support by fire position current location NV372075, Over this is Battle x-ray, Roger
5:40	radio	Delta company Bengal x-ray	Bangal x-ray this is Deathdealer 6, One enemy vehicle mobility killed, location NV408207, over Deathdealer 6 this is Bengal x-ray Roger	radio	Delta company Bengal x-ray		Bangal x-ray this is Deathdealer 6, One enemy vehicle mobility killed, location NV408207, over Deathdealer 6 this is Bengal x-ray Roger
6:00	mirr chat	predator report	Possible enemy artillery section obscured by camo net east of bicycle lake airfield near Bike Lake Pass.	paper copy	predator report		Possible enemy artillery section obscured by camo net east of bicycle lake airfield near Bike Lake Pass.
6:20	Location update	2nd squadron	Unit locations, All updated, Fox Troop: NV309046, E company: NV369073, Golf Troop: NV308093, hotel company: NVNV274073.	paper copy	location updates		X-Ray to Battle captain: Updated unit locations, Fox Troop: NV309046, E Company: NV369073, G Troop: NV308093, Hotel company: NV274073.

6:40	radio	Ghost 2-6 Blackhorse X-Ray	Blackhorse X-ray, this is Ghost 2-6, Currently in position at NV437055, over Ghost 2-6, this is Blackhorse x-ray, Copy location NV437055, over	radio	Ghost 2-6 Blackhorse X-Ray		Blackhorse X-ray, this is Ghost 2-6, Currently in position at NV437055, over Ghost 2-6, this is Blackhorse x-ray, Copy location NV437055, over
7:00	chat	radio intercept	Senior commander informing a company level commander at airfield to disrupt enemy advance as long as possible.	paper copy	radio intercept		Senior commander informing a company level commander at airfield to disrupt enemy advance as long as possible.
7:20	radio	Delta company bangal x-ray	Bengal x-ray this is Deathdealer 6, track 1-1 took a direct hit, minor injury to the gunner should be RTD. Tank is still operational at this time, over. Deathdealer this is Bengal X-ray, Roger	radio	Delta company bangal x-ray		Bengal x-ray this is Deathdealer 6, track 1-1 took a direct hit, minor injury to the gunner should be RTD. Tank is still operational at this time, over. Deathdealer this is Bengal X-ray, Roger
7:40-9:00	telephone	brigade commander		6:00	telephone		brigade commander
8:40	location update	1st squadron	1st squadron icons populate on map. A company: NV369119, bravo company NV440103, Charlie Company: NV482131, Delta company: NV398209.	Paper copy	location update		Location Updates: A company: NV369119, Bravo company NV440103, Charlie Company: NV482131, Delta company: NV398209.
9:00	e-mail	Ghost 1-6	E-Mail To: Blackhorse x-ray, Battle x-ray. Tactical report: Enemy activity at bicycle Lake airfield, 2 BMP platoons and 1 tank platoon in defense of airfield. Observed a tactical resupply offloading ammunition and supplies. We observed an engineer platoon traverse possible obstacle belt from approximately NV335060 Following Unimproved Rd. Southwest to NV320048, roughly within Drop Zone 27. 2 vehicles traversing a 1/2 square kilometer NE of obstacle belt. Enemy command post located within buildings on airfield near helipad.	Paper copy	Ghost 1-6		Tactical report: Enemy activity at bicycle Lake airfield, 2 BMP platoons and 1 tank platoon in defense of airfield. Observed a tactical resupply offloading ammunition and supplies. We observed an engineer platoon traverse possible obstacle belt from approximately NV335060 Following Unimproved Rd. Southwest to NV320048, roughly within Drop Zone 27. 2 vehicles traversing a 1/2 square kilometer NE of obstacle belt. Enemy command post located within buildings on airfield near helipad.

9:40	cpof	Coldsteel 6	Coldsteel 6: Be advised that I have currently lost radio contact with 3rd platoon, they were in the John Wayne Fothills en-route to recon a cave in John Wayne Pass, attempting to reestablish communication, over	radio	Coldsteel 6	Bengal X-Ray this is Coldsteel 6, Be advised that I have currently lost radio contact with 3rd platoon, they were in the John Wayne Fothills en-route to recon a cave in John Wayne Pass, attempting to reestablish communication, over
					Bengal X-Ray	Coldsteel, this is Bengal x-ray, Roger
10:00	cpof	Easy 6	Easy 6: 2d enemy BMP from this platoon destroyed in fighting position. 2 BMPs remain with approximately 20 enemy troops fighting from hasty fighting positions along the end of main runway	radio	Easy 6	Battle X-ray this is Easy 6, 2d enemy BMP from this platoon destroyed in fighting position. 2 BMPs remain with approximately 20 enemy troops fighting from hasty fighting positions along the end of main runway, Over.
					Battle X-Ray	Easy 6 this is Battle X-Ray, copied two enemy BMPs destroyed, approximately 40 troops and 3 vehicles remain, over
10:40	e-mail	Ghost 1-6	e-mail to: Blackhorse X-Ray, Battle X-Ray. Tactical report: enemy personnel appear to be rigging explosive charges on buildings near enemy headquarters position.	paper copy	Ghost 1-6	Tactical report: enemy personnel appear to be rigging explosive charges on buildings near enemy headquarters position.
11:00	location update	golf company, hotel company	icon locations:Hotel company: NV308067, golf company: NV323078.	radio	Gunslinger 6 Havoc 6 Battle x-ray	X-Ray this is Gunslinger 6, current location NV323078 X-Ray this is Havoc 6, current location NV308067 Gunslinger, Havoc, copy both locations, over
11:20	radio	Deathdealer 6 Bengal X-Ray	Bengal x-ray, this is Deathdealer 6, Second tank destroyed in hills north of granite pass, proximate location NV421205. Over. Deathdealer 6 this is bengal x-ray, Roger, two enemy vehicles destroyed	radio	Deathdealer 6 Bengal X-Ray	Bengal x-ray, this is Deathdealer 6, Second tank destroyed in hills north of granite pass, proximate location NV421205. Over. Deathdealer 6 this is bengal x-ray, Roger, two enemy vehicles destroyed
11:40	cpof	Assassin 1-6	Assassin 1-6: reserve platoon in position vicinity grid NV367117.	radio	Assassin 1-6 Blackhorse x-ray	Blackhorse X-ray this is Assassin 1-6, in position at grid NV367117, over Assassin 1-6, Roger

12:00	Radio	Easy 6 Battle X-Ray	Battle x-ray, this is Easy 6, Vehicles taking minor damage from enemy fire, all systems and vehicles still functional. When we occupied the support by fire, we saw 4 maybe 7 vehicles departing the airfield to the SE. Over. Easy 6, this is a Battle x-Ray, Roger all.	Radio	Easy 6 Battle X-Ray	Battle x-ray, this is Easy 6, Vehicles taking minor damage from enemy fire, all systems and vehicles still functional. When we occupied the support by fire, we saw 4 maybe 7 vehicles departing the airfield to the SE. Over. Easy 6, this is a Battle x-Ray, Roger all.
12:20	e-mail	Ghost 2-6	e-mail to Blackhorse X-Ray, Bengal x-ray, Battle X-Ray: No enemy activity observed to the East. Significant civilian vehicle movement on MSR's from Irwin on roads going to the East. 5 to 6 enemy vehicles moving with civilian traffic on MSR about to drive through Al Ameen. Appear to be engineer vehicles including trenching and at least 2 scatterable mine trucks.	paper copy	Ghost 2-6	report to: Blackhorse X-Ray, Bengal x-ray, Battle X-Ray: No enemy activity observed to the East. Significant civilian vehicle movement on MSR's from Irwin on roads going to the East. 5 to 6 enemy vehicles moving with civilian traffic on MSR about to drive through Al Ameen. Appear to be engineer vehicles including trenching and at least 2 scatterable mine trucks.
12:40	e-mail	Ghost 1-6	E-mail to Blackhorse X-Ray, Battle X-Ray: engineer platoon departed airfield. Easy company destroyed 3 vehicles in defensive positions on Northeast sector of airfield. Personnel continuing to rig buildings with possible explosives.	radio	Ghost 1-6 Blackhorse X-Ray	Blackhorse X-Ray this is Ghost 1-6, engineer platoon departed airfield. Easy company destroyed 3 vehicles in defensive positions on Northeast sector of airfield. Personnel continuing to rig buildings with possible explosives. Over this is x-Ray, Roger
13:00	radio	Deathdealer 6 Bengal X-Ray	Bengal X-Ray this is Deathdealer 6, 3rd enemy tank destroyed while maneuvering through granite pass, over Deathdealer 6 this is Bengal x-ray, Roger	radio	Deathdealer 6 Bengal X-Ray	Bengal X-Ray this is Deathdealer 6, 3rd enemy tank destroyed while maneuvering through granite pass, over Deathdealer 6 this is Bengal x-ray, Roger
13:20	location update	2nd squadron icons	E company: NV368074, Fox Troop: NV309045, hotel company: NV308067, golf company: NV324078.	paper copy	2nd squadron locations	E company: NV368074, Fox Troop: NV309045, hotel company: NV308067, golf company: NV324078.

13:40	chat	LNO channel	Division supply chain currently unable to resupply any units in sector, vehicles are dow. Expect 30 min. delay for any resupply operations, Coming from division asset.	radio	Division Battle captain Blackhorse X-Ray	Blackhorse X-ray this is Crazy horse 3A, supply chain currently unable to resupply any units in sector, vehicles are dow. Expect 30 min. delay for any resupply operations, Coming from division asset, over. Crazy horse 3A, Blackhorse X-ray, Roger
14:00	Chat	radio intercept	Instructions for a recon to scout route to Abar Layla, 1 BMP was reported destroyed in airfield northern defense line.	paper copy	radio intercept	Instructions for a recon to scout route to Abar Layla, 1 BMP was reported destroyed in airfield northern defense line.
14:20	chat	Predator	North side of Irwin, appears to be burning tires and roadblocks being emplaced by population. Large groups continuing to assemble.	paper copy	ISR report	North side of Irwin, appears to be burning tires and roadblocks being emplaced by population. Large groups continuing to assemble.
14:40	CPOF	bravo Troop	Blackjack 6: Made contact with Jabal Mayor, he was eager to speak with the CF commander, apparently dislikes enemy Army brigade commander. We've seen anti-coalition propaganda posters all over town. Mayor believes army commander possibly at Miami airfield.	radio	Blackjack 6 Bengal x-ray	Bengal X-ray this is Blackjack 6, made contact with Jabal Mayor, he was eager to speak with the Coalition commander, apparently dislikes enemy Army brigade commander. We've seen anti-coalition propaganda posters all over town. Mayor believes army commander possibly at Miami airfield. Over Blackjack 6 this is Bengal X-Ray, Roger
15:00	radio	Easy 6 Battle 6	Battle 6 this is Easy 6, Positions in the northern defensive line effectively suppressed, currently receiving minimal effective fire from enemy defense line, over Easy this is Battle, Roger that, thanks for the update	radio	Easy 6 Battle 6	Battle 6 this is Easy 6, Positions in the northern defensive line effectively suppressed, currently receiving minimal effective fire from enemy defense line, over Easy this is Battle, Roger that, thanks for the update
15:20	chat	ISR	Oobserving large mob, 100-200 people, burning items, currently moving toward coalition blocking position north of Irwin	radio	Blackhorse X-Ray Fox 6	Fox 6 this is Blackhorse x-ray, ISR reports approximately 100-200 people burning items and currently moving toward your position, over Blackhorse x-ray This is Fox 6, Roger thanks for the update.

15:40	e-mail	Ghost 1-6	To: Blackhorse x-ray, Battle x-ray. Civilian vehicle traffic moving in and out of hidden Valley, Something possibly happening in hidden Valley, drivers coming out telling others to turn around. Platoon size element departed South East corner of airfield. Possible engineer PLT with trenching and mining vehicles.	paper copies	Ghost 1-6	To: Blackhorse x-ray, Battle x-ray. Civilian vehicle traffic moving in and out of hidden Valley, Something possibly happening in hidden Valley, drivers coming out telling others to turn around. Platoon size element departed South East corner of airfield. Possible engineer PLT with trenching and mining vehicles.
16:00	CPOF	Assassin 6	Assassin 6: growing civilian mob in town throwing rocks, sporadic gunfire. No sign of enemy army occupation. Not outwardly hostile towards coalition forces.	Radio	Assassin 6	Bengal X-ray, Assassin 6, Civilian mobs in town are growing, throwing rocks, we are hearing sporadic gunfire in town. Not outwardly hostile towards coalition forces, over
16:20	CPOF	Blackjack 6	Blackjack 6: Civilian population gathering and mobs. Chants and protests growing. Anti-coalition messages played from mosque speakers.	radio	Blackjack 6 Bengal x-ray	Bengal this is Blackjack 6, We are also seeing civilian mobs, hearing chants and protests and anti-coalition messages playing from mosque speakers at this time, over. Assassin 6, Blackjack 6, Bengal x-ray. Copy all from both transmissions, over
16:40	chat	division command	battalion sized enemy force observed Southeast of 11th ACR area of operations. Currently traveling north, will continue to monitor.	paper copy	Division command	battalion sized enemy force observed Southeast of 11th ACR area of operations. Currently traveling north, will continue to monitor.
17:00	E-mail	Ghost 2-6	To: Blackhorse X-Ray, Bengal X-Ray, Battle X-Ray. No direct enemy activity observed to the East. Significant traffic continues between Irwin and either MMA or Miami airfield. Dust plumes are growing, possible large vehicle movement vicinity of Miami airfield. Also, vehicle movement observed from Miami heading East to Red Pass area.	paper copy	Ghost 2-6	To: Blackhorse X-Ray, Bengal X-Ray, Battle X-Ray. No direct enemy activity observed to the East. Significant traffic continues between Irwin and either MMA or Miami airfield. Dust plumes are growing, possible large vehicle movement vicinity of Miami airfield. Also, vehicle movement observed from Miami heading East to Red Pass area.
17:20	CPOF	Assassin 6	Assasin 6: Just made contact with the Medina Wasl Mayor. He's pretty eager to speak with me, full report to follow.	radio	Assassin 6 Bengal X-Ray	Bengal x-ray, this is Assassin 6, Just made contact with the Medina Wasl Mayor. He's pretty eager to speak with me, full report to follow. Over. this is Bengal x-ray Roger over

17:40	radio	Battle 6	Blackhorse X-ray this is Battle 6, We are just now making linkup with hotel company in their attack position.	radio	Battle 6	Blackhorse X-ray this is Battle 6, We are just now making linkup with hotel company in their attack position.
		Blackhorse X-ray	Battle 6 this is Blackhorse, Roger		Blackhorse X-ray	Battle 6 this is Blackhorse, Roger
18:00	chat	predator	ISR report: Possible military vehicle movement in and around Abar Layla, coming from Langford Lake MSR. Unable to determine composition due to dust.	radio	Blackhorse X-Ray	guidons: ISR indicates, Possible military vehicle movement in and around Abar Layla, coming from Langford Lake MSR. Unable to determine composition due to dust. Over.
18:20-20:40	Telephone	brigade commander		Telephone	brigade commander	
18:20	CPOF	division command	division civil affairs: Civil affairs team A, moving to Riot locations at blocking position north of Irwin. Civil affairs team B moving to help quell riots in Medina Wasl.	paper copy	division	division civil affairs: Civil affairs team A, moving to Riot locations at blocking position north of Irwin. Civil affairs team B moving to help quell riots in Medina Wasl.
18:40	Chat	Division Command	Two civil affairs teams en-route to Medina Wasl and blocking position near Irwin.	radio	Blackhorse x-ray Assassin 6 Fox 6	Assassin 6, And Fox 6. This is Blackhorse x-ray. Civil affairs teams currently en-route to both of your locations, over this is Assassin Roger This is Fox 6 Roger that
19:00	CPOF location Update	1st squadron	A company: No change, Bravo company: no change, Charlie Company: NV483123, Delta company: NV415211.	paper copy	location update	A company: No change, Bravo company: no change, Charlie Company: NV483123, Delta company: NV415211.
19:20	radio	Easy Company	Battle X-Ray, This is Easy 6, it appears the northern BMP platoon along the North/ South runway is pulling out of their positions, moving towards 4 HQ BMPs near airfield buildings	radio	Easy 6	Battle X-Ray, This is Easy 6, it appears the northern BMP platoon along the North/ South runway is pulling out of their positions, moving towards 4 HQ BMPs near airfield buildings
		Battle X-Ray	Easy 6, this is Battle x-ray, Roger.		Battle X-Ray	Easy 6, this is Battle x-ray, Roger.

19:40	e-mail	Ghost 2-6	To: Blackhorse x-ray, Bengal X-Ray, Battle x-ray. Significant civilian traffic on MSR through Valley of death. Engineer platoon, 6 vehicles, including trenching and mining vehicles moving along MSR currently North of Red Lake Pass. To the South, appears to be multiple improved dirt roads with access South to the Langford Lake MSR thru the hills.	paper copy	Ghost 2-6	To: Blackhorse x-ray, Bengal X-Ray, Battle x-ray. Significant civilian traffic on MSR through Valley of death. Engineer platoon, 6 vehicles, including trenching and mining vehicles moving along MSR currently North of Red Lake Pass. To the South, appears to be multiple improved dirt roads with access South to the Langford Lake MSR thru the hills.
20:40	Radio	Easy 6	Battle 6 this is Easy 6, Enemy defensive positions North of main runway are suppressed. Shifting some fires to Western positions to suppress for Gunslinger, over. Easy 6 this is Battle 6, Roger	Radio	Easy 6	Battle 6 this is Easy 6, Enemy defensive positions North of main runway are suppressed. Shifting some fires to Western positions to suppress for Gunslinger, over. Easy 6 this is Battle 6, Roger
21:00	CPOF message	Easy 6	Easy 6: E troop currently below 50% on ammunition	radio	Easy 6	Battle X-ray this is Easy 6, Currently below 50% on ammunition, at this time, over.
21:20	radio	Gunslinger 6	Battle 6, this is Gunslinger 6, Commencing assault on objective at this time, Over.	radio	Gunslinger 6	Battle 6, this is Gunslinger 6, Commencing assault on objective at this time, Over.
		Battle 6	Gunslinger, Battle, Roger, commencing your assault now, over.		Battle 6	Gunslinger, Battle, Roger, commencing your assault now, over.
21:40	CPOF	Deathdealer 6	Deathdealer 6: We just destroyed a 4th enemy tank departing granite pass area, appears to be last enemy vehicle in the area, over	radio	Deathdealer 6	Bengal X-Ray, this is Deathdealer 6. We just destroyed a 4th enemy tank departing granite pass area, appears to be last enemy vehicle in the area, over
					Bengal X-Ray	Deathdealer 6 this is Bengal x-ray., Roger, over
22:00	CPOF location update	G and H Troop	G Troop NV326069 H troop: NV315064.	paper copy	G and H Troop location update	Location updates provided for, G Troop NV326069, H troop: NV315064.
22:20	radio	Ghost 1-6	Bengal X-Ray, this is Ghost 1-6. We are receiving broken radio calls about a vehicle stuck in soft sand. Unsure if you're able to hear it but want to pass on the info, over Ghost 1-6, this is Bengal X-Ray. Thanks for the info will check into it and get back to you. Over.	radio	Ghost 1-6	Bengal X-Ray, this is Ghost 1-6. We are receiving broken radio calls about a vehicle stuck in soft sand. Unsure if you're able to hear it but want to pass on the info, over
		Bengal X-Ray			Bengal X-Ray	Ghost 1-6, this is Bengal X-Ray. Thanks for the info will check into it and get back to you. Over.

22:40	CPOF Message	Coldsteel 6	Coldsteel 6: observing activity on MSR East Range Road vehicles are moving west towards our location. Unable to determine size or composition due to dust.	radio	Coldsteel 6 Bengal X-Ray	Bengal X-Ray, this is Coldsteel 6. We are observing enemy activity on MSR East Range Road. Vehicles moving west towards our location. Unable to determine size or composition at this time, dust is terrible, over. Coldsteel 6 Roger, just keep us informed on their location and please pass composition when possible, over
23:00	mIRC Chat	radio intercept	airfield company commander orders northern positions to keep fighting. Mechanized company referenced for location at airfield. Commander acknowledges losses at the airfield, unable to determine number.	paper copy	radio intercepts	airfield company commander orders northern positions to keep fighting. Mechanized company referenced for location at airfield. Commander acknowledges losses at the airfield, unable to determine number.
23:20	CPOF messaging	Blackjack 6	Blackjack 6: 20-30 civilian vehicles departing Medina Jabal towards Miami airfield, possible weapons, they are staying away from coalition forces.	radio	Blackjack 6 Bengal X-Ray	Bengal X-Ray this is Blackjack 6, Approximately 20-30 civilian vehicles just departed Medina Jabal towards Miami airfield, possible weapons, they are staying away from coalition forces, over Blackjack 6, this is Bengal X-ray, Roger all.
23:40	e-mail	Blackjack 6	Medina Jabal Mayor report positive: Population not trusting of military in general, though not hostile. Anti coalition propoganda from enemy forces remains up. Mayor asked if we would allow his people to move freely to the E through hidden valley, currently an armored checkpoint near the cave is blocking all traffic. Not sure what he's talking about with the checkpoint. Possible enemy?	radio	Blackjack 6 Bengal X-Ray	Bengal X-Ray, This is Blackjack. Conversation with Jaball Mayor positive: situation in town shows that population currently not trusting of military in general. Anti Coalition propoganda remains up in town. Mayor also asked if we would remove the armored checkpoint near the cave in hidden valley, but that's not us. Possible enemy location? Over.
24:00:00	mIRC Chat	division command	civil affairs teams should have arrived at the blocking position and Medina Wasl.	paper copy	division command	Blackjack 6 this is Bengal X-Ray, Roger all. civil affairs teams should have arrived at the blocking position in Medina Wasl.

24:20	CPOF messaging	Assassin 6	Assassin 6: Medina Wasl mayor very happy to see Americans, population not bothered by enemy and does not want to be occupied by coalition forces either. Mayor says he would like to support us anyway possible in return for needed supplies	Radio	Assassin 6 Bengal X-Ray	Bengal X-Ray, this is Assassin 6. Medina Wasl mayor very happy to see Americans, population not bothered by enemy and does not want to be occupied by coalition forces either. Break... Mayor says he would like to support us anyway possible in return for needed supplies. Over. Assassin 6, Bengal X-Ray, Roger
25:00:00	radio	Gunslinger 6 Battle 6	Battle 6, this is Gunslinger 6. We just made contact with obstacles on West side of airfield, trying to bypass to the north. Obstacles North boundary is approx NV335060 extending southwest about a kilometer on the improved road. Over. Gunslinger, this is Battle. Copy that you made contact with obstacles and moving around to the north, just keep me informed, over.	radio	Gunslinger 6 Battle 6	Battle 6, this is Gunslinger 6. We just made contact with obstacles on West side of airfield, trying to bypass to the north. Obstacles North boundary is approx NV335060 extending southwest about a kilometer on the improved road. Over. Gunslinger, this is Battle. Copy that you made contact with obstacles and moving around to the north, just keep me informed, over.
25:20	e-mail	Ghost 2-6	Ghost 2-6: Have not observed anymore military vehicles on MSR. Observed an enemy element moving West on East Range Road MSR, unable to determine size or composition. Engineer vehicles stopped at Miami entrance, starting to dig and prepare positions.	radio	Ghost 2-6 Blackhorse X-Ray	Blackhorse X-Ray, This is Ghost 2-6. Have not observed any more military vehicles on Langfor Lake MSR. Engineer vehicles stopped at Miami entrance, starting to dig and prepare positions Break.... Observed enemy unit moving West on East Range Road MSR, unable to determine size or composition, Over. Ghost 1-6, This is Blackhorse X-Ray, Roger, Over
25:40:00	CPOF location updates	all units	2nd squadron: Golf company: NV334063, H company NV315060, Fox Troop: NV309046, E company NV368071. 1st squadron: Assassin 6: NV374122, Blackjack 6: NV440098, Charlie Company: NV470113, D company NV403201.	paper copy	Location updates	2nd squadron: Golf company: NV334063, H company NV315060, Fox Troop: NV309046, E company NV368071. 1st squadron: Assassin 6: NV374122, Blackjack 6: NV440098, Charlie Company: NV470113, D company NV403201.

26:00	mIRC Chat	radio intercept	Enemy tank platoon commander reported observing a blocking position on the main avenue of travel directly to their front. Indicated he's going to start bounding his tanks forward. Current location is approximately 5km East of the racetrack. Continuing to move West and scout the enemy positions	paper copy	radio intercept	Enemy tank platoon commander reported observing a blocking position on the main avenue of travel directly to their front. Indicated he's going to start bounding his tanks forward. Current location is approximately 5km East of the racetrack. Continuing to move West and scout the enemy positions
26:20	radio	Fox 6 Battle X-Ray	Battle X-Ray, this is Fox 6. We just made contact with civilians at our blocking position. Able to make out anti-American chants, but they haven't thrown anything or fired on us, over. Fox 6, this is Battle x-ray, Roger, over.	radio	Fox 6 Battle X-Ray	Battle X-Ray, this is Fox 6. We just made contact with civilians at our blocking position. Able to make out anti-American chants, but they haven't thrown anything or fired on us, over. Fox 6, this is Battle x-ray, Roger, over.
26:40:00	e-mail	Ghost 2-6	Able to see civilians departing Irwin, moving on MSR in the Valley of death. Appear to be heading to MMA or Miami airfield.	radio	Ghost 2-6 Blackhorse X-Ray	Blackhorse X-Ray, this is Ghost 2-6. We are able to see civilians departing Irwin, moving on the MSR in the Valley of death heading towards MMA or Miami airfield. Ghost 2-6 this is Blackhorse X-Ray, Roger all.
27:00:00	CPOF location update	Gunslinger 6	Gunslinger 6: NV335063.	paper copy	Gunslinger 6	Location update for Gunslinger 6: NV335063
27:20	radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. Two of our tracks were just hit by direct fire. Tracks 1-6 and 1-1 are down. 1-7 and 1-2 are moving in to assist. Engaging 4 enemy tanks on our right flank at this time. Over. Gunslinger 6, this is Battle X-Ray. I copy two tracks down from direct fire, those tracks are 1-6 and 1-1. 1-7 and 1-2 are moving in to assist. Over.	radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. Two of our tracks were just hit by direct fire. Tracks 1-6 and 1-1 are down. 1-7 and 1-2 are moving in to assist. Engaging 4 enemy tanks on our right flank at this time. Over. Gunslinger 6, this is Battle X-Ray. I copy two tracks down from direct fire, those tracks are 1-6 and 1-1. 1-7 and 1-2 are moving in to assist. Over.
28:00-30:40	telephone call	brigade commander		telephone call	brigade commander	

28:20:00	e-mail	Ghost 1-6	Observing golf troop assault on airfield. Appears they came into contact with enemy obstacle belt previously reported. Instead of breaching obstacles they are moving around to the north. Advise against moving to the north for possible minefield.	Paper copy	Ghost 1-6	Ghost 1-6: Observation reporting. Observing golf troop assault on airfield. Appears they came into contact with enemy obstacle belt previously reported. Instead of breaching obstacles they are moving around to the north. Advise against moving to the north for possible minefield.
30:00	CPOF location update	Deathdealer 6	Deathdealer 6: NV395196	paper copy	Deathdealer 6	location update: Deathdealer 6: NV395196
30:40	radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. Track 1-2 has just been hit. Unable to reach 1-6 on the radio, 1-7 taking command of the platoon in the situation on the ground. Over. Gunslinger 6, this is Battle X-Ray. Copy 1-2 has been hit by direct fire, unable to reach 1-6 on the radio and 1-7 taking command of the platoon. Over	radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. Track 1-2 has just been hit. Unable to reach 1-6 on the radio, 1-7 taking command of the platoon in the situation on the ground. Over. Gunslinger 6, this is Battle X-Ray. Copy 1-2 has been hit by direct fire, unable to reach 1-6 on the radio and 1-7 taking command of the platoon. Over
31:20:00	CPOF message	Coldsteel 6	Coldsteel: We have negative contact with 3rd platoon, have been unable to reach them by Primary or alternate methods. Moving 1 PLT to last known location, vicinity John Wayne Foothills.	paper copy	Coldsteel 6	Coldsteel: We have negative contact with 3rd platoon, have been unable to reach them by Primary or alternate methods. Moving 1 PLT to last known location, vicinity John Wayne Foothills.
31:40:00	e-mail	Ghost 1-6	Observed Golf company vehicles hit by direct fire at grid NV336062. Enemy vehicles in fighting positions breaking contact and moving in direction of airfield buildings.	radio	Ghost 1-6 Battle x-Ray	Battle X-Ray, this is Ghost 1-6. We observed golf company vehicles hit by direct fire at grid NV336062. Enemy tank platoon and BMP platoon currently breaking contact and moving in direction of airfield buildings at this time. Over. Ghost 1-6 this is Battle x-ray. Copy all, over.
32:00:00	CPOF message	Easy 6	Easy 6: We had direct line of site and did not observe enemy fire hitting Gunslingers vehicles. We are red on ammo, currently only a quarter remains.	radio	Easy 6 Battle X-Ray	Battle x-ray, this is Easy 6. We had direct line of site and did not observe enemy fire hitting Gunslingers vehicles. Break..... We are red on ammo, currently only a quarter remains. Over. Easy 6, this is Battle x-ray. Copy all about golf company and that you are red on ammo.

32:40	CPOF message	Gunslinger 6	Gunslinger 6: Destroyed one enemy tank, appeared to be falling back from defensive positions. 3 more tanks bounding back at this time.	radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. We just destroyed one enemy tank falling back from defensive positions. 3 more tanks bounding back at this time, over. Gunslinger 6 this is Battle x-ray, Copy, destroyed one enemy tank.
33:00:00	mIRC Chat	division Battle captain	Division Battle Captian: Enemy activity reported just south of 11th ACR boundary line.	paper copy	division Battle captain	Division Battle Captian: Enemy activity reported just south of 11th ACR boundary line.
33:20	CPOF message	Assassin 6	Assassin 6: We have positive link up with the civil affairs team. They report that the town didn't realize it was coalition forces, now they want to help us. Aggressive civilian activity has all but ceased. I just received information that the Abar Layla mayor is concerned about activity in his town. Three vehicles towing big guns just pulled into the area near the helipad.	Radio	Assassin 6	Bengal X-Ray, this is Assassin 6. Positive link up with the civil affairs team. They report the town didn't realize it was us, now they want to help us. Aggressive activity has all but ceased.....Break..... Just received information that the Abar Layla mayor reported three vehicles towing big guns just pulled into town near the helipad. Over.
34:00:00	e-mail	division Battle captain	Division Battle Capt: ISR indicates an armored scout platoon located in the NV5113 gridsqre. Overhead view of bicycle Lake shows defensive positions all along the western side and along the North end of the main runway. Concentration of vehicles and antennae around the buildings at bicycle Lake near the helipad.	paper copy	division Battle captain	Bengal X-Ray Assassin 6, this is Bengal X-Ray, Roger all. Over. Division Battle Capt: ISR indicates an armored scout platoon located in the NV5113 gridsqre. Overhead view of bicycle Lake shows defensive positions all along the western side and along the North end of the main runway. Concentration of vehicles and antennae around the buildings at bicycle Lake near the helipad.
34:40	E-mail	Ghost 2-6	Ghost 2-6: enemy tanks observed east of Charlie Company position. Originally moving west along East Range Road. Currently making cloverleafs to the south with approximate position of NV570110, moving behind high ground near the snowcone. Will continue to monitor and report.	Paper copy	Ghost 2-6	Ghost 2-6: enemy tanks observed east of Charlie Company position. Originally moving west along East Range Road. Currently making cloverleafs to the south with approximate position of NV570110, moving behind high ground near the snowcone. Will continue to monitor and report.

35:20:00	CPOF message	Deathdealer 6	Deathdealer 6: Intel report. Four vehicle scout element destroyed north of granite pass. Recovered map indicates significant defensive positions to the East of the central corridor in the mountain range passes. Central valley area is part of a disruption zone. No artillery positions marked on the map in our AO. Concentration of markings, obstacles, and possible units on this map are Miami airfield, Eastgate area East of Al shark, Al Sabah east of red pass, as well as areas farther to the south out of our area of operations.	paper copy	Deathdealer 6	Deathdealer 6: Intel report. Four vehicle scout element destroyed north of granite pass. Recovered map indicates significant defensive positions to the East of the central corridor in the mountain range passes. Central valley area is part of a disruption zone. No artillery positions marked on the map in our AO. Concentration of markings, obstacles, and possible units on this map are Miami airfield, Eastgate area East of Al shark, Al Sabah east of red pass, as well as areas farther to the south out of our area of operations.
36:20:00	CPOF Message	Deathdealer 6	Enemy scout platoon: NV575115, bicycle Lake enemy update, enemy recon platoon near Granite Pass update with 4 vehicle markers destroyed, NV408207, NV412205, NV429212, NV438214. Possible enemy locations at Miami, MMA, Al shark, Al Sabah.	paper copy	enemy location update	Enemy scout platoon: NV575115, bicycle Lake enemy update, enemy recon platoon near Granite Pass update with 4 vehicle markers destroyed, NV408207, NV412205, NV429212, NV438214. Possible enemy locations at Miami, MMA, Al shark, Al Sabah.
37:00	CPOF message	Deathdealer 6	Deathdealer 6: Currently transporting four detainees to MP detention facility in Medina Wasl. All lower ranking, no English-speaking.	Radio	Deathdealer 6 Bengal X-Ray	Bengal X, this is Deathdealer 6. Transporting four detainees to detention facility in Medina Wasl. No English-speaking, no officers. Over. Deathdealer, this is Bengal, Copy transporting four detainees to Medina Wasl. Over.
37: 40	E-mail	Ghost 2-6	Ghost 2-6: Enemy recon platoon observed on unimproved desert trail 2 kilometers south of the snowcone. Currently stationary at approximately NV547088	radio	Ghost 2-6 Bengal X-Ray	Bengal X-Ray, this is Ghost 2-6. Enemy recon platoon observed on unimproved desert trail 2 kilometers south of the snowcone. Currently stationary at approximately NV547088. Over. Ghost, this is Bengal. Copy all, over

38:00:00	MIRC Chat	radio intercepts	airfield company commander Calling for indirect fire on coordinates NV335063. Asked for immediate fire for effect.	radio	Crazyhorse 3A Blackhorse X-Ray short pause Blackhorse X-Ray Battle X-Ray	Blackhorse X, This is Crazy horse 3A. Radio intercept indicated airfield company commander is calling for indirect fire on coordinates NV335063. Asked for immediate fire for effect, over crazy horse 3A, This is Blackhorse X-Ray, copy all. Battle X-Ray this is Blackhorse X-Ray, radio intercept indicates Possible indirect fire being called on NV335063, over Blackhorse X-ray, This is Battle x-ray, Roger, over.
38:40	radio	Ghost 2-6 Blackhorse X	Blackhorse X-Ray, this is Ghost 2-6. We just heard 6 rounds of artillery fire south of our location, specific origin unable to determine at this time, over Ghost 2-6, this is Blackhorse X-Ray, Roger, over.	radio	Ghost 2-6 Blackhorse X	Blackhorse X-Ray, this is Ghost 2-6. We just heard 6 rounds of artillery fire south of our location, specific origin unable to determine at this time, over Ghost 2-6, this is Blackhorse X-Ray, Roger, over.
39:00:00	CPOF message	Gunslinger 6	Gunslinger 6: 1st platoon has 3 vehicles down with severe damage, all 3 have one or both sides of tracks completely blown off, significant damage to the rest of the vehicles, all vehicle systems inop. 1-7 In charge of platoon and currently working recovery, 2nd and 3rd platoons continuing the fight.	radio	Gunslinger 6 Battle 6	Battle 6, this is Gunslinger 6. 1st platoon currently has 3 vehicles down. All 3 have one or both sides of the tracks completely blown off, all vehicle systems inoperable. 1-7 is in charge of a platoon and working recovery, 2nd and 3rd platoon continuing to fight. guns, this is Battle, Roger all, Continue to fight, over
39:40:00	Radio	Gunslinger 6 Battle 6	Battle 6, This is Gunslinger 6. We just had 6 rounds of artillery impact inside my formation, four more vehicles damaged, inoperable, still assessing situation. Unable to establish foothold on airfield, Standby. guns 6, This is Battle, standing by for report, over	Radio	Gunslinger 6 Battle 6	Battle 6, This is Gunslinger 6. We just had 6 rounds of artillery impact inside my formation, four more vehicles damaged, inoperable, still assessing situation. Unable to establish foothold on airfield, Standby. guns 6, This is Battle, standing by for report, over

40:00:00	e-mail	Ghost 1-6	Ghost 1-6: Enemy vehicles departing bicycle Lake airfield into the valley of death. Vehicles and personnel in the North remain in positions, Suppressed by Easy company. Western defensive line has fallen back to the airfield buildings, preparing to depart airfield. Remainder of 2 platoons, 8 to 12 armored vehicles departed airfield and moving through Bike Lake Pass.	Radio	Ghost 1-6	Battle X-Ray, this is Ghost 1-6. Enemy vehicles departing bicycle Lake airfield into the valley of death. Vehicles and personnel in the North remain in positions, Suppressed by Easy company. Break..... Western defensive line has fallen back to the airfield buildings, preparing to depart airfield. Remainder of 2 platoons, 8 to 12 armored vehicles departed airfield and moving through Bike Lake Pass. Over. Battle X-Ray Ghost 1-6, Roger, Over.
40:40:00	CPOF message	Battle 6	this is Battle 6, ordering hotel commander to assume foothold mission.	Radio	Battle 6 Havoc 6	Havoc 6, this is Battle 6. Assume Gunslinger's mission to establish a foothold on the airfield. Over. Battle 6, this is Havoc 6. Roger, I copy, assume Gunslinger's mission, and establish foothold on the airfield, over
41:00:00	MIRC Chat	Division command/ ISR	predator information: Predator being allocated to 11th ACR. Requests grids for focus locations.	paper copy	division command/ ISR	predator information: Predator being allocated to 11th ACR. Requests grids for focus locations.
41:20:00	CPOF message	Gunslinger 6	Gunslinger 6: Requesting wrecker support. 4 more tracks down approximately 200m directly N of obstacle belt.	Radio	Gunslinger 6 Battle X-Ray	Battle X-Ray, this is Gunslinger 6. Requesting wrecker support. 4 more tracks down down approximately 200m N of obstacle belt. Gunslinger 6, this is Battle x-ray, Roger copy all.

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APPENDIX B. SCENARIO 2, 3RD BRIGADE, 10TH MOUNTAIN DIVISION

Scenario 2 development, 10th MTN

Last Update: 10 Feb @ 15:32

6 Source				2 Source		
Time	Source	Callsign/channel	Report	Source	Callsign	Report
0:00	CPOF message	Delta 6	Delta 6: request ammunition resupply. Continuing to engage enemy positions from support by fire. Currently at 60% ammunition.	radio	Delta 6	Chosin x-ray this is Delta 6, request ammunition resupply. Continuing to engage enemy positions from support by fire. Currently at 60% ammunition. Over.
					Chosin X-Ray	this is Chosin X-Ray, Roger, over
0:20	radio	Ghost 1-6	Chosin X-Ray, this is Ghost 1-6. Still moving to observation position. Enemy at airfield is in prepared defensive positions. Currently observe 4 BMP's in defensive line at the end of the main runway, 1.5 km in front of Attack and Delta companies, over	radio	Ghost 1-6	Chosin X-Ray, this is Ghost 1-6. Still moving to observation position. Enemy at airfield is in prepared defensive positions. Currently observe 4 BMP's in defensive line at the end of the main runway, 1.5 km in front of Attack and Delta companies, over
		Chosin X-Ray	this is Chosin X-Ray, Roger all.		Chosin X-Ray	this is Chosin X-Ray, Roger all.
0:40	radio	Combat 6	Chosin x-ray, this is Combat 6. Obstacle belt breached near southern edge of runway, moving onto airfield at this time, over.	radio	Combat 6	Chosin x-ray, this is Combat 6. Obstacle belt breached near southern edge of runway, moving onto airfield at this time, over.
		Chosin X-Ray	Combat 6, this is Chosin X-Ray, Roger all.		Chosin X-Ray	Combat 6, this is Chosin X-Ray, Roger all.
1:00	Radio	Apache 6	Mohawk x-ray, this is Apache 6. We just made contact with enemy forces north of Medina Jabal, Standby for report. Over.	Radio	Apache 6	Mohawk x-ray, this is Apache 6. We just made contact with enemy forces north of Medina Jabal, Standby for report. Over.
		Mohawk x-ray	This is Mohawk x-ray, Roger.		Mohawk x-ray	this is Mohawk x-ray, Roger.
1:20	radio	Blackhawks 6	Mohawk x-ray, this is Blackhawk 6. Contact, enemy forces north of Jabal. Tracks 1-7 and 1-2 are stuck in the sand, currently taking fire from 6 defensive positions, I can see 4 BMP's and 2 tanks spread along the line, over	radio	Blackhawks 6	Mohawk x-ray, this is Blackhawk 6. Contact, enemy forces north of Jabal. Tracks 1-7 and 1-2 are stuck in the sand, currently taking fire from 6 defensive positions, I can see 4 BMP's and 2 tanks spread along the line, over
		Mohawk x-ray	This is Mohawk x-ray, Roger all.		Mohawk x-ray	This is Mohawk x-ray, Roger all.
1:40	location update	Battle 6	NV363120.	Radio	Battle 6	Chosin X-Ray, this is Battle 6, current location is, NV363120. Establishing security perimeter, holding here for instructions. Over
					Chosin X-Ray	Battle 6, this is Chosin x-ray, Roger, over.

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Scenario 2 development, 10th MTN

Last Update: 10 Feb @ 15:32

2:00	e-mails	Crazyhorse 3A	To: Spartan x-ray, Mohawk x-ray, Chosin x-ray. Message: Division Attack aircraft not able to fly at this time due to high winds and dust storm.	Radio	Crazyhorse 3A	To: Spartan x-ray, Mohawk x-ray, Chosin x-ray. Message: Division Attack aircraft not able to fly at this time due to high winds and dust storm.
2:20	mIRC Chat	predator operator	predator on station: Beginning surveillance according to tasking matrix.	Paper copy	predator operator	predator on station: Beginning surveillance according to tasking matrix.
2:40	E-mail	Spartan x-ray	To: Spartan x-ray, from Crazyhorse x-ray: message: we received a report that the 105 artillery pieces are currently stuck in the sand unable to occupy firing position for Charlie company.	Paper copy	Spartan X	Crazyhorse x-ray: message: we received a report that the 105 artillery pieces are currently stuck in the sand unable to occupy firing position for Charlie company.
3:00	mIRC Chat	radio intercept	(undecipherable), Request for a tank platoon to reinforce a northern defensive line and relocation of an artillery battery to support defensive line north of Medina Jabal.	paper copy	radio intercept	(undecipherable), Request for a tank platoon to reinforce a northern defensive line and relocation of an artillery battery to support defensive line north of Medina Jabal.
3:20	CPOF	Location update	Location update: 1-32, A: NV355074, Charlie Company: NV320050, weapons company: NV364061, 2-87: Charlie company: NV376079, A company NV404130.	paper copy	Location update	Location update: 1-32, A: NV355074, Charlie Company: NV320050, weapons company: NV364061, 2-87: Charlie company: NV376079, A company NV404130.
3:40	mIRC Chat	radio intercept	An order was given for a Tank platoon to recon the area north of NV395200.	radio	Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A. We just intercepted a radio transmission ordering a tank platoon to recon the area north of NV395200, over
					Spartan x-ray	this is Spartan X, Roger all.
4:00	e-mail	Ghost 2-6	From: Ghost 2-6, To: Chosin X-Ray, Message: observing heavy enemy BDA, multiple vehicles destroyed, enemy almost fully suppressed at this time. Little resistance, Charlie company has cleared obstacle belt just East of Barstow Road. Over.	radio	Ghost 2-6	Chosin X-Ray, this is Ghost 2-6. At the airfield, observing heavy enemy BDA, multiple vehicles destroyed, enemy almost fully suppressed at this time. Little resistance, Charlie company has cleared obstacle belt just East of Barstow Road. Over.
					Chosin X-Ray	this is Chosin x-ray, Roger

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4:20	radio	Mohawk 6	Comanche 6, this is Mohawk 6. Once you are moving into Hidden Valley, Make sure you pass location updates. Break....., BlackHawk 6, Mohawk 6, what's the status on your stuck vehicles. Over	radio	Mohawk 6	Comanche 6, this is Mohawk 6. Once you are moving into Hidden Valley, Make sure you pass location updates. Break....., BlackHawk 6, Mohawk 6, what's the status on your stuck vehicles. Over
4:40		Comanche 6 Blackhawk 6	Mohawk 6, Comanche 6 Roger over Mohawk 6, Blackhawk 6, still working to get them out, over		Comanche 6 Blackhawk 6	Mohawk 6, Comanche 6 Roger over Mohawk 6, Blackhawk 6, still working to get them out, over
5:00	CPOF message	Combat 6	Combat 6: Effectively suppressing 8 BMPs along Western side of main runway. Continuing advance towards airfield buildings and headquarters location.	radio	Combat 6	Chosin X-ray, this is Combat 6. Effectively suppressing 8 BMPs along Western side of main runway. Continuing advance towards airfield buildings and headquarters location. Over.
5:20	mIRC Chat	Predator report	Predator: Observing 4 heat signatures, possible BMPs in a prepared defensive positions vicinity NV660095. Also observing approximately 15-20 personnel moving supplies and digging. Camouflage netting covering possible gun Section.	paper copy	predator report	Predator: Observing 4 heat signatures, possible BMPs in a prepared defensive positions vicinity NV660095. Also observing approximately 15-20 personnel moving supplies and digging. Camouflage netting covering possible gun Section.
5:40	CPOF	location update	2-87: Charlie company, NV390075.	Radio	Comanche 6	Mohawk x-ray, this is Comanche 6. starting our movement into Hidden Valley, current location NV390075.
6:00	radio	Blackhawks 6	Mohawk 6, this is Blackhawk 6. 1-7's vehicle has been hit and destroyed while stuck in the sand. Trying to work the bump plan and get him back in the fight. 1-1 is also stuck, trying to aid recovery, we are still under fire. Over.	radio	Blackhawks 6	Mohawk 6, this is Blackhawk 6. 1-7's vehicle has been hit and destroyed while stuck in the sand. Trying to work the bump plan and get him back in the fight. 1-1 is also stuck, trying to aid recovery, we are still under fire. Over.
		Mohawk 6	Blackhawk 6, mohawk 6, Roger all.		Mohawk 6	Blackhawk 6, mohawk 6, Roger all.

6:20	E-mail	Battle 1-6	to: Mohawk x-ray, Spartan x-ray. From: Battle 1-6. Message: current location South of Medina Wasl at NV370115. some locals have been coming to check us out trying to bring us food and tea, do not appear hostile in any way.	paper copy	Battle 1-6	to: Mohawk x-ray, Spartan x-ray. From: Battle 1-6. Message: current location South of Medina Wasl at NV370115. some locals have been coming to check us out trying to bring us food and tea, do not appear hostile in any way.
6:40	mIRC Chat	predator report	Located an additional 20-30 prepared vehicle fighting positions near Red Pass in the East, still only observed previously reported activity. No additional hotspots.	radio	Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, ISR has located an additional 20-30 prepared vehicle fighting positions near Red Pass, still only observed previously reported activity, no additional hotspots. Over
7:00	Radio	Comanche 6	Mohawk x-ray, this is Comanche 6. We're at the entrance of Hidden Valley, On improved road directly south of Hill 928 near Miller's hole, tall hills may cutoff line of sight comms, will work with the primary and alternate communications, over	Radio	Comanche 6	Mohawk x-ray, this is Comanche 6. We're at the entrance of Hidden Valley, On improved road directly south of Hill 928 near Miller's hole, tall hills may cutoff line of sight comms, will work with the primary and alternate communications, over
		Mohawk x-ray	Comanche 6, this is Mohawk x-ray, Copy you are moving into Hidden Valley, will work both primary and alternate communication, over		Mohawk x-ray	Comanche 6, this is Mohawk x-ray, Copy you are moving into Hidden Valley, will work both primary and alternate communication, over
7:20-10:00	telephone	Brigade commander		telephone	Brigade commander	
8:20	CPOF message	Apaches 6	Apache 6: Destroyed 1 enemy BMP on northern edge of defensive line. Over	radio	Apaches 6	Mohawk x-ray, this is Apache 6. Destroyed 1 enemy BMP on northern edge of defensive line. Over
					Mohawk x-ray	Roger 1 enemy vehicle destroyed.
9:00	e-mail	Crazyhorse 3A	to: Spartan x-ray, Mohawk x-ray, Chosin x-ray, from: Crazyhorse 3A, message: brigade CCA still unable to fly due to high winds. Wind measurements taken every 10 min. will notify when able to fly.	paper copy	Crazyhorse 3A	to: Spartan x-ray, Mohawk x-ray, Chosin x-ray, from: Crazyhorse 3A, message: brigade CCA still unable to take off due to high winds. Wind measurements taken every 10 min. will notify when able to fly.

10:00	radio	Combat 6 Chosin X-Ray	Chosin x-ray, this is Combat 6. Enemy forces engaging us in the southwest have stopped fighting. Taking EPW's and securing equipment at this time. Over This is Chosin x-ray, Roger, over	radio	Combat 6 Chosin X-Ray	Chosin x-ray, this is Combat 6. Enemy forces engaging us in the southwest have stopped fighting. Taking EPW's and securing equipment at this time. Over This is Chosin x-ray, Roger, over
10:40	CPOF message	Apache 6	Apache 6: 2nd BMP destroyed on northern edge of defensive line approximately 1 and a half kilometers to our front (enemy @ NV445134). Continuing our advance East. Over.	Radio	Apache 6 Mohawk x-ray	Mohawk x-ray, this is Apache 6. 2nd BMP destroyed on northern edge of defensive line approximately 1 and a half kilometers to our front (enemy @ NV445134). Continuing our advance East. Over. This is Mohawk x-ray, Roger all, over
11:00	radio	Crazyhorse 3A Spartan x-ray	Spartan x-ray, this is Crazyhorse 3A, brigade Net, conducting radio check. Crazyhorse 3A this is Spartan x-ray, read you loud and clear, Over	radio	Crazyhorse 3A Spartan x-ray	Spartan x-ray, this is Crazyhorse 3A, brigade Net, conducting radio check. Crazyhorse 3A this is Spartan x-ray, read you loud and clear, Over
11:20	mIRC Chat	Radio intercepts	Commander at airfield coordinating forces in defense, calling for a position to fall back and others to hold their ground. Asking his commander (battalion commander) to support with mortars from Jabal.	Paper copy	radio intercept	Commander at airfield coordinating forces in defense, calling for a position to fall back and others to hold their ground. Asking his commander (battalion commander) to support with mortars from Jabal.
11:40	CPOF message	Blackhawk 6	Blackhawk 6: SITREP. 2 platoons continuing to engage enemy force along the defensive line extending north from Medina Jabal, 1st platoon vehicle stuck in sand with one destroyed. Over.	radio	Blackhawk 6 Mohawk x-ray	Mohawk x-ray, this is Blackhawk 6, SITREP.... 2 platoons continuing to engage enemy force along the defensive line extending north from Medina Jabal, 1st platoon vehicle stuck in sand with one destroyed. Over. this is Mohawk x-ray, Roger, over
12:00	CPOF	location updates	1-32: C Company: NV323046, A company: NV352069, Weapons Company: NV363061, bravo company: NV354124. 2-87: A company NV435132 Weapons Company NV417118, Bravo Company: NV419105, C Company still showing NV390075.	paper copy	location updates	1-32: C Company: NV323046, A company: NV352069, Weapons Company: NV363061, bravo company: NV354124. 2-87: A company NV435132 Weapons Company NV417118, Bravo Company: NV419105, C Company still showing NV390075.

12:20	e-mail	Crazyhorse 3A	To: Spartan x-ray, from: Crazyhorse 3A, message: winds have died down, CCA able to fly, 15 min. till airborne. 20 min. transit time to your AO.	radio	Crazyhorse 3A Spartan x-ray	Spartan x-ray, this is Crazyhorse 3A, CCA is able to fly, 15 min. until airborne, 20 min. transit time to your AO, over this is Spartan X-ray, Roger
12:40	radio	Combat 6 Chosin X-Ray	Chosin X-Ray, this is Combat 6, my lead element called for a cease-fire, white flags are coming out. Standby for rollup, Over. this is Chosin x-ray, Roger all, Over	radio	Combat 6 Chosin X-Ray	Chosin X-Ray, this is Combat 6, my lead element called for a cease-fire, white flags are coming out. Standby for rollup, Over. this is Chosin x-ray, Roger all, Over
13:00	CPOF message	Ghost 1-6	Ghost 1-6: Observe enemy vehicles displacing from fighting positions East of Al Shark. Organizing near the MSR on the western side. Looks like they are uncovering something, possibly gun tubes on the SoutEast side of town.	radio	Ghost 1-6 Mohawk x-ray	Mohawk x-ray, this is Ghost 1-6. We are observing enemy vehicles displacing from fighting positions East of Al Shark. Currently organizing near the MSR on the western side. Looks like they may be uncovering gun tubes on the southeast side of town as well. Over Roger all, over
13:20	mIRC Chat	radio intercept	Unknown enemy unit reporting less than 30 min. of ammunition remaining (Unable to tell which unit, North or South called it in)	radio	Crazyhorse 3A Spartan X	Spartan x-ray, this is Crazyhorse 3A. Radio intercept indicates an enemy unit reporting less than 30 min. of ammunition remaining. Over Crazyhorse this is X-ray, Roger.
14:00	CPOF message	Battle 6	Battle 6: Made linkup with the mayor of Medina Wasl. Mayor is very happy coalition forces are here. Wants us to protect his town, does not want us to leave, We'll see what other information he has for us.	Radio	Battle 6 Chosin X-Ray	Chosin X-Ray, This is Battle 6. Just made link up with the Mayor of Medina Wasl. He's very happy coalition forces are here and wants us to protect his town. He does not want us to leave. Will see what other information he has for us. Over this is Chosin x-ray, Roger all.
14:20	MIRC Chat	predator report	Predator: Tank company observed in prepared fighting positions facing West. Possible headquarters tents and mast antennas observed vicinity, NV745150.	paper copy	Predator report	Predator: Tank company observed in prepared fighting positions facing West. Possible headquarters tents and mast antennas observed vicinity, NV745150.

14:40	CPOF message	Blackhawk 6	BlackHawk 6: 1st platoon is still stuck in the sand. Platoon leaders track is only one operational. 1-6 is currently moving to pull security on disabled vehicles. 1st platoon is out of the fight for Blackhawk company.	Radio	Blackhawk 6	Mohawk x-ray, this is Blackhawk 6. 1st platoon is still stuck in the sand.Break..... Platoon leaders track is only one operational. 1-6 is currently moving to pull security on disabled vehicles. 1st platoon is out of the fight for Blackhawk. Over.
					Mohawk x-ray	Blackhawk 6, this is Mohawk x-ray, Copy, vehicles departing Medina Jabal and 1st platoon out of the fight. Over
15:20	CPOF	location update	A company, 2-87: NV444137.	paper copy	location update	A company, 2-87: NV444137.
15:40	e-mail	Crazyhorse 3A	to: Spartan x-ray, from :Crazyhorse 3A, message: Winds currently borderline for CCA. If they remain, aircraft are approximately 10 min. from take off.	radio	Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, Winds are currently borderline for CCA take off. If they remain, aircraft are approximately 10 min. from takeoff. Over
					Spartan x-ray	This is Spartan X-ray, Roger
16:00	radio	Combat 6	Chosin X-Ray, this is Combat 6. We have moved onto the airfield, securing EPW's. Approximately 50 personnel, 8 BMPs Break..... One platoon securing EPW's, 2 platoons moving forward to clear buildings. Over	radio	Combat 6	Chosin X-Ray, this is Combat 6. We have moved onto the airfield, securing EPW's. Approximately 50 personnel, 8 BMPs Break..... One platoon securing EPW's, 2 platoons moving forward to clear buildings. Over
			Chosin X-Ray, Combat 6, this is Chosin x-ray, Roger.		Chosin X-Ray,	Combat 6, this is Chosin x-ray, Roger.
16:20	e-mail		Placeholder			
16:40	radio	Blackhawk 6	Mohawk x-ray, this is Blackhawk 6. Currently engaging 6 BMPs and 2 tanks at this time. Over	radio	Blackhawk 6	Mohawk x-ray, this is Blackhawk 6. Currently engaging 6 BMPs and 2 tanks at this time. Over
		Mohawk x-ray	BlackHawk 6, this is Mohawk x-ray, copy, engaging BMPs and tanks north of Jabal. Over		Mohawk x-ray	BlackHawk 6, this is Mohawk x-ray, copy, engaging BMPs and tanks north of Jabal. Over
17:00	Radio	Combat 6	Attack 6, this is Combat 6. We currently have rounds impacting near our position. Suspecting maybe yours. Shift fires to the East, over	Radio	Combat 6	Attack 6, this is Combat 6. We currently have rounds impacting near our position. Suspecting maybe yours. Shift fires to the East, over

		Attack 6	Combat 6, Attack 6. Roger, shifting fires to the East, what is your current frontline trace. Over		Attack 6	Combat 6, Attack 6. Roger, shifting fires to the East, what is your current frontline trace. Over
		Combat 6	this is Combat 6, Front line trace is NV330034, over.		Combat 6	this is Combat 6, Front line trace is NV330034, over.
17:40	CPOF message	Mohawk 6	Mohawk 6: Comanche 6, What is your current SITREP.	radio	Mohawk 6	Mohawk 6: Comanche 6, What is your current SITREP.
18:00	CPOF	Location update	2-87 : Comanche company icon falls off, B Company: NV427105, weapons Company: NV426119, A company: NV453138	paper copy	location updates	2-87 with bravo company: NV427105, weapons Company: NV426119, A company: NV453138, Charlie Company no report.
18:20	Radio	Combat 6	Delta 6, This is Combat 6. Can you confirm that you have shifted fires to the East, my frontline trace is NV330034, over	Radio	Combat 6	Delta 6, This is Combat 6. Can you confirm that you have shifted fires to the East, my frontline trace is NV330034, over
		Delta 6	Combat 6 this is, Delta 6. Roger, confirm our fires are shifted east. Over.		Delta 6	Combat 6 this is, Delta 6. Roger, confirm our fires are shifted east. Over.
18:40	CPOF message	Blackhawks 6	Blackhawk 6: Confirm. Engaging 2 platoons north of Medina Jabal. (1 BMP platoon, one mixed tank and BMP platoon)	paper copy	Blackhawks 6	Blackhawk 6: Confirm. Engaging 2 platoons north of Medina Jabal. (1 BMP platoon, one mixed tank and BMP platoon)
19:00	CPOF message	Battle 6	Battle 6: Civilians in town currently providing limited information about enemy vehicles and locations around Medina Jabal. Mayor and townspeople want us to come into town. Very friendly.	paper copy	Battle 6	Battle 6: Civilians in town currently providing limited information about enemy vehicles and locations around Medina Jabal. Mayor and townspeople want us to come into town. Very friendly.
19:20	CPOF	location update	A company, 2-87: NV461139.	Radio	Apache 6	Mohawk x-ray, this is Apache 6. We are currently North and East of the enemy defensive line. Executing a short- halt, current location NV461139. Over
					Mohawk x-ray	This is Mohawk x-ray, Roger, over
19:40	radio	Mohawk 6	Comanche 6, this is Mohawk 6, what's your current SITREP. Over	radio	Mohawk 6	Comanche 6, this is Mohawk 6, what's your current SITREP. Over
20:00	CPOF message	Blackhawk 6	Blackhawk 6: Possible location for company headquarters and mortar position. Just south of Denver, approximate grid to follow.	radio	Blackhawk 6	Mohawk x-ray, this is Blackhawk 6. possible location for company headquarters and mortar positions. Just south of Denver, approximate grid....

				Mohawk x-ray	Blackhawk 6, this is Mohawk x-ray. You trailed off at the end did not copy grid, Say again, over.	
20:20	mIRC Chat	radio intercept	Radio intercept: A commander notifying that they have been flanked in the North. Requesting permission to begin a phased withdrawal to the main defensive line, Red Pass. Asks for Battalion mortar support for withdrawal.	paper copy	radio intercept	Radio intercept: A commander notifying his higher headquarters that they have been flanked in the North. Requesting permission to begin a phased withdrawal to the main defensive line, Red Pass. Asks for Battalion mortar support for withdrawal.
20:40	mIRC Chat	radio intercept	Radio intercept: Phased withdrawal request denied. Commander does not want to expose mortar positions. Brigade artillery assets may be repositioned from defensive line to support the Battalion's withdrawal.	paper copy	radio intercept	Radio intercept: Phased withdrawal request denied. Commander does not want to expose mortar positions. Brigade artillery assets may be repositioned from defensive line to support the Battalion's withdrawal.
21:00-23:20	Telephone	brigade commander		Telephone	brigade commander	
23:00	E-mail	Ghost 1-6	To: Spartan X-Ray, Mohawk X-Ray. From: Ghost 1-6, message: 2 enemy tanks directly in front of Destroyer company displacing to the southeast. Will continue to monitor and report.	paper copy	Ghost 1-6	To: Spartan X-Ray, Mohawk X-Ray. From: Ghost 1-6, message: 2 enemy tanks directly in front of Destroyer company displacing to the southeast. Will continue to monitor and report.
23:20	mIRC Chat	radio intercept	Commander advising his forces that coalition troops are inside the wire, They must continue fighting.	paper copy	radio intercept	Commander advising his forces that coalition troops are inside the wire, They must continue fighting.
23:40	radio	Destroyer 6 Mohawk x-ray	Mohawk x-ray, this is Destroyer 6. 1 enemy tank destroyed moving Southeast. Over. copy 1 enemy tank destroyed, Over	radio	Destroyer 6 Mohawk x-ray	Mohawk x-ray, this is Destroyer 6. 1 enemy tank destroyed moving Southeast. Over. copy 1 enemy tank destroyed, Over
0 24:00	CPOF message	Apache 6	Apache 6: Visual contact. Possible enemy tank company moving West on MSR E. Range Rd. They halted movement and established a hasty defensive line. Currently 5-6km east, southeast of our current location. North of MSR.	radio	Apache 6	Mohawk 6, this is Apache 6. We have visual contact with possible enemy tank company moving West on MSR East Range Road. They currently halted movement and established hasty defensive line, standby for grid. Over
					Mohawk 6	Keep me informed get me that grid. Over.

				Apache 6	Mohawk 6, Unable to get an exact grid. Approximately 5 to 6 kilometers east, southeast from our current location, just north of MSR, over	
0 24:40	radio	Blackhawk 6 Mohawk x-ray	Mohawk x-ray, this is Blackhawk 6. Destroyed enemy BMP, north of Jabal, over Roger, over	radio	Blackhawk 6 Mohawk x-ray	Mohawk x-ray, this is Blackhawk 6. Destroyed enemy BMP, north of Jabal, over Roger, over
0 25:00	e-mail	Ghost 1-6	to: Spartan x-ray, Mohawk x-ray, from: Ghost 1-6, message: observed enemy tank company establish hasty defensive line near NV520135	paper copy	Ghost 1-6	to: Spartan x-ray, Mohawk x-ray, from: Ghost 1-6, message: observed enemy tank company establish hasty defensive line near NV520135
0 25:20	radio	Apache 6	Mohawk 6, this is Apache 6. We are going to pull back 1 to 2 clicks in order to establish a hasty defensive line. Over.	radio	Apache 6	Mohawk 6, this is Apache 6. We are going to pull back 1 to 2 clicks in order to establish a hasty defensive line. Over.
0 25:40	radio	Mohawk 6 Apache 6	Apache 6, this is Mohawk. Negative on relocating to the West. Maintain your current position. We'll see if we can get the brigade reserve to provide support. Over. Roger maintain position, will establish hasty defense here, over	radio	Mohawk 6 Apache 6	Apache 6, this is Mohawk. Negative on relocating to the West. Maintain your current position. We'll see if we can get the brigade reserve to provide support. Over. Roger maintain position, will establish hasty defense here, over
026:20	CPOF message	Apache 6	Apache 6: Establishing defensive line at current location. Only 2 tow missile vehicles available for anti-armor weapons	paper copy	Apache 6	Apache 6: Establishing defensive line at current location. Only 2 tow missile vehicles available for anti-armor weapons
0 26:40	CPOF message	Blackhawk 6	Blackhawk 6: 2d BMP, destroyed in defensive line.	Radio	Blackhawk 6 Mohawk x-ray	Mohawk x-ray, 2d BMP, Destroyed in defensive line, over Roger, over
0 27:00	CPOF message	Mohawk x-ray	Mohawk x-ray: Comanche 6, What is your current SITREP, no response from radio.	radio	Mohawk x-ray	Comanche 6, this is Mohawk x-ray. What is your current SITREP, over.
0 27:20	mIRC Chat	radio intercept	A company commander asking again for battalion commander approval of a phased withdrawal. Notified that 3 vehicles have been destroyed and defensive line is vulnerable.	radio	Crazyhorse 3A Spartan X-Ray	Spartan X-Ray, Crazyhorse 3A, radio intercept indicates A company commander asking again for battalion commander approval of a phased withdrawal. Notified that 3 vehicles have been destroyed and defensive line is vulnerable, Over This is Spartan X-Ray, Roger

0 28:20	e-mail	Ghost 1-6	To: Mohawk x-ray, Spartan x-ray, from: Ghost 1-6, message: Observe enemy tank company establish hasty defensive line Vicinity, NV520135 Understand no indirect fire available at this time. Recommend getting CCA or fixed wing on station to engage. Remaining enemy vehicles in defensive line are beginning to displace and move to the South East, at this time.	Paper copy	Ghost 1-6	To: Mohawk x-ray, Spartan x-ray, from: Ghost 1-6, message: Observe enemy tank company establish hasty defensive line Vicinity, NV520135 Understand no indirect fire available at this time. Recommend getting CCA or fixed wing on station to engage. Remaining enemy vehicles in defensive line are beginning to displace and move to the South East, at this time.
0 29:00	mIRC Chat	predator report	Observed enemy vehicles in prepared fighting positions and possible headquarters antenna masts vicinity Al shark. 12 positions currently occupied, heat signatures confirming BMP hulls, another 20 positions recently vacated.	paper copy	Crazyhorse 3A	Crazyhorse 3A: ISR reports, observing enemy vehicles in prepared fighting positions and possible headquarters antenna masts vicinity Al shark. 12 positions currently occupied, heat signatures confirming BMP hulls, another 20 positions recently vacated.
0 29:40	radio	Battle 6 Chosin X-Ray	Chosin X-Ray, this is Battle 6, the Wasl mayor just informed me that one of his villagers saw an element moving towards granite pass from the Northeast. Currently prepping my unit to establish a blocking position just south of the pass, over Battle 6, This is Chosin X-Ray, understand all, over	radio	Battle 6 Chosin X-Ray	Chosin X-Ray, this is Battle 6, the Wasl mayor just informed me that one of his villagers saw an element moving towards granite pass from the Northeast. Currently prepping my unit to establish a blocking position just south of the pass, over Battle 6, This is Chosin X-Ray, understand all, over
30:20	MIRC Chat	Radio intercept	radio intercept: (Indecipherable)... Phased withdrawal ordered for all units. Order of withdrawal, North, Central, then South.	paper copy	radio intercept	radio intercept: (Indecipherable)... Phased withdrawal ordered for all units. Order of withdrawal, North, Central, then South.
30:40	e-mail	Ghost 2-6	approximately 5 to 10 min. ago. Personnel were starting a fire on the east side of the buildings. Observed material being dumped onto the fire.	radio	Ghost 2-6 Chosin X-Ray	Chosin X-Ray, this is Ghost 2-6, About 10 min. ago we observed personnel starting a fire on the east side of the airfield buildings. Personnel currently dumping material onto the fire. Over. Roger all, over

31:00:00	mIRC Chat	radio intercept	radio intercept: 3 commanders acknowledged the Battalion commanders order for withdrawal. Airfield commander acknowledged he's overrun will be unable to withdraw.	paper copy	radio intercept	radio intercept: 3 commanders acknowledged the Battalion commanders order for withdrawal. Airfield commander acknowledged he's overrun will be unable to withdraw.
31: 20	radio	Battle 6 Chosin 6	Chosin 6, this is Battle 6. 4 enemy BMPs moving south from granite pass. Moving to engage at this time, over This is Chosin 6, Roger	radio	Battle 6 Chosin 6	Chosin 6, this is Battle 6. 4 enemy BMPs moving south from granite pass. Moving to engage at this time, over This is Chosin 6, Roger
32:00-34:20	telephone call	brigade commander		telephone call	brigade commander	
33:20:00	CPOF message	Apache 6 Destroyer 6	Apache 6: Observed one tank and 2 BMPs Falling back to the South East from defensive line. Destroyer 6: Observing 3 tanks and four BMPs displacing from defensive line.	paper copy	Apache 6 Destroyer 6	Apache 6: Observed one tank and 2 BMPs Falling back to the South East from defensive line. Destroyer 6: Observing 3 tanks and four BMPs displacing from defensive line.
34:00	e-mail	Ghost 2-6	To: Spartan x-ray, Chosin x-ray, from: Ghost 2-6, message: observing enemy personnel throwing paper and equipment into the fire. May be trying to burn down the building.	Paper copy	Ghost 2-6	Ghost 2-6, message: observing enemy personnel throwing paper and equipment into the fire. May be trying to burn down the building.
34:40	CPOF message	Chosin 6 Mohawk 6 Chosin 6	Mohawk 6, this is Chosin 6. sounding like a pretty tough fight up there in the North, If you need reinforcements, Attack and Delta companies from my support by fire will be freed up momentarily, over Chosin 6, this is Mohawk, I was about to radio and ask you the same thing. Seems like we have them on the run up here, Are you in a heavy fight? Ahhhh, Negative, not at this time, over	radio	Chosin 6 Mohawk 6 Chosin 6	Mohawk 6, this is Chosin 6. sounding like a pretty tough fight up there in the North, If you need reinforcements, Attack and Delta companies from my support by fire will be freed up momentarily, over Chosin 6, this is Mohawk, I was about to radio and ask you the same thing. Seems like we have them on the run up here, Are you in a heavy fight? Ahhhh, Negative, not at this time, over
35:20:00	mIRC Chat	radio intercept	Tank company in the North ordered to disrupt coalition forces advance, or pursuit, during Battalion withdrawal.	radio	Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, Radio intercept indicates tank company in the North ordered to disrupt coalition forces advance, or pursuit, during Battalion withdrawal., over

				Spartan x-ray	Crazyhorse 3A, this is Spartan X-Ray, Roger all, over
35:40:00	CPOF message	Chosin 6	Chosin 6: All enemy forces at the airfield have surrendered, Attack Company secured platoon in the NE, 4 BMP's and all personnel, Combat 6 secured the command post, with 2 more BMPs and radio equipment. All fighting has ceased at the airfield at this time.	Paper copy Chosin 6	Chosin 6: All enemy forces at the airfield have surrendered, Attack Company secured platoon in the NE, 4 BMP's and all personnel, Combat 6 secured the command post, with 2 more BMPs and radio equipment. All fighting has ceased at the airfield at this time.
36:00:00	CPOF message	Battle 6	Battle 6: Engaging BMPs near Granite Pass. Enemy returning fire, and breaking contact, moving back to the north.	radio Battle 6	Chosin X-Ray, this is Battle 6. engaging enemy BMPs near Granite Pass. Enemy is returning fire and breaking contact, moving back to the North at this time, over
36:20	radio	Mohawk 6	Chosin 6, this is Mohawk 6. Are you observing tracers vicinity John Wayne Pass? Can you confirm? Over.	radio Mohawk 6	Battle 6, this is Chosin x-ray, Roger all, over Chosin 6, this is Mohawk 6. Are you observing tracers vicinity John Wayne Pass? Can you confirm? Over.
36:40:00	CPOF message	Combat 6	Combat 6: Appears most enemy documents and Intel was destroyed in a fire. Sorting through some usable remains at this time.	radio Combat 6	Chosin X-Ray, this is Combat 6, Appears most enemy documents and Intel was destroyed in a fire. Sorting through some usable remains at this time, over
				Chosin X-Ray	Combat 6, this is Chosin x-ray Roger, Must've been the fire Ghost 2-6 was reporting, over
37:00:00	e-mail	Ghost 1-6	to: Spartan X-ray, Mohawk x-ray, From: Ghost 1-6, message: 2 remaining enemy tanks from platoon on northern edge of defensive line have fallen back to the 1-1 grid line, 1km E of Denver. Remaining forces from southern platoon remain on line between Denver and Jabal. Possible battalion headquarters observed approximately 500 m south of Jabal's eastern helipad. Observe another headquarters element 500 m south of Denver, currently stationary.	paper copy Ghost 1-6	Ghost 1-6 message: 2 remaining enemy tanks from platoon on northern edge of defensive line have fallen back to the 1-1 grid line, 1km E of Denver. Remaining forces from southern platoon falling back on line between Denver and Jabal. Possible battalion headquarters observed approximately 500 m south of Jabal's eastern helipad. Observe another headquarters element 500 m south of Denver, currently stationary.

37:40	radio	Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, intercept indicates 3 artillery positions in addition to organic battalion mortars in your sector.	radio Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, intercept indicates 3 artillery positions in addition to organic battalion mortars in your sector. Over.
		Spartan x-ray	Crazyhorse 3A, this is Spartan x-ray Roger, over	Spartan x-ray	Crazyhorse 3A, this is Spartan x-ray Roger, over
38:00:00	mIRC Chat	predator report	Predator: Camouflage netting, covering vehicles or artillery sections east of Al Sabah near the NV6709 grid intersection. Similar netting and positions also observed East of Al Shark, near helipad. Unit in contact vicinity NV458066	radio Crazyhorse 3A	Spartan X-Ray, this is Crazyhorse 3A, ISR indicates Camouflage netting, covering vehicles or artillery sections east of Al Sabah near the NV6709 grid intersection. Break... Similar netting and positions also observed East of Al Shark, near helipad. Break... Possible friendly unit in contact vicinity NV458066. Over.
				Spartan X-Ray	Crazyhorse 3A, this is Spartan X-Ray, Roger all, over
38:40:00	radio	Blackhawk 6	Mohawk x-ray, this is Blackhawk 6, Request wrecker support for 2 vehicles from 1st platoon, at grid NV417104 Break.... 1-7 is still with the vehicles and will coordinate movement, over	radio Blackhawk 6	Mohawk x-ray, this is Blackhawk 6, Request wrecker support for 2 vehicles from 1st platoon, at grid NV417104. Break.... 1-7 is still with the vehicles and will coordinate movement, over
			Blackhawk 6, this is Mohawk x-ray, Roger all.	Mohawk x-ray	Blackhawk 6, this is Mohawk x-ray, Roger all.
39:00:00	CPOF	location update	C company: NV333028.	radio Combat 6	Chosin X-Ray, this is Combat 6. I'm currently located within the buildings of airfield, conducting sensitive site exploitation at this time. Over
				Chosin X-Ray	Combat 6, this is Chosin x-ray, Roger, over
39:20	MIRC Chat	Crazyhorse x-ray	division: CCA grounded due to high winds, continuing to monitor.	radio Crazyhorse 3A	Spartan x-ray, this is Crazyhorse 3A, CCA is currently grounded due to high winds, continuing to monitor, over
				Spartan x-ray	Crazyhorse 3A, this is Spartan X, Roger, over

39:40:00	CPOF message	Battle 6	Battle 6: Enemy scout platoon has broken contact and fallen back north of grant pass. I have reoccupied my initial rear security position. I have left one platoon on Granite Pass MSR North of Medina Wasl for constant observation on the pass.	radio	Battle 6 Chosin X-Ray	Chosin X-Ray, this is Battle 6, Enemy scout platoon has broken contact and fallen back north of Granite Pass. I have reoccupied my initial rear security position. I have left one platoon on Granite Pass MSR, North of Medina Wasl for constant observation on the pass. Over Battle 6. I copy all, over.
40:00:00	CPOF message	Blackhawk 6	Blackhawk 6: Just lost 2 tracks from 2d platoon to mechanical issues approximately 1km directly south from 1st PLT disabled tracks. Remaining section still in the fight. Unable to observe enemy movement at this time due to a smokescreen. I have ordered Platoons to conserve ammunition.	radio	Blackhawk 6 Mohawk x-ray	Mohawk x-ray, Blackhawk 6. Just lost 2 tracks from 2d platoon to mechanical issues approximately 1km directly south from 1st PLT disabled tracks. Remaining section still in the fight. Unable to observe enemy movement at this time due to a smokescreen. I have ordered Platoons to conserve ammunition. Over Roger Blackhawk 6
40:40	e-mail	Ghost 1-6	To: Spartan x-ray, Mohawk x-ray, from: Ghost 2-6, message: enemy mortar team observed, location NV445104.	Radio	Ghost 1-6	Mohawk X-Ray this is Ghost 1-6, observed enemy mortar team at grid NV445104. Over
41:00:00	e-mail	Battle 6	To: Spartan x-ray, Chosin x-ray, from: Battle 6, message: Mayor report. Mayor met with a man in few days ago, said he was the battalion commander, he said his 3 companies of men would require food and water from both Medina Jabal in Medina Wasl. He said the Mayor could find him just outside the South East corner of Medina Jabal. Mayor has not seen him since.	paper copy	Battle 6	Battle 6: Mayor report. Mayor met with a man in few days ago, said he was the battalion commander, he said his 3 companies of men would require food and water from both Medina Jabal in Medina Wasl. He said the Mayor could find him just outside the South East corner of Medina Jabal. Mayor has not seen him since.
41:40:00	mIRC Chat	radio intercept	radio intercept: Enemy brigade commander just ordered his subordinate commanders to keep the artillery covered in camouflage, we have confirmed coalition forces have ISR looking for it. Artillery will not be moved to support a withdrawal.	paper copy	radio intercept	radio intercept: Enemy brigade commander just ordered his subordinate commanders to keep the artillery covered in camouflage, we have confirmed coalition forces have ISR looking for it. Artillery will not be moved to support a withdrawal.

APPENDIX C. SLANT REPORT

1

Participant ID#: _____

Scenario 1

Line 1 - TF SLANT (operational quantities)

Companies: ____ / (8) **Platoon:** ____ / (28) **Tanks:** ____ / (56) **BFV's:** ____ / (64) **Key Leaders (PSG and Higher):** ____ / (74)

Units in Contact (list callsigns) : _____, _____, _____, _____

Line 2 - Known Enemy Strength

(Known **ALIVE** enemy equipment) / (**Destroyed or Captured**) Quantity

- A: Tanks (T-72) _____ / _____
- B: BMP _____ / _____
- C: Obstacle/minelfield
 IED location _____ / _____
- D: CCA (Atk Helo) _____ / _____
- E: Engineer Vehicles _____ / _____
- F: Artillery Sections _____ / _____
- G: Enemy HQ locations _____ / _____

Line 3 - Known Enemy Indirect Fire

Composition and size / (mtr or arty, section or plt)	Location / Grid	Friendly unit to notify Squadron or Troop callsign
1. _____ / _____	_____ / _____	_____
2. _____ / _____	_____ / _____	_____
3. _____ / _____	_____ / _____	_____
4. _____ / _____	_____ / _____	_____

Line 4 - Coalition Company, Combat Ineffective (<70% combat power vehicles, or <25% ammunition)

Unit /	Current Grid Location /	% combat power available (vehicle/ammo)
_____ / _____	_____ / _____	_____
_____ / _____	_____ / _____	_____
_____ / _____	_____ / _____	_____

Line 5 - Any Maneuver Unit (Platoon Or Higher) Out Of Radio Contact

Unit /	Last known grid location /	Possible current grid location
_____ / _____	_____ / _____	_____
_____ / _____	_____ / _____	_____
_____ / _____	_____ / _____	_____

Line 6 - Status of town/population support for CF presence

Green= Supportive, Amber= Neutral, Red= Unsupportive UK=UnKnown

- A: Town: Irwin _____
- B: Town: Medina Wasl _____
- C: Town: Medina Jabal _____

Line 7 - Sender's Assessment/ Key reporting

Figure 28. Scenario 1, SITREP, SLANT Report

Line 1 - TF SLANT (operational quantities)

Companies: ____ / (8) Platoon: ____ / (28) BFV's: ____ / (120) Key Leaders (PSG and Higher): ____ / (74)

Units in Contact (list callsigns) : _____, _____, _____, _____

Line 2 - Known Enemy Strength

(Known ALIVE enemy equipment) / (Destroyed or Captured) Quantity

- A: Tanks (T-72) _____ / _____
- B: BMP _____ / _____
- C: Obstacle/minefield
IED location _____ / _____
- D: CCA (Atk Helo) _____ / _____
- E: Engineer Vehicles _____ / _____
- F: Artillery Sections _____ / _____
- G: Enemy HQ locations _____ / _____

Line 3 - Known Enemy Indirect Fire

Composition and size / (mtr or arty, section or plt)	Location / Grid	Friendly unit in range of IDF Squadron or Troop callsign
1. _____ / _____	_____ / _____	_____
2. _____ / _____	_____ / _____	_____
3. _____ / _____	_____ / _____	_____
4. _____ / _____	_____ / _____	_____

Line 4 - Any Company Currently Combat Ineffective (<70% combat power vehicles, or <25% ammunition)

Unit /	Current Grid Location /	% combat power available (vehicle/ammo)
_____ /	_____ /	_____
_____ /	_____ /	_____
_____ /	_____ /	_____

Line 5 - Any Maneuver Unit (Platoon Or Higher) Out Of Radio Contact

Unit /	Last known grid location /	Possible current grid location
_____ /	_____ /	_____
_____ /	_____ /	_____
_____ /	_____ /	_____

Line 6 - Status of town/population support for CF presence

Green= Supportive, Amber= Neutral, Red= Unsupportive UK=UnKnown

- A: Town: Irwin _____
- B: Town: Medina Wasl _____
- C: Town: Medina Jabal _____

Line 7 - Sender's Assessment/ Key reporting

Figure 29. Scenario 2, SITREP, SLANT Report

APPENDIX D. PAPER TOC NOTES EXAMPLE

Urgent <input type="checkbox"/>
For: <u>Battle Captain</u>
Message type: radio <input checked="" type="checkbox"/> telephone <input type="checkbox"/> In person <input type="checkbox"/>
Message:
<p><i>From Ghost 2-6</i></p> <p><i>Enemy tanks observed east of Coldsteel's position. Originally moving west along East Range Road. Currently making cloverleafs to the south with approximate position of NV570110, moving behind high ground near the Snowcone.</i></p> <p><i>Will continue to monitor and report.</i></p>
3440

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APPENDIX E. DIGITAL TOC SIMULATION SCREENSHOTS

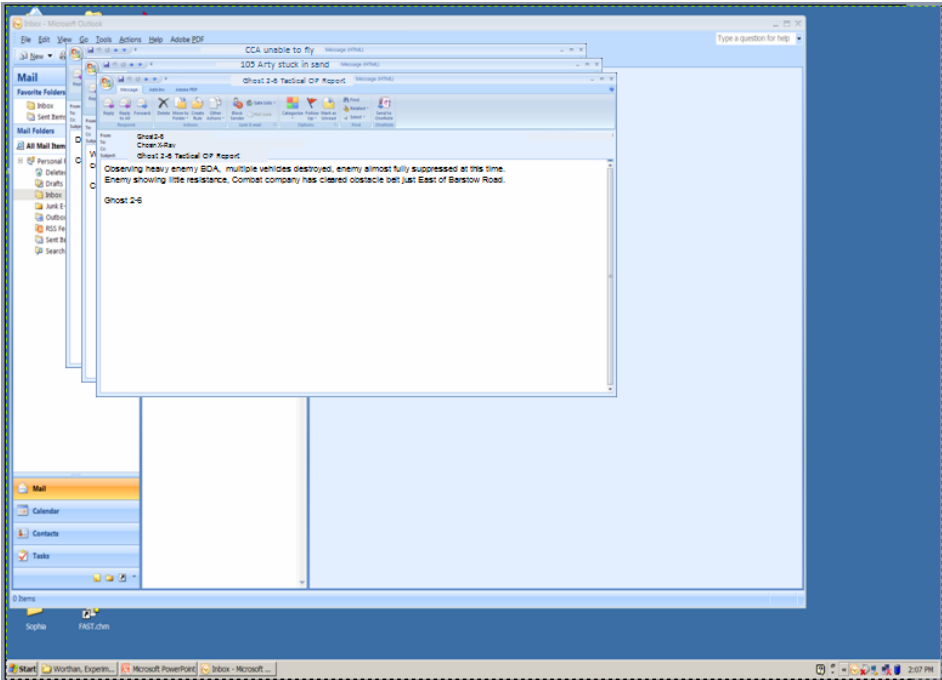


Figure 30. E-Mail Simulation Screenshot

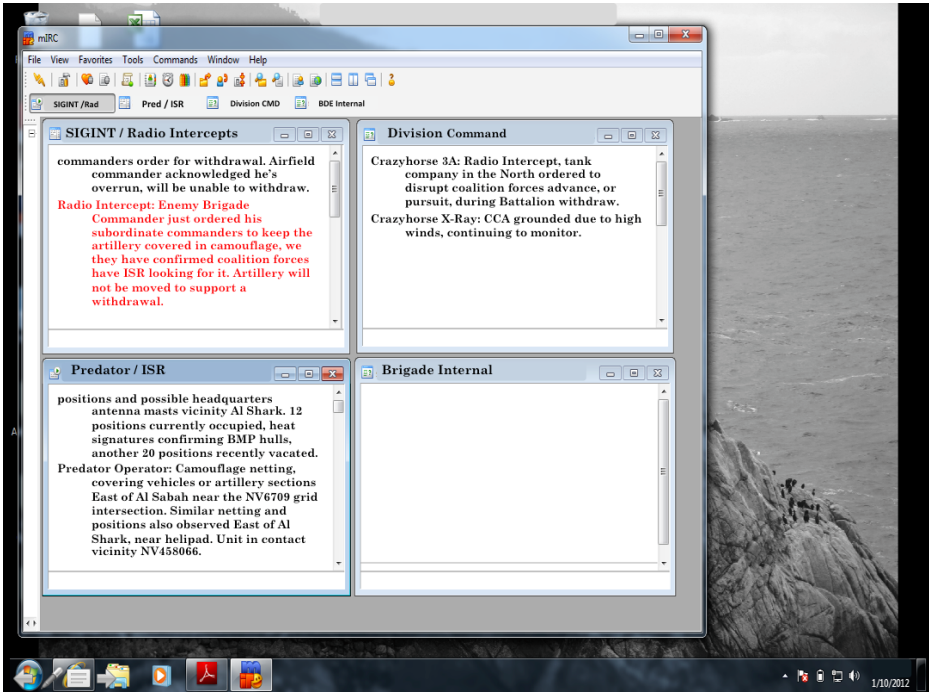


Figure 31. Mirc Chat Simulation Screenshot

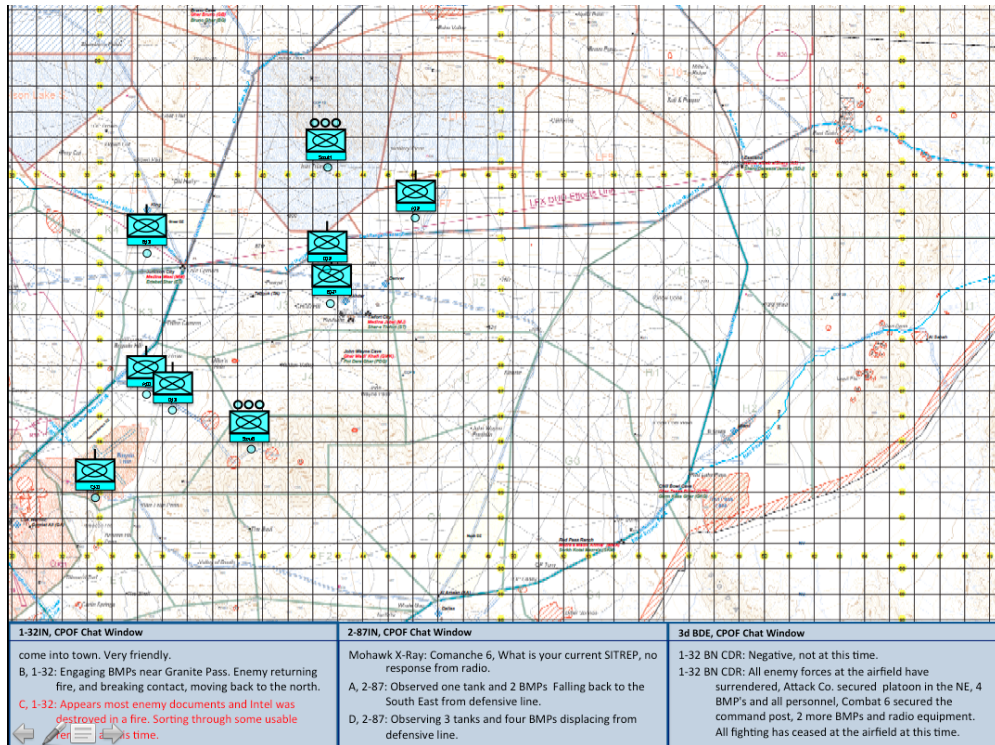


Figure 32. CPOF and Message Traffic Simulation Screenshot

APPENDIX F. DEMOGRAPHIC QUESTIONNAIRE

Participant ID#: _____

Date: _____

Demographic Information:

The following information is kept confidential and is used for data collection purposes only. Please omit any information that you do not wish to share. Information collected will be destroyed after completion of the study.

Please circle or fill in where appropriate:

Age: _____ Rank: _____
 Military specialty: _____ (example: infantry officer/artillery officer).
 Military service branch: _____ (example: Army/Marine Corps).
 What is your time in service? _____ years _____ months.
 Number of months in combat: Iraq _____, Afghanistan _____, Other _____.

Please answer the following questions:

Have you served as a battle captain? Yes / No
(If you answered no please return this form to the researcher and you will be excused from the experiment)

At what levels have you serve as a battle captain? (ex. battalion, brigade, division)
 Battalion: Y / N For how long?: _____ months On deployment Y / N
 Brigade: Y / N For how long?: _____ months On deployment Y / N
 Division: Y / N For how long?: _____ months On deployment Y / N
 Other: Y / N For how long?: _____ months On deployment Y / N

Have you participated in a mission rehearsal exercise at a Combat Training Center (CTC)? Y / N
 - How many rotations have you completed at a CTC? _____
 - How many rotations did you serve as a battle captain at a CTC? _____

Have you used command post of the future (CPOF)? Y / N

Do you have previous experience with a digital C2 interface? Y / N
 - ex. FBCB2

Have you used Mirc chat or jabber chat? Y / N

Have you used Microsoft outlook? Y / N

Are you familiar with military standard radio protocols? Y / N

Is your vision 20/20 correctable? Y / N

If you require correction lenses are they with you? Y / N

Do you have color vision deficiencies? Y / N

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APPENDIX G. OPERATIONS ORDERS

Scenario 1, Operations Order

Unit: 11 th ACR	OPORD# 001	Loc: Ft Irwin	DTG: 5/8/12 12:44 PM	Page 1
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Task Organization:

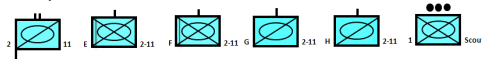
11th ACR Control:



1st Squadron 11th ACR:



2d Squadron 11th ACR:



1.b. Unit	Task	Purpose
1 st Sqdn (Ironhorse)	Disrupt enemy forces N of Bicycle Lake Airfield	Prevent enemy from massing combat power on Bicycle Lake Airfield
2d Sqdn (Eaglehorse)	Clear Bicycle Lake Airfield of enemy forces	Deny enemy ability to use airfield for operations
Scout 1	Occupy OP1	Support 2-11 with ISR information on OBJ Hester
Scout 2	Occupy OP2	Support 11 ACR with ISR information W of AO Irwin

1.c. Unit	Attach/Detach Instructions
Aviation	Detached to 3 ACR for duration of operation
ISR support	Detached to 3 ACR for duration of operation

2. Mission:	O/O, 11 th ACR attacks on Axis Rhineland to clear OBJ HESTER, vic Bicycle Lake Airfield (NV3004) to Deny enemy use of airfield
--------------------	---

3. INTENT- Purpose:	Maneuver units will conduct a search and attack to destroy all enemy forces established in defensive positions in the area that may interdict the Regiment as it prepares for follow-on operations. All airfields and possible landing strips must be secured to prevent enemy aviation assets from engaging Division high value targets and secure pick-up zones (PZ's) for future operations.
Methods:	Secure bicycle lake airfield and usable high ground on Tiefert Mountain; Establish secure mobility corridor though central valley on MSR East Range Road; Establish contact with town mayors in Medina Wasl, Medina Jabal and Irwin, gain and maintain civilian population support; Locate and destroy enemy IDF capability; Clear all enemy minefields, destroy weapons caches
EndState:	Area of operations (AO) clear of enemy forces, airfields and possible landing strips secure; Enemy indirect fires (IDF) unable to engage friendly forces; Civilian population protected, supported, and secure in where they live; Local leaders willing to provide information about enemy forces; Friendly units have freedom of movement on and off roads, enemy obstacles cleared, minefields neutralized; Maintain Troop size elements at 80% or higher to support follow-on operations

3.a. Concept of Operations: (Phase II only)
Phase IIA – Clear Objective Hester (Decisive): This phase begins when 1-11 ACR crosses phase line Abrams and attacks on Axis Rhineland. 2-11 follows 1-11 until reaching PL Laughlin, then 2-11 maneuvers south of 1-11 and attacks to clear OBJ Hester. 2-11 must establish a blocking position to the south to secure the southern flank of the Regiment. 1-11 conducts hasty clearing and occupation of OBJ Wilcox (Medina Wasl) and OBJ Peare (Medina Jabal) while establishing blocking positions in Granite pass to the N to secure northern flank and on MSR East Range Road, E of OBJ Peare. Fires priority to counterbattery and C2 nodes. At the end of this phase, 1-11 occupies OBJ Wilcox and OBJ Peare, established BP on Northern flank and screening force to the East. 2-11 has cleared OBJ Hester, established a BP to the South. Enemy IDF location identified. Friendly forces complete refuel and rearm in preparation for Phase III.

DP#	When	Grid	Decision (Action)	Criteria
1	1-11 Contact	Axis Rhineland	Redirect adjacent unit from primary mission to engaging enemy forces in central valley	1-11 decisively engaged by superior enemy force, or, Squadron combat power reduced below 70%
2	All	AO Irwin	Commit Reserve Company to maneuver squadron	Company element reduced below 80% effectiveness during ongoing TIC. If maneuver squadron is engaged by Brigade size enemy force
3	Obstacle or minefield contact	AO Irwin	Commit Engineer assets to deliberate clearance of minefield and/or obstacle belts	Identification of minefield on Axis Rhineland. Unable to bypass minefield or obstacle belt Enemy forces no longer able to place effective fires on the obstacle or minefield location

Concept of Fires:
 11th ACR has no dedicated artillery for this operation.
 Close air support is on call from fixed wing and rotary wing assets controlled by division HQ.

3.a.1. Scheme of Maneuver:

Event>	PL Abrams	PL Laughlin	Clear OBJ Hester	Clear Axis Rhineland	Consolidate/ Reorganize
Unit Est Time>	H Hour	H+30	H+2	H+2:30	H+3:30
1-11 ACR	2d in OOM	2d in OOM	Clear OBJ Wilcox and OBJ Peare	Clear Axis Rhineland to gridline 50-Easting	Prep for follow on operations
2-11 ACR	3d in OOM	Begin ATK South to OBJ HESTER	Clear OBJ Hester	Clear OBJ Hester	Prep for follow on operations
EN Co. 11 ACR	Lead element IED clearance	Lead element on Axis Rhineland	Support priority: 2-11, 1-11	Support Priority: 2-11, 1-11	Prep for follow on operations

Fire Support
 All fire support is provided by organic IDF assets within each squadron.
 CCA is on call. Priority to 2-11 then 1-11.

M-CM-S
 Phase II Mobility to PL Laughlin: obstacle/IED clearance- 1-11, 2-11
 Phase II Mobility after PL Laughlin: Obstacle clearance- 2-11, 1-11

Intelligence, Surveillance, and Recon (ISR) Priorities: (Phase or by Phase Line)	Situation Development	Targeting	Battle Damage Assessment	Indications & Warnings
1: Locate and Target IDF locations		IDF locations		
2: Location of enemy Brigade headquarters		HQ locations		
3: Locate or Support missing or cutoff CF unit				

b. Man Units	Tasks (Phase II ONLY)
1-11 ACR	<ol style="list-style-type: none"> O/O attack into AO Irwin Clear Axis Rhineland of IEDs Establish BP vic. Granite Pass in the N Occupy OBJ Wilcox Occupy OBJ Peare Establish screen-line E of OBJ Peare on East Range Rd Conduct rearm and refit in place and prepare for follow on missions
2-11 ACR	<ol style="list-style-type: none"> O/O attack into AO Irwin Follow 1-11 on Axis Rhineland until crossing PL Laughlin Attack South after PL Laughlin Establish BP on MSR S of OBJ Hester Clear OBJ Hester Conduct rearm and refit in place and prepare for follow on missions
Scout 1	<ol style="list-style-type: none"> Infiltrate AO Irwin ahead of 1-11 and report enemy disposition when observed Occupy OP 1 vic Millers Hole (NV3808) and report activity on OBJ Hester Provide enemy obstacle and minefield information to 2d Squadron Observe and report enemy disposition and activity surrounding OBJ Hester
Scout 2	<ol style="list-style-type: none"> Infiltrate AO Irwin ahead of 1-11 and report enemy disposition when observed Occupy OP 2 vic NV4305 on Tiefort Mtn Observe and report enemy disposition and activity E and S of Tiefort Mtn

c. CS Units	Task
ENG CO	<ol style="list-style-type: none"> O/O attack into AO Irwin Provide IED clearance support for 1-11 on Axis Rhineland Establish Regiment rear security W of OBJ Wilcox O/O coordinate movement through and conduct coordination with Squadrons in AO to clear obstacles as required O/O coordinate movement through and conduct coordination with Squadrons in AO to clear minefields as required
ADA CO	<ol style="list-style-type: none"> Prepare for split section ADA coverage Section 1 occupies firing position on Eastern screening boundary with 1-11 Section 2 Occupies firing position on Northern BP with 1-11
MP	<ol style="list-style-type: none"> Secure any EPW's or detainees from maneuver units Establish detention holding facility near OBJ Wilcox and report location when established

3.d. Coordinating Instructions

#	Priority Intelligence Requirements (PIR)	Start	End	Why? (DP or HPT)
1	What is the location, or suspected location of enemy IDF assets?	All	All	HPT
2	What is the composition and disposition of 1-77 th forces at Bicycle Lake?	Phase II	Phase II	
3	What is the composition and disposition of 1-77 th forces on Axis Rhineland	All	All	
4	Location of aviation assets capable of CCA	All	All	HPT
5	Status of Civilian population regarding presence of CF forces	All	All	

#	Friendly Forces Information Requirements (FFIR)	Start	End	DP#
6	Blocking positions making enemy contact with equal or superior enemy force	Phase II	Phase II	
7	Any maneuver company that becomes combat ineffective (less than 80% combat power)	All	All	2
8	Loss of contact with any maneuver element (platoon or higher) for 15min or more	All	All	
9	Loss of Platoon Sergeant (PSG) or higher	All	All	

#	Essential Elements of Friendly Information (EEFI)	Start	End
10	Time and location of 2d Squadron attack on Bicycle Lake airfield	Phase II	Phase II
11	Location and disposition of Reserve Company	All	All
12	Location of friendly indirect fire assets in AO Irwin	Phase II	Phase II
13	Location of Squadron command posts	All	All

4. Service Support.

Push critical supplies to support consolidation, rearm and refit of all Regiment units. Priority of support: 2-11 then 1-11. Maintenance, forward resupply 2 DOS of critical combat resources (Class V, Class IIIB and Class IV).

5.a. Command: (Phase II ONLY)

Location of Commander: Commander is located with 1-11 during initial movement then relocating to the TAC as 2-11 maneuvers to ATK Hester

b. Signal:

Scenario 2, Operations Order

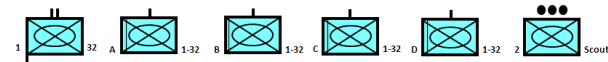
Unit: 3d Brigade, 10th MTN	OPORD# 002	Loc: Ft Irwin	DTG: 5/8/12 12:44 PM	Page 1
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Task Organization:

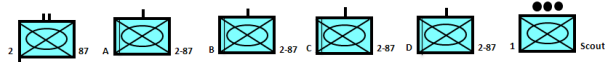
3d Brigade:



1-32 Infantry:



2-87 Infantry:



1.b. Unit	Task	Purpose
1-32IN 10 th MTN (Chosin)	Clear OBJ ORR (Bicycle Lake Airfield)	Prevent enemy ability to use airfield for operations and mass forces against 2-87
2-87IN 10 th MTN (Catamounts)	Clear enemy forces N of OBJ ORR (Bicycle Lake Airfield)	Allow freedom of movement for follow-on division operations
Scout 1	Occupy OP1	Support 2-87 with ISR information
Scout 2	Occupy OP2	Support 1-32 with ISR information

1.c. Unit	Attach/Detach Instructions
Aviation	None
ISR support	Division level Predator available

2. Mission:

O/O, 3d Brigade 10th Mountain attacks on Axis Chosin to clear the Division mobility corridor Mountain Climber allowing freedom of movement for follow-on Division operations

3. INTENT- Purpose:

Maneuver units will conduct a search and attack to destroy all enemy forces established in defensive positions in the area that may interdict the Brigade as it prepares for follow-on operations. All airfields and possible landing strips must be secured to prevent enemy aviation assets from engaging Division high value targets and secure pick-up zones (PZ's) for future operations.

Methods:

Secure bicycle lake airfield and usable high ground on Tiefert Mountain and northern high ground;
 Establish secure mobility corridor though central valley on MSR East Range Road;
 Limit enemy ability to withdraw and reconstitute;
 Locate and destroy enemy IDF capability;
 Clear all enemy minefields, clear IEDs, destroy weapons caches

EndState:

Area of operations (AO) clear of enemy forces, airfields and possible landing strips secure;
 Enemy indirect fires (IDF) unable to engage friendly forces in mobility corridor Mountain Climber;
 Enemy unable to reconstitute a force large enough to mount a successful defense or counterattack;
 Limited damage to towns and surrounding villages;
 Local leaders willing to provide information about enemy forces;
 Friendly units have freedom of movement on and off roads, enemy obstacles cleared, minefields neutralized;
 Maintain Troop size elements at 80% or higher to support follow-on operations

3.a. Concept of Operations: (Phase II only)
Phase IIA – Clear Objective Orr (supporting), Miller (Decisive), and Telley (decisive): This phase begins when 2-87IN crosses phase line Albaugh and attacks on Axis Chosin. 1-32 follows 2-87 until reaching PL Briseno, then 1-32 maneuvers south of 2-87 and attacks to clear OBJ Orr. 2-87 executes hasty clearance of OBJ Miller (Medina Wasl) and OBJ Telley (Medina Jabal) enroute to identified enemy defensive positions N of OBJ Telley. Fires priority to counterbattery and C2 nodes. At the end of this phase, 1-32 occupies OBJ Orr. 2-87 has cleared OBJ Miller and OBJ Telley and enemy defensive positions E to the 50-easting gridline. Enemy IDF locations identified. Friendly forces complete refuel and rearm in preparation for Phase IIB.

DP#	When	Grid	Decision (Action)	Criteria
1	Enemy Contact	AO Irwin	Redirect unit from primary mission to engage enemy forces in another AO	Battalion requires assistance
2	All	AO Irwin	Commit Reserve Company to maneuver squadron	Company element reduced below 80% effectiveness during ongoing TIC. If maneuver squadron is engaged by Brigade size enemy force
3	Obstacle or minefield contact	AO Irwin	Commit Engineer assets to deliberate clearance of minefield and/or obstacle belts	Identification of minefield on Axis Rhineland. Unable to bypass minefield or obstacle belt Enemy forces no longer able to place effective fires on the obstacle or minefield location

Concept of Fires:
 3d Brigade has a battery of 105s moving in support of the operation.
 The 105's are to follow 1-32 and provide supporting fires for their clearance of OBJ ORR.

 Close air support is on call from fixed wing and rotary wing assets controlled by division HQ.
New document

3.a.1. Scheme of Maneuver:

Event>	PL Albaugh	PL Briseno	Clear OBJ Orr, OBJ Telley, OBJ Miller	Clear Axis Chosin	Consolidate / Reorganize
Unit Est Time>	H Hour	H+30	H+2	H+2:30	H+3:30
2-87 IN	2d in OOM on Axis Chosin	2d in OOM on Axis Chosin	Clear OBJ Telley and OBJ Miller	Clear Axis Chosin to gridline 50 Easting	Prep for follow-on operations
1-32 IN	3d in OOM on Axis Chosin	Begin ATK Sout to OBJ Hester	Clear OBJ Orr	Clear OBJ Orr	Prep for follow-on operations
EN Co	Lead element IED clearance	Lead element on Axis Chosin	Support Priority: 2-87, 1-32	Support Priority: 2-87, 1-32	Prep for follow-on operations

Fire Support
 3d Infantry Brigade has a battery of 105's in support. Priority for 105s goes to 2-87 for the duration of the operation.
 Close air support is on call from fixed wing and rotary wing assets controlled by division HQ.

M-CM-S
 Phase II Mobility to PL Briseno: Obstacle/IED clearance- 2-87, 1-32
 Phase II Mobility after PL Briseno: Obstacle clearance- 2-87, 1-32.

Intelligence, Surveillance, and Recon (ISR) Priorities: (Phase or by Phase Line)	Situation Development	Targeting	Battle Damage Assessment	Indications & Warnings
1: Locate and Target IDF locations		IDF locations		
2: Location of enemy Brigade headquarters		HQ locations		
3: Locate or Support missing or cutoff CF unit				

b. Man Units	Tasks (Phase II ONLY)
2-87IN	<ol style="list-style-type: none"> O/O attack on Axis Chosin Clear Axis Chosin of IEDs Clear OBJ MILLER (Medina Wasl) Clear OBJ TELLEY (Medina Jabal) Clear enemy defensive positions to the 50-Easting gridline Conduct rearm and refit in place and prepare for follow on missions
1-32IN	<ol style="list-style-type: none"> O/O attack on Axis Chosin Follow 2-87 on axis Chosin until crossing PL Briseno Attack South after PL Briseno Maintain Brigade rear security throughout operation Clear OBJ ORR Conduct rearm and refit in place and prepare for follow on missions
Scout 1	<ol style="list-style-type: none"> Infiltrate AO ahead of 2-87 and report enemy disposition when observed Occupy OP 1 vic N of mobility corridor (NV425145) and report activity in mobility corridor Mountain Climber Provide enemy obstacle and minefield information to 2-87 Observe and report enemy disposition and activity surrounding OBJ MILLER and OBJ TELLEY
Scout 2	<ol style="list-style-type: none"> Infiltrate AO Irwin ahead of 2-87 and report enemy disposition when observed Occupy OP 2 vic NV385041 on Tiefert Mtn Observe and report enemy disposition and activity E and S of Tiefert Mtn to 1-32IN

c. CS Units	Task
ENG CO	<ol style="list-style-type: none"> O/O attack on Axis Chosin Provide IED clearance support for 2-87 on Axis Chosin O/O coordinate movement through and conduct coordination with Battalions in AO to clear obstacles as required O/O coordinate movement through and conduct coordination with Squadrons in AO to clear minefields as required
MP	<ol style="list-style-type: none"> Secure any EPW's or detainees from maneuver units Establish detention holding facility near OBJ ORR and report location when established

3.d. Coordinating Instructions

#	Priority Intelligence Requirements (PIR)	Start	End	Why? (DP or HPT)
1	What is the location, or suspected location of enemy IDF assets?	All	All	HPT
2	What is the composition and disposition of 1-78 th forces at Bicycle Lake?	Phase II	Phase II	
3	What is the composition and disposition of 1-78 th forces on Axis Chosin	All	All	
4	Location of aviation assets capable of CCA	All	All	
5	Status of civilian population regarding presence of CF forces	All	All	

#	Friendly Forces Information Requirements (FFIR)	Start	End	DP#
6	Blocking positions making enemy contact with equal or superior enemy force	Phase II	Phase II	
7	Any maneuver company that becomes combat ineffective (less than 80% combat power)	All	All	2

8	Loss of contact with any maneuver element (platoon or higher) for more than 15min	All	All	
9	Loss of Platoon Sergeant (PSG) or higher	All	All	

#	Essential Elements of Friendly Information (EEFI)	Start	End
10	Time and location of 1-32 IN attack on Bicycle Lake airfield	Phase II	Phase II
11	Location and disposition of Reserve Company	All	All
12	Location of friendly indirect fire assets on Axis Chosin	Phase II	Phase II
13	Location of Squadron command posts	All	All

4. Service Support.
 Push critical supplies to support consolidation, rearm and refit of all Brigade units. Priority of support: 2-87 then 1-32. Maintenance, forward resupply 2 DOS of critical combat resources (Class V, Class IIIB and Class IV).

5.a. Command: (Phase II ONLY)
 Location of Commander: Commander is located with 2-87 during initial movement then relocating to the TAC as 1-32 maneuvers to ATK OBJ ORR

b. Signal:

APPENDIX H. SHIFT CHANGEOVER BRIEFS

Scenario 1, Shift Changeover Brief

Scenario 1, 11th ACR

TOC Change-over/ Mission brief for 11th ACR

This brief is a quick rundown of the Operations Order and TOC changeover brief to get you up to speed on military operations currently happening in AO Irwin before you take over as the 11th ACR Battle Captain. You may follow along if you like with the paper copy on your desk. Your callsign as the Battle Captain is Blackhorse 3A.

At this time the commander is about 40 to 50 min. out, and is en-route to this location. The commander calls regularly on Satellite phone to get an update on the battlefield situation. You must be able to provide him a SITREP using the modified SLANT report format on your desk.

Currently the 11th ACR is conducting operations in AO Irwin to defeat elements of the 177th mechanized infantry brigade currently established in defensive positions throughout the AO.

Task organization is unchanged from previous operations. As you can see it's 11th ACR pure with only the 2 maneuver squadrons and the engineer platoon and MP platoon attached from the support Squadron. 1st squadron consists of its 4 maneuver companies and an attached Scout platoon, alpha and bravo companies are mechanized infantry, Charlie and Delta companies are tank companies. 2nd squadron also consists of 2 infantry companies and 2 tank companies and an attached scout platoon. E and Fox companies are the mechanized infantry, golf and hotel are tank companies. The engineers and MP units remain under 11th ACR control.

The mission for 11th ACR is to attack on axis Rhineland to clear objective Hester, which is Bicycle Lake airfield, to deny enemy the use of the airfield.

Commander's intent for this operation is for maneuver units to conduct a search and attack, to destroy all enemy forces established in defensive positions in the area that may prohibit the Regiment from establishing a secure mobility corridor. All airfields and possible landing strips must be cleared to prevent enemy aviation assets from engaging division high-value targets and secure pickup zones for future operations.

The end state for this operation is, AO Irwin clear of enemy forces, with airfields and possible landing strips secure. Enemy indirect fire must be unable to engage friendly forces within the AO. The civilian population is protected and supported within the towns and rural areas. Local leaders must be willing to provide information about enemy force composition and locations. Friendly units must have freedom of movement on and off roads, enemy obstacles cleared, all mine fields neutralized. Maintain troop size elements at 80% or higher to support follow-on operations.

As you can see from mission graphics for the concept of operations in this phase, phase 2, 2nd squadron is the main effort and will clear objective Hester of enemy forces and establish a blocking position just north of Erwin. 1st squadron conducts a

Scenario 1, 11th ACR

shaping operation in the north along the main mobility corridor clearing objective Wilcox, which is Medina Wasl, and also clear objective Peare, which is Medina Jabal. 1st squadron is also tasked with establishing a blocking position on the main MSR traveling north from Medina Wasl through granite pass, and also establishing a screen line to the east of Medina Jabal near the 47 E. grid line.

At this time elements from 11th ACR are at or near their assigned locations and objectives according to the mission graphics.

Objective Wilcox and objective Peare have been secured by Assassin and Blackjack companies. ColdSteel is in the process of establishing the screenline to the east and Deathdealer company has established a blocking position in the North. 2nd squadron is prepared to commence its assault to clear Objective Hester. Easy Troop is in the process of establishing the support by fire position to the North. Fox Troop is close to establishing the blocking position just north of Irwin. And golf and hotel companies are in the process of occupying their attack positions.

As you can see from the sparse enemy graphics overlay, we do not have a lot of information about enemy forces in this area. We expected to see mechanized infantry platoons in Medina Wasl and Medina Jabal, but Assassin and Blackjack encountered no enemy forces when they cleared those towns. At this time no enemy forces have been observed in the northern mobility corridor.

At this time we know there are enemy forces on objective Hester occupying defensive positions on the airfield, but we are unable to determine an accurate size or composition at this time. Best estimates from Intel indicates there may be a company size element of either tank or mechanized infantry forces supported by mechanized engineers platoon, or possibly an engineer company.

If you want, at this time you can review the tasks to maneuver units, however, most important thing for you to get acquainted with is the coordinating instructions and the CCIR for the regimental commander. Along with keeping track of friendly slant reports, compiling reports on enemy size, composition, and location along with the BDA, the commander calls regularly, about every 10 minutes asking for the battle captain to give them the most updated information from the standard SITREP report format.

11th ACR has no dedicated artillery for this operation, all fire support is on call from fixed wing and rotary wing assets currently being controlled by a division.

And as per SOP due to the volatile nature of our power grid, you need to keep analog copies of all information, particularly the SLANT report and unit locations on the map in case we lose power and digital systems go down. (ie. At the end of the experiment and the presentations are complete.)

Scenario 1, 11th ACR

Since you're just getting up to speed with this current operation, I'll give you a quick breakdown about where the units are on the map, as well as all the call signs associated with the units. I made up a chart so you have the units and call signs for a quick reference handout.

Most all of the information the commander is looking for on the SITREP format comes straight from the CCIR on page 3-4 of the OPORD.

Do you have any questions at this time about unit locations, call signs, mission objectives, commander's critical information requirements, or what will be required for your final brief once the commander makes it to the TOC?

Scenario 2, Shift Changeover Brief

Scenario 2, 3d BDE

TOC changeover/mission brief for 3rd brigade 10th Mountain division

This brief is a quick rundown of the operations order and TOC changeover brief to get you up to speed on military operations currently happening in AO Irwin before you take over as the 3d BDE Battle Captain. You may follow along if you like with the paper copy on your desk. Your callsign as the Battle Captain is Spartan 3A.

At this time the commander is about 40 to 50 min. out, and is en-route to this location. The commander calls regularly on Satellite phone to get an update on the battlefield situation. You must be able to provide him a SITREP using the modified SLANT report format on your desk. We will review the format during a short familiarization session prior to your taking over the Battle Captain desk.

Currently 3rd brigade is conducting operations in AO Erwin to defeat elements of the 178 mechanized infantry brigade currently established in defensive positions throughout the AO.

Task organization is unchanged from previous operations. As you can see it's 3rd Brigade pure with only the 2 maneuver battalions and the engineer platoon and MP platoon remaining under brigade control. 1-32 infantry consists of its 4 maneuver companies Alpha through Delta as well as the scout platoon. 2-87 infantry also consists of 4 infantry companies and one scout platoon. All units are mechanized infantry or mechanized scouts in 3rd brigade.

The mission for 3rd brigade is to on order, attack on axis chosen to clear the division mobility corridor, mountain climber, allowing freedom of movement for follow-on division operations.

The commander's intent for this operation is for maneuver units to conduct a search and attack to destroy all enemy forces established in defensive positions in the area that may prohibit them from establishing a secure mobility corridor. All airfields and possible landing strips must be secured to prevent enemy aviation assets from engaging division high-value targets and secure pickup zones for future operations.

The end state for this operation is, AO Irwin clear of enemy forces from all airfields and possible landing strips secured. Enemy indirect fire must be unable to engage friendly forces within mobility corridor (mountain climber). Enemy must not be unable to reconstitute a force large enough to mount a successful Defense or counterattack against a battalion sized force. Minimize collateral damage to towns and surrounding villages throughout the operation, and all local leaders must be willing to provide information about enemy forces.

As you can see from the mission graphics for the concept of operations in this phase, phase 2, 2-87 infantry is the main effort and will clear objectives Miller and Telley of enemy forces to enable the establishment of the division mobility corridor. 1-32 infantry conducts a shaping operation in the South to clear Objective Orr, which is

Scenario 2, 3d BDE

Bicycle Lake Airfield, and also establish a blocking position to the North of Medina Wasl on the MSR going to Granite Pass.

At this time elements from 3rd brigade are at or near their assigned locations and objectives according to the mission graphics.

Objective Miller has been secured, and Apache, Destroyer, and Black Hawk companies are continuing their advance East, towards enemy defensive positions north of Objective Telley.

For 1-32 Attack and Delta companies have established the support by fire, on the north side of the airfield, and Combat Company is in the process of breaching an obstacle belt west of the airfield. Battle company is establishing the blocking position near Medina Wasl.

As you can see from the sparse enemy graphics overlay, we do not have a lot of information about enemy forces in this area. We did not encounter enemy forces occupying objective Miller, (Medina Wasl), but have observed a defensive line extending north from Medina Jabal as well as enemy forces on the airfield.

Intel estimates place a company size element at the airfield and a company size element or larger north of Medina Jabal.

If you want, at this time you can review the tasks to maneuver units, however, most important thing for you to get acquainted with is the coordinating instructions and the CCIR for the Brigade commander. Along with keeping track of friendly slant reports, compiling reports on enemy size, composition, and location along with the BDA, the commander calls regularly, about every 10 minutes asking for the battle captain to give them the most updated information from the standard SITREP report format.

3d Brigade has no dedicated artillery for this operation, all fire support is on call from fixed wing and rotary wing assets currently being controlled by division.

And as per SOP, due to the volatile nature of our power grid, you need to keep analog copies of all information, particularly the SLANT report and unit locations on the map in case we lose power and digital systems go down. (ie. At the end of the experiment and the presentations are complete.)

Since you're just getting up to speed with this current operation, I'll give you a quick breakdown about where the units are on the map, as well as all the call signs associated with the units. I made up a chart so you have the units and call signs for a quick reference handout.

Before we complete the changeover, take a look at the SITREP report format you will have to brief to the commander when he calls on the telephone. Most all of the

Scenario 2, 3d BDE

information the commander is looking for on the SITREP format comes straight from the CCIR on page 3-4 of the OPORD.

Do you have any questions at this time about unit locations, call signs, mission objectives, commander's critical information requirements, or what will be required for your final brief once the commander makes it to the TOC?

APPENDIX I. COVARIATE ANALYSIS TABLES

Memory Search

SITREP

	β Value	SD (β)	t-Score	p-Value
β_0	-0.039	0.073		
β_1	-0.115	0.104	-0.4	0.714
β_2	0.177	0.121	-1.0	0.351
β_3	-0.039	0.171	1.0	0.314

Map

	β Value	SD (β)	t-Score	p-Value
β_0	0.630	0.054		
β_1	-0.005	0.077	-0.06	0.954
β_2	0.112	0.090	1.24	0.229
β_3	0.014	0.127	0.11	0.914

Workload

	β Value	SD (β)	t-Score	p-Value
β_0	0.825	0.110		
β_1	-0.067	0.156	-0.43	0.673
β_2	-0.200	0.182	-1.10	0.285
β_3	-0.162	0.258	-0.63	0.536

Delayed Memory

SITREP

	β Value	SD (β)	t- Score	p- Value
β_0	0.571	0.080		
β_1	0.026	0.114	0.23	0.824
β_2	-0.027	0.137	-0.20	0.843
β_3	0.064	0.193	0.33	0.744

Map

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.587	0.052		
β_1	0.065	0.073	0.89	0.386
β_2	0.191	0.088	2.17	0.042
β_3	-0.112	0.125	-0.90	0.380

Workload

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.823	0.118		
β_1	-0.017	0.167	-0.10	0.922
β_2	-0.201	0.201	-1.00	0.329
β_3	-0.257	0.284	-0.90	0.377

Reading Rate**SITREP**

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.481	0.090		
β_1	0.210	0.127	1.65	0.115
β_2	0.000	0.000	0.87	0.393
β_3	0.000	0.000	-1.23	0.234

Map

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.716	0.066		
β_1	0.114	0.093	1.22	0.235
β_2	0.000	0.000	-0.37	0.712
β_3	0.000	0.000	-1.25	0.227

Workload

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.825	0.149		
β_1	-0.225	0.210	-1.07	0.298
β_2	0.000	0.000	-0.79	0.436
β_3	0.000	0.001	0.33	0.744

Effective Reading Rate

SITREP

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.477	0.068		
β_1	0.135	0.097	1.40	0.177
β_2	0.000	0.000	1.26	0.223
β_3	0.000	0.000	-0.83	0.414

Map

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.759	0.050		
β_1	0.012	0.071	0.18	0.863
β_2	0.000	0.000	-1.45	0.163
β_3	0.000	0.000	-0.14	0.891

Workload

	β Value	St. Dev (β)	t- Score	p- Value
β_0	0.802	0.112		
β_1	-0.331	0.158	-2.09	0.049
β_2	0.000	0.001	-0.87	0.396
β_3	0.001	0.001	1.19	0.248

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LIST OF REFERENCES

- XVIII Airborne Corps. (1991). DS-F-118-12A [photograph]. PFC John F. Freund. Retrieved from http://www.history.army.mil/photos/gulf_war/ods.htm
- Air Force 711 Human Performance Wing, Directorate of Human Performance Integration, Human Performance Optimization Division. (2008). *Air Force Human Systems Integration Handbook*. Washington D.C.: Government Printing Office.
- Alberts, D.S., Garstka, D.J., Hayes, R.E., & Signori, D.A. (2001, August). *Understanding information age warfare*. Washington, D.C.: CCRP publication.
- Alberts, D.S., Garstka, J.J., & Stein, F.P. (2000). Network centric warfare. *Developing and leveraging information superiority*. Washington, D.C.: CCRP Publication.
- Alberts, D.S., & Hayes, R.E. (2003). *Power to the edge*. Washington, D.C.: CCRP publication.
- Automated Neuropsychological Assessment Metrics (Version 4) [Computer software]. (2007). Norman, OK: Center for the Study of Human Operator Performance (C-SHOP), University of Oklahoma.
- Battle Command Training Center. (2006). *Staff officer's guide*. Fort Leavenworth, KS: Battle Command Training Center.
- Booher, H. R. (2003). *Handbook of human systems integration*. Hoboken, NJ: Wiley-Interscience.
- Brehmer, B. (2005, June). The dynamic OODA loop: Amalgamating Boyd's OODA loop and the cybernetic approach to command and control. In the *10th International Command and Control Research and Technology Symposium, The Future of C2*. Symposium conducted at the Department of War Studies, Swedish National Defence College, Stockholm.
- Broadbent, D. (1971). *Decision and stress*. London: Academic Press.
- Butcher, H. (1995). Information overload in management and business. *IEE Colloquium Digest*, 95/223, (pp. 1–2).
- C-SHOP. (2007). *ANAM4: Software user manual*. Center for the Study of Human Operator Performance, Norman, OK: University of Oklahoma.

- CCRP, & AIAA TC IC2S. (2001, June). Report of the workshop on sensemaking. March 6-8, 2001. Retrieved from http://www.dodccrp.org/events/2001/sensemaking_workshop/index.htm
- Department of the Army. (2003). *Mission command: Command and control of Army forces*. Army Field Manual 6-0. Washington, D.C.: U.S. Government Printing Office.
- Department of the Army. (2004). *Operational terms and graphics. Field Manual 1-02*. Washington, D.C.: U.S. Government Printing Office.
- Department of the Army. (2008). *Operations. Field Manual 3-0*. Washington, D.C.: U.S. Government Printing Office.
- Department of the Navy. *OPNAV Instruction 9640.1A, Shipboard habitability program 3 September 1996* [memorandum].
- Dixon, S.R., & Wickens, C.D. (2003, April). Control of multiple UAVs: A workload analysis. *International Symposium on Aviation Psychology*, Dayton, OH.
- Driver, M., & Mock, T. (1975). Human information processing decision style theory, and accounting information systems. *Accounting Review*, 50, 490–508.
- Edmunds, A., & Morris, A. (2000). The problem of information overload in business organizations: A review of the literature. *International Journal of Information Management*, 20 (17–28), Loughborough, UK.
- Endsley, M.R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors*, 37(1), 32–64.
- Fang, I.E. (1997). *A history of mass communication: Six information revolutions*. Boston, MA: Focal Press.
- Gilmore, G.J. (1999, October 13). Army to develop future force now, says Shinseki. *Army News Service*, Washington, D.C. Retrieved from <http://www.fas.org/man/dod-101/army/unit/docs/a19991013shinvis.htm>
- Government Accounting Office. (1998, June 30). *Battlefield automation: Acquisition issues facing the army battle command, brigade and below program* (Letter Report, GAO/NSIAD-98-140).

- Jensen, E. & Brehmer, B. (2005, March). Sensemaking in the fog of war. An experimental study of how command teams arrive at a basis for action. Paper submitted to the *10th Command and control Research and Technology Symposium*, McLean, VA, June 13–16.
- Klapp, O.E. (1986). *In overload and boredom: Essays on the quality of life in the information society*. Connecticut: Greenwood Press.
- Klein, G., Moon, B., & Hoffman, R.R. (2006a). Making sense of sensemaking 1: Alternative perspectives. *Intelligent Systems, IEEE*, 21(4), 70–73.
- Klein, G., Moon, B., & Hoffman, R.R. (2006b). Making sense of sensemaking 2: A macrocognitive model. *Intelligent Systems, IEEE*, 21(5), 88–92.
- Kramer, A.F., Sirevaag, E.J., & Braune R. (1987). A psychophysiological assessment of operator workload during simulated flight missions. *Human Factors*, 29(2), 145–160.
- Leedom, D.K. (2001, October). Sensemaking Symposium. Final report to the Command and Control Research Program, Office of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence, U.S. Department of Defense.
- Lewis, D. (1996). *Dying for information?* London: Reuters Business Information.
- Luximon, A., & Goonetilleke, R. (1998). Continuous subjective workload assessment technique. In R. Bishu, W. Karwowski, & R. Goonetillege (Eds.), *Ergonomics for Global Quality and Productivity*, Human Performance Laboratory, Department of industrial Engineering and Engineering Management, Howloon, Hong Kong: Hong Kong University of Science and Technology Clear Water Bay.
- MANPRINT Directorate. (2005). *Manpower and personnel integration*. MANPRINT Handbook, Washington, D.C.: Author.
- McKendrick, R., Shaw, T., Saqer, H., De Visser, E., & Parasuraman, R. (2011). Team performance and communication within networked supervisory control human-machine systems. Presented at the *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 55(1), 262–266.
- Miller, G.A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63, 81–97.
- Miller N.L., & Shattuck, L.G. (2004, June). A process model of situated cognition in military command and control. *Command and Control Research and Technology* symposium. Symposium conducted at the Naval Postgraduate School, Monterey, CA.

- Office of Force Transformation. (2005). *The implementation of network-centric warfare*. Washington, D.C.: Department of Defense.
- O'Reilly III, C.A. (1980). Individuals and information overload in organizations: Is more necessarily better? *Academy of Management Journal*, 23(4), 684–696.
- Oskamp, S. (1965). Overconfidence in case-study judgments. *Journal of Consulting Psychology*, 29(3), 261.
- Rhodes, D.H., & Minami, N.A. (2007). *Re-Architecting the battalion tactical operations center: Transitioning to Network Centric Operations*. Cambridge, MA: Massachusetts Institute of Technology.
- Sarno, K.J., & Wickens, C.D. (1995). The role of multiple resources in predicting time-sharing efficiency: An evaluation of three workload models in a multiple task setting. *International Journal of Aviation Psychology*, 5(1), 107–130.
- Schroder, H., Driver, M., & Steufert, S. (1967). *Human information processing*. New York: Holt Rinehart & Winston.
- Shattuck, L.G., & Miller, N.L. (2006). Extending naturalistic decision making to complex organizations: A dynamic model of situated cognition. *Organization Studies*, 27(7), 989.
- Sutz, R., & Weverka, P. (2012). Speed reading pre-test: Establishing your effective reading rate. Retrieved from <http://www.dummies.com/how-to/content/speed-reading-pretest-establishing-your-effective-.html>
- Thunholm, P. (2008). Providing battlespace information to reduce uncertainty: Will more information lead to better plans? *Human Factors: The Journal of Cognitive Engineering and Decision Making*, 2(4), 295–310.
- von Clausewitz, C. (1976). *On war*. Translated by M. Howard, & P. Paret. Princeton: Princeton University Press.
- Wallace, W.S. (2005). Network-enabled battle command. *Military Review* May-June 2005, pp. 2–5.
- Welford, A.T. (1967). Single channel operation in the brain. *Acta Psychologica*, 27, 5–21.
- Wickens, C.D. (2002). Multiple resources and performance prediction. *Theoretical Issues in Ergonomics Science*, 3(2), 159–177.

Wickens, C.D. (2008). Multiple resources and mental workload. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 50(3), 449–455.

Wickens, C.D., Gordon, S.E., & Liu, Y. (1998). *An introduction to human factors engineering*. Longman Publishing, New York.

Yeh, Y., & Wickens, C.D. (1988). Dissociation of performance and subjective measures of workload. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 30(1), 111–120.

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