

**Command and Control of the Future Mechanized Task:
The Impact of Technology on the Task Force Commander**

**A Monograph
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ABSTRACT

**COMMAND AND CONTROL OF THE FUTURE MECHANIZED TASK:
THE IMPACT OF TECHNOLOGY ON THE TASK FORCE COMMANDER BY
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The mechanized task force commander contends with many factors that define his environment. To assist him in contending with this environment, he employs a command and control system consisting of personnel, communication, equipment, facilities, and procedures. To the extent that this system allows the commander to understand and operate within its environment, it contributes to the unit's ultimate success or failure.

The US Army intends to replace the 1990's command and control system with an information age system termed Force XXI Battle Command System, Brigade and Below (FBCB2). This system promises to improve the performance of the command and control system by incorporating advanced technologies and systematic improvements to the legacy system. FBCB2's ability to achieve this goal depends upon its ability to understand the environment and to communicate this information to the commander.

This monograph examines the dynamic relationship that exists between FBCB2 and its environment. It does so by examining first the environment in which all command and control systems operate and identifying sources of complexity. Then the paper assesses command and control as a system as well as the objective design and function of FBCB2. Finally the monograph compares FBCB2 to the projected future environment to assess its ability to assist the commander in understanding that environment.

This study concludes that FBCB2 will assist the commander in understanding his environment because it will simplify the execution of his command and control tasks. FBCB2 will simplify these tasks because it will increase the time available to the commander to execute his command and control tasks, reduce the number of those tasks, and reduce those tasks' difficulty.

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CHAPTER ONE INTRODUCTION

Major General John W. O'Daniel wrote in 1946 that "we paid heavily in lives and in material to learn that armor, like every other arm, is not sufficient unto itself but must work with other arms not only for its own security but to achieve maximum results from combat."¹ O'Daniel, the Post-World War II Commandant of the Infantry School, related in this statement two original reasons for tank and mechanized infantry task forces. The US Army employs the task force to this day not only for these reasons, but also because doctrinally it "has the necessary command and control and support capabilities to employ combined arms formations."²

Forty-three years after it made its debut in the European Theater of World War II, the US Army held an experiment involving tank and mechanized infantry task forces at the National Training Center (NTC). Called the Task Force XXI Advanced Warfighting Experiment (TF XXI AWE), this experiment hypothesized that "if information age battle command capabilities and connectivity – digitization - exist across all battlefield operating systems (BOS) and functions within and up to a brigade TF (Task Force), then significant increases in lethality, survivability, and tempo will be achieved."³ This experiment included testing of proposed future tank and mechanized infantry task forces. The experiment also reinforced the idea that command and control systems played a significant part in that future.⁴

The TF XXI AWE demonstrates that technology will play an increased role in future command and control systems. This example reinforces experiences of tank and mechanized infantry task forces in World War II, Korea, Vietnam, and the Persian Gulf. These experiences demonstrate a trend of increased technological influence on the efficiency of command and control systems. They also demonstrate an increasing level of complexity in the task force's environment.

The task forces' command and control systems and their operating environment constitute entities that fundamentally conflict with each other. The command and control system exists to enable the commander to successfully complete his

mission. The task force's environment consists of a series of factors that provide challenges to mission accomplishment. Whether the command and control system succeeds depends upon the commander's ability to employ it in a manner that accounts for the demands posed by the environment in which the task force operates.

This struggle illuminates a fundamental historical challenge facing commanders. One may view this underlying tension between the commander and his environment as the essence of command. Theorist Martin Van Creveld identifies this tension when he writes that "the history of command in war consists of essentially an endless quest for certainty—certainty about the state and intentions of the enemy's forces; certainty about the manifold factors that together constitute the environment in which the war is fought...and, last but definitely not least, certainty about the state, intentions, and activities of one's own forces."⁵ This quest provides focus for this paper's examination of command and control systems.

The Force XXI Battle Command System, Brigade and Below (FBCB2), represents the US Army's quest of certainty in the future. As a command and control system, FBCB2 will succeed because it provides future commanders the ability to exceed the challenges posed by the future environment. This system and its ability to enable the future tank and mechanized infantry commander to dominate his environment allows one to examine future military operations.

The term environmental complexity describes one challenge facing future task forces. The environment in this context refers to what Field Manual 71-2, *The Tank and Mechanized Infantry Battalion Task Force*, describes as the factors of mission, enemy, terrain and weather, troops, and time available (METT-T).⁶ According to expert M. Mitchell Waldrop in his book *Complexity*, this term communicates that "a great many independent agents are interacting with each other in a great many ways."⁷ Environmental complexity, therefore, simply means that the METT-T factors the commander faces become more difficult as time progresses. Since the command and control system serves the commander by assisting him in understanding his particular situation in order to act in it, studying this system requires studying its environment.

The US Army defines command and control as “the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission.”⁸ To exercise command and control, the commander has available to him a system. This command and control system consists of resources including personnel, communication, equipment, facilities, and procedures.⁹ The command and control system enables the commander to accomplish his command and control tasks by assisting him in developing plans, preparing the unit to execute them, and in controlling the execution of the mission.

The tasks the commander must accomplish in commanding and controlling the mechanized battalion task force follow this same “plan, prepare, and execute” format. These tasks, listed in the *Mission Training Plan for the Tank and Mechanized Infantry Task Force*, focus the commander on his critical tasks of executing the military decision making process (MDMP), issuing orders, and commanding and controlling the unit in execution of its assigned mission.¹⁰

This monograph examines the effectiveness of the command and control system equipped with FBCB2 by examining its impact on command and control as a function of simplicity. The commander with a system that simplifies the command and control process in a complex environment commands more effectively because he devotes more time and effort to commanding his unit and less time to sorting out and understanding the environment. Essentially, this raises the question, “Will FBCB2 simplify the task force commander’s tasks of commanding and controlling the tank and mechanized infantry task force?”

Three measures used as criteria to establish whether simplicity exists in a command and control system are the time available to the commander to execute his tasks, the numbers of tasks the commander must execute, and the cognitive difficulty of these tasks. Because FBCB2 reduces the time it takes the commander to execute his tasks, reduces the number of tasks he must perform, and makes those tasks easier to accomplish, it simplifies the commander’s execution of his tasks. FBCB2 therefore provides a more effective command and control system to the future task force commander.

In order to demonstrate how FBCB2 simplifies the commander's tasks, this monograph examines command and control in the present and its expected future against its corresponding environment. Initially the monograph describes the existing and future sources of complexity in the task force's operational environment. Next this paper examines the doctrinal basis of command and control as the US Army practices it today. Given this foundation, the monograph then establishes what FBCB2 is and how it will impact the command and control system's ability to assist the commander in dominating this environment.

This assessment identifies the some key challenges facing command and control systems internally and within their environments. Consequently this assessment allows the paper to examine FBCB2's ability to provide future commanders with the ability to meet these challenges. This examination identifies how FBCB2 performs, or aids in performing those command and control tasks in order to assess how FBCB2 impacts the commander's effectiveness.

In conclusion to this study, the papers establishes that FBCB2 simplifies the tank and mechanized infantry task force commander's command and control tasks according to the selected criteria. This assessment results from the analysis throughout the paper concerning the future environment and the Army's approach to command and control for task forces operating in it: FBCB2. The analysis that follows should inform the future tank and mechanized infantry task force commander and staff and allow them to better understand of their unit's command and control system.

CHAPTER TWO THE ENVIRONMENT

The environment in which the mechanized task force operates has grown in complexity. Conceived of and created in France during World War II,¹¹ the task force has since performed missions in the Korean, Vietnam, and Persian Gulf Wars. Each deployment found additional factors entering the battlefield environment, making the command and control of task forces more difficult over time.

Army doctrine contained in FM 100-5, *Operations*, and the *1998 Annual Report on the Army After Next (AAN) Project* predict a future consistent with the idiom that "the past is prologue." These works reflect complexity existing and expected in the operating environments of all type units across the spectrum of military operations. As the AAN report itself succinctly states, "operational environments will likely become more complex."¹²

According to the AAN report, an assessment of each of the environmental factors of METT-T reflects an expanding number of challenges interacting within the future task force command and control system. Assessed independently of each other, these challenges indicate various levels of increasing complexity. Together these challenges portray the hurdle facing FBCB2 and the commanders who employ it.

A sequential assessment of the METT-T factors illuminates the challenges these factors pose to the task force in the future. The first factor, mission, refers to the "primary task assigned to the unit," according to FM 71-2.¹³ The nature of those missions assigned to task forces reflects the nature of interventions in which the US involves itself, an evolution in itself.

The range of missions assigned to the task force increases in the expected future. The AAN report addresses future operational environments in terms of war, conflict, and peacetime.¹⁴ This description employs the same range of military operations currently described in FM 100-5.¹⁵ The AAN report, however, predicts further evolution of missions assigned to the task force for several reasons.

One of these reasons reflects military theorist Carl Von Clausewitz' dictum that war is a "continuation of political

intercourse, carried on by other means.”¹⁶ Finding its basis in the current National Security Strategy mandate of “engagement and enlargement, the AAN report predicts that “accordingly, US involvement and participation in international contingency operations are likely to expand even further beyond the current heavy frequency and scope.”¹⁷

While this prediction applies to the Army at large, the AAN report also addresses a need for balance within future deployed forces.¹⁸ This approach confirms the continued need for mechanized forces in 2025. Balance implies that mechanized forces augment light forces in this future and vice-versa.

This approach increases the range of missions for the mechanized task force. Additionally, by placing emphasis on the “versatility” of the force,¹⁹ the AAN report perpetuates a concept first elaborated on in the 1993 edition of FM 100-5, *Operations*.²⁰ Defined as “the ability of units to meet diverse mission requirements,” versatility, a Tenet of Army Operations, provides insight into the diversity of those missions to which the mechanized task force may find itself assigned.²¹

Versatility acknowledges that the engagement and enlargement strategy remains a predominant factor in employing military force. Rather than restricting the potential missions of the future force, this emphasis instead intentionally broadens them. The term “versatility” dispels the notion that the military can predict how civilian leaders intend to use force. Unpredictability contributes complexity to the task force’s environment.

The second environmental factor of METT-T, the enemy, likewise adds complexity to the future-operating environment of the mechanized task force. One assumes that adversaries of the mechanized task force adapt to meet or avoid US Army capabilities.

The Vietnam War provided evidence of this effect. The North Vietnamese Army withheld mechanized and armored forces from entering the battles for South Vietnam until after the US withdrew.²² Additional evidence of the enemy’s adaptation to the mechanized and armored force arrived with the numbers of “Anti-Tank” units and equipment found after the tank’s arrival. Clearly the anti-tank phenomenon arrived on the battlefield as a result of enemy adaptation.

Adversaries of the United States will continue to adapt to US Army capabilities as they pursue their own survival. In many instances, US mechanized forces will discover unfamiliar enemy tactics, techniques, and procedures designed to halt them only when US forces encounter them on the next battlefield. Future task force commanders may oppose enemy forces employing tactics, techniques, and procedures never before seen. Consequently, they may face an enemy that US Army doctrine inadequately addresses.

The manifestation of complexity in potential adversaries will appear in two ways. The first way it will appear is through the increasing number of conflicts resulting from current sources of conflict.²³ The second way it will appear results from the continued evolution of transnational threats, according to the 1998 report on the AAN.²⁴

In either of these two potentialities, enemies of the US will logically fight the Army in ways they believe enable them to survive or win. To do otherwise would assure the potential enemy's own defeat and failure to survive. The result of this adversarial evolution will contribute to the complexity of the task force's environment.

The third METT-T factor, terrain also adds complexity to the task force commander's environment. Doctrinally, the significant effects of terrain include both natural and manmade features.²⁵ Manmade features include cities, sprawling suburban areas, and manmade obstacles.

The development of complex terrain represented by cities and suburban areas continues as the world's development does.²⁶ This fact makes the future operating environment for the task force commander more complex. Operating in this complex terrain becomes more difficult, as does the analysis beforehand in support of planning. These difficulties contribute to the overall trend toward a more complex environment.

Troops available, the fourth factor of METT-T may also complicate the task force commander's environment. Contingency forces, including light and mechanized forces, campaign forces, homeland defense forces, and special operating forces all remain in the future Army according to the AAN report.²⁷ The AAN report also addresses the need for modularity in the future force.²⁸

This approach, packaging units together of different types to achieve the “balance” previously described, enables the deploying commander to tailor his force package to the threat. Given the potential in this technique for many combinations of type units together, one can predict that it too contributes complexity to the task force’s environment.

The AAN report addresses time available, the final METT-T factor in the operational environment twice. The first mention of this factor refers to a force’s ability to respond rapidly to preclude enemy actions at all levels of war.²⁹ The second reference of time available refers to the comprehensive influence that technology has on potential enemies. As enemies adapt to meet US force improvements, one can expect them also to acquire technology to improve their ability to generate combat power. This response by the enemy seeks the goal of mitigating the speed inherent in the US Army’s advances. The AAN report quotes research as indicating “that speed must increase by a factor of two or more to overcome the strength of a knowledge - and precision – based defense.”³⁰ Time, therefore, also complicates the future task force commander’s environment.

As each of these METT-T factors evolves, they will increase the number challenges facing a task force’s command and control system. The command and control system will have to enable the commander to understand his environment well enough to plan, prepare, and execute missions successfully. For FBCB2 to achieve its purpose in future war, conflict, and peacetime, it will need the ability to account for all these potential sources of complexity, and provide the commander a means to deliver his unit the ability to dominate its environment.

CHAPTER THREE

THE COMMAND AND CONTROL SYSTEM

The five resources composing the command and control battlefield operating system include: personnel, communication, equipment, facilities, and procedures.³¹ These resources apply to command and control systems at all echelons within the US Army. This chapter focuses on these resources as they apply to the mechanized task force.

The Army defines a task force as "a battalion-sized unit of the combat arms consisting of a battalion control headquarters, with at least one of its major organic subordinate elements (a company), and the attachment of at least one company-sized element of another combat or combat support arm."³² The mechanized task force, therefore, originates with a mechanized infantry battalion headquarters and receives at least one armor company in exchange for one of its organic mechanized infantry companies. This approach allows the infantry to protect the armor in restricted terrain while the armor can then protect the infantry in more open terrain.

The mechanized task force commander commands a group of subordinate organizations possessing unique capabilities and skills. This combined arms approach historically provides results greater than the sum of its component parts and justifies its existence.³³ Yet, if increasing numbers of agents create complexity, then adding different type units to a command also adds complexity.

To assist in managing this complexity, the first resource available to the commander is personnel. Personnel consist of the commander, his subordinate commanders, and his staff.³⁴ The commander remains the preeminent influence on the command and control system. Doctrine recognizes that his competency in employing the tools of this system most greatly influences the effectiveness of this system.³⁵ Future command and control systems will affect all resources within the command and control system, but will never replace the commander nor assume his role.

The mechanized infantry battalion commander is the lowest tactical level commander to possess a staff.³⁶ According

to the Tank and Mechanized Infantry Battalion manual, FM 71-2, the staff frees the commander to fight the battle by supervising all "supply, maintenance, communications, administration, and reporting."³⁷ The last dimension, reporting, provides much area for improvement as lessons learned from the National Training Center demonstrate.³⁸ Insights gleaned from the Task Force XXI Advanced Warfighting Experiment (AWE) recognize that the digitization process possesses the potential to remedy this weakness.³⁹

Subordinate commanders provide the terminal direction of the task force command and control system. Usually exchanging organic infantry or armor platoons for the other to form teams, FM 71-2 describes their contributions as the "commander's principal assistants for fighting the battle."⁴⁰ One may view subordinate commanders as the tools available to the task force commander to interact with his external environment, composed of both the terrain and the enemy.

Command and control systems provide the critical link between the task force commander and staff and the company team commander. They make a significant contribution to fighting the battle. This linkage places a premium on the communicative skills of both the task force and company team commanders. The ability of both senior and subordinate commanders to communicate effectively during the planning, preparation, and execution of their missions remains imperative.

Communication is the second resource available to the task force commander. This resource includes those pieces of communication equipment and networks available to the commander and his staff to assist in commanding and controlling the task force.⁴¹ FM 71-2 discusses the communication equipment and communication nets in the task force in detail. Significant to this discussion are three radio nets - the command net, the operation and intelligence net, and the administrative/logistics net - that the task force uses to communicate with its higher and subordinate units.⁴²

Communication represents yet another agent acting within a complex system. Specialists assigned to the tank and mechanized infantry task force operate its communication systems and handle its more technical aspects.⁴³ However, employing these assets remains the realm of the commander.

The commander's contributions in making the communication resource work for him come from his ability to direct these specialists in the proper employment of communications to support the task force.

The third resource available to the task force commander and his staff in commanding and controlling the battalion task force is the equipment enabling command. FM 101-5, Staff Organization and Operations, describes equipment both as automation equipment and the resources needed to sustain the command and control system.⁴⁴ As FBCB2 fuses automation and communication equipment, the difference between them becomes less distinguishable. Future doctrine may recognize this phenomena and unify these two resources.

Facilities constitute the fourth command and control system resource. FM 71-2 states that, "Facilities consist of the vehicles and locations from which the task force commander, assisted by his staff, directs the battle and sustains the force."⁴⁵ There are five facilities within the task force. These include the combat and field trains command posts, which support the administrative and logistics functions, and the main and tactical command posts, which support command and control functions.⁴⁶ The fifth facility exists wherever the commander may choose to fight from and with whomever he chooses to accompany him.⁴⁷

FBCB2 has the potential to affect each of these facilities profoundly. This monograph, however, focuses only on those command posts from which the commander plans, prepares, and executes the mission. This focus excludes the combat and field trains command posts without discounting their obvious significance to the task force.

The fifth and final resource available to the task force commander in his command and control system is the set of procedures he and his supporting staff use to plan, prepare, and execute the mission.⁴⁸ In order to explain procedures as a command and control resource, FM 71-2 describes the troop-leading procedures.⁴⁹ The troop-leading procedures encompass the military decision-making process.⁵⁰ The estimate of the situation, which assesses the factors of METT-T, is correlatively part of the decision-making process.⁵¹

The potential for FBCB2 to automate many of these procedures possesses great potential for simplifying the commander's tasks in commanding and controlling the task force. While these procedures require application of judgment and experience in making a decision, many of the data and informational processing tasks lend themselves to digitization. The ability to automate steps within procedures, however, provides promise in the reduction of time spent processing information, the numbers of tasks within a process, and the difficulty inherent in each automated procedure.

These five resources: personnel, communication, equipment, facilities, and procedures provide the task force commander the assets he needs to command and control the task force in combat operations. The commander possesses the authority and responsibility for employing these resources effectively in the accomplishment of assigned missions.⁵²

The commander's tasks, especially those of executing the military decision making process (MDMP), issuing orders, and commanding and controlling the unit in execution of its assigned mission, provide a significant workload to the task force commander in combat. The command and control system requires time and effort from the commander and his staff simply to operate it. The commander must contend with these demands on him in an environment where he only positively controls one of the METT-T factors, troops available. If this environment grows more complex, the command and control system must improve in its ability to provide him the means to manage this complexity. To accomplish this improvement, the command and control system needs to increase its speed and effectiveness, decrease significantly its own inherent complexity, or accomplish a combination of both.

Recognition of this need has provided the necessary impetus for the development of FBCB2. This tension between the environment and the command and control system's abilities to assist the commander in executing his tasks within it is not a new phenomenon. The history of the mechanized task force's command and control systems demonstrates a legacy of command and control systems struggling to enable the commander to accomplish his mission in increasingly complex environments.

CHAPTER FOUR

FBCB2

The Force XXI Battle Command System, Brigade and Below (FBCB2) represents the Army's objective for future command and control systems at the small unit level. Comprised of the Appliqué computer system, the Enhanced Position-Location Reporting System (EPLRS), and the tactical internet, FBCB2 merges with the existing "legacy" system of command and control resources to become the objective command and control system under investigation.⁵³ This system provides the commander the means with which to understand and operate within his environment. Assessing FBCB2's chances to simplify the commander's execution of his command and control tasks requires first understanding the system.

The Appliqué computer system consists of computer hardware "ruggedized" for military use and software designed to automate command and control functions.⁵⁴ Product managers develop hardware and software separately, enabling more flexibility in developing each.⁵⁵ This approach allows software developers to work closely with commanders in the field. This allows commanders to inform software developers of desired changes, as the environment demands it. The software developer retains the ability to improve the system as technology allows.

The Director of Army Digitization recognizes the importance of software's responsiveness to commanders writing that, "information must be tailored to meet the needs of each decider (commander), shooter, and supporter – allowing each to maintain a clear and accurate vision of his battlespace necessary to support planning and execution."⁵⁶ By separating the software development from hardware and emphasizing user needs, FBCB2 developers have placed as much responsibility as possible for the its effectiveness into the future commanders hands. This approach enables continued and progressive development of FBCB2 as it, the commanders, and other command and control resources interact with and learn from the operational environment over time.

The Appliqué software system also operates within a "common operating environment" (COE) linking the task force

vertically and horizontally with other computers.⁵⁷ These include other Appliqué equipped computers, and the five Army Tactical Command and Control Systems (ATCCS) found in current task force command posts.⁵⁸ These five systems: the Maneuver Control System (MCS), the All-Source Analysis System (ASAS), the Advanced Field Artillery Tactical Data System (AFATDS), the Forward Area Air Defense Command, Control, and Intelligence System (FAADC2I), and the Combat Service Support Control System (CSSCS) constitute the ATCCS. Only through Appliqué can those separate ATCCS computers communicate.

The COE enables the seamless flow of information in digital format between units along the Tactical Internet without the need for frequent encoding and decoding. This approach speeds the communication process due to the efficiency inherent in digital information transfer compared to the “analog” system of radio transmission requiring human communication including the decoding required at the distant end station. As the radio link remains, the COE also serves to establish redundancy in the communication process.

Joined with EPLRS, the Appliqué software also generates the “Relevant Common Picture” (RCP) aspect of FBCB2.⁵⁹ The EPLRS continuously reports the location of its sending platform as well as all other EPLRS – equipped platforms in the task force, creating the “Situational Awareness” (SA) benefit inherent in FBCB2.⁶⁰ SA, when depicted on a digital terrain map with reported enemy locations, gives the commander an understanding of his force’s posture in relation to both the terrain and the templated and/or reported enemy.⁶¹ This understanding captures the essence of the RCP.

According to Brigadier General (Ret.) Huba Wass de Czege, the decision – making utility of RCP represents its relevant contribution to command and control.⁶² RCP enables commanders to make better informed decisions. Commanders without FBCB2 rely upon their staffs and their own intuition to assemble the current situation through reports.

Appliqué hardware development remains firmly tied to the evolution of commercial technology.⁶³ Due to this fact, the hardware and its data transfer link, the Tactical Internet, both possess capability limitations that improve only as technology does. The Tactical Internet consists of commercial standard

internet technology wedded to the Army's digitally capable Single-Channel Ground and Airborne Radio System (SINCGARS).⁶⁴

The fundamental constraint on the tactical application of digital transfer is bandwidth.⁶⁵ Bandwidth, in digital carrying capacity, equates to a pipe's ability to carry fluid. The technical aspects of bandwidth exceed the scope of this monograph. Nevertheless, throughput capacity of digital information at present remains a challenge. As data and voice communications compete for the same bandwidth, this problem presents itself most acutely when the execution phase arrives. TF XXI AWE lessons learned reflect this phenomena and indicate that current technology can not handle the demands of voice and data transmission technology at current execution phase rates.⁶⁶

This problem will present the greatest concern for FBCB2 for the near term. The interim solution to this problem will remain largely procedural while technology evolves to meet the demands of the communication system. Given current rates of technological development, and the Army's emphasis on FBCB2, one can expect this evolution to reach a solution within the next five years.

The impact of FBCB2 on those resources existing in today's command and control system remains unclear. The TF XXI AWE, testing the FBCB2 concept among many other initiatives, provides some insight. Yet as the authors of one study comparing information based organizations in the private sector to the Army's development commented, "the second – and third – order effects of the changes will not be felt until organizations adapt and learn how to take advantage of new capability."⁶⁷ Based on this effect, the command and control system's will be an iterative process; requiring experience to inform it.

A few insights have already been obtained. The need for commanders at the task force and subordinate company/team level as part of the personnel resource remains apparent. Their roles directing the command and control system remain the same. The need for and nature of staffs to assist these commanders, given FBCB2, remains less clear. As commanders reap the benefits of FBCB2, the tasks previously accomplished by their staffs become more automated.

This effect begs the question of what staff is needed and what purpose do they serve? Many views exist and most diverge on this topic. Understanding what a staff does, the tasks the staff possesses responsibility for, and those achieved by FBCB2 provides insight to a possible answer.

FM 101-5 declares that the "staff and procedures are structured to meet the CCIR."⁶⁸ Doctrine defines CCIR, or the commander's critical information requirements, as "Information required by the commander that directly affects his decisions and dictates the successful execution of operational or tactical operations."⁶⁹ One can deduce from this definition that the first step in the CCIR process requires identifying what decisions the commander must make. As identifying decisions requires the application of judgment, computers can not accomplish this task.

Doctrine explains the limitations of computers through its explanation of a concept known as the cognitive hierarchy.⁷⁰ The cognitive hierarchy consists of four levels: data, information, knowledge, and understanding.⁷¹ Data consists of facts.⁷² Facts assembled into a meaningful format create information.⁷³ The comprehension of what this information means within a context generates knowledge.⁷⁴ The application of judgment to this information creates the understanding that results in decisions.⁷⁵ From this hierarchy one clearly sees the threshold of computers lies at the ability to format data into information. Knowledge and understanding are two levels of cognition exceeding the ability of computing.

The simple answer to the need for staffs therefore results from assessing how many people the commander requires assisting him in determining these requirements. General Hartzog, then the Commanding General of Training and Doctrine Command (TRADOC), noted that during the TF XXI AWE "It took a while to discover that not everyone needed the same information all the time."⁷⁶ Hartzog's comments indicate that, at least during the TF XXI AWE, commanders could not by themselves identify what they needed to know. If this initial indication reflects the current state of FBCB2, and the role of the staff remains to provide CCIR, then clearly the need for a staff remains.

The nature of that staff provides yet another challenge for the future. LTC Kevin Benson proposes a "battalion without a staff in the traditional sense."⁷⁷ Benson's idea for a staff relies on a physical separation of that staff from its traditional place on the battlefield.⁷⁸ This approach, he believes, frees the commander to command and the staff to work from as far away potentially as the home base, relying on the digital link to communicate its work to the field.⁷⁹

Benson's proposal reflects the nature of the tasks from FM 71-2 that a staff performs, those freeing the commander of concerns of "supply, maintenance, communications, administration, and reporting."⁸⁰ While these tasks may lend themselves to automation, one can not automate the determination of their respective purposes and directions. Purpose and direction rely upon the staff imparting their knowledge upon the information provided by FBCB2.

While Benson's approach may reflect hyperbole on his part, he considers the "secondary – and tertiary - effects." Digitizing the command and control process possesses the capacity to move the staff farther from the battlefield. One potential argument against such an approach is the idea of media richness.

Media richness reflects the difference between electronic mail and a written note, or a face to face conversation versus a telephonic one. While immeasurable, a difference exists. One communicates more readily than the other does. As this concept applies to a staff, one may infer that a staff communicating its work farther away loses some of the effectiveness achieved through proximity.

A second view on staff results from lessons learned at the National Training Center (NTC) over its seventeen-year existence.⁸¹ Jon Grossman published a study of statistics gathered over several years and concluded that ineffective staffs contributed to mission failure of more than half the battles fought at the NTC.⁸² Grossman's study reflects that staff failures result in inadequate plans, battle preparation, and an inability to assist the commander in tracking the battle.⁸³ If Grossman's assertions are true, then FBCB2 may cure the symptoms represented by poor battle preparation and poor battle tracking, but not the causes.

A poorly trained staff, equipped with FBCB2, still produces poor plans for the commander. Clearly the future task force requires well-trained staffs just as current task forces do. The cognitive hierarchy demands the application of judgment to knowledge to create understanding. The Commander requires this ability of his staff. General of the Army Omar Bradley once quoted General Bolivar Buckner saying that "judgment comes from experience and experience comes from bad judgment."⁸⁴ In Army terms, staffs must train in order to acquire judgment.

If a training gap exists, FBCB2 can not resolve it by itself. FBCB2 enables training by accomplishing many tasks previously done by the staff. This task reduction frees the staff to train in a more focused manner. It also provides more time to recover from poor plans given its inherent speed. Yet the commander retains responsibility for his staff's proficiency and must train them to that end.

FBCB2 profoundly affects the communication resource of the command and control system. The increased capacity to transfer information provides one benefit. One would fault the Army if it did not leverage this inherent capacity of digital technology.

Accepting this premise, one must consider the insights of theorist Martin Van Creveld who writes in *Command in War*, "Far from determining the essence of command, then, communications and information processing technology merely constitutes one part of the general environment in which command operates. To allow that part to dictate the structure and functioning of command systems, as is sometimes done, is not merely to become the slave of technology but also to lose sight of what command is all about."⁸⁵ Van Creveld's caution warns not against integrating technology, but rather maintaining technology as a means to command and control, not an end in itself.

Chris Bellamy in *The Future of Land Warfare* likewise warns against this idea stating that "It is sensible to use modern technology to expedite the acquisition and processing of information, but organization and learning is ever more important, and excessive concentration on technology at the expense of the former could be self-destructive."⁸⁶ Bellamy reaffirms the idea that technology possesses its place, but that

place exists within a broader context. This context dictates the role of technology, not the other way. Given the benefits of technology gained by FBCB2, commanders must employ judgment in order to harness them in the proper direction.

The impact of equipment to FBCB2 and the command and control system provides costs also in addition to the benefits it delivers. The benefits manifest themselves in the increased speed and automation. The costs come from the added complexity of superimposing the Applique on the legacy system. The addition of more technology to an already complex system creates concern for the reliability of these systems. TF XXI AWE insights confirm that reliability remains an issue with the Appliqué computer system and the tactical internet.⁸⁷

The impact of FBCB2 on facilities as a command and control resource does not seem as significant. The commander equipped with applique may travel the battlefield in his vehicle and maintain constant SA of his fight. He communicates laterally with the staff and vertically with both senior and subordinate headquarters with the RCP as his touchstone.

The impact of FBCB2 on procedures provides many benefits to the task force command and control system. These benefits come from the automated assistance of previously manually accomplished tasks. The time and effort saved through automation harvests the advantages of technology and frees the commander, staff, and subordinate commanders to accomplish other tasks. The assessment of FBCB2's impact on procedures parallels that of its impact on the commander's command and control tasks. The assessment of this impact follows.

FBCB2 affects each of the command and control resources in different ways. The true impact of FBCB2 on these resources requires time and experience to inform those relying on and responsible for the system. The lessons learned during the TF XXI AWE join those learned from the task force's history to allow an effective starting point. One such starting point is the task list in FM 71-2-MTP for commanding and controlling the task force.

CHAPTER FIVE

FBCB2's IMPACT ON THE COMMANDER'S TASKS

Beyond the plan, prepare, and execute format of the commander's tasks lies the myriad of tasks a commander must perform. These tasks parallel the troop leading procedures. As such, the commander relies upon his staff and the command and control system to assist him in executing his tasks.

The tasks the commander must execute during the planning phase begin with issuing a warning order, analyzing the mission and giving guidance, and gathering needed information by conducting reconnaissance.⁸⁸ FBCB2 assists with each of these tasks. In issuing orders and conducting mission analysis the commander and staff employ the various message formats inherent in the Appliqué software.⁸⁹ These formats enable the digital transmission of products, allowing the commander and staff to transmit orders and overlays to subordinates instantaneously.

This effect means that FBCB2 saves time over the "analog" technique of receiving orders in written format in person and hand carrying these back to the task force's main command post for reproduction or even receiving them by facsimile machine. The staff in the "analog" command and control system must then reproduce the order, distribute the copies among the staff, and then begin the mission analysis. The staff then assembles warning and fragmentary orders and distributes them by hand or over the radio, a technique that requires transcription.

FBCB2 does not automate the mission analysis itself, as this process requires the "understanding" level of cognition. Instead FBCB2 makes issuance and receipt of orders simultaneous, enabling quicker commencement of the mission analysis. FBCB2 also enables the staff to review the order in digital format, speeding their ability to excerpt those parts of the order that they require. As General Wass de Czege wrote, "Improved analysis, communication, and presentation technology will allow us to transform this information into knowledge which can be quickly acted upon. Commanders and staffs will learn to make their decisions and plans faster than ever before."⁹⁰

Reconnaissance commences as soon as the commander approves the reconnaissance and surveillance plan. Through the ASAS link to Appliqué, the battalion intelligence officer and operations officer can commence planning upon receipt of the mission, plan faster, and can share information through the COE. Movement can be initiated faster. If the task force is allocated unmanned aerial vehicles reconnaissance can be completed even more rapidly.

The parallel development of digital links from reconnaissance platforms also enables the more rapid dissemination of information. Consequently assessment of terrain and enemy information comes more quickly. Transferred from the ASAS to the SA function of Appliqué, this ability provides near real-time dissemination of the intelligence product.

The staff assists the commander in developing and wargaming courses of action. These tasks remain labor intensive, as they require the application of judgment throughout. Consequently, FBCB2 does not relieve the commander and staff of these tasks, nor does it reduce the difficulty of them. The fact that Appliqué runs applications in addition to the SA function allows a digital record of the process, precluding redundant effort in the process. This impact saves the commander and staff valuable planning time.

Finally the commander approves a course of action enabling the staff to issue the order. The Appliqué enables the commander to issue this order from his command post digitally. Depending upon the nature of the task force's current activities, the commander may choose to issue the order in person. FBCB2 therefore speeds the process and reduces many manual tasks in support of planning. While the commander may choose to take more time to create and issue an order, FBCB2 allows him the option.

During the preparation phase, the commander and staff coordinate and refine the plan, execute task organizations, prepare them to conduct operations and supervise and monitor preparations of subordinate units. FBCB2 enables digital execution of task organization changes,⁹¹ but the remainder of these tasks FBCB2 only indirectly impacts. It enables the execution to the extent that the commander and staff require

less time to prepare. Therefore they have more time to allocate to these tasks.

This increased time assists the commander in overcoming a previously observed shortcoming in performance at the NTC. One observer-controller reported that, "In general, experience at the National Training Center indicates that leaders fall down on two of their tasks as leaders – communicating plans to their subordinates and supervision...(they believe their) responsibilities end when they issue their order."⁹² FBCB2 does not resolve those failures that come from poor training, instead it merely allows more time for the commander to accomplish those tasks. Whether he uses that time effectively or not depends upon the commander's training and education.

The tasks the commander must execute during the execution of the task force's mission begin with the task "TF sees the battlefield."⁹³ FBCB2 enables this task in two ways. First, FBCB2 allows the commander and his command group command post to travel to any location and maintain the RCP. Secondly, that RCP alone provides the commander with a more complete picture of the battlefield than the legacy system did.

One insight from Jon Grossman's extensive studies at the NTC reveals that commanders during the execution of a battle often spend the majority of their time trying to track the battle.⁹⁴ Grossman's observations conclude that current staffs do not battle track effectively and fail to communicate what they do track to the commander.⁹⁵ Instead, demands on the command radio nets preclude extensive discussions on the current situation. The commander makes decisions without the information doctrine deems necessary.

FBCB2 precludes much of this distraction to command by automating the current situation with the RCP and SA. The commander equipped with FBCB2 does not require extensive radio transmissions to determine the current situation. FBCB2 allows him to make his conversations on the radio concern the significance of the current situation rather than the situation itself. Given the payoff to the task force of this benefit alone, FBCB2 provides a generational leap to task force command and control systems.

One team that studied task force commanders information needs writes that "A better model of information flow, and one

that is closer in reality in well-functioning command posts, is interactive – one in which each passage of information is accompanied by feedback for the assessment of understanding.”⁹⁶ FBCB2 lowers the threshold for assessing the situation for task force commanders, their subordinates, and their staffs. FBCB2 frees these radio nets from the transmission of information requirements that SA provides. However, FBCB2 does not prevent poor decisions based on this information.

One can not overstate the significance of training and education of the command and control system’s personnel. As LTC Jeffrey Leser states in a 1997 *Military Review* article, “The battle commander interprets what he knows by using intuition to complete his understanding of the battlefield.”⁹⁷ The intuition Leser refers to comes only from experience, which education and training create.

The next task the commander must accomplish during execution is the actual command and control of the execution.⁹⁸ The first subtask of this task is to correct deviations from the plan.⁹⁹ The RCP and SA functions of FBCB2 create the ability of the task force commander to accomplish this requirement. The ability to see where each of his subordinate units are at any given time allows the commander immediate observation of those units not in their proper position. While the subordinate units’ awareness of their own situation prevents this occurring anyway, the immediate inventory of units and locations that accompanies FBCB2 allows the commander greater ability than ever of understanding how his plan is progressing.

The second subtask of commanding and controlling the execution is to direct changes to the plan based upon changes in the METT-T.¹⁰⁰ Since FBCB2 assists the commander and staff in tracking CCIR during the battle, it enables them to recognize the METT-T conditions supporting CCIR faster. The commander then directs changes by voice or message format to his subordinates. This task also relies upon a well - trained command and control system, as FBCB2 merely enables this process to occur. The commander and staff must formulate effective CCIR, recognize the change in conditions, and communicate the proper response to those changes.

The philosophical approach of a task force commander towards command and control also affects the task of directing

changes. FBCB2's ability to provide the commander with greater information than ever before sparks debate as to whether these commanders should retain decentralized execution by their subordinates under the US Army's doctrine of mission orders.¹⁰¹ Mission orders, according to FM 100-5, "specify what the subordinate commands are to do without prescribing how they must do it."¹⁰²

General Wass de Czege believes that "The Army's current 'mission orders' command philosophy will continue."¹⁰³ Wass de Czege states that although instances requiring centralized command exist today and in the future, "A battle environment that emphasizes speed will prevent leaders from 'superintending' their subordinates."¹⁰⁴ Wass de Czege's view mirrors the predictions of FM 100-6, Information Operations, which also states that mission orders remain with the advent of FBCB2 and other technologies.¹⁰⁵

Not all share this view however. In a 1996 article for *Armor* magazine, Captain Robert Bateman contended that mission orders exist to enable the commander on the ground to control his battle because that commander understands the battle better in his area than his senior commander does.¹⁰⁶ As technology enables commanders in the future to know that situation as well as if not better than their subordinates, Bateman contends that retaining mission orders as a command philosophy fails to harness the full potential of technology.¹⁰⁷

While Bateman's counterpoint serves to generate debate, he argues from a flawed premise. FBCB2 gives the subordinate commander the same information as his commander. The senior commander also commands more than one subordinate unit. Assuming that more than one unit executes missions simultaneously, the commander who focuses solely on one unit does so while neglecting the other. He becomes what Colonel (Ret.) Lloyd Matthews refers to as the "Overcontrolling (sic.) Leader."¹⁰⁸ Matthews offers that "Overcontrol may be a careerist manifestation by an untrusting leader."¹⁰⁹

The true effect on command and control philosophy of FBCB2 and its inherent information presentation advantages remains for experience to determine. While General Wass de Czege's views on the issue reflect logic born of experience, they do not preclude the "overcontrolling leader" from attempting to

centralize control. If Colonel Matthews observations from his career indicate a systemic problem in the Army, FBCB2 may serve only to exacerbate it, as the information it provides gives a credible argument to any senior commander to involve himself in his subordinates decision – making process.

The next subtask of commanding and controlling the execution is to prevent fratricide. Colonel John Rosenberger notes this specific benefit from his experience with the Experimental Force.¹¹⁰ Rosenberger also notes that experience during the AWE indicates that SA allows commanders to ensure that artillery remains within supporting range of troops, logistics arrives at the proper place and time, and that control of formations dramatically improves.¹¹¹ These advantages reflect most of the remaining subtasks for commanding and controlling the execution.

FBCB2 also allows accomplishment of the task to laterally coordinate with adjacent units.¹¹² This task assists in preventing fratricide as well as in coordination of movement between units. The assistance from FBCB2 degrades somewhat when the adjacent unit does not possess FBCB2. In such a case the unit with FBCB2 establishes liaison with the unequipped force, providing their headquarters with the RCP. Communications between the units degrades between dissimilarly equipped units.

The final task for the commander to accomplish is to report.¹¹³ FBCB2 inherently assist the commander in accomplishing this task through its variable message formats. Additionally, just as the task force commander no longer waits for the staff to portray the situation to him, neither does his commander either. The task force commander's higher headquarters, also equipped with FBCB2 possesses the same information about the situation as the task force commander.

FBCB2 therefore provides many advantages to the commander in executing his tasks. Some challenges remain with the system, mitigating its effectiveness while technological and procedural solutions manifest themselves in time. Nonetheless the system demonstrates an aggressive application of technology towards making command and control systems more effective.

CHAPTER SIX CONCLUSIONS

Force XXI Battle Command, Brigade and Below will simplify the mechanized task force commander's task of commanding and controlling the mechanized task force. FBCB2 provides the commander more time to execute these tasks due to the dramatic impacts of automating many command and control processes. The number of tasks declines immeasurably as automated processes assume many previously executed tasks. The cognitive requirements of the task force commander from the command and control system lessen with the numbers of tasks he must execute. By all measures the commander becomes more effective.

This impact clearly communicates at least one reason why the U.S. Army dedicated itself to the process of improving the command and control system through the introduction of future technologies. This approach will result in improvements that deliver greater effects of command and control systems to the battlefield across the spectrum of missions to which the task force commander may find himself committed. Within this context, however, remain several trends that suggest careful observation to both those who develop and those who implement command and control systems.

First, determining the nature of how command and control systems assist the commander in acting within an operational environment has grown complex in itself. This complexity demands a disciplined approach to assess those interacting factors in both to determine what challenges they present. This approach should transcend science since the command and control system and its environment both reflect immeasurable amounts of human interaction within complex environments.

Secondly, the environment in which mechanized task force commanders operate potentially may offset the gains made in simplicity. Significant changes in one or more of the METT-T factors will result in overall environmental complexity that FBCB2 may not meet. FBCB2 requires the ability for continuous improvements to maintain its ability to achieve its purpose. The Army's approach to these improvements seems to enable these improvements. The collaborative nature of this approach

integrating operational commanders with software developers will require jealous protection lest the command and control systems fail to maintain their effectiveness and efficiency.

Thirdly, the costs associated with failing to educate and train commanders will grow with the evolving environment. This effect will result from the lethal nature of technological innovation including command and control systems and the potential for enemies to acquire the same in time. The Army will not produce commanders capable of defeating a complex enemy in a complex environment during the battle. It must train them beforehand.

The capability of a commander to control forces over time will increase given FBCB2. However, events should mitigate the ability of a commander to direct every action on the battlefield. If the tension between centralized and decentralized command arises, the commander has failed his mission of command. His subordinates should know their commander well enough to recognize his competence in choosing one mode or the other of command.

FBCB2 therefore provides the Army a conduit to the information age for command and control systems. The inherent benefits of SA and a RCP alone deliver the ability to understand at a glance the current disposition of forces engaged in battle. This ability enables commanders equipped with the FBCB2 system to achieve an understanding of their environment exceeding any of their predecessors.

As FBCB2 evolves, it faces an increasingly complex environment in which commanders must plan, prepare, and execute their missions. As FBCB2 continues to simplify the tasks these commanders must execute, it will achieve its purpose of making these commanders more effective.

ENDNOTES

¹ MG John O'Daniel, "The American Armor-Infantry Team," *The Cavalry Journal* 3, May-June 1946, 43.

² United States Army, FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*, (Washington, D.C.: Government Printing Office, September 1998) 1-2.

³ O'Daniel, 44. Dennis Steele, "Testing EXFOR: Task Force XXI Advanced Warfighting Experiment at NTC," *Army*, May 1997, 14-22.

⁴ Steele, 16-17. Steele provides excerpts on these two pages from the Executive Summary of Emerging Insights relaying the successes of the experiment.

⁵ Martin Van Creveld, *Command in War* (Cambridge, MA: Harvard University Press, 1985), 264.

⁶ FM 71-2, 2-12 through 2-14.

⁷ M. Mitchell Waldrop, *Complexity*, (New York, NY: Touchstone, 1992), 11.

⁸ United States Army, FM 101-5-1, *Operational Terms and Graphics*, (Washington, D.C.: Government Printing Office, 30 September 1997), 1-33.

⁹ United States Army, FM 101-5, *Staff Organization and Operations*, (Washington, D.C.: Government Printing Office, 31 May 1997) 1-2.

¹⁰ United States Army, FM 71-2-MTP, *Mission Training Plan for The Tank and Mechanized Infantry Battalion Task Force*, (Washington, D.C.: Government Printing Office, October 1988) 5-88 through 5-91.

¹¹ O'Daniel, 42-46. See also Major Emerson J. Hurley, "Tank-Infantry Teamwork at its Peak in the Armored Division," *Armored Cavalry Journal*, May-June 1947, 27-28. Both discuss the development and evolution of the tank and infantry organizations, the costs of early failures to do so, and the events occurring in France in 1944 that led to the task force's conception.

¹² The United States Army Training and Doctrine Command, "1998 Annual Report on the Army After Next Project," (Fort Monroe, VA: Government Printing Office, 7 December 1998), B-17. Document is available online at (<http://www.tradoc.army.mil/dcsdoc/aan.htm>).

¹³ FM 71-2, 2-12.

¹⁴ Ibid., 1-3.

¹⁵ FM 100-5, 2-1.

¹⁶ Carl Von Clausewitz, *On War*, ed. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1976), 87.

¹⁷ *1998 Annual Report on the Army After Next Project*, 1-2.

¹⁸ *Ibid.*, 18.

¹⁹ *Ibid.*, 18.

²⁰ FM 100-5, 2-9.

²¹ FM 100-5, 2-6 through 2-9.

²² General Vo Nguyen Giap, *How We Won the War*, (Philadelphia, PA: RECON Publications, 1976), 13-14.

²³ *1998 Annual Report on the Army After Next Project*, 1.

²⁴ *Ibid.*, 1.

²⁵ United States Army, FM 34-130, *Intelligence Preparation of the Battlefield*, (Washington, DC: Government Printing Office, 8 July 1994), 2-14.

²⁶ William R. Hawkins, "Putting Urban Warfare in a Strategic Context," *Army*, December 1999, 8.

²⁷ *1998 Annual Report on the Army After Next Project*, 11.

²⁸ *Ibid.*, 18.

²⁹ *Ibid.*, 2.

³⁰ *Ibid.*, 10.

³¹ FM 101-5, 1-2. FM 71-2, 1-10 through 1-13. Tactical manuals refer to seven battlefield operating systems: Command and Control, Maneuver, Fire Support, Intelligence, Air Defense, Engineering Functions (properly called Mobility, Countermobility, and Survivability), and Combat Service Support. Page 2-12 of FM 100-5, *Operations*, contains a clear discussion of the difference between combat functions at the operational level and battlefield operating systems.

³² FM 101-5-1, 1-153.

³³ United States Army, FM 101-5-1, *Operational Terms and Graphics*, (Washington, D.C.: Government Printing Office, 30 September 1997), 1-32,1-33.

³⁴ FM 71-2, 1-7 through 1-8.

³⁵ Ibid., 1-8.

³⁶ Ibid., 1-8.

³⁷ Ibid., 1-8.

³⁸ Jon Grossman, *Battalion-Level Command and Control at the National Training Center* (Santa Monica, CA: Rand, 1994), xiii-ix. Grossman's report indicates that not only is reporting a weakness, it comes at a cost to commanders since commanders spend available time attempting to track the battle rather than in observing the battle and making decisions about execution.

³⁹ Steele, 16. Arguably the automation through digital technology of *Situational Awareness* (SA) will provide the greatest dividend of the Army's Force XXI process. SA allows the commander to view on a digital map of the terrain all friendly locations and those of detected enemy. This approach obviates many reporting requirements and returns commanders faster to their responsibilities of command.

⁴⁰ FM 71-2, 1-8.

⁴¹ FM 101-5, 1-2.

⁴² FM 71-2, 2-30 through 2-33. This discussion includes a graphic depiction of the net control stations, primary users and monitors on each net on page 2-31.

⁴³ Ibid., 2-29. Section 2-14 of FM 71-2 addresses communication-electronic responsibilities, clearly assigning the technical skill requirements to the signal officer under the commander's direction.

⁴⁴ FM 101-5, 1-2.

⁴⁵ FM 71-2, 2-7.

⁴⁶ Ibid., 2-8 through 2-10.

⁴⁷ Ibid., 2-8 through 2-10.

⁴⁸ Ibid., 2-10.

⁴⁹ Ibid., 2-14 through 2-22. Troop Leading Procedures consist of a series of steps designed to sequentially lead a commander through a mission from its receipt through its successful completion.

⁵⁰ Ibid., 2-11 through 2-29. FM 101-5-1, Chapter 5. This chapter of The Staff Organization and Operations manual addresses the military decision-making process in its entirety.

⁵¹ Ibid., 2-17 through 2-18.

⁵² FM 101-5-1, 1-33.

⁵³ MG Joe W. Rigby, "Digitizing Force XXI," *Army*, May 1995, 39-40.

⁵⁴ CPT Obediah Blair, "Update on Tactical Internet and Force XXI Battle-Command for Brigade and Below," *Army Communicator*, Summer 1998, 20.

⁵⁵ Ibid., 20.

⁵⁶ Rigby, 38.

⁵⁷ Ibid., 44.

⁵⁸ Blair, 20.

⁵⁹ Ibid., 21-22.

⁶⁰ Ibid., 21-22.

⁶¹ Ibid., 21-22.

⁶² BG (Ret) Huba Wass de Czege and Major Jacob Biever, "Optimizing Future Battle Command Technologies," *Military Review* 2, March-April 1998, 18.

⁶³ Ibid., 20.

⁶⁴ Ibid., 21.

⁶⁵ Ibid., 22.

⁶⁶ Ibid., 22.

⁶⁷ Francis Fukuyama and Abram N. Shulsky, *The "Virtual Corporation" and Army Organization*. (Washington, D.C.: Rand, 1997), ix.

⁶⁸ FM 101-5, 1-1.

⁶⁹ FM 101-5-1, 1-34.

⁷⁰ FM 100-6, 1-11. Doctrine defines the concept itself as "Situational Awareness". Previous instruction in pursuit of a MS in management employed the more descriptive phrase of "cognitive hierarchy" to this same concept.

⁷¹ Ibid., 1-11.

⁷² Ibid., 1-11.

⁷³ Ibid., 1-11.

⁷⁴ Ibid., 1-11.

⁷⁵ Ibid., 1-11.

⁷⁶ General William W Hartzog and Susan Canedy, "TRADOC: Moving the Army into the Future," *Army*, October 1997, 51.

⁷⁷ LTC Kevin C.M. Benson, "The Armor Battalion After Next, A Modest Proposal," *Armor* 5, September-October 1997, 12.

⁷⁸ Ibid., 12-13.

⁷⁹ Ibid., 12-13 & 50.

⁸⁰ FM 71-2, 1-8.

⁸¹ National Training Center, "Historical Summary," Available Online at: (<http://www.irwin.army.mil/historical%summary.htm>). This document relates the historical significance of the NTC to the mechanized and armored force. Established in 1982, the NTC allows mechanized task forces and their parent units to train against an opposition force in live training. The impact of this institution to the current understanding of mechanized combat at this level can not be overstated.

⁸² Jonathan G. Grossman, *Battalion-Level Command and Control at the National Training Center*, (Santa Monica, CA: Rand, 1994), 84.

⁸³ Ibid., 84.

⁸⁴ Omar N. Bradley, "On Leadership," In *The Challenge of Military Leadership*, ed. Lloyd J. Matthews and Dale E. Brown, (Washington, DC: Pergamon-Brasseyes, 1989), 9.

⁸⁵ Van Creveld, 275.

⁸⁶ Chris Bellamy, *The Future of Land Warfare*, (New York, NY: St. Martin's Press, 1987), 271.

⁸⁷ Blair, 20.

⁸⁸ FM 71-2-MTP, 5-88.

⁸⁹ Blair, 20.

⁹⁰ Wass de Czege and Biever, 18.

⁹¹ Blair, 22. CPT Blair relates the difficulties during the TF XXI AWE for commanders to execute task organization changes due to software problems. The developers did not realize that organizations were not fixed in the army and did not make the task organization option available.

⁹² **Major Vernon W. Humphrey , "NTC: Command and Control," *Infantry*, September-October 1984, 36.**

⁹³ FM 71-2-MTP, 5-90.

⁹⁴ Grossman, xiii-xiv.

⁹⁵ Ibid., xiii-xiv.

⁹⁶ Kahan, James P, D. Robert Worley, and Cathleen Stasz, *Understanding Commander's Information Needs*, (Santa Monica, CA: Rand, 1989), vii.

⁹⁷ LTC Jeffrey W.S. Leser, "Battle Command, Vision for Success," *Military Review* 2, March-April 1997, 54.

⁹⁸ FM 71-2-MTP, 5-90 through 5-91.

⁹⁹ Ibid., 5-90.

¹⁰⁰ Ibid., 5-90.

¹⁰¹ FM 100-5, 6-6.

¹⁰² Ibid., 6-6.

¹⁰³ Wass de Czege and Biever, 17.

¹⁰⁴ Ibid., 18.

¹⁰⁵ FM 100-6, 6-6.

¹⁰⁶ **Captain Robert L. Bateman, "Force XXI and the Death of Auftragstaktik,"**
***Armor* 1, January-February 1996, 13-15.**

¹⁰⁷ Ibid., 13-15

¹⁰⁸ Colonel (Ret) Lloyd J. Matthews, "The Over Controlling Leader," *Army*, April 1996, 31-36.

¹⁰⁹ Ibid., 34.

¹¹⁰ COL John D. Rosenberger, "A Year in the EXFOR," *Army*, November 1996, 27.

¹¹¹ Ibid., 27.

¹¹² FM 71-2-MTP, 5-91.

¹¹³ Ibid., 5-91.

BIBLIOGRAPHY

Books

Bellamy, Chris, *The Future of Land Warfare*, New York, NY: St. Martin's Press, 1987.

Beniger, James R, *The Control Revolution, Technology and Economic Origins of the Information Society*. Cambridge, MA: Harvard University Press, 1986.

-
- Blair, Clay, *The Forgotten War*, New York, NY: Doubleday, 1988.
- Bradley, Omar N, "On Leadership," In *The Challenge of Military Leadership*, ed. Lloyd J. Matthews and Dale E. Brown, 3-9, Washington, DC: Pergamon-Brassey's, 1989.
- Brown, Frederic J, *The U.S. Army in Transition II, Landpower in the Information Age*. Washington, D.C.: Brassey's, Inc., 1993.
- Clausewitz, Carl Von. *On War*. Translated by Michael Howard and Peter Paret. Princeton, NJ: Princeton University Press, 1976.
- Cohen, Eliot A. and John Gooch, *Military Misfortune*, New York: MacMillan, 1990.
- D'Este, Carlos, *A Genius for War*, New York, NY: Harper Perennial, 1995.
- English, John A, *On Infantry*. New York, N.Y.: Praeger Special Studies, 1981.
- Fehrenbach, T.R., *This Kind of War*. Washington, DC: Brassey's, 1963.
- Fukuyama, Francis and Abram N. Shulsky, *The "Virtual Corporation" and Army Organization*. Washington, D.C.: Rand, 1997.
- Giap, General Vo Nguyen Giap, *How We Won the War*, Philadelphia, PA: Recon Publications, 1976.
- Grossman, Jonathan G, *Battalion-Level Command and Control at the National Training Center*, Santa Monica, CA: Rand, 1994.
- Janowitz, Morris, *The Professional Soldier: A Social and Political Portrait*, New York: The Free Press, 1971.
- Johnson, Stuart E. and Alexander H. Levis, (editors), *Science of Command and Control: Coping with Uncertainty*, Washington, D.C.: AFCEA International Press, 1988.
- Kahan, James P, D. Robert Worley, and Cathleen Stasz, *Understanding Commander's Information Needs*, Santa Monica, CA: Rand, 1989.
- Van Creveld, Martin, *Command in War*. Cambridge, MA: Harvard University Press, 1985.
- Van Creveld, Martin, *Technology and War, From 2000 B.C. to the Present*. New York, N.Y.: The Free Press, 1989.
- Waldrop, M. Mitchell, *Complexity*. New York, N.Y.: Touchstone, 1992.

Articles

- Bateman, Captain Robert L, "Force XXI and the Death of Auftragstaktik," *Armor* 1, January-February 1996, 13-15.
- Benson, LTC Kevin C.M., "The Armor Battalion After Next, A Modest Proposal," *Armor* 5, September-October 1997, 12-13 & 50.

-
- Blair, CPT Obediah, "Update on Tactical Internet and Force XXI Battle-Command for Brigade and Below," *Army Communicator*, Summer 1998, 20-23.
- Boller, Major Michael and Major Lawrence A. Levine, "The C2 Spine," *Military Review* 3, May-June 1998, 34-39.
- Clarke, General Bruce C. "Mission-Type Orders," *Armor* 6, November-December 1961, 24-25.
- Clarke, LTG Bruce C, "The Planning of Battle Group and Battalion Tactics," *Armor* 2, March-April 1958, 24-26.
- Czerwinski, Thomas J, "Command and Control at the Crossroads," *Parameters* 3, Autumn 1996, 121-132.
- Duncan, LTC W.D., "Tanks and Infantry in Night Attacks," *Military Review* 7, October 1947, 46-56.
- Fontenot, Colonel Gregory, "Fright Night: Task Force 2/34 Armor," *Military Review* 1, January 1993, 38-52.
- Foss, General John W, "Command," *Military Review* 1, January-February 1997, 66-70.
- Goedkoop, Colonel Thomas R. and Captain Barry R. Venable, "Task Force XXI: An Overview," *Military Review* 2, March-April 1997, 68-78.
- Hartzog, Gen. William W and Susan Canedy, "TRADOC: Moving the Army into the Future," *Army*, October 1997, 49-54.
- Hastings, Major Henry S, "Employment of Armored Infantry," *Armored Cavalry Journal* 3, May-June 1947, 24-26.
- Hawkins, William R, "Putting Urban Warfare in a Strategic Context," *Army*, December 1999, 8-11.
- Humphrey, Major Vernon W, "NTC: Command and Control," *Infantry*, September-October 1984, 36-38.
- Hurley, Major Emerson F, "Tank-Infantry Teamwork at its Peak in the Armored Division," *Armored Cavalry Journal* 3, May-June 1947, 27-28.
- Kammerer, Major Jack, "Preserving Mission-Focused Command and Control," *Military Review* 5, September-October 1997, 65-70.
- Klein, LTC William E, "Mechanized Infantry in Vietnam," *Infantry* 2, March-April 1971, 18-21.
- Leser, LTC Jeffrey W.S., "Battle Command, Vision for Success," *Military Review* 2, March-April 1997, 52-59.
- Matthews, Colonel (Ret) Lloyd J, "The Over Controlling Leader," *Army*, April 1996, 31-36.

McLamb, Captain Joseph S, "The Future of Mission Orders," *Military Review* 5, September-October 1997, 71-74.

Meigs, General Montgomery C, "US Army Europe: On Point for the Nation," *Army*, October, 1999, 89-97.

Meyer, LTC Richard M, "The Road to Laos," *Armor* 2, March-April 1972, 18-26.

National Training Center, "Historical Summary," Available Online at:
(<http://www.irwin.army.mil/historical%summary.htm>)

Norman, LTC Brooks O, "Tank-Infantry Teamwork," *Armor* 3, May-June 1952, 54.

O'Daniel, MG John, "The American Armor-Infantry Team," *The Cavalry Journal* 3, May-June 1946, 42-46.

Rigby, MG Joe W, "Digitizing Force XXI," *Army*, May 1995, 38-44.

Rosenberger, COL John D, "A Year in the EXFOR," *Army*, November 1996, 26-29.

Roper, Major Daniel S, "Technology: Achilles' Heel or Strategic Vision?" *Military Review* 2, March-April 1997, 87-92.

Steele, Dennis, "Countdown to the Next Century," *Army*, November 1996, 16-22.

Steele, Dennis, "Forging Task Force XXI," *Army*, November 1996, 23-25.

Steele, Dennis, "Task Force XXI Advanced Warfighting Experiment," *Army*, May 1997, 14-22.

Steele, Dennis, "Testing EXFOR: Task Force XXI Advanced Warfighting Experiment at NTC," *Army*, May 1997, 14-22.

Sullivan, Gen. Gordon R, "A New Force for a New Century," *Army*, May 1994, 25-26.

TRADOC News Service, "TRADOC Commander Reveals Some TF XXI AWE Results," *Military Intelligence*, July-September 1997, 7.

Turner, COL Albert F, "On the Path to the Digital Division: Force XXI and the AWEs," *Military Intelligence*, July-September 1997, 11-13.

Wass de Czege, BG (Ret) Huba and Major Jacob Biever, "Optimizing Future Battle Command Technologies," *Military Review* 2, March-April 1998, 15-21.

Wishart, LTG Leonard P. III, "Leader Development and Command and Control," *Military Review* 1, January-February 1997, 62-65.

Monographs

Doughty, Major Robert A, *The Evolution of US Army Tactical Doctrine, 1946-1976*, Fort Leavenworth, KS, Combat Studies Institute, 1979.

Johnsen, William T, *Force Planning Considerations for Force XXI*, Carlisle, PA: Strategic Studies Institute, 1998.

Roman, Gregory A, *The Command and Control Dilemma, When Technology and Organizational Orientation Collide*. Maxwell AFB, AL. Air War College, 1997.

Government Documents

Headquarters Department of the Army. *FM 22-100 Army Leadership*. Washington, D.C., 1999.

Headquarters Department of the Army. *FM 34-130. Intelligence Preparation of the Battlefield*. Washington, D.C., 8 July 1994.

Headquarters Department of the Army. *ARTEP 71-2-MTP, Mission Training Plan for the Tank and Mechanized Infantry Battalion Task Force*. Washington, D.C., 1988.

Headquarters Department of the Army. *FM 100-5 Operations*. Washington, D.C., 1993.

Headquarters Department of the Army. *FM 101-5 Staff Organizations and Operations*. Washington, D.C., 1997.

Headquarters Department of the Army. *FM 101-5-1 Operational Terms and Graphics*. Washington, D.C., 1997.