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

Research Report 1748

Force XXI Training Program-Digital Project: Report on Development and Lessons Learned

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14. ABSTRACT *(Maximum 200 words)*:

This report discusses the Army's initial research into converting Force XXI Training Program (FXXITP) products to meet the increasingly pressing training needs of digital battle staffs. The report describes the activities and outcomes of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Force XXI Training Program – Digital (FXXITP-D) project. The project developed an approach that supports the conversion of existing training products in order to meet new training needs. During the project, the conversion approach was employed to research and enact conventional-to-digital conversions of selected FXXITP products, including the Battle Staff Training System (BSTS) and Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation (COBRAS) vignettes, Brigade Staff Exercise (BSE), and Brigade and Battalion Staff Exercise (BBSE). In addition to the conversion approach and prototype digital training products, the project identified a number of lessons for the continuing development of digital training and the digital force.

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Personnel Performance and Training Technology

FOREWORD

The phenomenon, "digitization," presents a new challenge and great potential for the Army of the 21st century. Digitization will revolutionize how the Army commands and controls its forces and requires that we leverage the technology of today to prepare the technology of tomorrow. To harness and advantage digital capabilities, the Army has emplaced its Force XXI initiative, and is preparing for a focused drive toward their Army After Next (AAN) concept. Together and in due course, the Force XXI and AAN initiatives will produce the digitally experienced network of leaders and soldiers that will define the digital force.

In 1995, the Army established the Force XXI Training Program (FXXITP), and gave it the goal of accelerating and improving force development, through the Force XXI and toward the AAN. In 1998, the Deputy Chief of Staff for Training (DCST) at the U.S. Army Training and Doctrine Command concluded that the FXXITP training support products had reached a sufficient state of maturity to support an attempt at their conversion to a digital application. It was the intent of the DCST that selected prototype training support packages (TSPs) be designed, developed, and tested utilizing the Digital Staff Training and Doctrinal Development environment at Fort Knox with the goal of integrating digital TSPs into institutional programs at Fort Knox and unit training, initially at Fort Hood. The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) was asked to meet the DCST's intent while working with the FXXITP and the Mounted Maneuver Battle Laboratory. The goal would be to design and develop training materials as proof-of-principle, rather than as actual instructional courses.

As a part of the FXXITP's effort to design a digital training program, this ARI project, the *Force XXI Training Program–Digital* (FXXITP-D), developed a procedural approach for converting training products based on new training needs. The project team applied the general approach to identify the activities required to convert selected FXXITP products to digital applications and performed those tasks in the design and development of prototype training products incorporating digital technology. Throughout the project, there was close coordination between ARI and the Directorate of Training and Doctrine Development (DTDD) at Fort Knox. This coordination allowed for evolving doctrine and emerging organizational and materiel considerations to be incorporated in the project design work. It also ensured that DTDD was aware of project decisions and directions. The project goals and findings were briefed to a DCST representative on July 12, 1999.

This report discusses the background of the FXXITP-D project and documents project activities and outcomes. The conversion approach, prototype products, and lessons learned should support the development of digital TSPs which will improve the near-term readiness of the Army's digitally equipped forces, and in doing so, advance the emergence of an Army that turns digital capabilities into combat proficiencies. Army policy makers and training developers will find this report useful in the course of continuing steady progress toward Force XXI and AAN goals.

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Technical Director

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This report reflects the efforts of a team of research scientists, military experts, performance analysts, training developers, digital experts, simulation systems experts, and administrative support personnel. During the course of this 11-month effort to convert and develop prototype training products, some 50 Army Research Institute for the Behavioral Sciences (ARI) and contractor personnel were involved with the conversion, design, development, and evaluation. All contractor personnel were from the *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation* consortium: the Human Resources Research Organization, Raytheon, TRW S&ITG, and Litton PRC.

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FORCE XXI TRAINING PROGRAM–DIGITAL PROJECT: REPORT ON DEVELOPMENT AND LESSONS LEARNED

EXECUTIVE SUMMARY

Research Requirement:

In recent years, the technology front has produced a new challenge that will revolutionize how the Army commands and controls its forces. The phenomenon is termed "digitization," and it is "... the essential enabler that will facilitate the Army of the 21st century's ability to win the information war" (Army Digitization Office, 1998a). In response, the Army presented its Force XXI concept for the evolution of the Army of the early 21st century (Department of the Army [DA], 1991, 1994b). Force XXI is a precursor to the future Army, termed the "Army After Next (AAN)." Great strides in the development, testing, and implementation of digital equipment are being made during the Force XXI timeframe, but the AAN will define the digital Army.

To address the training and force development needs of Force XXI, the Army established the Force XXI Training Program (FXXITP). The FXXITP is based on Army Warfighting Experiment lessons learned (DA, 1994a) suggesting that the employment of digital systems necessitate a progressive learning strategy. The TRADOC Digital Learning Strategy (1998) employs the three successive steps of learning fundamentals, acquiring digital skills, and integrating digital skills into mission performance to achieve a highly proficient level of performance.

To date, the FXXITP, through the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), has produced several training support packages (TSPs) that train fundamental skills and staff processes and represent research on which new digitally-oriented products can be based. Satisfying the additional training requirements of the TRADOC Digital Learning Strategy, however, will also demand a simulated representation of the digital environment.

In 1998, the Army initiated the development of the Digital Staff Training and Doctrinal Development Environment within the Mounted Maneuver Battlespace Laboratory at Fort Knox, Kentucky, to support training and doctrine development. Concurrently, the Deputy Chief of Staff for Training at TRADOC concluded that the FXXITP products had reached a sufficient state of maturity to support an attempt at their conversion to a digital application. The ARI met this intent through the *Force XXI Training Program–Digital* (FXXITP-D) project, whose objectives included: (a) develop an approach for the conversion of selected FXXITP products to a digital application, (b) use the approach to identify the requirements to convert the products, and (c) design and develop digital prototypes of the products.

Procedure:

The project began with the development of a conversion approach, a method for converting structured training products based on shifts in training needs. The conversion approach entails a

three-step process for identifying conversion requirements and converting structured training products. The process is based on ARI's structured training development methodology (Campbell, Campbell, Sanders, Flynn, & Myers, 1995), and is intended to be conducted in light of that or a similar methodology (e.g., the Army's Systems Approach to Training).

The first step of the conversion approach represents a front-end analysis phase of development, which is a process assumed by the methodology (Campbell et al., 1995) to be complete, or approaching completion, before design and development begin. Step 2 represents an application of the development methodology's procedures and considerations to a specific conversion effort and type of product. The performance of these procedures may vary in any given conversion, but the basic activities of the development process remain the same. Finally, Step 3 is the execution of the conversion plan, which is performed according to the principles of the methodology and yields a TSP appropriate for the training purpose identified in Step 1.

During the project, developers used the conversion approach to design prototypes of needed digital training. The team performed the analysis (Step 1) and prepared conversion plans (specific applications of the conversion approach in accordance with Step 2) for the FXXITP Battle Staff Training System (BSTS), vignettes, Brigade Staff Exercise, and Brigade and Battalion Staff Exercise. The team then used the BSTS and vignette conversion plans to develop digital applications of the BSTS Brigade Common Core Module and two vignettes (Step 3).

Findings:

The FXXITP-D project outcomes represent a compilation of research methods, products, lessons, and recommendations. The outcomes included the conversion approach, product-specific conversion plans, prototype digital training products, a list of tasks required to convert Brigade/Battalion Battle Simulation-supported products to Janus-supported products, a list of "high payoff" digital vignette topics, and lessons learned for the continuing development of digital training. The prototype products were tested and evaluated by ARI and military personnel. While they are not ready for implementation, the products and evaluation results form the basis for further development.

Project lessons indicate the importance of developing training that supports both current and future force readiness and identifies issues that will surface in the production of that training. The lessons stress the need for digital training that is structured, focused, and that forces the utilization of digital equipment. The team's experience indicates that the training must also accommodate the fast-paced evolution of the digital battlefield and the Army. To create this training, the project team noted that the existing digital equipment does not support training and training development, but is designed primarily for operations; this can and must be remedied. Finally, the lessons identify the benefits of the conversion concept and the project's approach to conversion, but warn that conversion should not be used as a short cut to development or allowed to stagnate the development of new training concepts and techniques.

Utilization of Findings:

The FXXITP-D project has generated information and lessons that will facilitate the development of training and, subsequently, a digital force. As a continuing emphasis is placed on providing low-resource, cost-effective digital training for U.S. Army personnel, this report can lead those training development efforts into the selection of purposeful design and implementation initiatives. However, the development of technologies to support the digital force is still in progress. Continuing technological advances and acquisition, decisions on organizations and doctrine, and training development must be synchronized if we are to achieve the superiority that digitization can promise.

FORCE XXI TRAINING PROGRAM–DIGITAL PROJECT:
REPORT ON DEVELOPMENT AND LESSONS LEARNED

CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

Force XXI Training Program–Digital Project: Report on Development and Lessons Learned

Introduction

Throughout its history, the U.S. Army has continually and successfully adapted to changing operational environments. These changes have ranged from new and evolving enemy types and strengths, to the introduction of 20th century warfighting technologies. In recent years, the technology front has produced a new challenge that will revolutionize how the Army commands and controls its forces–the phenomenon is termed "digitization." Digitization has already affected force structure, leader development, and training, and it will continue to change the way the Army operates as our understanding of its capabilities matures.

Digitization, as defined by the Army Digitization Office (ADO), is "the application of information technologies to acquire, exchange, and employ timely battlefield information throughout the entire battlespace" (ADO, 1998c). The importance of digitization is being stressed by the ADO, and is perhaps best expressed by Major General Joe Rigby's statement that, "Digitization is the essential enabler that will facilitate the Army of the 21st century's ability to win the information war and provide deciders, shooters, and supporters the information each needs to make the vital decisions necessary to overwhelm and overcome their adversary" (ADO, 1998a). Digital capabilities will provide the force with "significantly enhanced capabilities in terms of survivability, lethality, and operational tempo" (ADO, 1998b).

All told, the potential of a fully integrated digital force is awesome; but achieving this potential will be equally challenging. Currently, great strides have been made in the development and procurement of technologies that support a digital force. The Army has fielded many of these technologies to varying degrees in the "digital" division, 4th Infantry Division (ID) Mechanized (M), at Fort Hood. The Army's capability to digitize itself, however, is most dependent on ingenuity in reconciling current doctrine, training, leader development, organization, material, and soldiers (DTLOMS) with the ever-expanding capabilities of digital warfighting technology. Creative analysis and experimentation will be required for the broad development of a truly digital force.

Force XXI and the Army After Next

In 1991, the Army presented its Force XXI concept for the evolution of the Army of the early 21st century (Department of the Army [DA], 1991, 1994b). Force XXI is not doctrine, but a set of ideas about future operations. The concept is centered on developing quality soldiers and leaders through the synchronization of information age technologies, training, and leader development.

While being "cutting edge" itself, the Force XXI concept is, at its core, a precursor to the future Army, termed the "Army After Next" (AAN). Building on the Force XXI development, testing, and implementation of digital equipment, the AAN represents the "next step" in defining the digital Army. In line with its purpose of force development, Force XXI will explore and experiment with digital capabilities and their effects on DTLOMS, and in doing so, will produce

the generation of digitally acclimated soldiers that will be required to perform the defining tasks of the AAN. These tasks encompass the full synchronization among digital capabilities and DTLOMS. Indeed, the true potential of digital capabilities can only be exploited upon the Army's decision to redefine itself, and that definition will require a digitally experienced network of leaders and soldiers.

To prepare for full digitization, Force XXI is utilizing a spiral development process that relies on cross-fertilization among DTLOMS, with a heavy emphasis on technology and doctrine development. But Force XXI requirements include maintaining force readiness for near-term conflict as well as working toward the future. It is the requirement for current readiness, a readiness that exploits the available digital technology, that positions the "training" component of DTLOMS as the precursor for advancement in the other areas. Consistently, the ADO suggests that the full integration of digitization will only be possible with timely, effective training that covers the operation, employment, and maintenance of digital equipment (ADO, 1998b).

Force XXI Training Program

To address the training needs of Force XXI, the Army established the Force XXI Training Program (FXXITP), and gave it the goal of accelerating and improving force development through an extensive but prudent utilization of simulation training technologies.

The strategy for FXXITP development is based on early lessons learned about the application of digital technology on the battlefield. These lessons were produced during a Mounted Maneuver Battlespace Laboratory (MMBL) advanced warfighting experiment entitled Desert Hammer VI (DA, 1994a). The lessons suggest that the employment of digital systems necessitates a number of training requirements, which have since been adopted into the TRADOC digital learning strategy (TRADOC, 1998):

- *Step 1 Training*: Training to produce proficiency on essential combat fundamentals that apply in both the conventional and digital operating environments. Until doctrine is significantly modified to allow for a seamless integration of "how the force is employed" and digital capabilities, the fundamentals of unit performance at battalion and above (e.g., staff decision-making processes) remain generally unchanged. The focus is on the Military Decision-Making Process (MDMP), gunnery and tactics, and the basic warfighting missions.

- *Step 2 Training*: Training that stresses proficiency with the digital systems. This includes training such as New Equipment Training and other unit activities to ensure soldiers and leaders are fully capable of operating digital systems.

- *Step 3 Training*: Training with digital systems during warfighter training exercises to produce highly proficient individuals and teams. This level of training focuses on manipulating combat fundamentals and tactics, techniques, and procedures (TTPs) to advantage digital systems. By practicing the utilization of digital systems within the

current, evolving, warfighting environment, this third level training will eventually allow leaders and soldiers to match DTLOMS with digital capabilities.

To date, the FXXITP, through research and development (R&D) performed by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), has produced prototype training support packages (TSPs) that address combat fundamentals, the first level of training described above. These products are simulation-based, either live, virtual, or constructive, and apply the principles of structured training (Campbell, Deter, & Quinkert, 1997). The products[1] include:

- Battle Staff Training System (BSTS): computer assisted training modules for members of maneuver battalion and brigade staffs.

- *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation* (COBRAS) vignettes: small group exercises for members of a maneuver brigade's staff. Each vignette focuses on a slice of the staff process conducted during the planning, preparation, and execution mission phases. Each vignette can be completed in 4-8 hours.[2]

- COBRAS Brigade Staff Exercise (BSE): a structured simulation-based exercise that walks the brigade commander and his primary and special staff leaders through the MDMP and the execution of their plan. The exercise covers each phase of mission conduct, from planning through consolidation and reorganization. The scenario includes three missions. Missions can be conducted within a continuous story line or separately.

- COBRAS Brigade and Battalion Staff Exercises (BBSE): a structured, multiechelon, simulation-based training exercise for the brigade and battalion commanders and their staffs. The BBSE provides a high intensity training ramp-up for deployment or a Combat Training Center (CTC) rotation.

Each of the above programs was piloted with U.S. Army personnel during its development and has been fielded in maneuver brigades at Fort Hood and Fort Riley in preparation for National Training Center (NTC) rotations[3]. Through these implementations, the effectiveness of

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[1] Short descriptions of the ARI-developed TSPs are provided in this section, and more complete descriptions of the Battle Staff Training System (BSTS) and *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation* (COBRAS) vignettes are contained in Sections 2 and 3 of this report, respectively.

[2] The COBRAS vignettes were renamed Staff Group Exercises by the Directorate of Training and Doctrine Development (DTDD) as this project neared completion.

[3] The fielding of the products at Fort Hood and Fort Riley was accomplished as part of ARI's *Implementation and Support Team for the Assessment of Force XXI Training Program Products* (ISAT) project (Pratt, Graves, Campbell, Leibrecht, & Quinkert, in preparation). The ISAT project was a TRADOC Deputy Chief of Staff for Training (DCST) effort to assess the viability of the products in their incorporation into unit training strategies.

their structured designs has been noted[4]. As introduced earlier, however, the FXXITP also intends to provide structured TSPs for the second and third levels of digital training requirements, which address the training of digital skills and integration.

The existing FXXITP products represent fundamental R&D on which the development of digitally oriented products can be based. In the development of training specifically for digital environments, however, more than a carefully designed, structured training architecture is required. To train digital operations, digital environments must be defined and replicated.

Digital Training Environment

One important training support development at Fort Knox, Kentucky, was the establishment of a digital training environment within the MMBL of the Mounted Warfare Test Bed. The MMBL's Digital Staff Training and Doctrinal Development (DSTD2) environment was proposed to support doctrine and training development, as well as actual unit and staff training. It includes both the Force XXI Battle Command Brigade and Below (FBCB2) system and components of the Army Tactical Command and Control System (ATCCS), all linked to a Janus simulation system.

The FBCB2 is the digital battle command information system that provides on-the-move, real-time and near-real-time battle command information to tactical combat, combat support (CS), and combat service support (CSS) leaders and soldiers. The FBCB2 integrates with ATCCS at the battalion-level, and supports situational awareness down to the soldier/platform level across all battlefield functional areas.

The ATCCS is designed to meet the need for automated support to command and control (C^2). It includes five distinct systems to support key C^2 functions of Maneuver, Intelligence, Fire Support, CSS, and Air Defense. While each C^2 system provides detailed support of its battlefield functional process, they all share pertinent information to provide all commanders with a common picture of the battlefield. This common picture helps ensure a more responsive and integrated execution of the commander's intent. The ATCCS components represented in the DSTD2 include the following:

- Maneuver Control System (MCS): A tactical information and computer network using a client-server architecture with a distributed database to automate the C^2 process. Field commanders and staffs are provided the capability to receive, access, and process information, rapidly disseminate decisions and orders, and react inside the enemy's decision cycle. The MCS includes a subordinate system called Maneuver Control System-Engineer. In the very near future, the current MCS is to be replaced with the MCS Phoenix, designed to perform the same functions.

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[4] Preliminary estimates of the effectiveness of product designs are provided for BSTS Andre, Wampler, Olney (1997); for the COBRAS vignettes and BSE in Campbell, Graves, Deter, and Quinkert (1998); and for the COBRAS BBSE in Campbell et al. (1999). The viability of the products during fielding tests is discussed in the ISAT report (Pratt et al., in preparation).

- All Source Analysis System (ASAS): Provides automated processing, analysis, and dissemination of near-real-time information about the threat. The ASAS rapidly correlates large volumes of combat and sensor-fed information into a fused, all-source threat picture of the battlefield, and provides timely and accurate targeting information.

- Advanced Field Artillery Tactical Data System (AFATDS): Provides an automated fire support coordination and tactical fire direction system. As a C^2 system providing automated planning and execution capabilities to fire support facilities, AFATDS will operate in the Fire Support Coordination Center and in the Fire Support Element of the supported maneuver force.

- Combat Service Support Control System (CSSCS): Provides a common picture of unit CSS status and supportability by collecting, processing, and displaying information on key items of supplies, services, and personnel that the commanders deem crucial to the success of an operation. The management of all items within a class of supply or support function remains the Standard Management Information System (STAMIS) function; items tracked in CSSCS represent a small portion of the items managed by STAMIS.

The Air and Missile Defense Workstation (AMDWS) system is not currently replicated in the DSTD2 environment. When it is added, it will provide sensor-to-shooter connectivity and integrate the air picture from external and internal sources and real-time data enabling the engagement of air threats at the maximum effective range by air defense artillery weapons with slew-to-cue capabilities. The AMDWS will also provide air picture situational awareness.

The Force XXI Training Program–Digital Project

The FXXITP products have reached a sufficient state of maturity to garner support from the Deputy Chief of Staff for Training (DCST) at TRADOC for an attempt at their conversion to a digital application. It was the intent of the DCST that prototype TSPs be designed, developed, and tested utilizing the digital environment at Fort Knox. The ARI was asked to meet the DCST's intent while working with the FXXITP and the MMBL.

As a part of the FXXITP's effort to design a digital training regimen, this ARI project, the *Force XXI Training Program–Digital* (FXXITP-D), developed a method for bridging the gap between today's training programs and those of the future. That method is a procedural approach for the conversion of training based on new training needs. The project team applied the general approach to identify the tasks required to convert selected FXXITP products to digital applications. Finally, the team performed these conversion tasks in the design and development of prototype training products incorporating digital technology. The conversion approach and the tasks, prototype products, and lessons learned should support the near-term readiness of the Army's digitally equipped forces, and in doing so, advance the emergence of an Army that turns digital capabilities into combat proficiencies.

Project Objectives, Tasks, and Outcomes

The five specific objectives of the FXXITP-D project were:

- *Objective 1:* Develop an approach that guides the conversion of selected components of the FXXITP to a digital application.

- *Objective 2:* Work within the digital training infrastructure provided at Fort Knox, Kentucky, to identify the requirements to convert selected components of the FXXITP to a digital application.

- *Objective 3:* Design and develop a "digital" prototype BSTS Brigade Common Core Course.

- *Objective 4:* Utilize the digital training infrastructure at Fort Knox, Kentucky, to design and develop "digital" prototypes of brigade and battalion vignettes.

- *Objective 5:* Document the outcome of the conversion process for use in future digital staff training programs and document the design and development of the selected prototype TSPs.

Following the intent and guidance provided by the project objectives and tasks, the team generated the designated set of project outcomes. Together, these outcomes represent a compilation of research methods, products, lessons, and recommendations. Each outcome, according to its purpose, supports the continued development of training for the digital force. The final set of project outcomes, as described in this report, included:

- *An approach to determining the requirements for converting structured training.* This conversion approach, as it is termed in this report, has a broad application that includes but extends beyond the scope of conventional-to-digital conversions. The approach supplements the documented structured training development methodology (Campbell & Deter, 1997; Campbell, Campbell, Sanders, Flynn, & Myers, 1995). It addresses any structured training conversion effort stimulated by new training needs. The conversion approach is described in Section 1 of the report.

- *Product-specific conversion plans.* The conversion plans represent applications of the project's conversion approach to perform conventional-to-digital conversions of selected FXXITP products. The conversion plans document the tasks required to convert the products and are discussed in Sections 2, 3, 4, and 5 of this report.

- *Descriptions of the project's conversion plan implementation.* These descriptions document the methods used in the project's development of prototype digital training products. The descriptions detail the circumstances of the analysis, design, and development processes of conversion. The project's implementations of the conversion plans are contained in Sections 3 and 4 of this report.

- *Prototype digital training products.* These products included a brigade common core BSTS-like computer-based instruction (CBI) module and two vignettes. These prototypes demonstrated the potential for developing digital TSPs from the training concepts and techniques utilized in current FXXITP products. Their development was instrumental in refining this project's conversion approach and product conversion plans. As prototypes, they provide a general model of both the process and products of conversion, but are not suitable for institutional or unit use. The prototypes are described in Sections 2, 3, and 4 of this report.

- *Lessons learned regarding the production of digital training.* These lessons focus on the irregular or unexpected aspects of conversion, with the intent of expediting future conversion efforts. Lessons learned are discussed in Section 6 of this report.

- *Recommendations for the continued development of future digital training.* From the experiences incurred during this project, developers compiled a set of recommendations for the future of digital training. The conclusions speak to digital training strategies and the transition from Force XXI to the AAN. These recommendations are contained in Section 7 of this report.

- *A list of tasks required to convert Brigade/Battalion Battle Simulation (BBS)-supported products into Janus-supported products.* This information was derived during the production of the digital battalion-level vignette prototype, but is presented to support future simulation-driven conversions. Developers documented these tasks because of the wider availability of the Janus simulation and because Janus is the constructive simulation that is linked to the ATCCS in the DSTD2.

- *A list of "high payoff" digital vignette topics.* The project produced a list of topics for high payoff digital vignettes to support the future expansion of the FXXITP's digital training library. The topics and the process by which they were identified are presented in Section 4 of this report.

Organization of the Report

This report provides a succinct account of the history of the FXXITP-D project. The introduction has described the antecedent training and technology developments, as well as the rationale for project performance. The following sections address the activities, outcomes, and lessons learned during the effort:

- Section 1. The Force XXI Training Program–Digital Conversion Approach: Presents the general approach for converting existing training products into products with different and expanded applications.

- Section 2. Conversion of Battle Staff Training System to a Digital Application: Describes the application of the conversion approach to identify the tasks required to convert the BSTS to a digital application. The tasks, which comprise a BSTS conversion plan, were used to convert one BSTS course.

- Section 3. Conversion of the COBRAS Vignettes to a Digital Application: Describes the application of the conversion approach to identify the tasks required to convert the COBRAS vignettes to a digital application. The tasks, which comprise a vignette conversion plan, were used to produce one digital vignette.

- Section 4. Conversion of a COBRAS Brigade-level Conventional Vignette to a Battalion-level Digital Vignette: Describes the application of the conversion approach to identify the tasks required to develop digital vignettes for the battalion staff. The tasks, which comprise a battalion vignette conversion plan, were used to produce one battalion-level digital vignette.

- Section 5. Conversion of the COBRAS BSE and BBSE to Digital Applications: Describes the application of the conversion approach to identify the tasks required to convert the COBRAS BSE and BBSE to a digital application.

- Section 6. Lessons Regarding Digital Force and Training Development: Presents lessons learned during the project's conversion efforts. The lessons summarize and generalize team observations and insights regarding the development of digital training products.

- Section 7. Conclusions. This section discusses the resourcing requirements for the Army's evolution from a conventional to an information-age force and provides a summary of the FXXITP-D report.

Appendix A contains definitions of the acronyms and abbreviations used in this report. Appendix B contains the description of the digital environment produced during the FXXITP-D. Appendix C describes the tasks required to convert the BBS-supported FXXITP products into Janus-supported products. These conversion tasks for the BBSE, BSE, and BBS-supported vignettes identify the actions to take on the individual components of the product TSPs and a rough estimate of developer hours required by each action.

Section 1. The Force XXI Training Program–Digital Conversion Approach

The conversion approach describes a way of converting structured training products based on shifts in training needs. The approach is based on the premise that converting an existing product to meet a new training need will be as effective, *and more efficient*, than developing an entirely new product. Although the premise is debatable, there will be situations where such conversions are necessary, due to available time or other resources. In this project, the approach was used to guide conventional-to-digital conversions during this project, but its potential application is much wider.

The team began with the production of a draft conversion approach to provide structure for remaining project activities, and as an aid for future training development. During the project, developers refined the approach, and this report presents the refined version.

The conversion approach entails performance of three steps (shown in Figure 1) for identifying conversion requirements and converting structured training products. The steps represent a generally linear process, but provide considerable freedom to move back and forth between steps. Freedom to negotiate the process is a built-in control that supports decision-making during development.

The conversion approach is not totally new or innovative. It is based on ARI's structured training development methodology (Campbell et al., 1995), and therefore, should be conducted in light of that or a similar methodology (e.g., the Army's Systems Approach to Training [SAT]). In other words, if a developer is not skilled or knowledgeable in the development of structured training, he/she will struggle in converting the existing programs.

The first step of the conversion approach represents a front-end analysis phase of development, which is a process assumed by the methodology (Campbell et al., 1995) to be complete, or approaching completion, before design and development begin. Step 2 represents an application of the development methodology's procedures and considerations to a specific conversion effort and type of product. The performance of these procedures may vary in any given conversion, but the basic activities of the development process remain the same. Finally, Step 3 is the execution of the conversion plan, which is performed according to the principles of the methodology and yields a TSP appropriate for the training purpose identified in Step 1.

The remainder of this section describes the general activities that are required in the performance of each step, regardless of the particular type of product or the conversion need.

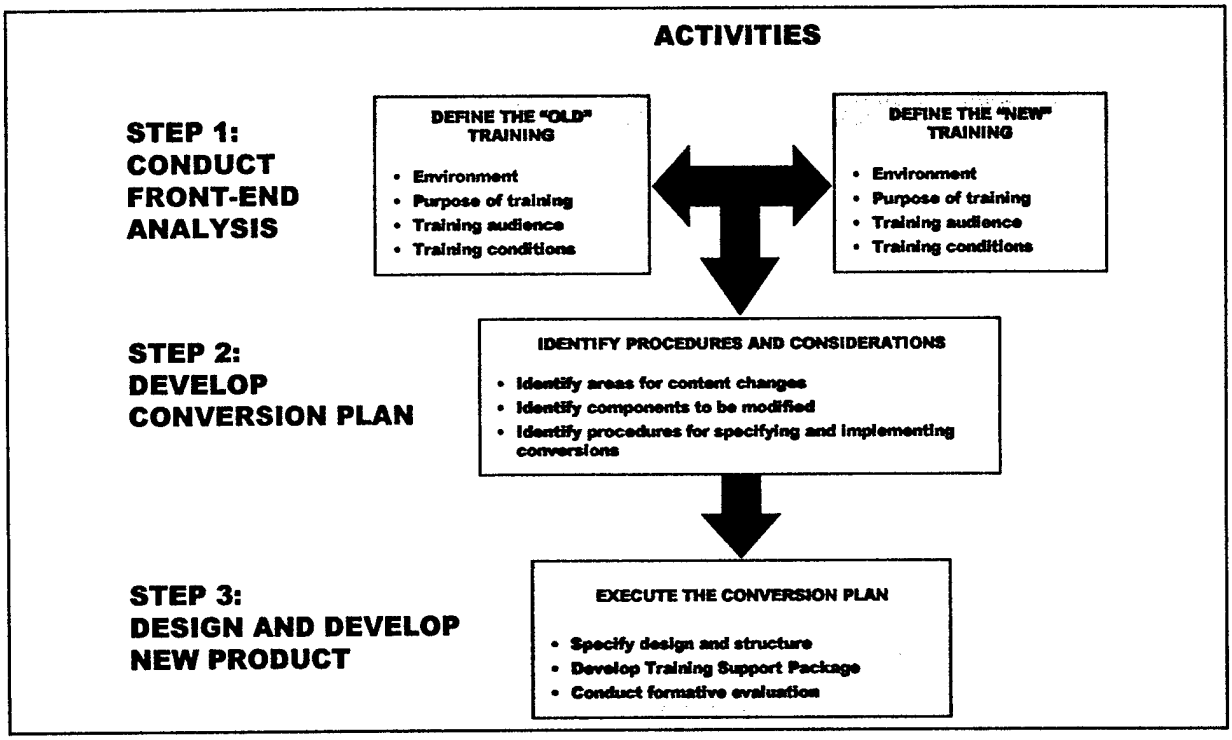

Figure 1. Steps and activities in the conversion approach.

Step 1: Conduct Front-End Analysis

In Step 1, developers collect all the background information needed to support the conversion of an existing product type so that it meets the new training need. This requires a thorough specification of the current product type[5] and the target product type (after conversion). The specification needs to focus on four aspects of the product types:

- the underlying environment that the training situation represents,
- the purpose of the training and how it fits in a larger training strategy,
- the training audience for whom the product type is intended, and
- the implementation conditions for the product type.

Each of these considerations needs to be examined for both the existing product type and the intended product type. The two steps described below discuss some of the details of exploring those considerations in the existing and target product types, respectively.

1.1 Define the Product to be Converted

Before any conversion, the developers must have a complete understanding of the product to be converted. The first consideration, the environment, actually stretches beyond the bounds of the product type itself. It demands that the underlying environment that constitutes the setting for the training be specified. Some of the details may not be immediately apparent, but it is important that the developers understand the mission, enemy, terrain, troops, time available, and civilian considerations (METT-TC) and other conditions that are the "reality" on which the training product is based.

Developers must also look at the product itself. They must know the purpose of that product, including its overall objective and placement within a training strategy. The purpose defines the intent for the type of product, and is not as specific as the training objective of an individual exercise. For example, the purpose of COBRAS vignettes is to provide easily-implemented practice opportunities on well-defined slices of the brigade decision-making process; the focus is on collective and not individual performance, and thus on the intangible aspects of the staff process, including integration, coordination, synchronization, and the establishment of roles and associations.

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[5] By "product type", we mean the category or general description of the training, such as computer-based individual training, small group situation-based training, and so on. At this point in the approach, the training developer will usually be preparing for conversion of multiple products of a particular type (e.g., several CBI courses for individual instruction), and should not yet be focused on any one instance of the product type. When there is only one instance of a product type to be converted, of course, the product type and the product itself are the same.

Developers must understand for whom the product is intended and how that product is structured or organized to achieve its purpose. They must also understand the content of the product (i.e., what the product trains), and the conditions for implementation (i.e., personnel and facility resources, use of instructional technologies, use of operational equipment and simulation, delivery media).

By specifying the "why," "who," "what," and "how" intended in the training, the developer is defining the purpose of the product type. A more in-depth analysis of the conditions will be performed in Step 2 as well, when the specific elements and linkages among elements of the product must be identified.

1.2 Define the New Product

Developers must document their understanding of the training need and the new product that will support the new training need. The documentation should parallel the specifications identified for the existing product, discussed above. That is, developers must specify the new METT-TC and other aspects of the environment that will underlie the new training product. They must specify a clear statement of the purpose, or purposes, for the new product. To continue the example of the vignettes (above), the purpose of the converted vignettes may change so that an additional focus is on using digital equipment to facilitate integration, coordination, and synchronization.

To determine the purpose, developers work from their knowledge of the existing product, the conditions of the new training environment, and the new training need. This activity is not the most resource intensive step in the conversion approach, but is critical to designing the new product, as the product purpose is the primary determinant of a product's design. Developers should not assume that a given product, once converted, will have a purpose parallel to that of the existing product. Thus, developers must clearly identify the purpose for the new product.

Factors to be considered when determining the purpose of the new product include the overarching need that prompted the conversion effort, as well as the same factors that defined the purpose of the original product (the target users, definition of factors of METT-TC, training environment, product presentation mode, implementation conditions, and where the product fits within a larger strategy for training).

These two activities in Step 1 may require a significant amount of research and analysis, especially if the new training need and the means of achieving that need have not been thoroughly explored. Developers should review the purpose statement defined during Step 1 again in light of the results of Step 2, when they define the tasks required during conversion. The capacity of the existing product to support the new training need may restrict the purpose of a converted product.

Step 2: Develop the Conversion Plan

In this step, developers identify the development tasks, procedures, and considerations necessary to convert an existing product into a new product that will support the purpose defined

during Step 1 and, thus, the training need. The product of Step 2 performance is a conversion plan for the particular product type. Step 2 requires developers to compare the existing and new training that were defined in Step 1, looking closely at the design parameters and content. Based on that comparison, developers will:

- identify the content areas within the existing product that must be modified during conversion,
- identify the components of the existing product that must be modified during conversion, and
- identify appropriate conversion processes.

The outcome of these activities will be the conversion plan for a particular *product type*; that is, the activities will not address the changes that are specific to any exercise or module that exists within a larger set of exercises or modules. As the plan is executed (Step 3), the content areas and components that were identified for modification will be examined for each exercise or module within the product type, and the conversion will be done one exercise at a time.

2.1 Identify Areas for Content Changes

The first task in preparing the conversion plan for a given product is to compare the existing training and the target training to determine how the training content will change in the new version. One area of consideration is the underlying METT-TC. For example, if a set of exercises on an NTC-type terrain were to be converted to Korean-type exercises, the content areas to be modified would include not only matters of terrain, but also the features of Korea-specific missions, organizations, and tactics.

Another area that must be considered is the instructional technology and use of simulation. For example, if an existing product requires simulation systems that are no longer used, then one area for conversion will concern the simulation and any TSP components associated with the simulation.

2.2 Identify Components to be Modified

Course elements that may change include briefing or orientation materials, practical exercises, tactical materials and scenario specifications, simulation files, exercise previews, job aids, training audience, and readaheads. This activity requires that the developer understand all of the content and interrelated elements of the existing product.

Every element of the TSP and all of the linkages among elements, for each component of the product type, must be considered in light of the conditions and purpose work done in Step 1 and the content areas noted in the first activity of Step 2. During this activity, it will be important to understand the areas of focus for the various components within the product type. A final documentation requirement is to identify and record references for the content.

From this information, the developers will work from what they know about the new environment to identify which elements of the TSP require modification. Each modification will require the documentation of the sources that were used to specify content conversions. From this work, the development team will produce a listing of the components to be contained in the new product, with a notation indicating the nature of the modifications. In addition to modifications, new components may be required and existing components may become unnecessary or obsolete.

2.3 Identify Conversion Processes

Identifying the conversion processes is the last step before actually converting a specific training exercise or module. In many cases, research of existing documentation and work with subject matter experts (SMEs) will provide the needed information. Other times, hands-on experimentation of new systems or job and task analysis will be required.

Documentation of the content areas, product components, and processes for conversion will comprise the conversion plan. The appropriate proponent agencies or offices should be asked to approve the statement of the training purpose and the conversion plan before the plan is executed.

Step 3: Design and Develop the New Product

In Step 3, developers carry out the plan developed in Step 2, performing the tasks required to convert the exercises or modules within a product type. The conversion process should follow the conversion plan, but may require improvisation as idiosyncrasies of specific exercises or modules surface. For instance, content differences among modules of a given product type may produce slight variations in the purposes of those specific modules. In cases such as this, developers may have to add a step to the conversion plan that provides a solution.

In executing the conversion, unanticipated problems (e.g., lack of simulation capability to portray environmental conditions or to support task performance) may arise that relate to the convertibility of the product or components within the product. In some cases, these may represent fatal flaws that force developers to reexamine the purpose of the training or even whether the existing product is the "right" product to convert. In most cases, however, acceptable work-arounds can be devised that circumvent the problem. It is important that work-arounds do not change significantly the audience's performance of tasks and training objectives and, thus, do not lead to negative training.

In some cases, an existing product or particular components of the product may not be suitable for conversion. This may occur when the content does not have a counterpart in the new environment or conditions, or when the content is identical within the new environment. In either case, the existing product would not be converted. A related situation occurs when there is content that is so peculiar to the new environment that it causes the developer to add product components (e.g., courses, modules, exercise tables) to the converted product.

An essential part of the approach is evaluation. Newly developed products should be reviewed by experts and trial implementations should be conducted with prospective users. Developers will then be able to assess the appropriateness of the content and the structure of the converted products. Findings from such reviews and trials should be incorporated prior to final production and implementation. Furthermore, there should be a continuing cycle of evaluation and improvement of the training after fielding. Improvement may mean changes to the training, another round of conversion (more than moderate change required), or complete new development.

Summary

The three steps of the conversion approach represent an application of the methodology for development of structured training, from front-end analysis, through conversion planning, to design, development, and evaluation. The conversion approach is intentionally general, and can be applied in a variety of situations for different conversion requirements.

The next four sections of this report describe the project's applications of the conversion approach. To design prototypes of needed digital training, the development team performed the analysis (Step 1) and prepared conversion plans (that is, specific applications of the conversion approach in Accordance with Step 2) for the BSTS and the COBRAS vignettes, BSE, and BBSE. The team then used the BSTS and vignette plans to develop digital applications of the BSTS Brigade Common Core Module and two COBRAS vignettes. It was during this conversion work that the broader implications of the project were refined. These implications are discussed in Sections 6 and 7, which contain lessons learned and recommendations for the continued development of training for the digital force.

Section 2. Conversion of Battle Staff Training System to a Digital Application

This section of the report addresses the research conducted to identify the tasks required to convert the BSTS to a digital application. The effort was based on the overarching need to provide digital training for staff officers in digital units. When applied in the context of BSTS type training, the need was narrowed to introducing and keeping the commanders and staffs of digital maneuver brigades and battalions abreast of the doctrine of the digital battlefield.

Developers began the effort by applying the project's conversion approach to perform the initial analyses and develop a BSTS conversion plan. The conversion plan defined the procedures and considerations required to digitize the BSTS. The team then performed a single implementation of the conversion plan by converting one component of BSTS, Brigade Common Core Course. Because the purpose of the conversion was to try out and refine the general approach and the BSTS conversion plan, the product was a prototype that allowed a proof-of-principle rather than an actual instructional course.

This section is organized according to the steps of the project's conversion approach. It begins by describing the front-end analysis (Step 1) conducted as preparation for developing a BSTS conversion plan (Step 2). The section then describes how the project implemented the plan in the digital conversion of the BSTS Brigade Common Core Course (Step 3) as a single

prototype. Issues that surfaced throughout the effort are identified in this section; implications for future development are discussed in Sections 6 and 7 of this report.

Step 1 of the Conversion Approach for Battle Staff Training System: Front-End Analysis

The first step of the conversion approach, analysis, required the collection of all the information that would be needed to develop and implement a conversion plan for the BSTS. The analysis consisted of two interrelated activities: defining the purpose, structure, and conditions of the existing BSTS; and defining the digital BSTS in terms of conditions and purpose.

BSTS 1.1 Define the Existing Battle Staff Training System

A conversion effort requires an extensive understanding of the purpose, structure, content, and conditions of the system. The team used three sources to determine the parameters of the BSTS. Two readily available sources were the BSTS *Trainer's Guide* (BDM International, 1996) and the description of the development of the BSTS (Andre, Wampler, & Olney, 1997). Developers used these resources to enhance their understanding of the program and its basic components, including the courses, tests, and training management system (TMS). The final source obtained by the project was a copy of the Brigade Common Core Course. Developers explored this course to determine the scope and nature of the BSTS material and its presentation.

One source that was requested during the analysis process, but was not available, was the storyboard materials that documented the non-compiled content of all the courses. These storyboards would have documented all course content, including text- and narration-presented information, as well as the structure and linkages of the material. As described later, having this type of documentation of CBI courses can make the difference between effecting a conversion or deciding to embark on new development.

To determine the full purpose of the existing BSTS, developers first looked at the context in which it was developed. The BSTS was developed for the FXXITP under the direction of ARI in 1996. The program was developed using the Army's SAT as documented in TRADOC Regulation 350-70 (DA, 1995[6]). The BSTS was developed to provide knowledge-level training for individual staff members on the requirements of various staff functions, both individual and collective. It allows commanders to address various needs through the provision of battle-focused training. These needs include overcoming the adverse effects of high turnover, filling the void in existing formal staff training, and preparing staff officers who serve in positions that require a more senior or experienced person. It can be used within the context of self-development, unit, and institutional training.

With an understanding of the purpose of the BSTS, developers continued their research by further exploring the structure and design of the overall system. The BSTS courses at the

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[6] Although TRADOC Regulation 350-70 has since been updated (DA, 1999), the earlier version was current at the time the project work was being performed.

brigade level are shown in Figure 2. These courses are structured around traditional staff positions and functional areas. The principal training audience includes the brigade commander and selected brigade staff officers (primary and special). An additional set of courses, shown in Figure 3, was developed for the battalion commander and staff.

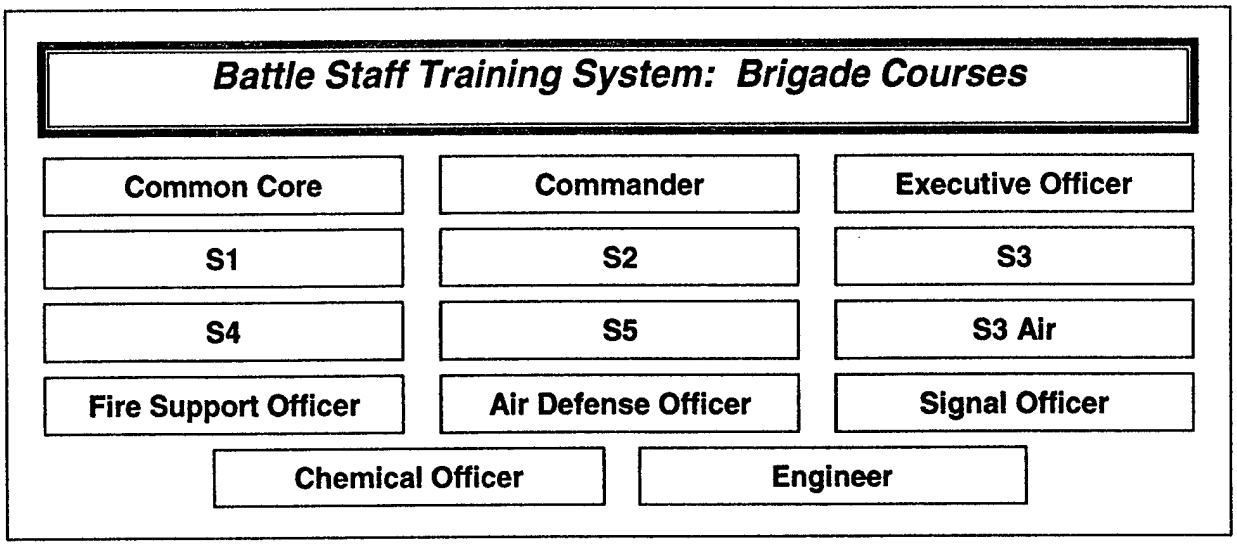

Figure 2. Courses contained in the brigade-level Battle Staff Training System.

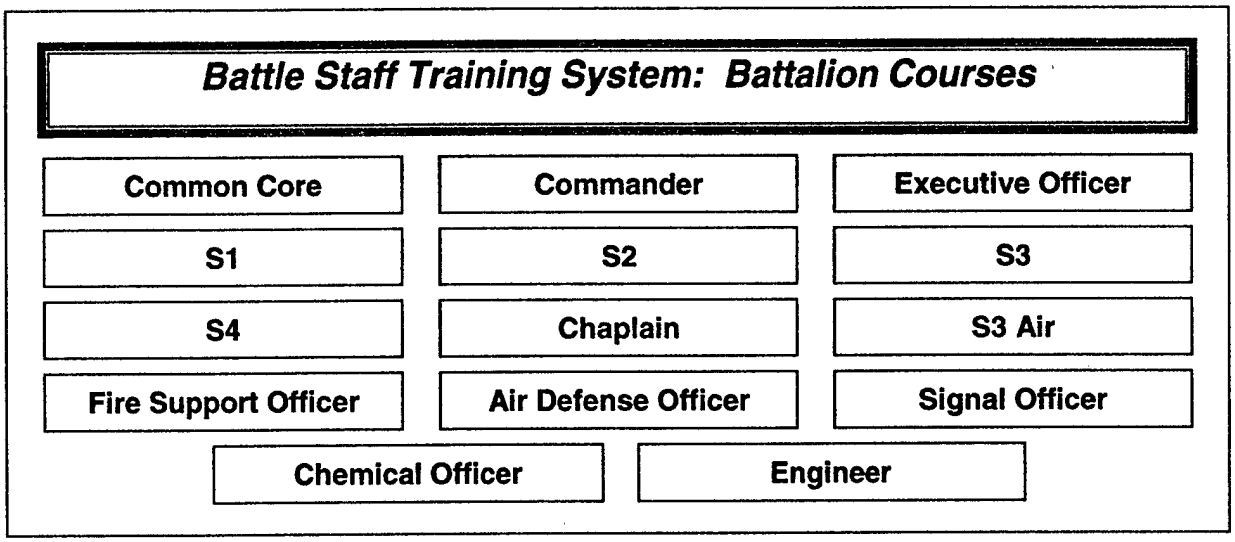

Figure 3. Courses contained in the battalion-level Battle Staff Training System.

In their implementation, the courses are mainly self-administered and allow completion on flexible "student-paced" schedules. Training may take place in a stand-alone mode (at the student's home or unit), on a local area network, or (theoretically) on a wide area network, depending upon how the system is set up at a particular organization or installation. Battalion and Brigade Common Core Courses, which give students a basic grounding in both doctrine and TTP, are designed to be taken before the staff position-specific courses.

Apart from the courses themselves, the BSTS includes two other components: a comprehensive assessment component (COMPS) and a TMS. The COMPS was intended to be utilized independently of the courses as a final evaluation tool for commanders by evaluating a student's ability to perform critical tasks. The COMPS evaluation is based on an NTC scenario and assesses all course performance measures. During a COMPS, the student roleplays a staff position in planning and preparing for a mission. The student conducts planning, interacts with other members of the staff, makes decisions in his staff area, and makes recommendations to the commander. The COMPS was designed to reinforce material taught in the course and demonstrates to the student that he can perform to standard in his staff position. Upon successful completion of the COMPS, the student should be prepared to assume duties in his staff position at the entry level, and participate in collective training.

The BSTS TMS is the component that integrates the courses and COMPS to facilitate feedback and evaluation and the management of training. Like any CBI TMS, it relies on programming that supports the distribution and tracking of critical information (e.g., test results, courses completed). The BSTS TMS is written in EMMii® and utilizes a database compiled in an early version of Microsoft Access® that is not Year 2000 (Y2K) compliant[7].

After exploring the BSTS, developers concluded that any extensive conversion of BSTS would necessarily have to address all three parts of the system: courses, the COMPS, and the TMS. The conversion plan, then, would address all three components through an integrated development process.

BSTS 1.2 Define the Digital Battle Staff Training System

In addition to understanding the existing BSTS, developers researched the conditions that would influence the design and content of a digital equivalent to meet the new training need. Again, the training need, defined at the highest level, was to provide knowledge-level digital training for staff officers in digital units. In relating this need to the purpose and design of the existing BSTS, developers refined this need to include introducing soldiers of digital maneuver brigades to the doctrine of the digital battlefield and keeping them current. The research to be conducted, then, was to define the doctrine of the digital environment. In the conversion, determining how to integrate this information into the BSTS would be the key activity.

The BSTS is comprehensive in its coverage of published doctrine associated with the operations and characteristics of maneuver brigades and battalions. Because of this, the analysis of the digital environment was not limited to segments of the decision-making process, selected missions, or any other factor that would restrain the scope of the investigation. The approach taken during the project was to conduct a complete review of digital doctrine, including emerging doctrine and doctrine-based TTP. The planned process and the process that actually occurred are described below.

[7] In an effort independent of this project, DTDD is researching methods to make the TMS Y2K compliant.

The analysis of the digital environment was divided into two components, one investigating conditions of the battlefield and the other exploring staff operations. The investigation of battlefield conditions was further broken out to differentiate between the conditions in the brigade and battalion command post (CP) locations and METT-TC. The CP conditions included information such as the number and types of CPs, CP personnel and their locations, and the equipment and information provided to CP personnel.

Developers used a baseline approach to identify the METT-TC conditions of the digital battlefield. The baseline of conventional conditions was derived from the conditions underlying the COBRAS BBSE, as this exercise provided a concise list of all pertinent conditions. Once these conditions had been specified, developers searched the available documentation of the digital environment to identify which conditions currently deviate in the digital battlefield. The resulting description of the conditions of the digital environment is provided in Appendix B. The sources used to arrive at this description included U.S. Army Armor School and TRADOC websites and publications, as well as emerging doctrinal materials developed in conjunction with Force XXI. These sources are also listed in Appendix B.

The second component of the environment represented staff operations. The development team believed that the analysis of this domain was of primary importance because the development of any structured training must be based on well-defined performance objectives, which in the case of BSTS focus on staff functions. Initial examinations of the difference between digital and conventional staff performance focused at the Mission Training Plan (MTP) subtask and TTP levels; this was based on a cursory level examination of Force XXI Experimental Force (EXFOR) MTPs and field manuals (FMs). In addition to producing a description of digital staff operations, the project's analysis would give developers a better understanding of the specifics of digital staff operations; this would represent a move from comprehension to synthesis of how digital operations are performed. In turn, this level of understanding would support greater returns in defining both the details and essence of digital staff performance.

Developers planned to conduct a performance analysis to determine precisely where digital staff performance differs from conventional staff performance. The team would explore the effects of digitization on TTP as well as on the MDMP, which has been touted as being generally unaffected by the current application of digital technology.

Preparation for the performance analysis began with information drawn from the BBSE, which contained a very fine-grained detailing of staff activities. The BBSE conditions would serve as stimuli for roleplay exercises, such as those employed during the COBRAS staff performance analyses (Ford & Campbell, 1997). The objective would be to define the digital equivalents of the staff operations that occurred during mission planning, preparation, execution, and consolidation and reorganization, such as is represented in the BBSE. Developers, acting out the staff functions, would be able to experience first hand the unique requirements and aspects of operating in the digital world. At the same time, the conditions could be manipulated systematically to allow the staff to replicate a full range of tasks and responsibilities.

As the staff process is generally consistent among missions (i.e., movement to contact [MTC], area defense [AD], and deliberate attack [DATK]), the team planned to base the analysis on just one mission, the MTC. The analysis was to be conducted at the MMBL and would document how the FBCB2 and ATCCS would be used during the mission, and how those technologies affected staff operations. Resources on which developers would base their performance were to include the *Staff Leader's Guide for the Army Battle Command System* ([ABCS] TRADOC Program Integration Office-ABCS, 1998), the 1 Brigade (Bde) 4 ID (M), Standing Operating Procedures ([SOP] 1998), and the EXFOR MTPs and FMs.

However, as developers explored the feasibility of conducting a roleplay performance analysis, they found that the DSTD2 would not support such a full-scale analysis. That is, there were not a sufficient number of ATCCS components, nor were there the necessary network linkages among the systems present, to support a full brigade staff exercise. A series of partial staff roleplay exercises may have been possible, but without replicating the full interaction involved in a whole staff operation, the findings would have been limited in their utility. There also were functional problems with certain ATCCS systems, which limited roleplay possibilities even further.

Based on these limitations and given the assumption that the basic staff process does not change upon digitization, the team decided to rely on the previously documented digital staff operations for the project's definition of digital staff operations. Because the BSTS trains doctrine and not emerging theory that will in time affect future doctrine, this course of action (COA) was consistent with and would support a plausible and valid conversion of the product.

In addition to identifying the environment and performance requirements, the team specified the purpose of the digital BSTS. Determining the purpose involved defining who the system would train, what it would train, and to a limited extent, how it would train it. The purpose would have to fit within the training need and the context of the Army's currently accepted digital training strategy. In achieving this, the purpose would also have to be defined in consideration of the digital environment.

The process began by refining the overarching training need so that it related to the type of training provided by the existing BSTS. The refined need was to introduce commanders and staffs of digital maneuver brigades and battalions to the doctrine of the evolving digital environment and keep them current.

The "who" of the training, according to this need, included the current and prospective commanders and members of digital brigade and battalion staffs. The audience would include primary staff as well as selected assistants. This audience would be assumed to have only that level of basic staff knowledge that target users of the original BSTS have, and no in-depth familiarity with FBCB2 or ATCCS.

The "what" of the training was to encompass the doctrine that is unique to the digital battlefield. This specification of what would be trained was based on the conditions that distinguished the existing BSTS from its digital version and was derived with respect to the currently accepted digital learning strategy (TRADOC, 1998). The strategy stresses a

conventional-first, digital-second model for training. The development of a digital-only BSTS to supplement and be completed after the existing BSTS met the standards of the model.

Finally, developers determined the "how" of the training. There were four design considerations that led to decisions about the converted product. First, the digital BSTS would not diverge far from the CBI model employed by the existing BSTS. The BSTS also uses paper-based materials, but the complete set of digital training would be, like the brigade common core, purely CBI. Second, the digital BSTS would also maintain the idea that the training is appropriate for self-development, unit, and institutional training settings.

Third, the digital BSTS would be developed as a set of updates to the existing BSTS. One factor in making this decision was the extent to which the content of the BSTS would require "digitization." For instance, if only a small proportion of the content was to require digitization, then an add-on module would be appropriate; however, if most of the content was to require digitization, then a replacement might be a more attractive alternative. Analysis of the Brigade Common Core showed that only a limited amount, approximately 20%, of the content would require conversion, and that 80% would remain valid. Another factor was how well each alternative would fit within the proposed digital training strategy. Clearly, the add-on alternative fits in the strategy, as a soldier could first complete a conventional course and then complete the digital add-on as his/her training needs progressed.

The fourth decision involved choosing software for the new system. The new product could either be compatible with the BSTS and its TMS, or use newer CBI software. The advantage of using the software employed by the existing BSTS was that the digital data capture could be added to the existing TMS. This would provide for complete integration of the digitized component into the existing BSTS. The disadvantage to this option was that the current software was developed in 1990 and is not as capable as more recently developed software. Additionally, the newer software would allow for the incorporation of more dynamic features, increasing potential interactivity. Eventually, after discussing the issue with Army trainers, ARI, and software experts, the decision came down in favor of using the more up-to-date software. Given the Y2K problem and the continuous need to update training products to incorporate the latest doctrine, the decision to convert to a newer software package seemed the most tenable for future development.

Step 2 of the Conversion Approach for Battle Staff Training System: Define the Requirements for Conversion (Develop a Conversion Plan)

Working from the Step 1 analyses described above, the FXXITP-D project team created a conversion plan that laid out the procedures and considerations involved in converting the existing BSTS to a digital application. The new application would be based on the purpose as defined during Step 1. The conversion plan presented below addresses the conversion of the complete BSTS, including its courses, COMPS, and TMS. The plan identifies the training design decisions that would shape a digital BSTS design model. By executing the plan for each of the courses, as well as the COMPS and TMS, a digital BSTS converted from the existing BSTS would be developed.

The conversion plan for the BSTS was developed by carrying out the activities described in the previous section:

- identify areas for content changes for the digital BSTS,
- identify the components of the existing BSTS that must be modified during conversion, and
- identify appropriate conversion processes.

Step 3 then would be to execute the plan repetitively for each course, the COMPS, and the TMS, resulting in development of the converted product.

BSTS 2.1 Identify Content Changes for Digital Battle Staff Training System

The first task in preparing the conversion plan for the BSTS was to conduct an analysis of the existing content and determine how that content should change in the digital version. Because BSTS is primarily a means of communicating facts and information, defining the system's content proved integral to understanding the elements and linkages among elements. The information about the digital environment (collected during Step 1) is the source for identifying the content that must be modified, including the removal or addition of content, during conversion. The information is presented in Appendix B, and forms the basis for the decisions on content changes.

While the information on both the conventional and the digital environments has been collected, the decisions must be made separately for each course and course component. Because the digital courses will be prepared as supplemental modules, it will be important to understand the areas of focus for each of the courses. New content, especially, should be consistent with course focus. Because the BSTS is not documented in a storyboard format, developers will need to examine and document the content, including narratives and screen presentations. With this information, the developers should work from what they know about the digital environment.

Each modification will require the documentation of the sources that were used to specify content conversions. Because BSTS is a trainer of doctrine, developers should consult the appropriate Army agencies and schools to both solicit and review emerging characteristics of the digital battlefield. Some emerging doctrine may not be incorporated in the initial version of the digital updates, but developers should keep a file of such information for future updates. From this work, the developers will identify a set of digitized content to be contained in the updates for each of the courses.

BSTS 2.2 Identify Components for Modification

Examination of the Brigade Common Core, taken to be representative of all of the courses, revealed a structure of subject, lessons, and topics within the course. Within these topics, the

BSTS courses lead the student through a series of elements that train, reinforce, and evaluate knowledge and abilities. Table 1 lists and describes the elements that comprise BSTS courses.

Course elements that will change with the conversion to digital include the following: subject pre-tests, lesson introductions, practical exercises, tutorials, quizzes, lesson exams, remediation, final exams, and job aides. The COMPS component may require modifications depending on how the developers choose to integrate the digital update modules into the existing BSTS.

For each course, the conversion will require the developers to review those course elements within each lesson, subject, and topic.

Table 1
Description of Battle Staff Training System Course Elements

Course Element	Description
Subject Pre-test	A diagnostic test that assesses the student's knowledge. By scoring 80% or higher, the student receives credit for the subject and is not required to study the subject material.
Lesson Introduction/ References	Each lesson begins with the presentation of the lesson's task, condition, and standard (performance measures). References that support lesson content are also provided at multiple locations throughout the lesson.
Practical Exercises	Lessons that require the performance of complex tasks include practical exercises. The exercises are computer-based and designed to integrate the knowledge and skills taught in the lesson. The exercises place the student in a tactical scenario and cause him to consider multiple issues simultaneously and apply what he has learned. Only a few of the lessons contain practical exercises.
Tutorials	Tutorials provide technical data, teach complex tasks, or familiarize students with joint procedures.
Quizzes	Some lessons contain quizzes that provide a "check on learning" during the lesson. Lesson materials cue students to take quizzes. Students are provided immediate feedback on quiz results.
Lesson Exam	At the end of each lesson, an exam assesses the student's grasp of the instructional material. Feedback is presented after each question, and the student receives a percentage score at the completion of the exam. Students who score below 80% are advised to review the lesson material before moving to new material.
Remediation	Some particularly difficult or complex lessons incorporate a remediation component (additional training). Where available, a remediation lesson is offered to students who score less than 80% on the lesson exam.
Final Exam	Presented upon completion of all lessons in a course. Feedback is given after each question, whether the student selects the correct or incorrect response. Students must score 80% or greater before they are considered to have mastered the subject within that course.
Job Aids	Each course includes a set of job aids or tools that the student may use during the course, and copy for use in his staff position. The tools include various checklists, standing operating procedure items, briefing guides, formats, planning factors, descriptions of system capabilities and limitations, and doctrinal templates.

BSTS 2.3 Identify Conversion Processes

The conversion processes for BSTS are associated with construction of the storyboards that organize the content and will serve as the structure for the courses.

1. *Identify digital topics for the course*: The first step in this process will be to examine the content and decide what the courses should teach. The storyboards will then be constructed according to those decisions. Based on the content, developers will also have to specify the content that should be included in the BSTS COMPS and decide how the courses should be integrated into the BSTS TMS. These decisions will be influenced by the storyboarding process.

2. *Organize topics and determine presentation techniques*: During the storyboarding process, the developers will organize subject matter and determine presentation methods (e.g., pictures, narration, slides, links, interactive learning). This phase of conversion should be conducted in consideration of the basic principles of instructional systems development and with the assistance of instructional systems designers and courseware developers.

3. *Obtain expert reviews*: As the development of storyboards progresses, the development team should then recruit expert panels to review the storyboards. The focus of the reviews, at this juncture, should be on content accuracy as well as on the effectiveness of the presentation methods and content organization. The reviewers should include instructional designers and digital SMEs from both the digital technology and operations perspectives. The review panels should include personnel from both unit and institutional training settings. The reviews conducted at this stage will represent the most comprehensive and critical of the project's evaluation components.

4. *Construct CBI modules*: The actual development of the course updates (Step 3) will be based on the revised storyboards. Developers will then transfer the storyboards into an electronic format through an authoring tool. TRADOC's preferred authoring tool is Asymetrix Toolbook II Instructor®, and should be used during the conversion of BSTS.

5. *Conduct pilot tests*: Finally, the courses will require beta testing to ensure the courses are constructed and work as designed, and trial implementations to ensure acceptability.

By means of the processes described above, the development team will complete the construction of the updates to BSTS courses. The COMPS will also require updating, and the process will mirror the course conversion process. Just as the digital conversion products serve as add-ons to the conventional course, the digital COMPS update will be a supplemental component to the existing COMPS.

Conversion of the TMS will be a different matter. The TMS must serve as a comprehensive management system for BSTS, not a combination of a conventional basic system with a digital update. The current system will need to be completely replaced. As the replacement is made, a number of upgrades should be made. First, the BSTS should be accessible for users at units, in learning centers, or at home. This means that the individual systems would not be linked in a network as they are currently. Rather, the individual results would be sent electronically to the

TMS, running on common hardware systems at the brigade or some other centralized location. Battalion training managers could access the database of results (courses completed, examination score) by means of a password. Item data on the exams should be accessible by the proponent agencies to permit statistical analyses of item validity. Ideally, the TMS should also accommodate other courses (e.g., Common Task Tests, the Engineer version of the BSTS, and other locally developed CBI) and be linked to the Standard Army Training System.

This section has described the analysis and development associated with the conversion of the BSTS to a digital application. These activities constitute the BSTS conversion plan. The following section describes a single execution of the BSTS conversion plan.

Step 3 of the Conversion Approach for Battle Staff Training System: Executing the Conversion Plan

During the project, the development team converted one BSTS course, the Brigade Common Core, to a digital application. The resulting prototype was a Digital Update for the BSTS Brigade Common Core Course. The purpose for constructing the Update was twofold: developers needed to evaluate and refine the BSTS conversion plan, and also needed to demonstrate the utility of the approach.

As a historical account of the conversion process, this section presents considerable detail about the processes involved in conversion, as well as the specific circumstances associated with the conversion effort. The conversion of the Brigade Common Core Course did not include converting the BSTS TMS or COMPS components to accommodate the update module. The following discussion, therefore, does not address the processes that would have been required to perform this aspect of conversion, but is limited to a discussion of course conversion.

The specific purpose for the prototype Update was to supplement the BSTS Brigade Common Core Course. The Update is intended for soldiers assigned to digitized units, to introduce them to the unique aspects of the digital operating environment. Soldiers would complete the BSTS Brigade Common Core Course prior to completing the Update to the course.

Executing the Plan for BSTS: Content of Brigade Common Core

As described above, developers had sought access to the storyboards that documented the non-compiled content of all the courses. Because these storyboards were not available, the developers reconstructed the storyboards from the course itself, documenting all course content, including text- and narration-presented information.

Figure 4 shows the topics covered by the Brigade Common Core Course. All of the topics were subject to the reverse-storyboarding process.

The first step in the project's BSTS conversion process was to identify the proposed content for the digital update. The team first developed content for the tutorial component of the course, and then used that content to complete the conversions of the remaining course components including subject pre-tests, the lesson introduction, quizzes and the lesson exams.

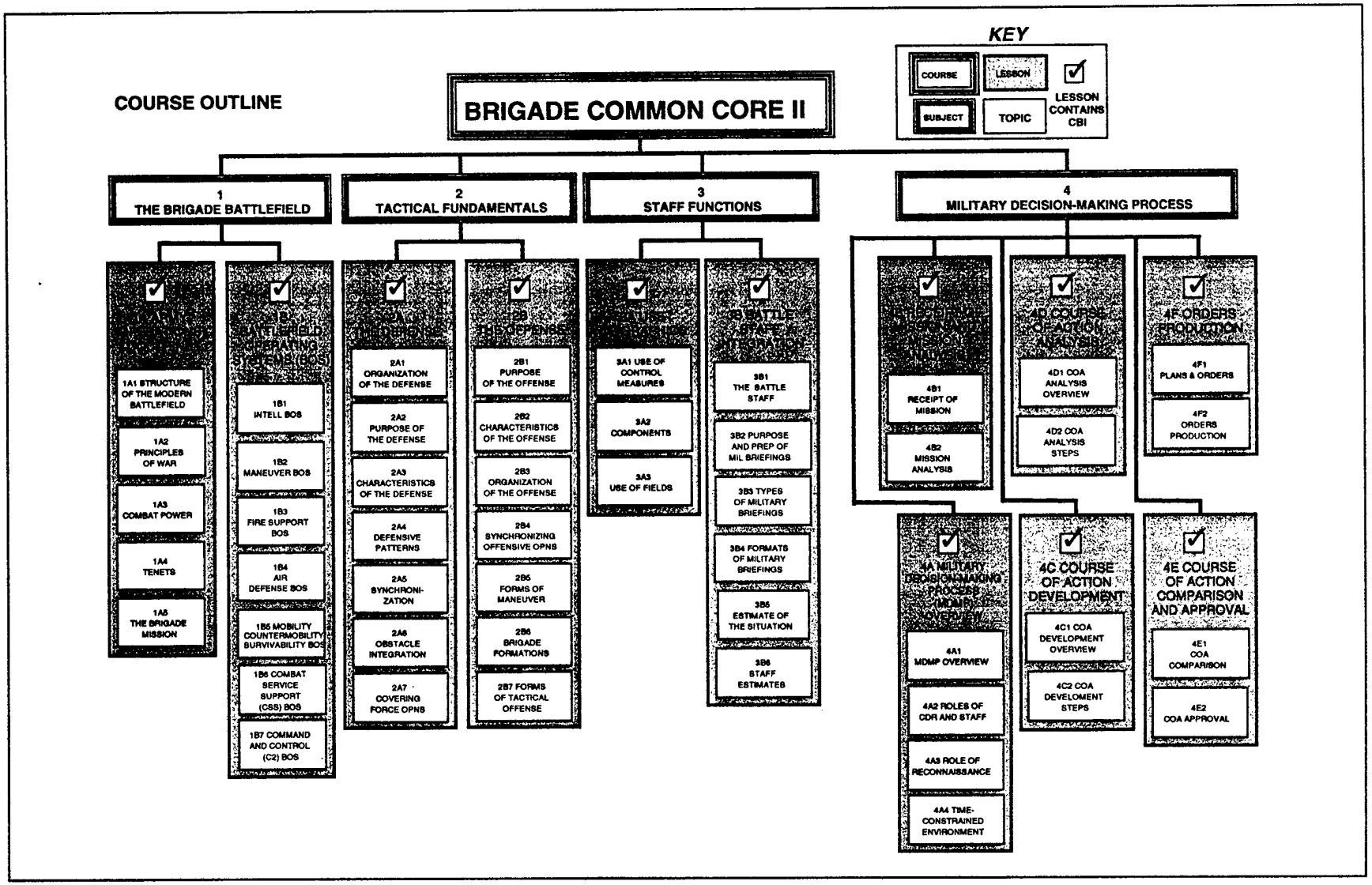

Figure 4. Subjects and lessons in the Brigade Common Core.

Developers used their knowledge of the digital environment to identify course topics that would require conversion. They began by documenting the content of the existing course and the associated references. Due to the lack of storyboards for the existing course, this required a laborious process of working through the course to record all information presented. Once the content was documented, the team identified references for the content.

Upon creating a content listing of the Brigade Common Core Course, developers compared the content to that specified in parallel digital reference sources. This allowed for a thorough specification of the content that would require conversion, and therefore, would be included in the prototype update. After evaluating the existing content, developers then used what they knew about the digital environment (based on their examination of the digital environment [Step 1 of the conversion approach]) to identify additional subject matter that would be appropriate for the course. The content for these topics was refined and structured during the next steps in the design of the prototype.

Executing the Plan for BSTS: Components for Modification

To refine the content, the project staff concurrently organized the topics for presentation and further specified the content for those topics. Military SMEs and CBI developers worked together in identifying content for the topics and storyboarding the content into an "instructional system."

As the research and design process continued, a preliminary structure for module topics was created. The structure was based on the amount and types of digital battlefield information collected by the development team.

Executing the Plan for BSTS: Conversion Processes

The five conversion activities outlined in the BSTS conversion plan were executed for the Brigade Common Core course. This process allowed developers to test both the general approach and the BSTS-specific plan, and to make refinements in the plan.

Identify digital topics for the common core. In identifying the digital topics that would be covered in the Digital Update to the common core, there were two considerations. In addition to being consistent with the nature of the Brigade Common Core Course and the purpose of the prototype, the content was also required to be consistent with current or developing doctrine. As most sources for the new information were doctrinal sources, additional SME reviews of the initial content list were not performed. The initial structure of the prototype course is presented in Figure 5. As the final efforts to identify content for topics were completed, three of the topics were dropped from the initial list (the topics shaded in the figure) because of the lack of accepted doctrinal information regarding these topics.

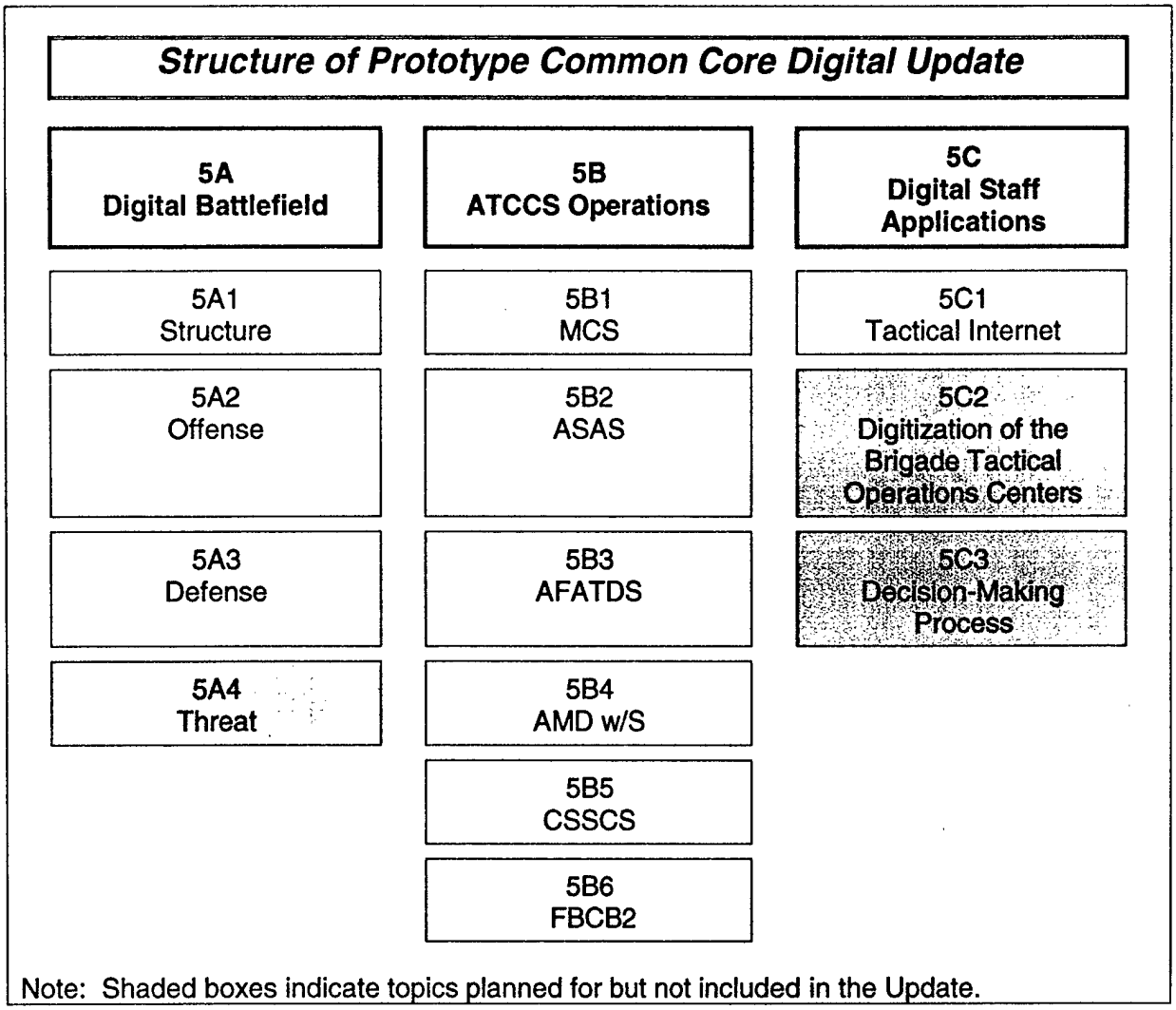

Figure 5. Topics contained in the prototype Battle Staff Training System Common Core Digital Update.

Organize topics and determine presentation techniques. The most time consuming task in the prototype design and development process was the refinement of the module's structure and design. Decisions made here related to the organization of the information within topics, the selection of course delivery means, and the identification of software and hardware requirements for the course.

The information to be presented within topics was refined through the storyboard technique. Storyboarding simply requires that the information to be presented in the course be designed on paper before it is entered into an electronic format. The SMEs worked with the CBI developer to determine which information would be presented on screen versus what information would be presented in narration. The interplay between on-screen and narrative information served to limit the amount of content presented, as repetition between the presentation methods is required for the production of a sound instructional tool.

Obtain expert reviews. The use of expert reviewers for the developing module was not fully implemented. Given the prototype nature of the module and the intent of trying out and refining the conversion plan, some content was deliberately treated superficially, in order to focus on identifying conversion requirements. The goal was to design and develop a module as proof-of-principle rather than for use as an actual instructional course. The SME developers themselves served as the reviewers for the content.

Construct computer-based instruction modules. Developing the prototype lesson required the transition of the information from storyboards into the electronic format through the authoring tool Asymetrix Toolbook II Instructor®. This step was the responsibility of the CBI developer, but SMEs played the role of formative evaluators as work progressed. As topics were completed, SMEs piloted the topics and continued to seek improved presentation organizations and content schemes for the topics.

Conduct pilot tests. The initial conversion plan had called for evaluations of the prototype by the intended users of a digital BSTS. Pilot tests were to occur at Fort Hood and Fort Knox with members of the 1Bde, 4 ID (M) and Armor School students respectively. As the development process and not the product was the focus of this project, however, this quality review step was not exercised. This is not to say that pilot tests would be unnecessary or optional in an actual conversion. ARI has developed a BSTS quality review process that includes ways of gathering and documenting feedback from SMEs and target audience soldiers and incorporating feedback in the training materials (W. Sanders, personal communication, September 1, 1999).

However, because soldiers were not available for a pilot test, a partial quality review process was employed. This review entailed examination of the storyboards and prototype by one ARI researcher[8]. Most of the review comments pointed toward a single (and not completely unexpected) conclusion: In its current version, the update was not an effective instructional tool in its presentation to the student. That is, narratives and screen presentations were not always mutually supporting and did not facilitate the learning experience. Because of the project's limited duration, as well as the requirement to produce a prototype and not an exportable tool, developers had focused more on identifying the extent of changes to components and less on actual construction of the content presentation. While this deficiency did not detract from the current project's efforts to design a conversion process, future conversions will need to spend considerable time not only identifying conversion requirements, but on producing courses that improve on the usability of the prototype.

Summary

The FXXITP-D project development of a digital common core module to supplement the BSTS brigade common core was not intended to yield a finished module, ready for use by brigade staffs. Instead, the processes of analysis, design, and development followed in constructing the prototype and the external review provided by ARI provided valuable information to developers. The general approach outlined in Section 1 of this report was robust

[8] The full set of review comments was provided to DTDD for further development efforts.

enough to support development of a conversion plan. Execution of the conversion plan was handicapped by two factors: the fact that digital doctrine is still being formulated and the nonavailability of a brigade staff for pilot testing. The former was by far the most significant, leading developers to attend more to the conversion processes than to digital content. As a result, the conversion plan seems likely to be useful, but production of digital products will continue to be impeded until digital doctrine is developed.

Section 3. Conversion of the COBRAS Vignettes to a Digital Application

This section describes the project's identification of tasks required to convert the COBRAS vignettes to a digital application. As was the project's BSTS conversion effort, this effort was based on the overarching need to provide digital training for staff officers in digital units. When applied to the vignettes, the need was narrowed to providing practice opportunities for small groups of staff members of digital maneuver brigades in performing the staff processes.

Developers began the effort by applying the project's conversion approach to perform the initial analyses and develop an initial vignette conversion plan. The team then implemented the conversion plan to convert a single vignette. This conversion facilitated the refinement of the conversion approach and the vignette digital conversion plan for future application.

This section is organized according to the steps of the project's conversion approach. It begins by describing the front-end analysis (Step 1) conducted as preparation for developing a vignette conversion plan (Step 2). The section then describes how the project implemented the plan in the conversion of one vignette as a digital prototype (Step 3).

Lessons learned during the vignette conversion effort were to guide the development of a digital battalion-level vignette from an existing brigade-level vignette. This second conversion, which was driven by both the digital training need and a change in training audience, is discussed in Section 4 of this report. Issues that surfaced throughout the effort are identified in this section; lessons learned and implications for future development are discussed in Sections 6 and 7 of this report.

Step 1 of the Conversion Approach for Vignettes: Front-End Analysis

The first step of the conversion approach, analysis, required the collection of all the information that would be needed to develop and implement a conversion plan for the vignettes. The analysis consisted of two interrelated activities: defining the purpose, structure, and conditions of the existing vignettes; and defining digital vignettes in terms of conditions and purpose.

Vignettes 1.1 Define the Existing Vignettes

Every member of the development team had been involved in the production of the existing vignettes during ARI's COBRAS I and II projects, therefore attaining an extensive comprehension of the vignettes was neither difficult nor time-consuming. To document the analysis of the purpose, structure, content, and conditions of the vignettes, the team referred to

the COBRAS II project final report (Campbell, Graves, et al., 1998) and the small group exercise development methodology (Campbell, Ford, Campbell, & Quinkert, 1998). This development methodology was produced as a secondary outcome of the COBRAS vignette development and represented a variation of ARI's structured training development methodology (Campbell & Deter, 1997).

The vignettes are short, structured, self-contained training activities that allow members of brigade staffs to practice isolated segments of the staff process. Each vignette focuses on a specific staff process event and on specific groupings of the brigade staff. Activities within a given vignette are a "snapshot" of a segment of the entire staff process. They represent extracts of activities that are normally performed by the staff in a context-rich situation. That is, the vignettes lift discrete events out of the context in which they are normally found and, for training purposes, treat them in isolation.

Vignettes support practice without heavy investments of time in preparation or actual conduct, which is the key to their value. Each sets up an environment in which selected staff members can focus on the performance of the activities required by well-defined segments of the plan, prepare, and execute processes. Vignettes are well suited for the intangible aspects of staff processes, including integration, coordination, synchronization, and the establishment of roles and associations. As such, vignettes focus on the performance of groups of staff members, rather than on the isolated performance of any individual members.

The topics of the COBRAS vignettes focus on selected aspects of the staff process. These topics are based on the requirements outlined in the MDMP as described in FM 101-5 (DA, 1997), and represent "high pay-off" training tasks for brigade staffs. Many vignette topics were initially identified from NTC and Center for Army Lessons Learned (CALL) research identifying problem areas for brigade staffs.

To date, ARI has produced 24 vignettes. Four of the vignettes are simulation-based (using the constructive simulations Janus and BBS), and the remainder are live simulation exercises. By using a live simulation environment, vignettes require relatively little time to prepare for and execute (e.g., one to two days for preparation *and* execution), resource costs are kept low, and the training becomes more accessible for brigade staff development. Table 2 presents the titles and target training audiences for each of the 24 vignettes.

Each of the 24 vignettes is an independent, stand-alone exercise, and the vignettes can be executed in any order. Each vignette is self-contained in a single TSP, and these TSPs are supported by a *Guide to Use and Implementation of Vignettes*. This guide provides all of the background and instructions needed to execute the vignettes and serves as the training management component for the vignettes.

Converting the vignettes would require the conversion of two components, the individual vignette TSPs and the supporting *Guide to Use and Implementation of Vignettes*. The conversion plan, then, will address both components through an integrated development process.

Table 2
Titles and Target Training Audience for the COBRAS Brigade Vignettes

	Vignettes	Target Training Audience
1	Plan for Dislocated Civilians	Personnel Officer (S1), Intelligence Officer (S2), Supply/logistics Officer (S4)
2	Plan Refuel on the Move	S4, Forward Support Battalion Commander (FSB Cdr)
3	Develop a Concept of Service Support	S1, S4
4	Develop a Reconnaissance and Surveillance Plan	S2, Operations and Training Officer (S3)
5	Conduct Target Development	Executive officer (XO), S2, S3, Fire Support Officer (FSO)
6	Develop Air Defense Concept	S2, S3, Air Defense Coordinator (ADCOORD)
7	Develop Contingency Plan	S2, S3, FSO, Engineer (ENG)
8	Conduct Mission Analysis	XO, S1, S2, S3, S4, FSO, ENG, ADCOORD
9	Develop Courses of Action	XO, S1, S2, S3, S4, FSO, ENG, ADCOORD
10	Conduct Course of Action Analysis	XO, S1, S2, S3, S4, FSO, ENG, ADCOORD
11	Conduct Special Staff Rehearsal	XO, S2, S3, FSO, ENG, ADCOORD
12	Develop a Reconnaissance Order	S2, S3, S4, FSO, ADCOORD, ENG, Signal Officer (SIGO), Military Intelligence (MI) Co Cdr, Chemical Officer (CHEMO)
13	Develop a Course of Action Branch	S3, FSO, Aviation Liaison Officer (AVN LNO), ENG
14	Plan Nuclear, Biological, and Chemical Defense Operations	S2, S3, CHEMO
15	Plan Deliberate Smoke Operations	S2, S3, FSO, CHEMO
16	Plan Brigade Rear Battle	S2, S3, FSO
17	Plan Combat Service Support Rehearsal	S1, S4, FSB Cdr
18	Identify and Resolve Airspace Conflicts	S3, S3-Air, FSO, AVN LNO, Air Liaison Officer, ADCOORD
19	Conduct a Brigade Rehearsal	Brigade (Bde) Cdr, XO, S2, S3, S4, FSO, Fire Support Coordinator (FSCOORD), ENG, ADCOORD, CHEMO, Battalion/Task Force Cdrs
20	Conduct Accelerated Decision Making Process	Bde Cdr, XO, S1, S2, S3, S4, FSO, FSCOORD, ENG, ADCOORD, CHEMO, SIGO, MI Co Cdr
21	Coordinate Mission Operations (Janus)	XO, S2, S3, FSO, ENG, ADCOORD
22	Coordinate a Mission Transition–Offense to Defense (Brigade/Battalion Battle Simulation [BBS])	XO, S1, S2, S3, S4, FSO, ENG, ADCOORD, FSB Cdr
23	Conduct Parallel Planning (BBS)	Bde Cdr XO, S1, S2, S3, S4, FSO, ENG, ADCOORD, FSB Cdr, CHEMO, MI Co Cdr
24	Plan and Execute a Fragmentary Order (Janus)	Bde Cdr, XO, S2, S3, FSO, FSCOORD, ENG, ADCOORD, CHEMO

Vignettes 1.2 Define the Digital Vignettes

With an understanding of the existing vignettes, developers began to define the conditions that would affect the design and development of vignettes with a digital application. Because the vignettes all focused on the performance of the staff process, the digital staff process and the digital environment in which that process would be conducted were identified as the conditions to be defined.

In the BSTS conversion effort (see Section 2 of this report), developers had already produced a description of the digital environment. Section 2 of this report discusses that analysis, which defined three aspects of the digital environment: CP conditions, METT-TC conditions, and staff operations. Developers relied on the results of this analysis to specify the unique conditions of digital vignettes.

The development of digital vignettes required developers to evaluate and determine how the existing vignette training concept should be utilized in the context of digital training. As in the BSTS effort (see Section 2 of this report), developers had to examine the purpose of the existing vignettes, and then refashion that purpose in line with the training need and TRADOC's current concept for digital training (TRADOC, 1998). Following this analysis, the team decided that the digital vignettes would best represent the Level 3 training products that would focus on the performance of digital skills within the context of staff processes. That is, staff would practice integrating digital skills into the Army's current decision-making process (DA, 1997).

The precise purpose of digital vignettes would be to provide practice in conducting the staff process under digital METT-TC and CP conditions, which include the presence of digital equipment. The focus was to be on: (a) performing the staff process, (b) using the digital equipment during the staff process, and (c) performing under additional digital METT-TC and CP conditions (e.g., different missions or staff organizations). The digital vignettes were not to focus specifically on how to operate the digital equipment, as this should be accomplished during individual training.

As with BSTS, developers anticipated that some of the vignettes would not be suitable for conversion. It was conceivable that one or more topics addressed in the current set of 24 vignettes would not be relevant in a digital environment. Additionally, some vignettes might consist solely of activities that were absolutely not influenced by the presence of digital equipment or METT-TC. While both situations were possible, they would be rare. In either case, the vignette would simply be set aside to not be converted.

Step 2 of the Conversion Approach for Vignettes: Define the Requirements for Conversion (Develop a Conversion Plan)

Following Step 1 analyses, developers created a conversion plan that specified the procedures and considerations involved in converting the existing vignettes to a digital application. The conversion plan addresses the conversion of the vignette TSPs and the *Guide to Use and Implementation of Vignettes*, and identifies the training design decisions that would shape the vignette design model. By executing the plan for each of the vignettes and for the

implementation guide, developers could produce a digital vignette library converted from the existing vignettes.

The team developed the conversion plan by carrying out the following activities:

- identify areas for content changes for the digital vignettes,
- identify the components of the existing vignettes that must be modified during the conversion, and
- identify appropriate conversion processes.

Vignettes 2.1 Identify Content Changes for Digital Vignettes

The first task in preparing the conversion plan for the vignettes was to conduct an analysis of the existing vignette topics and TSPs with the purpose of determining how those topics and TSPs should change when applied in the digital environment. Developers worked under the assumption that the basic staff process does not currently change under digital battlefield conditions. As a result, all vignettes were tentatively marked as candidates for conversion.

Interestingly, the vignette objectives would be largely unchanged. Currently, the objectives are stated as work to be accomplished (*what to do*), rather than in terms of defining *how to* do the work. In digital vignettes, the *how to* would be more affected than the *what to do*.

Vignettes 2.2 Identify Components for Modification

Developers next looked at the components of the individual vignette TSPs to identify which of those components might require modification upon conversion. Each of the vignette TSPs contains all of the necessary information for conducting that particular vignette. To facilitate implementation, individual vignette TSPs have similar structure and appearance. The structure and a description of the types of materials contained in the individual vignette TSPs are presented in Table 3. It was determined that, as a vignette was converted, all of the contents of the vignette TSP will have to be examined.

In addition to the general types of materials (as shown in Table 3), developers identified additional design parameters that will require examination upon conversion. These parameters included the following: the individual vignette scope, scenario, and performance requirements. Any conversion of a vignette TSP will require an analysis of how these parameters would be affected by the digital environment.

Table 3
Structure and Content of Vignette Training Support Packages

Training Support Package Item	Description
Training Coordinator Materials	Overview of the vignette scope, participants, and tasks; information on how to get ready; list of training objectives; how to initiate and control the vignette; after action review questions.
Training Participant Materials	Overview of the vignette scope and tasks; information on how to get ready; list of training objectives and references.
Preparation Materials	Selected tactical materials to provide the setting and situation for the vignette.
Execution Materials	Selected tactical materials to cue and shape the vignette problem.
Job Aid Materials	Provided for selected vignettes to help participants perform the tasks.
Sample Products	For use in illustrating general form and content of brigade staff products.
Support Coordinator Materials	For use in simulation-supported vignettes; guidance for roleplayers and interactors; simulation tapes and documentation.

Vignettes 2.3 Identify Conversion Processes

The conversion processes for the vignettes are based on ARI's small group exercise development methodology (Campbell, Ford, et al., 1998). The processes followed the analyze-design-develop-evaluate model, but were broken out in more detail in the vignette conversion plan, which contains seven activities. The activities were as follows:

1. *Identify digital performance opportunities*: The first activity of conversion will require an analysis of how the training audience would be able to use the ATCCS during the vignette. This analysis will provide an early indication of the digital performance opportunities offered by the digital vignette. The development team should use the results to verify the suitability of the vignette for conversion to a digital application. The analysis should involve a mental walk-through of the vignette activities, paying particular attention to how the digital equipment could or should be used. Developers should also closely examine the specific training objectives and tasks in the current vignette to ensure that they are both necessary and sufficient for the converted vignette. In the process, the developers will make initial decisions regarding which TSP materials should be presented in digital form, and how participants might use the digital systems to accomplish the vignette's objective and tasks.

2. *Convert scope and implementation conditions*: Developers will use results of this analysis to identify changes to the vignette scope (training audience and scenario events) and to specify the digital vignette's implementation conditions. The team should conduct a second walk-through of the vignette, this time paying particular attention to both the vignette's scope and supporting requirements (personnel and equipment). Together with the analysis results, this step will yield a vignette outline that will guide the remainder of the conversion process for that vignette.

3. *Convert the scenario*: Structured training requires a scenario that supports designated performance requirements by providing cues and conditions requiring the performance. The development team must evaluate any changes made to vignette tasks and objectives, and modify the scenario so that it will support those tasks and objectives. The scenario will also require consideration of modifications for conditions of the digital environment, including METT-TC. The TSP products that would require conversion include the preparation and execution materials. After conversion in this activity, the scenario will be complete enough to support construction of digital system files, hard copy files, and simulation files, as required.

4. *Build digital system files and prepare tactical scenario materials*: Developers must construct the digital system files that contain the digitized preparation and execution materials to be used in the vignette. This step will require access to a functional ATCCS network or FBCB2 and simulation, for at least those components that were identified as appropriate in the first step. They must also prepare the other materials that drive performance during the vignette. The files and materials will be used in the pilot tests.

5. *Pilot test*: By means of iterative pilot tests of the vignette using the digital equipment, developers should now refine the scenario and associated materials and the objective, tasks, and after action review (AAR) materials. This step will ensure that digital tasks are presented accurately and that the performance of those tasks will be supported by the scenario and other exercise conditions. The activity will vary in complexity and scope depending on the extent of the conversion of the performance requirements. The pilots will provide data regarding the accuracy of performance requirement statements (representing digital TTP) included in the TSP, but will also aid in the further specification of the vignette's implementation conditions.

6. *Convert the TSP*: On the basis of the pilot test of the scenario and implementation conditions, developers will complete the conversion by modifying implementation instructions and other components of the TSP to track with other changes. A thorough walk-through of the original vignette's TSP is required, rewriting, subtracting, and adding material and information as appropriate.

7. *Conduct trial and refine the TSP*: The final check on the conversion will be a trial of the vignette TSP by external participants representative of the intended training audience. The proposed participants should include brigade staff personnel from 1Bde, 4 ID (M) at Fort Hood, or other soldiers with experience operating ATCCS.

Because the *Guide to Use and Implementation of Vignettes* covers the full set of vignettes, its conversion should be the final one. Modifications will be based on the results and conclusions of the conversions of the entire set of vignettes. The process would include a walk-through of the guide's content, incorporating any modifications made to the vignettes. The updated guide must include guidance on how to use both the original and the converted vignettes. It will require extensive additions to address the use of digital equipment within specific vignettes.

Step 3 of the Conversion Approach for Vignettes: Executing the Conversion Plan

This section describes the execution of the plan described above to convert one vignette to a digital application. As a historical account of the conversion process, this section presents considerable detail about the processes involved in conversion, as well as the specific circumstances associated with the present conversion effort. The project's vignette conversion effort did not include the *Guide to Use and Implementation of Vignettes*, as this document covers the entire set of vignettes. Conversion of the guide should be done after all of the vignettes are converted.

The FXXITP-D project entailed one peculiarity that would not be associated with future efforts to convert FXXITP products. That is, developers had to select only one COBRAS vignette for conversion before beginning the conversion process. The decision was made to select for conversion one of the live simulation vignettes. This decision was made so that the prototype would require only access to a digital tactical operations center. The prototype would minimize overhead because it would not require the operation of any constructive simulation.

The team chose the vignette *Mission Analysis* for conversion. This vignette was selected because it offered the potential for involving a large training audience, and therefore, the use of multiple ATCCS and FBCB2 systems for gathering information.

Executing the Plan for Vignettes: Content of the Mission Analysis Vignette

The *Mission Analysis* vignette, in its original version, was designed for the brigade Executive Officer (XO), Personnel Officer, Intelligence Officer (S2), Operations and Training Officer (S3), Supply/logistics Officer (S4), Engineer, Fire Support Officer (FSO), and Air Defense Coordinator. The brigade is in an assembly area with operational, logistical, and personnel reports already forwarded from subordinate units; these reports are provided to the staff for pre-vignette preparation. The vignette begins with receipt of the division operation order (OPORD), and ends with delivery of the mission analysis brief. In support of the objective of conducting a mission analysis, the staff will identify facts and assumptions; identify specified, implied, and essential tasks; identify restrictions and constraints; produce a restated mission; prepare staff estimates; and brief the mission analysis.

Examination of this content indicated that the vignette was, in fact, suitable for conversion. All of the mission analysis activities must be performed in digital environments, although the actual methods for performing the tasks could incorporate use of ATCCS and FBCB2.

Executing the Plan for Vignettes: Components for Modification

As stated previously, all of the vignettes had essentially the same structure, with the components listed in Table 3 (page 34). All of the components of the *Mission Analysis* vignette would have to be examined for possible modification, but the precise nature of the modifications would depend on changes to the scope, scenario, and support requirements. Those changes would be identified once developers completed their examination of the digital performance

opportunities. At this point, it was sufficient to know that, based on initial analyses, no component could be set aside for "no change."

Executing the Plan for Vignettes: Conversion Processes

The seven conversion activities outlined in the vignette conversion plan were executed for the *Mission Analysis* vignette. In the course of performing those activities, developers discovered more precise ways of specifying the conversion requirements; those improvements were incorporated in the plan that appears in the earlier part of this section.

Identify digital performance opportunities. In consideration of the designated purpose of digital vignettes, the first conversion activity required the analysis of how the training audience would be able to use the ATCCS during the vignette. This analysis provided an early indication of the digital performance opportunities offered by the digital vignette. The development team used the results to verify the suitability of the vignette for conversion to a digital application.

To identify how digital systems could be integrated into the vignette, the team utilized the project's description of the digital environment and staff operations and documentation of ATCCS capabilities. With this information, they conducted a mental walk-through of the vignette. In the process, the team made initial decisions regarding which unit preparation and vignette execution materials should be presented in digital form, and how the digital systems should be used to accomplish the vignette's objective and tasks.

The analysis began with a cursory look at how each piece of the preparation and execution materials would be used during a digitized version of the vignette. Materials included a division order, with annexes and overlays, and CS and CSS status report data. The order, along with the annexes and overlays, could be presented to the training audience via MCS. The status information was to be presented via CSSCS.

In analyzing vignette tasks, the team determined that the S2 could use ASAS to assist in the conduct of the intelligence preparation of the battlefield (IPB); terrain analysis represented the primary digitally supportable IPB activity. Finally, as a brigade warning order (WARNO) is the logical outcome of the vignette, developers identified that FBCB2 could be used to disseminate the WARNO. In sum, the integration of three ATCCS systems (MCS, CSSCS, and ASAS) and FBCB2 could be accommodated by this vignette. No new materials would be necessary due to digitization, although some tactical materials would require conversion to an electronic, digital system format.

As developers examined how digital equipment would be used during the vignette, they also considered requirements for modifying the vignette objective and tasks. Their initial judgment was that the presence of digital equipment does not change the fundamental requirements of the decision-making process. As a result, the training audience remained the same, as did the scenario slice on which the vignette would be based.

For the same reasons, the team made no changes to the vignette's tasks. The original vignette contained task statements that reflect fundamental aspects of the Army's decision-

making process, but no TTPs are included in tasks statements. Given this, and the fact that current doctrine indicates no digitization-driven changes in the decision-making process, beyond TTP, the tasks required no modification.

While the task statements remained constant, the objective was modified to include a phrase indicating that the mission analysis was to be performed using the components of ABCS (specifically FBCB2 and ATCCS). The change was slight, but reiterated the intent of the digital vignette as a tool for training the integration of digital equipment into staff operations. This intent, along with the supporting digital TSP materials, are what distinguish the digital vignette from the original vignettes.

Another important outcome of this activity was the decision to continue with the conversion of the vignette. The team verified that the vignette, upon its digitization, would be able to support training on integrating digital equipment into the staff process.

Convert scope and implementation conditions. In this activity, developers sought to redesign the original vignette according to the purpose of the digital vignette. The basic purpose of the vignettes, to provide practice on the staff process, did not change upon conversion of the vignettes to a digital application. Rather, the purpose was supplemented with the requirement to integrate digital performance into the process. As a result, the basic structure of the new vignette closely resembled that of the original vignette.

The development team used the vignette purpose and their plans for digital system usage (from the previous activity) to create an outline for the digital vignette. The team conducted a second walk-through of the vignette, this time examining closely the vignette's scope (training audience and scenario events) and supporting requirements (personnel and equipment).

First, developers examined the prospective supporting requirements of the digital vignette. Supporting requirements referred to equipment and personnel requirements. Developers had determined that two FBCB2, two MCS, one ASAS, and one CSSCS would be required to execute the vignette.

With the addition of digital equipment, however, developers had to determine whether new supporting personnel would be required. The team first estimated that the training audience might require the addition of personnel (i.e., staff leader assistants) to operate the digital systems. These assistants are already included as supplementary training audience members in the existing vignettes, but developers did not know the extent to which their role and importance within the training would change upon the introduction of digital systems. It was even suggested at one point that these assistants might become part of the training audience.

Because the focus of the training was still on the staff process using the ABCS components, and not on the operation of the equipment itself, the team decided that the assistants should remain as supplemental training audience members. Furthermore, an examination of who actually operates the equipment during mission analysis revealed that the primary staff would do the majority of the work. Thus, the team kept the assistants as supplemental training audience and saw no need to require the presence of additional supporting personnel. The decision not to

add new personnel requirements to the vignettes represented anecdotal support for the validity of the digital vignette concept–vignettes are to be low-resource, high-value training.

Convert the scenario. So far, the development team had made no changes to the tasks, and only changed the objective to introduce the notion that digital equipment was to be integrated. As a result, the scenario required no major alterations. In fact, the only facet of the scenario that was modified was its setting–from a conventional to a digital environment. The primary changes made to the scenario during the conversion were the incorporation of digital METT-TC (primarily task organization). From the description of the digital environment created earlier in the project, developers manipulated the scenario to make it represent a digital environment to the extent possible. The products that required conversion were the preparation and execution materials, including the OPORD. The scenario in its original form was suitable enough to support construction of digital system files and other tactical materials to drive pilot testing with the digital equipment.

Build digital system files and prepare tactical scenario materials. In preparation for the pilot testing, the development team constructed digital system files that contained the digitized preparation and execution materials to be used in the vignette. The preparation and execution materials to be converted included an OPORD and its annexes, status reports, and overlays. In anticipation of the long arduous process typically associated with employing new technologies in a training context, and because the original scenario required delivery changes rather than content changes, developers began building the files very early in the project, even as the first two activities above were being performed.

This activity required access to a functional ATCCS network, and was impeded by the limited operability of the ATCCS in the MMBL. In fact, discovery and testing associated with creating digital system files was the most time consuming aspect of the vignette conversion effort. This section describes the construction of digital system files, discusses the project's attempts at creating those files, and documents the methods by which the digital systems were incorporated into the training.

The vignette's paper-based OPORD and annexes were converted to files on MCS to be sent from the Training Coordinator to the training audience at the beginning of the vignette. When trying to accomplish this task, however, the team experienced a problem with the MCS version 7.1.A.F.1, the version available at the MMBL. The problem was that this version of MCS would not allow developers to enter and save all the annexes along with the OPORD–the MCS software crashed when all the annexes were added.

At Fort Hood, training managers develop large OPORDs on MCS Light (a system that employs laptop NT-based software) and then send the OPORDs to the MCS for distribution. The only OPORDs actually developed on MCS are small (main body and a few annexes), and those small OPORDs don't cause the system to crash. Thus, the problem experienced by the FXXITP-D team was not relevant at Fort Hood where MCS is currently used in training.

At the time of this part of the project, a new version of MCS was under development. The version is on SOLARIS 2.51 and runs Windows 95 by the SUN PC emulation. The new

software, however, had not been completely tested and perfected, and thus could not be used at the MMBL at Fort Knox for the FXXITP-D project. The software was to be adopted for MCS shortly after the timeframe of the FXXITP-D project and would be available to the MMBL in the near future.

The development team's solution to this problem was to develop the division OPORD on MCS as a message file and send it according to typical MCS protocol–an e-mail message. The annexes, however, were produced as file transfer protocol (FTP) files that would be downloaded by the training audience from the Training Coordinator's MCS. This problem with MCS was temporary and the development team judged that it would not have any significant negative impact on the training. Because the software was still under development, and the procedures were not set in stone as operational TTP, the workaround would not produce any negative training effects in the vignette.

The conversion of the vignette's paper-based status reports to CSSCS files revealed a similar problem. There was no mechanism in the CSSCS system for uploading pre-developed status reports. For each exercise, the data had to be entered line by line, and that required significantly more human resources than the vignettes were designed to accommodate. Given this situation, developers decided to provide the status reports to the audience in a paper-based mode, but to design the reports so that, in their presentation, they resembled the reports that would have been elicited from CSSCS.

The immediate impact on the present vignette was that the S4 would not be able to use the CSSCS system to receive status reports. The ATCCS systems to be used, then, included only MCS and ASAS (usage discussed below). As the vignette was a prototype, however, developers believed that the lessons learned from the development experience, and the fact that multiple systems would still be required, still justified the continued development of the "proof-of-principle" vignette.

The final materials to be converted were the overlays, which were to be entered into ASAS as situation maps. Developers were able to create the situation map files in ASAS, but neither the developers nor the system managers were able to determine where ASAS saved the files. As with the CSSCS dilemma, in order to have situation maps available on ASAS during the vignette, the maps would have to be created for each implementation of the vignette, and this was judged as inconsistent with the low-resource requirements of vignettes.

The FXXITP-D project's solution was to provide one enemy situation and one friendly operations overlay to the S2 prior to beginning the vignette. The S2 could then perform preliminary IPB before the vignette and would be prepared to input manually battlefield geometry and perform IPB functions such as terrain evaluation using ASAS. Again, the problem was a direct result of the ASAS being designed for operations rather than for operations and training.

Pilot test. In this activity, the team used a series of pilot tests to examine and refine the objective, tasks, and all new documentation of performance requirements for the vignette. The purpose was to ensure that digital tasks were presented accurately and that the performance of

those tasks was supported by the scenario and other exercise conditions. Because the vignette tasks are not written as TTPs, there was no change to task statements. In future conversions, and once digital TTP has matured, it may be beneficial to include some TTP information in vignette performance requirements. Based on this rationale, the team did not eliminate the activity of examining performance requirements from the vignette conversion plan.

The pilot tests were also intended to ensure that the scenario specifications did in fact drive execution of the vignette's performance requirements. These pilot tests examined the functioning of the digital systems and provided demonstrations of inputting data, sending messages, and employing the FTP function. More extensive pilot tests were not conducted, in part because of project resource limitations, but primarily because of the prototype nature of the vignette. As with the BSTS, the vignette was not developed for export, but to investigate the requirements for producing such an exercise.

Convert the training support package. Once the basic materials had been pilot tested, developers converted and refined implementation instructions and other components of the TSP to incorporate the digital design specifications determined during preceding conversion activities. Developers walked through the original vignette's TSP, rewriting, subtracting, and adding material and information as appropriate. Due to the similarity between the original and digital purposes of the exercise, relatively few modifications to the original TSP materials were required. Those changes that were required, however, are presented in Table 4, which lists the components of the TSP and summarizes the types of changes that were made within each component.

Conduct trial and refine the training support package. Activities described above had produced a digital TSP that was ready for a trial using external participants representative of the intended training audience. The proposed participants for the trial included brigade staff personnel from 1Bde, 4 ID (M) at Fort Hood, or other soldiers with experience operating FBCB2 and ATCCS. These personnel, however, were unavailable for the trial, and because the exercise was a prototype, no effort was made to find replacement personnel. The trial, had it occurred, would have been conducted consistently with previous ARI training product trials[9] and with the structured training development methodology (Campbell & Deter, 1997).

[9] Recent ARI trials of structured training exercises are described in a number of ARI Research Reports, including the Virtual Training Program (Hoffman, Graves, Koger, Flynn, & Sever, 1995) and COBRAS (Graves, Campbell, Deter, & Quinkert, 1997; Campbell, Graves, et al., 1998; Campbell et al., 1999) development and lesson learned reports.

Table 4
Mission Analysis Vignette Training Support Package Components and Digital Conversion Requirements

Component	Digital Conversion Requirement
Training Coordinator materials	• Edited overview to indicate that the vignette occurs in a digital environment. • Edited the description of the scenario to reflect the organization of 4 Infantry Division (Mechanized) since the electronic address book in the digital systems are currently constrained to that organization. • Described the digital conditions required to conduct the vignette. • Edited the statement of the training objective to emphasize the digital conditions and integration of Army Battle Command Systems. • Edited the situation brief to reflect the digital task organization and unit designations. • Modified instructions for issuance of the operation order (OPORD) to include utilization of Maneuver Control System (MCS). • Edited references to reflect new Field Manuals (FMs) and incorporate digital references.
Participant Materials	• Incorporated all the changes made to the Training Coordinator materials, minus the modification of the situation brief which is not included in participant materials.
Preparation Materials	• Edited all Blue, Yellow, and Red reports to reflect digital unit designations, changes in equipment and personnel, and Zulu times.
Execution Materials	• Updated to reflect doctrinal changes as a result of digitization. • Edited to reflect new terminology applied to opposing force (OPFOR) formations. • Converted all OPORD times from local to Zulu. • Edited to align with OPORD format in accordance with latest FM 101-5. • Converted the OPORD to electronic medium. • Converted overlays to electronic situation maps for transfer via file transfer protocol within MCS. • Edited instructions to Training Coordinator that hard copy tactical products are furnished for reference only.
Job Aid Materials	• The job aid provides an overview of each staff officers' responsibilities during mission analysis. Because doctrine indicates no changes in these basic responsibilities, no changes were made to the job aid.
Sample Products	• Converted timeline analysis from local to Zulu to align with OPORD. • Edited requests for information to incorporate changes in equipment, personnel, and organization identifications. • Edited to reflect changes in OPFOR unit designations.

Summary

The FXXITP-D project conversion of a brigade vignette was not intended to yield an exportable training product. Instead, the analyses conducted to develop the exercise produced many lessons for developers. Observations by developers during the pilot testing indicate that this type of exercise has the potential to offer many benefits to a unit seeking to develop its digital expertise. Upon the correction of ATCCS and FBCB2 system limitations that hinder training development opportunities, this prototype (when finalized) has potential as an easily resourced exercise capable of supporting the development and practice of digitized SOP and TTP. Admittedly, the prototype did not undergo trials with representative unit members. Such trials are still essential, in order to ensure that any problems associated with a fully functional ATCCS and FBCB2 are discovered and accounted for.

Section 4. Conversion of a COBRAS Brigade-Level Conventional Vignette to a Battalion-Level Digital Vignette

This section describes a more ambitious and complex conversion effort than the two previously covered. The original requirement was to convert an existing battalion vignette into a digital application. However, there were no existing battalion vignettes to serve as the baseline. Conversion would have to begin with a conventional brigade-level vignette, or else be conducted as an original development rather than a conversion. Because it would require fewer resources to work from the existing vignette TSPs than to begin new development, developers chose to pursue a conversion effort rather than a full blown developmental effort. As a result, the conversion proceeded simultaneously on two axes: converting from conventional to digital, and converting from brigade-level to battalion-level.

The conversion of the brigade vignette, discussed in Section 3 of this report, dealt with vignettes supported by live simulation. To research the full extent of vignette conversion requirements, developers focused the battalion vignette conversion effort on vignettes that utilize constructive simulation. This meant that the project, at its completion, would have identified the conversion requirements for both types of COBRAS vignettes (live and constructively simulated).[10]

Step 1 of the Conversion Approach for Battalion Vignettes: Front-End Analysis

The conversion approach's analysis step required the collection of all the information that would be needed to develop and implement a conversion plan for the present effort. Developers had to understand the purposes and underlying conditions of the existing conventional brigade-level vignettes, and how conversion of those vignettes to a battalion-level digital environment would change the conditions and the purposes of the resulting vignettes. Most of the information on the existing program's purpose and content had been assembled and examined during development of the digital brigade vignette (described in Section 3 of this report). However,

[10] Throughout the rest of this section, vignettes supported by constructive simulation will be referred to as "simulation-based vignettes."

further analyses were required due to the shift in echelon trained and the involvement of constructive simulation.

Battalion Vignettes 1.1 Define the Existing Vignettes

The four existing brigade vignettes that utilize constructive simulation (two BBS-based and two Janus-based) are shown in Table 5. Developers analyzed the structure of these four TSPs, contrasting them with the TSPs of vignettes conducted in live simulation. The only important difference is that the simulation-based TSPs include a guide for a Support Coordinator. This guide contains instructions for the Support Coordinator on arranging for personnel and equipment support, guidance for roleplayers and interactors who operate the simulation during the vignette, and simulation tapes and backup documentation for the simulation system. These materials are, for the most part, specific to either a BBS or a Janus application. Developers discovered no differences in TSP structure between the BBS and Janus vignettes, but there were differences in the content. As a result, the developers concluded that this TSP structure could serve as a useful model for the construction of the digital prototype battalion-level vignette TSP.

Table 5
Titles and Target Training Audience Members of the Brigade-Level Constructive Simulation-Based Vignettes

Vignette Titles	Training Audience Members
Coordinate Mission Operations (Janus)	Executive Officer (XO), Intelligence Officer (S2), Operations and Training Officer (S3), Fire Support Officer (FSO), Engineer (ENG), Air Defense Coordinator (ADCOORD)
Coordinate a Mission Transition–Offense to Defense (Brigade/Battalion Battle Simulation [BBS])	XO, Personnel Officer (S1), S2, S3, Supply/Logistics Officer (S4), FSO, ENG, ADCOORD, Forward Support Battalion Commander (FSB Cdr)
Conduct Parallel Planning (BBS)	Brigade (Bde) Cdr, XO, S1, S2, S3, S4, FSO, ENG, ADCOORD, FSB Cdr, Chemical Officer (CHEMO), Military Intelligence Co Cdr
Plan and Execute a Fragmentary Order (Janus)	Bde Cdr, XO, S2, S3, FSO, Fire Support Coordinator, ENG, ADCOORD, CHEMO

Battalion Vignettes 1.2 Define the Digital Vignettes

With an understanding of the existing vignettes, developers looked to define the purpose and conditions that would change with conversion from conventional brigade to digital battalion vignettes. During earlier analyses, developers had already defined the purpose of the brigade-level digital vignettes as providing practice on integrating the use of digital equipment into the Army's current staff process. The focus was on: (a) performing the staff process, (b) using the digital equipment available to the staff during the staff process, and (c) performing under digital METT-TC and CP conditions. The purpose of the battalion-level digital vignettes is the same.

Developers had already produced a description of the digital environment (see Section 2 of this report), which included digital staff operations at the brigade level. The remaining task, therefore, was to identify the differences between the brigade and battalion staff processes. The battalion staff process mirrors the brigade staff process in its basic structure and varies only in the focus and amount of detail within the steps of the process (e.g., terrain, weather and impact on weapons systems). The performance techniques and procedures differ due to differences in resources (i.e., personnel, equipment, time), the unit's tactical focus, and the fact that the battalion staff is driven by the brigade staff process and uses brigade staff products. A final difference between the two staffs is that the battalion staff process is often more accelerated, primarily due to time and resource constraints, but also due to the more focused scope of the planning.

Step 2 of the Conversion Approach for Battalion Vignettes: Define the Requirements for Conversion (Develop a Conversion Plan)

Based on the Step 1 analyses, developers began preparation of a battalion vignette conversion plan. This plan was to address conversion requirements to accommodate changes in environment (conventional to digital) and echelon (brigade to battalion), and was expected to be based on the structure and content of the conventional-to-digital conversion plan described in Section 3 of this report.

This conversion plan, like the plan described in Section 3, would not assume the developer is going to convert, or attempt to convert, the entire set of brigade vignettes. In both plans, developers may judge that certain vignette topics are not suitable for digital conversion (e.g., Plan for Dislocated Civilians), either because they do not change or because they are largely irrelevant in a digital environment. Alternatively, this conversion plan *would* assume that developers may identify training topics for battalion-level vignettes that are not explicitly covered by existing brigade-level vignettes. In these cases, it should still be advantageous to work from one or more existing vignettes, converting them to prepare new battalion-level vignettes.

Battalion Vignettes 2.1 Identify Content Changes for Digital Battalion Vignettes

For the battalion vignette effort, examination of the content was conducted with an eye to both of the conversion factors. The content considerations for the change from conventional to digital were judged to be the same as for the brigade vignettes (Section 3), except that inputs from subordinate elements (companies and separate platoons) are provided via FBCB2 which is stimulated by an actual vehicle or by Janus simulation. Because developers had already determined that the battalion-level vignette would be supported by constructive simulation (Janus), no further examination or documentation of the existing vignettes was required for that factor.

Developers also identified instances where a battalion vignette would be different from the brigade vignette in objectives, tasks, and performance requirements. It was known that certain systematic changes would be necessary–changing "division" to "brigade," changing "brigade commander" to "battalion commander," and so on. However, the instances where the

performance requirements, cues, and observation would be different at the battalion level than they were at the brigade level were of greater concern.

Moving from brigade to battalion, even if there remained great consistency in training objective, would affect the performance requirements during the exercise. The brigade and battalion staffs may be required to perform the same task, but they will use different processes to do so, according to their resources and production needs. Given that the performance requirements would change, guidance to observers regarding how to observe critical behaviors would have to be converted.

Finally, content differences would certainly result from differences in the topics to be trained at battalion- versus brigade-level. Due to personnel and resource differences (e.g., battalions don't have the same engineer personnel and equipment), many existing vignette topics may not transfer very cleanly to the battalion level. Thus, modifications to those topics would have to be identified, which could have a dramatic and unpredictable effect on content. Following the identification of modified topics, developers would have to reevaluate the potential that a conversion would still be feasible and appropriate.

Battalion Vignettes 2.2 Identify Components for Modification

Developers next looked at the components of the constructive simulation-supported vignette TSPs to identify which components might require modification upon conversion. It was determined that, as a vignette was converted, all of the contents of the vignette TSP would have to be examined.

In addition to the general types of materials (as shown in Table 3 on page 34 [Section 3]), developers identified additional design elements that would require examination upon conversion. These elements included the following: the individual vignette scope, scenario, and performance requirements. Any conversion of a vignette TSP would require an analysis of how these elements would be affected by the digital environment and echelon trained.

Battalion Vignettes 2.3 Identify Conversion Processes

Developers identified a great difference between existing simulation-supported vignette topics and the topics that would be suitable for battalion-level, simulation-supported vignettes. Thus, in identifying the processes for the conversion from brigade- to battalion-level vignettes, developers concluded that the processes could not be a detailed, one-fits-all method of conversion. Instead, developers produced a conversion strategy that is general enough to accommodate the wide variety of conversion variables (e.g., simulation differences, echelons, topics). The plan consisted of three steps:

1. *Identify content for battalion vignettes*: Developers should review existing vignette topics or select topics based on training needs identified in CALL reports or other Army sources.

2. *Analyze existing materials for the conversion*: Developers should search for existing vignettes or TSP components of existing vignettes that can support the development of the new vignette.

3. *Develop the vignette*: Depending on the amount of existing materials used, the activities involved in this development may resemble those involved in a conversion, such as described in Section 3 of this report, or those required by full development, such as described in the vignette development methodology (Campbell, Ford, et al., 1998).

Step 3 of the Conversion Approach for Battalion Vignettes: Executing the Conversion Plan

Developers executed the plan described above to produce one battalion-level prototype vignette. As a historical account of the conversion process, the following discussion provides considerable detail about the specific circumstances of the effort.

Executing the Plan for Battalion Vignettes: Identify Content for Battalion Vignettes

As developers considered the battalion-level performance requirements, they identified 16 potentially high-payoff battalion-level topics (seven of which were represented by existing brigade-level vignettes). These topics would represent the content areas for digital vignettes, as shown in Table 6. These topics are considered high-payoff not only because they are critical activities that battalion staffs must be able to perform, but also because they offer the opportunity to use one or more of the digital components of ATCCS and FBCB2. These topics are only a starting point, generated as the basis for further analysis. In order to construct vignettes that satisfy the purpose statement (specifically that are low resource and require use of ATCCS and/or FBCB2), developers could decide to split some topics into two or more vignettes, combine two or more topics into a single vignette, or drop a topic as unsuitable for a digital vignette application.

Developers reviewed the 16 topics to select one for the prototype. The prototype, and thus the topic, had to support the development of a simulation based vignette that would fully exploit the use of the ATCCS. Because simulation-based vignettes necessarily require significant resources, it was also important to select a topic that would make the resource investment worthwhile.

Table 6
Potential High-Payoff Topics for Development as Digital Battalion Vignettes

Proposed Battalion Vignette (Digital)	Simulation
Conduct Mission Analysis*	Live
Develop a Course of Action*	Live
Conduct Course of Action Analysis (Wargaming)*	Live
Develop a Reconnaissance and Surveillance Plan*	Live
Conduct Abbreviated Decision-Making*	Live and/or Janus
Conduct Command Post Operations*	Janus
Execute an In-Stride Breach	Janus
Coordinate/Execute Close Air Support Missions	Janus
Execute Actions on Contact	Janus
Develop and Execute a Fragmentary Order*	Janus
Assault a Mechanized Infantry Company Strongpoint	Janus
Develop Enemy Courses of Action	Live
Develop an Engagement Area	Live or Janus
Conduct Information Management	Janus
Plan and Execute a Security Mission for Counter-Reconnaissance	Janus
Develop Essential Fire Support Tasks	Live

*Topics represented by existing brigade-level vignettes

On analysis, developers decided that a combination of topics, or battalion tasks, would most effectively support a simulation-based vignette that would emphasize ATCCS usage. The vignette would combine concurrent planning with limited preparation and execution to fully "exercise" the digital staff. The primary tasks included aspects of six of the topics shown in Table 6:

- Conduct Abbreviated Decision-Making
- Conduct Command Post Operations
- Conduct Information Management
- Develop a Reconnaissance and Surveillance Plan
- Execute Actions on Contact
- Develop and Execute a Fragmentary Order.

This analysis provided the basis for the initial list of training objectives/tasks for the prototype. From there, the team continued to refine the scope of the vignette, which, at this juncture, involved identifying the start and end points for the vignette. Developers identified the tactical events and staff activities preceding the start point; the events and staff activities required during the vignette; and the training endstate at the conclusion of training. These procedures are a part of the basic vignette development methodology described in Campbell, Ford, et al. (1998).

Executing the Plan for Battalion Vignettes: Analyze Existing Materials for the Conversion

Developers began with the TSPs of the four existing simulation-based vignettes to develop the tactical scenario and identify existing vignette materials that could be used to expedite the development process. The team had to examine each brigade tactical situation (scenario) to determine how well it would support the battalion training objectives and scope, and estimate the extent of the modifications that would be required. The scenario selected had to provide a robust environment for abbreviated parallel planning and preparation by the battalion followed by execution under time constraints (the entire vignette to include execution and AARs was to fit within a seven hour time limit). Additionally, the scenario had to support a relatively independent execution by the battalion to economize on outside support requirements.

Developers chose the brigade vignette *Coordinate Mission Operations* based on these requirements. The vignette's mission was a DATK against an enemy defending in depth, but out of contact. The *Coordinate Mission Operations* vignette was an execution vignette, with a brigade OPORD and about 75% "read" on enemy dispositions. This scenario supported development requirements because it could be easily modified to portray possible enemy COAs (ECOAs) which the brigade and battalion would need to account for during the planning and execution phase of the vignette. The scenario would also support a degree of independence from extensive coordination with adjacent units.

By identifying the initial training objectives, scope, and scenario, developers were able to select a set of existing tactical and simulation materials that would be converted to develop the prototype. In addition, the prototype would be built from the existing simulation-based vignette TSP model.

Executing the Plan for Battalion Vignettes: Develop the Vignette

Developers worked from the training objectives, exercise scope, and existing materials to develop the prototype vignette. The process followed the small group exercise development methodology, starting with specification of the training audience, and proceeding through scenario design and preparation of the TSP.

Specifying the training audience. As with the brigade simulation-based vignettes, the battalion staff training audience is somewhat large, and the specified members can be very flexible. The minimal participation should include the following members of the battalion task force (TF) staff: Commander, XO, S2, S3, S4, ENGR, FSO, and air defense platoon leader. If available, the training audience could also include section personnel who will team with the leadership during planning and execution.

Designing the scenario. During scenario development, significant alterations were made to the existing tactical materials to support the new scenario and facilitate parallel planning and independent execution by the battalion staff. The initial brigade scenario drove a brigade DATK mission. Developers changed the scenario into a brigade hasty attack (HATK) mission occurring at the conclusion of a successful defense. The once clear enemy situation was modified to be less clear so that the brigade (notionally) believed that the enemy could adopt one of two COAs.

Developers transformed the existing brigade OPORD into one of two friendly COAs for the brigade. This COA was prepared to counter an ECOA that depicted the enemy defending in depth while in contact. The second ECOA had the enemy using a rear guard to protect establishment of a defense out of contact.

The scenario begins when the brigade receives an order to conduct a supporting HATK. Upon receipt, the brigade begins its decision making process to produce a HATK fragmentary order (FRAGO). Again, the enemy situation is unclear and information and intelligence indicates the enemy may adopt one of two possible COAs. The brigade first issues a series of orders for its subordinate units; the units are to conduct reconnaissance and initiate parallel planning.

The TF and a notional reconnaissance troop are issued instructions to conduct recon in zone to determine enemy dispositions–and by answering priority intelligence requirements, determine which ECOA is being adopted. At the same time, the two remaining TFs are planning for primary and alternate missions for the brigade HATK. These missions are to be based on the reconnaissance outputs by the TF training audience.

The vignette would end when the TF determined that the enemy was withdrawing from its positions in contact and identified for the brigade the ECOA adopted. This would allow the brigade to complete (notionally) its decision-making process and issue a HATK FRAGO.

The tasks of the vignette would include conducting an abbreviated decision-making process to develop an order for reconnaissance, executing the reconnaissance plan, executing a battalion branch to serve immediate objectives, and maintaining internal CP functions and operations.

In the scenario, developers adjusted the enemy so that it could execute either of the ECOAs. Other adjustments to the opposing forces (OPFOR) included the modification of some positions to reflect new OPFOR TTP being practiced at CTCs.

Preparing the training support package. Developers worked from the *Coordinate Mission Operations* TSP, customizing it to reflect the digital battalion-level focus, to generate the TSP for the prototype. Some of the general instructions and explanations regarding the nature of vignettes remained the same, not withstanding modifications for the digital orientation of the prototype. All content that was specific to the individual vignette, however, was changed to address the new echelon trained and the digital focus. Table 7 lists the components of the TSP and summarizes the types of changes that were made within each component.

Conducting the trial and refining the training support package. Activities described above had produced a digital TSP that was ready for trial. The proposed participants for the trial included battalion staff personnel from 1Bde, 4 ID (M) at Fort Hood, or other soldiers with experience operating FBCB2 and ATCCS. These personnel, however, were unavailable for the trial, and because the exercise was a prototype, no effort was made to find replacement personnel. The trial, had it occurred, would have been conducted consistent with previous ARI training product trials[11] and with the structured training development methodology (Campbell & Deter, 1997).

Table 7
Task Force Decision-Making Vignette Training Support Package Components and Conversion Requirements

Component	Digital Conversion Requirement
Training Coordinator Guide	• Edited overview to address the digital environment. • Described training audience for task force (TF) participation. • Developed scenario description reflecting units contained in the master address book for the digital equipment of 4 Infantry Division (Mechanized). • Converted scenario to TF scope. • Developed description of digital training conditions for a TF vignette. • Edited training audience description to reflect TF participants. • Edited instructions for training materials to outline use of digital equipment to distribute materials to the training audience. • Developed and edited after action review (AAR) questions for TF events and digital equipment use. • Referenced AAR tasks to draft digital Mission Training Plan.
Participant Guide	• Incorporated above changes in the Training Coordinator Guide into this guide.
Preparation Materials	• No change in medium nor method of use for these materials vis-à-vis the brigade vignette that served as a model. Developed new content to reflect scenario changes and digital doctrine.
Execution Materials	• Converted medium from hard copy to electronic files for use in Maneuver Control System and Force XXI Battle Command Brigade and Below. • Developed new tactical materials as a result of TF scenario, doctrinal changes, and digital equipment. • Changed medium for overlays from hard copy to electronic files.

(table continues)

[11] Recent ARI trials of structured training exercises are described in a number of ARI Research Reports, including the Virtual Training Program (Hoffman et al., 1995) and COBRAS (Graves et al., 1997; Campbell, Graves, et al., 1998; Campbell et al., 1999) development and lesson learned reports.

Table 7 (continued)

Component	Digital Conversion Requirement
Support Coordinator Guide	• Edited to discuss Digital Facility Manager instead of BBS Site Manager Guide. • Modified site layout and workstation configuration to reflect Janus simulation and digital equipment use. • Modified training model for pre-exercise simulation training for Janus. • Changed interactor and roleplayer tasks to reflect Janus tasks and requirements. • Changed training materials distribution directions to reflect changes in medium used for training materials. • Incorporated changes on training audience and scenario from Training Coordinator Guide. • Edited instructions for gathering AAR information due to differences in simulations. • Modified personnel requirements due to change to Janus and company- and platoon-level roleplayers.
Digital Support Facility Manager Guide	• Incorporated changes from Support Coordinator Guide and Training Coordinator Guide that were pertinent based on the training support package model. • Modified directions for simulation support due to Janus. • Developed directions for use of preparation materials due to change to electronic medium.
Roleplayer Interactor Guides	• Modified section on tasks to reflect the change to Janus and the integration of digital systems.
OPFOR Guide	• Modified section on workstation requirements to reflect the change in the scenario and to Janus.
Preparation Materials and Execution Materials	• See comments on preparation and execution materials under Training Coordinator Guide (above).

Summary

The FXXITP-D project's development of a digital, battalion-level vignette from the COBRAS vignettes was conducted to analyze conversion or development requirements. Under the conditions of functional ATCCS and FBCB2 systems, a product like this prototype will support the development and practice of digitized SOP and TTP.

This application of the general conversion approach represents a significant departure from the conversion described previously. The general approach appears to be robust with respect to different types of conversion. In practice, every conversion will be different, requiring that the approach be customized for specific situations. Even with all the alterations that were needed in

converting echelon and environment, the process of conversion is still more efficient than new development would be.

Section 5. Conversion of the COBRAS Brigade Staff Exercise and Brigade and Battalion Staff Exercise to Digital Applications

Unlike the BSTS and vignette conversion efforts, the effort for the COBRAS BSE and BBSE was limited to analyzing the requirement and identifying the development tasks required to convert the existing products to digital applications (Steps 1 and 2 of the general approach). It did not include development of prototype digitized products (Step 3). The conversions, in addition to being conventional-to-digital, also entailed the identification of the requirements of converting the products from BBS to Janus applications. The effort was designed to support the future conversion of the BSE and BBSE into digital training products.

This section describes the front-end analyses (Step 1) conducted as preparation for developing the conversion plan (Step 2), and also describes the conversion plan itself. Because the BSE and BBSE are similar in terms of their intent and design, developers produced only one conversion plan that applies to both products. When differences between the two products surfaced, the team noted the different activities or considerations in the conversion plan. Issues having implications for future development are discussed in Sections 6 and 7 of this report.

Step 1 of the Conversion Approach for Brigade Staff Exercise and Brigade and Battalion Staff Exercise: Front-End Analysis

Analysis for the present effort required the collection of all the information that would be needed to develop and implement a conversion plan. Developers had to understand the existing products, how the conditions of those products would change upon conversion, and the purposes of the converted products. Developers already understood much of this information from their development of the BSE and BBSE (during ARI's COBRAS I, II, and III projects), but the process required further analyses of selected variables. In particular, the simulation requirements would require detailed analysis.

BSE/BBSE 1.1 Define the Existing Brigade Staff Exercise and Brigade and Battalion Staff Exercise

The front-end analysis of the existing BSE and BBSE led to documentation of the purpose, structure, content, and conditions of each product. Developers (who were also the developers of the existing exercises) referred to the BSE and BBSE TSPs, the COBRAS project final reports (Graves et al., 1997; Campbell, Graves, et al., 1998; Campbell et al., 1999), and the structured training development methodology (Campbell et al., 1995; Campbell, Deter, & Quinkert, 1997). The text below summarizes the purpose, design, and content of each product. Certain notes on development processes are described to provide background for the processes included in the BSE/BBSE conversion plan.[12]

[12] The text describing the BSE and BBSE was adapted from the COBRAS III report on development and lessons learned (Campbell et al., 1999).

The Brigade Staff Exercise. The BSE is a multi-mission, large-scope practice exercise that focuses on the interactions among the brigade commander and his staff as they conduct planning and employ brigade assets during preparation, execution, and consolidation/reorganization. This focus was selected due to indications that the brigade commander and his staff need structured practice opportunities to achieve proficiency in basic brigade operations of planning and synchronizing assets. The program, as designed, gives the commander and his staff a chance to practice the tasks they should perform as they direct the brigade in the particular battles of a structured scenario. Within a simulated (BBS) combat situation, they must determine what has to be done on the battlefield, who does it, and how their actions are linked to actions of other units and battlefield operating systems (BOS).

The core training audience members include the brigade commander, his primary staff, and the special staff who serve as links between the brigade and its systems (e.g., fire support, air defense, and engineering)–a total of 16 persons. This primary training audience was operationally defined as those participants for whom training objective tasks lists would be generated, observers would be assigned, and AAR sessions would be provided. Other members of the brigade would also participate, both to support the staff and to receive the benefits of participating in structured exercises.

One of the most definitive features of the COBRAS BSE is its set of exercise training objectives and tasks. With a focus on the planning and synchronization of brigade assets, as well as a special emphasis on CSS functions, the BSE performance objectives cover a wide range of staff activities. These activities are summarized in the following staff performance objectives, as stated in the TSP:

- Performance of the full mission requirements of planning, preparation, and execution (including consolidation, reorganization, and planning for follow-on missions).
- Performance of both the deliberate MDMP, performed without time pressure, and a modified decision-making process, performed under time-constrained conditions.
- Complete production of planning and preparation products, including interim products and inputs.
- Integration of selected CS and CSS functions into the staff processes of planning, preparation, and execution.

These objectives are supported by arrays of brigade staff tasks that are specified for each of the members of the target training audience for each of the three missions. The tasks are consistent with current doctrine, as defined by Army manuals such as Army Training and Evaluation Program (ARTEP)-MTP and FM publications, but are not constrained to the contents of these documents. Rather, the tasks are descriptions of the necessary behaviors that underlie successful and exemplary performance. During the projects, the cumulative domain of these behaviors was termed "undocumented tasks" to differentiate them from the mainstream, primarily ARTEP-based, documented tasks.

The BSE requires 8-12 hour training days. The AARs are designed to be conducted throughout the exercise, with an AAR for each segment of the mission. The AAR discussions focus on the strengths and weaknesses of the staff process. During the AARs, observers guide the staff to recognize their weaknesses and direct them toward the "discovery" of alternative, more useful actions as outlined by the MDMP and the COBRAS tasks. The AAR materials help establish the links among staff performance in the just-completed exercise segment, the outcomes of the prior segments, and the processes of the upcoming segments.

As stated above, the BSE is implemented within the confines of the BBS, whose capabilities satisfied five criteria during development: functional representation, size of terrain database, the ability to generate combat report information, operator requirements, and brigade asset representation. The training is conducted using three simulated CP locations (the tactical CP, the main CP, and the rear CP) for the brigade staff and either 10 or 14 BBS workstations. Radio communications represent the basic eight brigade nets.

The Brigade and Battalion Staff Exercise. The BBSE was based on the BSE model, but differed in terms of its purpose and design. The BSE had been intended as a crawl-level exercise, to help brigade staff members learn about their own jobs within the larger staff process, to allow them to practice interactions and information flow, and to give them experience in using all of their assets–combat, CS, and CSS. In contrast, the BBSE is a walk- or run-level exercise that helps brigades prepare for a high-intensity, realistic field exercise and, by extension, for a real world mission-required deployment.

The training objectives for the BBSE, as stated in the TSP, are:

- Train on critical collective staff skills.
- Experience an intense battle rhythm with concurrent handling of multiple missions.
- Practice planning in parallel with subordinate units in a continuous, uncertain battlefield environment.

The BBSE has the following characteristics that distinguish it from the BSE:

- The BBSE focuses on the commanders, staff members, and staff sections at both the brigade and battalion levels. The exercise focuses on performance objectives for the combined audience of commander and staff members rather than on discrete or individual tasks.
- The BBSE has three maneuver battalions (two armor and one mechanized infantry) and does not include a cavalry troop in its task organization. All other brigade slice elements are similar to the BSE.
- The BBSE accommodates 24-hour operations and requires concurrent actions of future mission planning and current operations of different, unrelated missions.

- The BBSE enemy force is allowed to be more aggressive and audacious, within limits, imposing a greater challenge on the participating unit.

The greatest change in the BBSE from an instructional standpoint, compared to the BSE, is that the training objectives' focus would be on collective or team activities that were multiechelon and that crossed battlefield functional areas. These performance objectives were identified and selected through examination of experiences from the CTCs and from review of relevant Army literature. The focus was instrumental in ensuring that the activities and feedback for the full multiechelon brigade combat team training audience were integrated throughout the exercise.

The techniques and procedures contained within each performance objective description were not written to be prescriptive, but rather to provide performance guidance for the unit's consideration. They expanded on available ARTEP-MTP descriptions by adding suggestions concerning who would perform what essential parts of the function, what products could be useful, or how the staff could provide more timely support for the commander's decision-making.

The assessment guidance within the performance objective descriptions did not require that the unit perform as described in the techniques and procedures section. Rather, the assessment questions and considerations addressed the objective statement. The unit could use its own procedure or the given procedure; the important thing was that the objective be accomplished. Thus the techniques and procedures might serve as guidance for one unit, but as a checklist of considerations for another unit. The three key questions in assessment were:

- Does the unit have a procedure?
- Did the procedure accomplish the objective?
- Is the unit happy with its procedure, or what should be changed?

The observer materials contained additional guidance. Information was provided on where to observe, what to look for, and what BBS-generated data to obtain in order to provide feedback to the unit on their processes and the battlefield effects of their actions. This was not to be exhaustive guidance about all aspects of the performance objective; the considerations for assessment would provide most of the observation guidance. Rather, the observer guides would detail BBS-specific or BBSE scenario-specific suggestions.

Because of the inclusion of one or more battalions in the training audience, and because of the more intense implementation conditions described above, the training audience increased greatly from what had been specified for the BSE. Even with only one battalion participating fully, the primary training audience for two shifts, including minimal numbers of staff section members, was 169.

BSE/BBSE 1.2 Define the Digital Brigade Staff Exercise and Brigade and Battalion Staff Exercise

The second phase of the front-end analysis required developers to state the purpose of the digital exercises and identify the conditions of the digital environment that would affect the design and development of digitized products. Examination of the purpose of the original BSE and BBSE led developers to the conclusion that the digital BSE and BBSE would best represent the Step 3 training products that would encompass the performance of digital skills within the context of conducting staff processes. That is, staff would practice integrating digital skills into the Army's current decision-making process. The digital BSE could represent Step 2 or the more basic Step 3 training, while the digital BBSE would allow practice on more complex skills.

The purpose of digital BSE and BBSE would be to provide practice in conducting the staff process under digital METT-TC and CP conditions, which include the use of digital equipment. The digitized BSE and BBSE would not focus or formally address operating digital equipment, as this should be accomplished during other training (Step 2 of the digital training strategy).

For the digital BSE, the existing objectives were modified from the original objectives and were stated as follows:

1. Performance of the full mission requirements of planning, preparation, and execution (including consolidation, reorganization, and planning for follow-on missions) using digital capabilities; to include concurrent planning and execution.

2. Performance of the MDMP under time constraints that are possible in digital environments.

3. Complete production of planning and preparation products, including interim products and inputs, using digital capabilities.

4. Integration of selected CS and CSS functions, as well as digital information gathering and dissemination, into the staff processes of planning, preparation, and execution.

For the digital BBSE, the training objectives were restated as follows:

1. Train on critical collective staff skills utilizing digital capabilities.

2. Experience an intense battle rhythm with concurrent handling of multiple missions in a digital battlefield environment.

3. Practice planning in parallel with subordinate units in a continuous, uncertain, digital battlefield environment.

In the project's previously described conversion efforts, developers had already produced a description of the digital environment. Section 2 of this report discusses that analysis, which defined three aspects of the digital environment: CP conditions, METT-TC conditions, and staff

operations. During the conversion, developers will rely on the results of this analysis to specify the unique conditions that will be required in the preparation of a digital BSE or BBSE.

Because Janus supports linkages to the ATCCS and FBCB2 systems that would be used in digital simulation-based exercises (and BBS does not), developers also examined and documented capabilities of the Janus simulation. The Janus constructive simulation is designed primarily for platoon-, company-, and battalion-level training, and is therefore suitable for utilization in battalion-level vignettes, as discussed in Section 4. It supports training on all the BOS, but provides for only limited CSS play. Because CSS was an emphasis during the initial BSE and BBSE development efforts, developers expected that the limited allowance of CSS play by Janus might affect conversion. Janus is also limited in its capability to support continuous operations.

Step 2 of the Conversion Approach for Brigade Staff Exercise/Brigade and Battalion Staff Exercise: Define the Requirements for Conversion (Develop a Conversion Plan)

Following Step 1 analyses, developers prepared a conversion plan for the BSE and BBSE. This plan addressed conversion requirements based on changes in environment (i.e., conventional to digital), and the move from BBS to Janus as the constructive simulation for the exercises. Developers based the plan on the structure and content of the vignette conversion plans (described in Sections 3 and 4 of this report) and employed the same development procedures: identify content for modification, identify components for modification, and identify conversion processes.

BSE/BBSE 2.1 Identify Content Changes for the Digital Brigade Staff Exercise and Brigade and Battalion Staff Exercise

The performance of this step of the general approach during preparation of conversion plans for the BSTS and vignettes (described in Sections 2, 3, and 4) had already laid most of the groundwork for the BSE/BBSE conversion research. The one area that had not yet been explored was the added complication of changing from BBS to Janus for these exercises. To document the extent of the changes in the exercises that would be required by the simulation change, developers prepared a generalized crosswalk of system capabilities that would affect the exercises. Table 8 describes those differences, which have the potential to drive numerous changes in the products, including the overall product intents or purposes.

Based on the comparison of the conventional and digital environments, as well as the BBS and Janus capabilities, developers determined that changes in the scenario, performance requirements, and the observation and feedback guidance would be required. While many of the changes would be specific to the digital job conditions and tasks, the simulation change would also affect the scope of the training: how the scenarios could be presented, what tasks the training audience members could perform, and what information the observers could capture and provide as feedback. Actual conversion of the products would allow an analysis of how these areas will be affected by the digital environment and training capabilities in simulation.

Table 8
Contrast of the Capabilities of the Brigade/Battalion Battle Simulation and Janus Simulations

Issue	Brigade/Battalion Battle Simulation	Janus 7.3 Army/Advanced Research Projects Agency Training Version and Janus 6.88 Research and Development Digital Version
Icon Limit	• 1000	• 9999
Game Time	• Unlimited, but servers should be restarted daily. • Allows developer to design continuous story line covering multiple missions.	• 999 minutes (16.65 hours). • A different exercise must be made for each mission. • Positioning of forces must be done manually in order to have a continuous story line.
Aggregation	• Capable of aggregating multiple types of vehicles/equipment.	• Not capable of aggregating multiple types of vehicles/equipment into individual icon. • "Flag" (Headquarters) icon allows aggregation of dissimilar icons into one entity. *Janus 6.88 only:* • Aggregation not recommended if an icon is going to be replicated by Force XXI Battle Command Brigade and Below. • First piece of equipment will have the necessary Universal Resource Locator (URL), Internet Protocol (IP) address; if it is destroyed digital ability for entire icon is lost.
Combat Service Support	• Replicates Medical, Maintenance, Supply and Personnel actions. • Individual vehicles can be split-out to perform tasks.	• Limited supply and maintenance (towing and repairing) actions. • If aggregates are used all pieces of equipment in icon must perform the task. • Limited refueling capabilities. Icon cannot be re-filled. • Both sides have the same capabilities/ requirements.

(table continues)

Table 8 (continued)

Issue	Brigade/Battalion Battle Simulation	Janus 7.3 Army/Advanced Research Projects Agency Training Version and Janus 6.88 Research and Development Digital Version
Magic	• Multiple capabilities. • Allows exercise control cell to fix accidental problems. • Personnel and equipment *can* be added to the database after the exercise has started.	• None. • Personnel and equipment *cannot* be added to the database after the exercise has started.
Archiving/ Branch Points	• Archives can be done manually or automatically based on time interval set at the Higher Control (HICON) workstation. • Can be used as a starting point.	• Branch points can only be made manually. • Are not recommended for use as starting points.
Naming Convention	• Flexible. Use of actual unit names possible.	• Limited. Must use a naming convention. • Use of "flag" icons adds additional limitations.
Defilade Capability	• Not available.	• Available, but is usually misused resulting in negative training habits .
Chemical Weapons	• Full play, somewhat realistic results.	• Near-full play, no ability to recover contaminated icons.
Mines & Obstacles	• Full play, somewhat realistic results.	• Near-full play. Must be input by the developers, thus limiting the exercise unit's ability to execute a plan done during the exercise.
Software Upgrades	• Requires rebuild of simulation files.	• Requires rebuild of simulation files. *Janus 6.88 only:* • Requires building of simulation files to support the Army Tactical Command and Control Systems.

BSE/BBSE 2.2 Identify Components for Modification

Developers next looked at the components of the BSE and BBSE TSPs to identify the components that will require modification upon conversion. The TSPs provide the guides and materials for each training participant, appropriate for his/her role in the exercises. Despite similarities in the basic implementation model between the BSE and the BBSE, there were major differences in the TSPs due to the expanded audience, more complex scenario conditions, and broader performance objectives in the BBSE. Detailed descriptions of the structure and contents of both TSPs can be found in Campbell et al., (1999). A broad overview of the organization and contents of both the BSE TSP and the BBSE TSP is presented in Table 9.

Table 9
Structure and Content of the Brigade Staff Exercise and the Brigade and Battalion Staff Exercise Training Support Packages

Training Support Package Category	Contents
Exercise Management	Exercise Guide for the Exercise Director and his assistants Brigade Staff Exercise (BSE): Brigade Orientation Guide Brigade and Battalion Staff Exercise (BBSE): Brigade and Battalion Orientation Guide
Tactical Materials	Corps Concept (movement to contact, area defense, and deliberate attack) Division Order and Tactical Materials (including overlays) Scripted and hard-copy messages Sample products
Training Audience Materials	Training Audience–BSE: • Training Audience Guide and specific task lists • Initial Situation Packages and start of exercise (STARTEX) Position Overlays Training Audience–BBSE: • Training Audience Guide with Performance Objectives • XO Guide to Unit Preparation and Materials Distribution • Initial Situation Packages and STARTEX Position Overlays
Guides and Materials for Other Participants	Observers–BSE: • Observer Guide and specific task lists • Observer AAR Briefing Materials Observers–BBSE: • Observer Guide with Performance Objectives Workstation Personnel–BSE: • Specific Roleplayer Team Guides for each Brigade/Battalion Battle Simulation (BBS) workstation, including Initial Situation Packages and STARTEX Position Overlays • BBS Interactor Guides for friendly, enemy, and exercise control workstations Workstation Personnel–BBSE: • Specific Workstation Team Guides for Roleplayers and Interactors at each BBS workstation, including Initial Situation Packages and STARTEX Position Overlays
Simulation Materials	BBS System Tapes and Guides for initializing BBS and making changes or corrections

BSE/BBSE 2.3 Identify Conversion Processes

The conversion processes for the BSE and BBSE were derived from ARI's structured training development methodology (Campbell et al., 1995; Campbell, Deter, & Quinkert, 1997) and proceed along the lines of the vignette conventional-to-digital conversion plan (see Section 3 of this report). The processes followed the analysis-design-develop production model, but were broken out in more detail in the conversion plan, which contains eight activities. Within the processes of each activity, the plan distinguished between tasks unique to either the BSE or BBSE; otherwise, the processes can be applied to both products. The activities were as follows:

1. *Convert from BBS to Janus:* Due to the requirement for digital training to incorporate digital equipment (i.e., FBCB2 and ATCCS), both the BSE and BBSE must be converted from their initial versions as BBS exercises. While this requirement could represent a conversion on its own, it is also a prerequisite for a digital conversion of the training products. The specific requirements of converting the products from BBS to Janus applications are provided in Appendix C. This conversion will require developers to identify modifications in nearly all of the TSP materials (i.e., scenario, guidance for exercise support personnel, performance requirements, and even overall exercise intent). From these modification decisions, Janus-based versions of the existing BSE and BBSE TSPs could also be developed. However, identification of the required modifications will be sufficient as the starting point for the conversion to digital.

The extent of the conversion requires modifications to nearly all of the TSP components. The primary factor behind the major modifications is the limited capability of Janus to support performance of CSS functions, which are an integral aspect of the designs of the BSE and BBSE. Another pervasive factor is the difference in staffing and operations of Janus workstations. Once the exercises have been converted to a Janus application, developers can conduct the conversion procedures specific to the conventional-to-digital conversion.

2. *Identify digital performance opportunities:* Based on the established purpose of the digital products, the first activity of conventional-to-digital conversion itself would require the analysis of how the training audience would be able to use the ATCCS during the BSE/BBSE.

Activity 2 would consist primarily of a mental walk-through of the scenario and the staff processes. During development of the BSE and BBSE, developers performed complex roleplay activities of mission planning, preparation, execution, and consolidation and reorganization, documenting staff processes and interactions (Ford & Campbell, 1997; Deter, Campbell, Ford, & Quinkert, 1998). These staff performance analyses should be repeated in the digital context. In the process, the team would make initial decisions regarding which preparation and execution materials should be presented in digital form, and how the digital systems should be used to accomplish the products' performance requirements. The identified staff processes will then be verified in the digital environment during the pilot tests (Step 6), after the scenario files have been constructed.

3. *Convert implementation design model*: Developers would use the digital product purpose and their tentative findings about digital system usage (Activity 2) to create a concept of the digital product's implementation design model. The team would conduct a second walk-

through of the product, this time examining closely the BSE and BBSE training audiences, objectives, tasks, and supporting requirements (personnel and equipment), in light of the modification decision outlined in Activity 1. At its completion, Activity 3 would yield a design model concept that would guide the remainder of the conversion process.

4. *Convert the Scenario:* Structured training requires a scenario that supports designated performance requirements by providing cues and conditions requiring the performance. The development team must evaluate any changes made to product tasks and objectives, and modify the scenario so that it will support those tasks and objectives. The scenario will also require consideration of modifications for conditions of the digital environment, including METT-TC. After conversion in this activity, the scenario will be complete enough to support construction of digital system files, hard copy files, and simulation files, as required.

5. *Build digital system files and prepare tactical scenario materials*: Developers must construct the digital system files that contain the digitized preparation and execution materials to be used in the products. This step will require access to a functional ATCCS network or FBCB2 and simulation, for at least those components that were identified as appropriate in the first step. They must also prepare the other materials that drive performance during the exercises. The files and materials will be used in the pilot tests.

6. *Pilot test*: By means of iterative pilot tests of the BSE/BBSE using the digital equipment, developers should now refine the scenario and associated materials and the objective, tasks, and AAR materials. This step will ensure that digital tasks are presented accurately and that the performance of those tasks will be supported by the scenario and other exercise conditions. The activity will vary in complexity and scope depending on the extent of the conversion of the performance requirements. The pilots will provide data regarding the accuracy of performance requirement statements (representing digital TTP) included in the TSP, but will also aid in the further specification of the BSE/BBSE's implementation conditions.

7. *Convert the TSP*: On the basis of the pilot test of the scenario and implementation conditions, developers will complete the conversion by modifying implementation instructions and other components of the TSP to track with other changes. A thorough review of the original TSP is required with reference to the modification decisions, rewriting, subtracting, and adding material and information as appropriate.

8. *Conduct trial and refine the TSP*: The final check on the conversion will be a trial implementation of the TSP by external participants representative of the intended training audience. The proposed participants should include personnel from 1Bde, 4ID at Fort Hood, or other soldiers with experience operating FBCB2 and ATCCS.

Summary

It should be noted that the FXXITP-D project BSE/BBSE conversion plan has not yet been tried out in constructing a prototype. Therefore, the conversion plan steps described above probably do not describe in detail all the intricacies and issues that may arise during an actual conversion of the BSE or BBSE. Rather, they describe a general process, based on well-tried

processes, to discover the remaining issues and support decision-making to overcome those issues.

Section 6. Lessons Regarding Digital Force and Training Development

The work performed during the FXXITP-D project revealed a wide range of issues in three general areas of development: training, equipment (materiel), and the digital force. These are issues that will become increasingly important throughout the timeframe of the Force XXI and into the AAN. This section discusses those issues from the perspective of lessons learned during the project.

The Development of Digital Training

Given that digital training programs and practice opportunities are essential components of the continuing development of readiness in the digital force, there are a number of considerations that should be taken into account in the development of digital training. Five of the lessons learned address aspects of digital training development and implementation.

Lesson 1: Digital training for the force as a whole, including digital experimental units, should include structured training.

Recent research has indicated the potential of structured training for increasing the benefit received from training dollars (Campbell, Graves, et al., 1998; Graves & Myers, 1997). These R&D efforts looked at the use of scenario-based, task-focused training programs, supported by extensive usage guides, in addressing unit and staff training needs in a resource-conserving fashion. This research has indicated that structured training offers many advantages, including providing a focus on specific training objectives, helping units progress steadily along a training agenda, allowing units to prepare quickly, continuous performance improvement, and readily available TSPs. The amount is allowed to vary, depending on unit or staff readiness, from rigid and highly-controlled task performance, to more exploratory "what-if" opportunities and challenges. The amount of control can be relaxed by allowing different factors (e.g., enemy activity, rate of resupply, higher echelon guidance or changes to guidance) to vary within rather broad rules of engagement instead of being closely scripted. The more controlled training is generally appropriate at Step 1 and Step 2 of the Digital Learning Strategy (TRADOC, 1998).

What has not been fully explored, though, are the benefits that the range of structured training may provide in supporting the Army's exploration of the digital force. Structured training could support a quasi-experimental approach of multiple executions to explore, generate, and test doctrinal theories, by allowing selected factors to operate more freely. Employed in the context of an EXFOR-like unit, this type of training might allow the unit to focus on their readiness and development needs, addressing those needs in line with a purposeful training strategy and avoiding distractions that would otherwise divert focus.

Lesson 2: Digital TSPs should emphasize and facilitate the use of digital equipment.

The development of the prototype vignettes during this project revealed that the primary distinction between the existing TSPs and the "digital" TSPs was the stress placed on, and the facilitation of, using digital equipment during the training. In the absence of a mature and distinct digital doctrine to train, the project team designed the digital TSPs to focus on digital equipment usage. This approach was consistent with the notion that producing soldiers who can maximize the capabilities of the digital equipment will result in soldiers who can develop and refine digital doctrine.

Lesson 3: Digital training should provide a high-fidelity representation of the digital environment.

In addition to requiring the use of digital equipment, digital training products must provide realistic training by making the environment realistic. Representation of the digital environment should be detailed and complete in order to enhance transfer of training. The task is not just to know and replicate the digital METT-TC, but to provide other cues representative of those pieces of information that would be provided by an operating environment that includes the presence of digital equipment. One example of a top-down feed that was missing from the Janus-supported DSTD2 environment was information that would be emanating from Joint Surveillance and Target Attack Radar System (JSTARS). Another example, but of a bottom-up feed, was that of CSS information that would be coming from individual vehicles and require processing by battalion and brigade staffs.

In the case of digital training, the simulations should provide as complete a replication of the environment as possible so that the effects and conditions of the digital environment can be factored into the participants' interaction and exploration with that environment. Using the JSTARS example above, if JSTARS cannot be used to provide actual feeds for training exercises, then there should be some sort of JSTARS-like outputs through the simulation stimulus or through a digital system (ASAS) serving as a higher unit system.

To decide that certain digital features or inputs are not needed during digital staff training events is to accept a part-task approach to training. This is not necessarily bad: cost considerations may sometimes triumph over potentially modest benefits. However, training developers and users should be aware of the shortcomings inherent in part-task versus whole-task training. At some point, the "missing pieces" will need to be filled in.

For example, training with digital equipment under conventional conditions will not provide a realistic representation of incoming information that must be processed by "digital" staffs. The amount and complexity of the information and how to process it is what units need to experience during training in order to learn and, through doctrine and TTP, explore how to deal with it. The next lesson deals with defining the purposes of converted digital training products and states the following:

Lesson 4: Digital training products can be developed for multifunctional purposes.

During the project's conversion of vignettes to a digital application, there was some question among project staff as to whether the exercises would be Step 2 or Step 3 training products as they are applied to the TRADOC Digital Learning Strategy (TRADOC, 1998). Depending on how they are used, digital training exercises that require the use of digital equipment in a tactical scenario context can satisfy the high-proficiency priority of Step 3 training, but also offer the opportunity to focus on, and not just include, the use of digital equipment (Step 2 training).

It is possible to develop multifunctional products that can support either Step 2 or Step 3 training by allowing for various levels of METT-TC and expanding the performance feedback materials and implementation instructions contained in the TSPs. A "multifunctional" TSP might contain only one set of initiating conditions for the scenario, but several sets of guidance on how the scenario could progress. However, the TSPs must also contain clear guidance as to when each TSP component is appropriate, so that units will not attempt to achieve both purposes during the same implementation. A simultaneous focus would likely confuse all of the participants, as the alternative sets of support materials could not be used together.

This lesson was formulated while developers attempted to delineate a clear purpose for digital exercises such as vignettes and the BBSE that utilize constructive simulation and ATCCS as the primary simulation and simulators. As opposed to training that uses other simulations (Simulation Networking, BBS only, Janus only), the incorporation of the ATCCS provides an opportunity for realistic training on more than the staff process or tactics. It also offers the opportunity to focus on digital equipment skills.

If a multifunctional design is chosen for a given product, the benefits include savings in training development resources and TSP maintenance. Fewer products have to be developed and less time must be spent on updating TSPs to incorporate new doctrine and simulation/digital capabilities.

Lesson 5: TSPs should accommodate updates for simulation, digital equipment, and doctrinal advancements.

Doctrine and simulations change continually, but will change more quickly and with a greater intensity as the Force XXI Army matures and evolves into the AAN. The implication for TSP development is that the materials will need to be updated more extensively and frequently than they have in the past. All of the TSP materials will be affected, but the most difficult challenge concerns the scenario tapes. Currently, tapes containing scenario data are linked to specific the simulation software versions. Scenario tapes should contain only those data that will not be affected by the system software version; other data should be provided in hard copy or electronically for simulation site personnel to input. This will accommodate updates to simulations and digital systems while providing structure to the scenario "building" process which should drastically reduce the time it takes to rebuild a scenario with a new software version.

Other aspects of the TSP could also be better designed to allow for updates. On another ongoing ARI project, researchers are developing a Commander's Integrated Training Tool (CITT)–a computer- or Internet-based system that will allow unit training personnel to modify TSPs or guide them as they construct new ones. Currently, CITT supports only training conducted in the Close Combat Tactical Trainer (CCTT). But the design structure appears to be sound, and trial users are enthusiastic about the CITT capabilities.

The Development of Digital Equipment

To this point, our lessons have identified the need for digital training and several characteristics that will increase the effectiveness of future digital training products. Another aspect of training development is the design of the digital equipment itself, and how the design could support training.

Lesson 6: Digital equipment should be designed and constructed to support both training development and the conduct of training.

During the project, the team encountered two specific problems that delayed and complicated the development of the digital vignettes. Both problems were symptomatic of a more troubling circumstance: digital equipment is not designed to facilitate training.

The first problem encountered with the current equipment was that several of the ATCCS (i.e., MCS, CSSCS, and ASAS) did not offer accessible or functional data storage and/or retrieval capabilities. Because part of the power of structured training lies in its capability to support iterative executions of the same scenario, we planned to store the scenario data within the ATCCS component, but were unable to do so without creative solutions (described in Section 4 of this report). The storage and retrieval of exercise data files should not be an insurmountable problem for digital system designers, and would greatly enhance training opportunities.

The second problem encountered was due to the different terrain database map sizes resident in the Janus simulation and ATCCS. The existence of various map sizes complicated the training development process by restricting the area available for operations to the area common to all databases. Workarounds were found, but they limited scenario design alternatives and have the potential to restrict the scope of an exercise's training objectives. Furthermore, workarounds, no matter how easily accomplished or effective, always present the opportunity for miscues that may produce degraded or even negative training.

Because of the problems inherent in working with the lowest common denominator of map sizes, the Army might do well to establish a standard size that encompasses the terrain covered by Corps Battlefield Simulation or Warfighters' Simulation (WARSIM) 2000. This should allow for "congruent" scenarios through corps-level, supporting the recommendations of the Army Learning White Paper, Leader Preparation (Brown, 1999). That White Paper recommends the use of a common road to war (at the least) and scenarios (at the most) to reduce the time required for users to become familiar with the scenario in preparation for training exercises.

The Development of the Digital Force

Three of the project's lessons are based on observations of the development team regarding the continued development of the digital force. They also represent conclusions derived from the project's lessons about developing digital training (discussed above).

Lesson 7: As digital training for staffs moves forward, digital doctrine should be recorded and codified.

This lesson was formulated during an early phase of the project, when the project team was preparing a description of the digital environment and performance requirements in preparation for the project's BSTS conversion. The METT-TC and CP research revealed unique digital characteristics concerning task organization and assigned area of operations, but few other well-specified or defined characteristics of the digital METT-TC. The team's analysis of the staff process (i.e., digital performance requirements) was slowed by the lack of a complete and fully functional digital CP environment in which to conduct the analysis. The performance analysis turned instead to exploring the existing materials, specifically, the 1Bde, 4 ID (M) SOP, draft MTPs, and Fort Knox Supplemental Manuals. These materials represented the most comprehensive existing description of digital staff processes to date, but identified limited digital information, consisting only of digital techniques and procedures. They indicated no changes in the fundamental components of the staff process or warfighting doctrine.

The team's conclusion was that techniques and procedures have evolved to accommodate digitization, but that these differences have not yet led to the systemic exploitation, by doctrine and other DTLOMS, of digital capabilities. The Army has not developed a "digitized" doctrine that promotes the exploitation of digital capabilities to maximize soldier, leader, and unit performance. The fact that digital doctrine has not been defined is certainly no insurmountable problem for the Army and is even consistent with the overall deliberate and deliberative nature of the Force XXI-to-AAN force development strategy. But the lack of a digital doctrine has implications for current and near-term digital training development. Defining tasks, conditions, and standards for training with doctrinal specificity is speculative, at best.

Lesson 8: The Army should develop and employ simulated digital training environments as mechanisms for developing digital DTLOMS requirements.

This lesson is based on the premise that development of DTLOMS requirements is one of the still-existing needs for achieving the AAN potential. Traditionally, doctrine development has been achieved through the conduct and study of past wars and the integration of lessons learned from such into force development. To achieve digitization, however, this method of doctrine (or DTLOMS) development must be modified. Past wars do not provide the needed experience base for digital doctrine development.

As a result, the experience of war must be combined with the experience of "using digital equipment" during realistic training events. As stated in the TRADOC guidance on force development requirements determination, "When properly planned and executed, warfighting experiments and analyses give the Army an unsurpassed means to understand future warfighting

requirements. Progressive and iterative mixes of constructive, virtual, and live experiments combined with operational experience and appropriate analyses, yield insights to better define not only warfighting concepts, but also requirements across the spectrum of DTLOMS" (DA, 1998, p. 11).

The TRADOC Digital Learning Strategy (1998) supports this approach, as soldiers are first tasked to become proficient in the fundamental combat skills that will underlie the digital combat skills of the future. They then learn how to operate digital equipment, and finally practice integrating it in a warfighting (artificial) environment during training. This last step allows them to consider and experiment with how the technologies are best employed and how they can transform organizations, resourcing, and fighting strategies. This level of training is very close to the "discovery learning" model that has become popular in recent years.

> *Lesson 9: The Army needs a unit, or set of units, with the mission of discovering resources to focus on the exploration and discovery of digital performance techniques.*

The assumption in Lesson 8, above, that force development can emerge through the conduct of training, was one impetus behind the 1996 establishment of the EXFOR at Fort Hood, Texas. The EXFOR was designated as the unit that would explore the implementation of digital equipment and concepts and their effects on the entire range of DTLOMS. However, because the EXFOR also had to focus on its traditional mission requirements, the evolving digital expertise was not accessible by the project staff.

The FXXITP-D project team initially planned to rely on the EXFOR unit to provide a substantial amount of feedback on project analyses and prototype training products; this feedback was to be collected during reviews of training materials as well as during pilot tests of the prototype products. But as preparation for an NTC rotation intensified, very little of the reviews and no pilots were conducted with the unit. They simply could not devote the time to this specific DCST training development effort, an effort that was clearly in line with the EXFOR purpose.

The dual requirements, to accomplish the traditional mission (i.e., maintaining combat readiness) and to serve as a test bed for future-oriented R&D, may require more time than a unit will ever have. If the R&D mission is truly important to the future of the Army, then the traditional mission tasks must either: be waived during the time period the R&D mission tasks are being conducted, or the traditional mission must be modified to include the R&D mission tasks. Regardless of which option is selected, the unit needs to be singularly focused to complete the R&D task(s) if we are to fully explore the implementation of digital equipment and concepts and their effects on the entire range of DTLOMS.

The need for maintaining readiness is conceded, but the units tasked with the work of preparing the future Army should have the access and resources to conduct the appropriate digital training. The training should be conducted under the condition that the units have the freedom to participate in experimentation and the freedom from pressures that would relegate the discovery process to a secondary concern.

Building on the Past to Shape the Future

The final set of lessons brings the discussion back to the topic of the FXXITP-D project: conversion, its requirements, and its advantages. The lessons emphasize the importance of conversion in the development of digital training and point out some of the likely snares that will accompany conversion efforts. After a description of the unique characteristics of the project's conversion approach, this section concludes with the final three lessons learned.

The FXXITP-D conversion approach was developed to be a special application of the current structured training development methodology. The earliest guide for developing structured training (Campbell et al., 1995) included a chapter on conversion of existing training products. During development, the project team was forced to explore the differences between "development" and "conversion." From early design discussions, developers concluded that any distinction between the two would be based on little more than semantics. That is, all development involves some reference to past development (conversion), and all conversion involves some new development. The result was that the team decided not to draw a definitive line between the two concepts, but rather to consider them as points along a continuum.

The project team was very liberal in its application of the term conversion. The prototype efforts, especially the battalion vignette effort, were based on the assumption that if any part of an existing product (e.g., scenario, TSP model, analysis and presentation techniques) is used in the preparation of a new product, then the effort can be viewed and conducted as a "conversion."

The project's conversion approach, thus, is broad enough in its applicability to facilitate this liberal definition of conversion. The approach's analysis phase, in particular, supports the exploration of existing products to determine their applicability to the solutions for new training needs. The basic premise is that the range of structured training available today provides a solid foundation for future development until some revelation regarding fundamental learning theory comes along.

Given this broad definition of conversion and application of the conversion approach, three lessons learned emerge.

> *Lesson 10: In the development of digital training, developers should seek to take advantage of the materials and instructional techniques that reside in existing, proven, structured training products.*

This lesson is based on the assumption that a successfully evolving system relies on its past to create its future. The project's conversion approach supports this lesson, especially in the "conversion" of the battalion-level vignette from materials of various brigade-level vignettes.

> *Lesson 11: Conversion must not be perceived as a "short-cut" to full development.*

This lesson is closely related to the previous one. In any conversion, there will be a definite requirement for vigilance in modifying the detail in the converted TSPs. A natural tendency will

be to expedite the process and overlook details required by a thorough conversion. The developer must ensure that the details of the existing product are closely examined and modified as necessary to facilitate the development of the new product. The new product must completely conform to and support the new training needs. Conversion should be viewed as an extension of the development process that requires additional front-end analysis to leverage existing products and thus eliminate or reduce unnecessary development activities.

Lesson 12: Conversion should not stagnate development of innovative training solutions.

The final lesson relates to the stagnation of innovative ideas. Rather than stifling novel development, developers should generate ideas from the products that exist, spurring the development of new training tools, techniques, and concepts as is appropriate for the new training need. Developers should work from proven materials, but should not use them as a crutch that will only produce mediocre solutions.

Summary

Several of the lessons learned during the FXXITP-D project related to requirements for training, stating that it must be structured, digital, realistic, focused, and amenable to change. Each of these lessons points to the assertion that the training must support force development and readiness.

In the way of progress, however, stands an inventory of digital equipment that supports neither training development nor training. We believe that this situation can be resolved and that future systems will be designed to support training. If and when this happens, the production of digital training should work from existing training products, effecting conversions in a way that closely resembles spiral development approaches.

What this report has not tried to estimate or document, in either the description of project activities or in lessons learned, is the great demands that will fall on an already stressed resource pool because of the enormous amount of learning and preparation still ahead. Our conclusions only address the fact that, like any organization in transformation, the development of a digital Army will require enhanced training and development resources.

Section 7. Conclusions

The 21st century will introduce a number of needs to be addressed by the U.S. national defense. One of those will be the need to field a warfighting force that fully advantages the capabilities of digitization. The lessons discussed in Section 6 suggest that there are two challenges that the Army faces in making its military the clear power among digitally equipped forces. The first task is to continue to develop the technology that will enable and support a digital force. The second task is learning how to employ and fight with digital technology. Experience in Advanced Warfighting Experiments (AWEs) indicates that there are basic advantages offered by fighting with digital equipment. One is that it provides better situational awareness through portraying the environment. Other advantages could be the ability to provide

information more accurately and quickly, and the capability to automate some of the analytical requirements of staffs in interpreting large amounts of complex information.

In many ways these two tasks are inseparable and achieving both will require an interactive process that links advances in one to gains in the other. In anticipation of this need, the U.S. Army has already adopted a spiral development process that facilitates mutually supportive development among DTLOMS. As stated in Section 1 of this report, the Army's success in the digital domain will be dependent on ingenuity in reconciling current DTLOMS with the ever-expanding capabilities of digital warfighting technology. Furthermore, training should be an equal partner with materiel development in the quest for a superior digital force.

The requirements associated with learning how to develop effective training for the digital force have exacerbated the situation by diverting existing resources and adding another task to an already over committed force. But the decision to develop training products for the digital force demonstrates the commitment of the Army leadership in this area. In Section 6 (Lessons Learned), this report identified a number of factors that will make it difficult to satisfy the digital training need. These factors must be addressed both strategically and financially if the advancement of a digital force is to be achieved.

Summary

The purpose of this report was to describe the activities conducted and lessons learned during the ARI project, *Force XXI Training Program–Digital.* The report began by describing the antecedent training (FXXITP) and technology (ATCCS) developments and the digital training needs (TRADOC digital learning strategy) that provided the rationale for the project.

Project outcomes included a general approach for converting existing training products for alternative applications (Section 1). The approach is based on ARI's structured training development methodology (Campbell et al., 1995), and therefore, should be conducted in light of that or a similar methodology (e.g., SAT). The approach was used to guide conventional-to-digital conversions during this project.

Sections 2 through 5 of the report discussed the application of the conversion approach to investigate the tasks required to convert existing FXXITP products to digital applications. The products researched included the BSTS and COBRAS vignettes (both live and simulation-based), BSE, and BBSE. Prototype products were produced for the BSTS and vignettes. Plans for the conversion of the COBRAS BSE and BBSE were generated, but not implemented during the project.

The report concluded by presenting lessons learned (Section 6) and project conclusions (Section 7). The lessons highlight the important issues that surfaced during the project's activities, stressing the importance of digital training development to the Army's evolution from its current configuration to the Force XXI to the AAN. These, unless addressed, will in all likelihood detract from the efficient and effective provision of digital training.

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Appendix A
Acronyms and Abbreviations

AAN	Army After Next
AAR	after action review
ABCS	Army Battle Command Systems
AD	area defense
ADA	air defense artillery
ADCOORD	air defense coordinator
ADO	Army Digitization Office
AFATDS	Advanced Field Artillery Tactical Data System
AMDWS	Air and Missile Defense Workstation
ARI	U.S. Army Research Institute for the Behavioral and Social Sciences
ARTEP	Army Training and Evaluation Program
ASAS	All Source Analysis System
ATCCS	Army Tactical Command and Control System
AVN LNO	aviation liaison officer
AWE	Advanced Warfighting Experiments
BBS	Brigade/Battalion Battle Simulation
BBSE	Brigade and Battalion Staff Exercise
Bde	brigade
Bn	battalion
BOS	battlefield operating systems
BSC	base support company
BSE	Brigade Staff Exercise
BSTS	Battle Staff Training System
Btry	battery
C^2	command and control
CALL	Center for Army Lessons Learned
CBI	computer-based instruction
CCTT	Close Combat Tactical Trainer
Cdr	commander
CHEMO	chemical officer
CITT	*Commanders' Integrated Training Tool*
Co	company
COA	course of action
COBRAS	*Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation*
COL	colonel
COMPS	comprehensive assessment component
CP	command post
CRP	common relevant picture
CS	combat support
CSS	combat service support

CSSCS	Combat Service Support Control System
CTC	Combat Training Center
DA	Department of the Army
DATK	deliberate attack
DCST	Deputy Chief of Staff for Training
DS	direct support
DSTD2	Digital Staff Training and Doctrinal Development
DTDD	Directorate of Training and Doctrine Development
DTLOMS	doctrine, training, leader development, organization, material, and soldiers
ECOAs	enemy courses of action
ENG	engineer
EXCON	Exercise Control
EXFOR	Experimental Force
FBCB2	Force XXI Battle Command Brigade and Below
FLOT	forward line of troops
FM	Field Manual
FRAGO	fragmentary order
FSB	forward support battalion
FSC	forward support company
FSCOORD	Fire Support Coordinator
FSO	Fire Support Officer
FTP	file transfer protocol
FXXITP	Force XXI Training Program
FXXITP-D	*Force XXI Training Program–Digital*
HATK	hasty attack
HICON	Higher Control
ID	Infantry Division
IP	Internet Protocol
IPB	intelligence preparation of the battlefield
ISAT	*Implementation and Support Team for the Assessment of Force XXI Training Program Products*
ISP	initial situation package
JSTARS	Joint Surveillance and Target Attack Radar System
M	Mechanized
MAJ	major
MCS	Maneuver Control System
MDMP	military decision-making process
METT-TC	mission, enemy, terrain, troops, time available, and civilian considerations
MI	military intelligence

MMBL	Mounted Maneuver Battlespace Laboratory
MP	military police
MTC	movement to contact
MTOE	modified table of organization and equipment
MTP	Mission Training Plan
NTC	National Training Center
OPFOR	opposing forces
OPORD	operation order
Plt	platoon
PO	performance objective
R&D	research and development
R&S	reconnaissance and surveillance
S1	Personnel Officer
S2	Intelligence Officer
S3	Operations and Training Officer
S4	Supply/Logistics Officer
S5	Civil Affairs Officer
SA	situational awareness
SAT	Systems Approach to Training
SETA	Systems Engineering and Technical Assistance
SIGO	signal officer
SIMNET	Simulation Networking
SME	subject matter expert
SOP	standing operating procedures
STARTEX	start of exercise
STAMIS	Standard Management Information System
TF	task force
TMS	Training Management System
TOC	Tactical Operations Center
TOE	table of organization and equipment
TRADOC	U.S. Army Training and Doctrine Command
TSP	training support package
TTP	tactics, techniques, and procedures
URL	Universal Resource Locator
WARNO	warning order
WARSIM 2000	Warfighters' Simulation 2000
XO	executive officer

Appendix B
The Digital Environment Summary and References

This appendix contains the description of the digital environment produced during the *Force XXI Training Program–Digital* project. The changes in mission, enemy, terrain, troops, time available, and civilian considerations are contained in Tables B1 through B6, respectively. These tables identify the conditions included in the existing Brigade and Battalion Staff Exercise (BBSE), the conditions of the digital brigade, and the changes to the BBSE that would be required for digital training.

- Table B1: METT-TC Comparisons for Mission
- Table B2: METT-TC Comparisons for Enemy
- Table B3: METT-TC Comparisons for Terrain
- Table B4: METT-TC Comparisons for Troops Available
- Table B5: METT-TC Comparisons for Time
- Table B6: METT-TC Comparisons for Civilian Considerations.

The digital command post descriptions are contained in a series of figures, whose content is as follows:

- Figure B-1: Conventional Main Command Post
- Figure B-2: Digital Brigade Main Command Post
- Figure B-3: Conventional Brigade Tactical Command Post
- Figure B-4: Digital Brigade Tactical Command Post (Staff Leader's Guide variant)
- Figure B-5: Conventional Brigade Rear Command Post
- Figure B-6: Digital Brigade Rear Command Post
- Figure B-7: Conventional Battalion Main Command Post
- Figure B-8: Digital Battalion Main Command Post
- Figure B-9: Conventional Battalion Combat Trains Command Post
- Figure B-10: Digital Battalion Combat Trains Command Post

- Figure B-11: Digital Mechanized Battalion Command Group
- Figure B-12: Digital Armor Battalion Command Group.

The appendix concludes with a list of references used in the analysis.

Table B1
METT-TC Comparisons for Mission

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements

• 3 Separate Missions–Area Defense (AD), Deliberate Attack (DATK), Movement to Contact (MTC).
• Mid-intensity conflict.
• Concurrent and parallel planning stressed (National Training Center battle rhythm).
• Built-in flexibility.
  • AD: Fragmentary order (FRAGO) to increase area of operations.
  • DATK: Enemy repositioning.
  • MTC: Inherent in mission.
• Missions linked by combat service support (CSS) only (tactical scenarios not linked).
• Feedback focused on performance objectives (POs).
	MISSIONS
	• Information missions: Screen, MTC, feint, raid, demonstration.
	• Decisive missions: Attack, defend.
	• Security missions: Cover, delay, relief, stability and support operations, post conflict operations.
	Bottom Line: No real change.
	PATTERNS OF OPERATIONS
	• Project the force.
	• Gain information dominance.
	• Shape the battlespace.
	• Decisive operations (missions listed above).
	• Force protection.
	• Sustain the force.
	• Battlefield focus: Simultaneous attack of all enemy forces confronted (deep, close, rear) by leveraging timely, relevant, accurate and predictive information/intel obtained and disseminated digitally.
	• Same battlefield framework: Brigade assumes greater responsibility and significance in creation and employment of reserve due to smaller battalion/task forces (TFs).
	BATTLEFIELD OPERATING SYSTEM
	• Intel: Use of Army Tactical Command and Control System–primarily All Source Analysis System to enable/speed up intelligence preparation of the battlefield (IPB), reconnaissance and surveillance (R&S) collection, intel dissemination. Input/output IPB: Identify enemy input/output capabilities to input into command and control warfare planning.
	• Maneuver: Use of Force XXI Battle Command Brigade and Below (FBCB2)/global positioning system for navigation. Shared situational awareness (SA)/ common relevant picture (CRP), dispersion.
	• Fire Support: Advanced Field Artillery Tactical Data System
		• *Missions linked–Initial operation order (OPORD) and subsequent FRAGOS for change of mission.*
		• *Feedback focused on POs, with digital information management integrated into all (Observer/Controllers need "see/hear/read all" digital capability.).*

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
	and FBCB2–standing operating procedures for priorities of fire, direct observer/battery procedures. • Air Defense Artillery: Use of Air and Missile Defense Work Station for early warning, coordination and massing of fires. • Mobility/Survivability: Maneuver Control System (MCS) and FBCB2 for obstacle SA dissemination. • CSS: Forward Support Company (FSC) direct support (DS) to TFs, Base Support Company (BSC) DS to brigade rear area and backup to FSCs. • Battle Command: Enhanced w/digital systems. Increased emphasis on information management through use of commander's critical information requirements. **PLANNING** • Use planning process in Field Manual 101-5–adjust based on time available. • The Plans cell focuses on future operations only (not branches and sequels to current operations). • Speedier transition from current to next operation. • Parallel planning enhanced by CRP, shared SA, client-server relationships, whiteboard. • Rehearsals–must rehearse what is sent digital and what is sent voice. **OFFENSIVE OPERATIONS** • Increased tactical surprise due to better intel and shared SA. • "Situational" massing then return to dispersion. • Increase tempo due to better intel and more precise and efficient logistical operations. • Enhances audacity due to better SA. • MTC–Still included, but assumption is that a lot of the "unknowns" that lead to MTC will now be "known"–probably won't have to move to contact. • Hasty Attack–Continuation of MTC but can also occur in DATK and defense. Uses resources at hand with minimum preparation to defeat enemy before he's able to concentrate or establish defense. Flexibility key–standard formations, tactics,	

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements

	techniques, and procedures, checkpoints for navigation and FRAGO-ease.
	• DATK–Fully prepared, synchronized attack.
	• Breaching operations–Greater focus on the brigade in planning and executing breaches.
	• Night Operations–Enhanced with digital systems. Assume enemy has parity in night vision equipment. Digital escorts for non-digital units.
	DEFENSIVE OPERATIONS
	• Digital brigade ideally suited to transition quickly from defense to offense due to ability to acquire intel and disseminate information and plans.
	• Key aspects to defensive preparation:
	  • Facilitate parallel planning by sending warning orders early, defining subordinate missions and areas of operation.
	  • Develop terrain analysis and IPB products quickly, disseminate digitally.
	  • Counterrecon and security
	  • Move to defensive areas as early as possible.
	  • Security: Stress digital communication to increase operational security.
	  • Use SA to enhance mass, concentration, flexibility.
	• Deep operations–Improved lethality.
	• Counterrecon–Brigade has increased role with Brigade Reconnaissance Team (usually augmented with a maneuver force).
	• Rear operations–Improved SA leads to more rapid response to rear threats.
	• Digital brigade ideally suited for mobile defense, but can also conduct AD.
	• Use digital systems to integrate obstacles and fires (MCS, FBCB2).
	CSS
	• Mission support and continuous support.	

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
	• Forward Support Battalion (FSB): FSCs and BSC–can also push out a Forward Logistics Element. • Consolidation of CSS assets in FSB requires more activities controlled by brigade. • Reduced prescribed load limit/authorized stockage list stockage–just-in-time parts procurement. • On-hand supplies reduced–FSC needs 2 receipts of CL III(B), I, and V (one from division and one from corps) daily. • Use digital (FBCB2 & Combat Service Support Control System) systems to track, order supplies–more predictive/ anticipatory in nature. • Increased responsiveness and visibility due to shared SA. **RECON PLANNING** • Stresses R&S battle captain and R&S operations plan/OPORD. • 24-48 hours ahead of mission. • Key: Anticipating reconstitution–may require holding assets in reserve to prepare for next phase or mission.	

Table B2
METT-TC Comparisons for Enemy

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
• Krasnovian Front Army using standard heavy opposing force (OPFOR) organization and tactics, as detailed in U.S. Army Training and Doctrine Command Pamphlets 350-1 and 350-16, and Field Manuals 100-60, 100-61, and 100-62. • T-80, BMP-2, BTR-80 equipped • Area Defense (AD): Motorized Rifle Division (212/443/157) • Deliberate Attack (DATK): Motorized Rifle Regiment (-) (40/157) • Movement to Contact (MTC): Motorized Rifle Division (212/443/157). • MI-24, SU-25 (Frogfoot) (Ground Attack), MIG-25 (Foxbat) (Recce). • "Selecting" OPFOR: Multiple courses of action (COAs) to choose from (except DATK). • Weather: Mojave in the fall. • Minimal Air. • No rear area or unconventional threat Brigade/Battalion Battle Simulation enemy.	• Phenomenological threats: Nonmilitary–environmental disasters, health epidemics, famine, major population dislocations, illegal immigration. • Nonnation threats: Possess modern technologies that give capabilities similar to nation states. Subnational: political, racial, religious, cultural, ethnic conflicts that challenge defining features and authority of nation state. Anational: operate without regard to authority of nation states and have no desire to establish such status–crime, piracy, terrorism. • Metanational threats: Interregional or global scale. Religious movements (Islamic), international criminal organizations (drug cartels), informal economic organizations that facilitate weapons proliferation (arms dealers). • Infantry based armies with varying degrees of skill in integrating weapons technologies and combined arms operations. • Armor/mech infantry based armies with varying degrees of skill in integrating weapons technologies and combined arms operations. • Complex, adaptive armies that are technically and tactically advanced.	• *Armor/mech infantry based army.* • *COA 1: Leave OPFOR as is (Build into Janus Database).* • *COA 2: Structure OPFOR to look more like the National Training Center OPFOR in the Janus Database.*

Table B3
METT-TC Comparisons for Terrain

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
• National Training Center (NTC) terrain Database (Brigade/Battalion Battle Simulation). • Area Defense: Southern corridor + central after fragmentary order. • Deliberate Attack: Central corridor. • Movement to Contact: Southern corridor. • Not limited to NTC reservation boundaries. • Paper maps only.	• Frontages (from 1 Brigade/4 Infantry Division Standing Operating Procedures). • Platoon (Plt): 4 km width and up to 200m between vehicles. • Company/Team: 6-8 km width. • Task Force: 12-15 km width. • Use Terrain Index Reference System vice a lot of graphic control measures (no phase lines, no boundaries, square objectives, limited text). • Maintain section integrity for mutual support, not necessarily Plt integrity.	• *Same terrain (Fewer friendly forces on same terrain increases battlespace).* • *Develop tactical products with electronic overlays and paper back-ups.*

Table B4
METT-TC Comparisons for Troops

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
• 3 task forces (TFs) (2 Armor, 1 Infantry) • 8 Armor Company/Teams (Co/Tms) • 4 Infantry Co/Tms • Direct Support (DS) 155 Battalion (Bn) (18) + Reinforcing Multiple Launch Rocket System Battery (Btry) + Target Acquisition Btry • Engineer Bn • Air Defense Artillery (ADA) Btry • Direct Support Military Intelligence (MI) Co (Unmanned Aerial Vehicle) • Chemical Co (-) • Forward Support Battalion (FSB) • Military Police (MP) Platoon • Signal Section • Division/Higher Assets • Close Air Support • Aviation: Attack (Deliberate Attack only), observation, medevac, lift • Supply, medical, maintenance, personnel replacements • Brigade/Battalion Battle Simulation personnel and equipment.	• Three Force XXI Division Bns • 6 Armor Co/Tms • 3 Infantry Co/Tms • Light Infantry Bn • Same artillery, Engineer, ADA, MI, MP, division assets • Combat service support (CSS) assets consolidated into FSB • Chemical units from Corps-Bn • Analysis Control Team in Brigade Main • FSB: Forward Support Cos (FSCs) and Base Support Co–can also push out a Forward Logistics Element • Consolidation of CSS assets in FSB requires more activities controlled by brigade • FSC establishes TF situational awareness 12-15 km behind TF forward line of troops (FLOT) • Base Support Area no more than 30 km behind FLOT.	• *Three Force XXI Division Bns* • *6 Armor Co/Tms* • *3 Infantry Co/Tms* • *Light Infantry Bn* • *Same artillery, Engineer, ADA, MI, MP, division assets* • *CSS assets consolidated into FSB* • *Chemical units from Corps-Bn* • *Janus personnel and equipment* • *Digital assets for Exercise Control and Observers*

Table B5
METT-TC Comparisons for Time Available

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements

Execution Time
• 5-6 day continuous operations.
• Operation Order (OPORD) to execution time.
  • Area Defense: 46 hours.
  • Deliberate Attack: 66 hours.
  • Movement to Contact: 64 hours.
  • Concurrent planning at brigade level.
	Planning Timeline (Per 1 Brigade/4 Infantry Division Standing Operating Procedures).
	• Receipt of order from division.
	• Issue Warning Order (WARNO) #1.
	• 1 hour 30 minutes: Mission analysis.
	• 45 minutes: Mission analysis brief to commander.
	• 30 minutes: Commander's guidance/course of action (COA) determination.
	• Issue WARNO #2.
	• 1 hour: COA refinement.
	• 1 hour: Hasty Wargame with commander.
	• 45 minutes: Determine decision points and priority intelligence requirements. Develop reconnaissance and surveillance plan.
	• 1 hour: Develop draft plan including annexes.
	• 1 hour: Staff deliberate wargame of critical events.
	• 1 hour: Refine plan; Prep for orders brief.
	• 1 hour: Issue order.
	(9.5 hours from receipt of div OPORD)
	• Issue fragmentary orders (FRAGOs) as appropriate.
		• *Same.*
		• *Focus less on concurrent planning, more on continuous planning (OPORD + subsequent FRAGOs).*

<u>Exercise Preparation Time</u> • T-16 weeks: Study the *Exercise Guide.*		• *Same.*
• T-14 weeks: Brigade commander decides on mission(s) to train, performance objectives, and number of observed task forces (TFs). Develop outline of exercise schedule.		• *Same.*
• T-12 weeks: Release taskings for personnel to units. • Confirm facilities. • Issue outline of exercise schedule to brigade and task force executive officers (XOs).		• *Same.*
• T-10 weeks: Appoint Blue Forces Controller and issue his/her guide. • Reproduce and assemble training support package materials		• Same.

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements

• T-4 weeks: Issue appropriate guides and readahead materials to:
  • Training audience (through brigade and TF XOs)
  • Exercise Control (EXCON) G3 Roleplayer
  • Opposing Forces Controller
  • Observers (through Senior Observer).
		• *Same.*

• T-2 weeks: Issue appropriate guides and readahead materials to Blue Forces Controller for Blue Forces roleplayers. • Conduct orientation briefing for all participants.		• *Same.*
• T-1 week: Set up exercise area. • EXCON reviews division orders and tactical materials. • Conduct final readiness check.		• *May need to increase to establish local area network and/or tactical internet.*

Table B6
METT-TC Comparisons for Civilian Considerations

Current Brigade and Battalion Staff Exercise Conditions	Digital Brigade Conditions	Digital Training Requirements
• Contractor Logistics Support contractors for Brigade/Battalion Battle Simulation (BBS) support (Exercise planning, site scheduling, BBS training, execution control).		• *Same (replace BBS with Janus).* • *Force XXI Battle Command Brigade and Below/Army Tactical Command and Control System contractor support.*

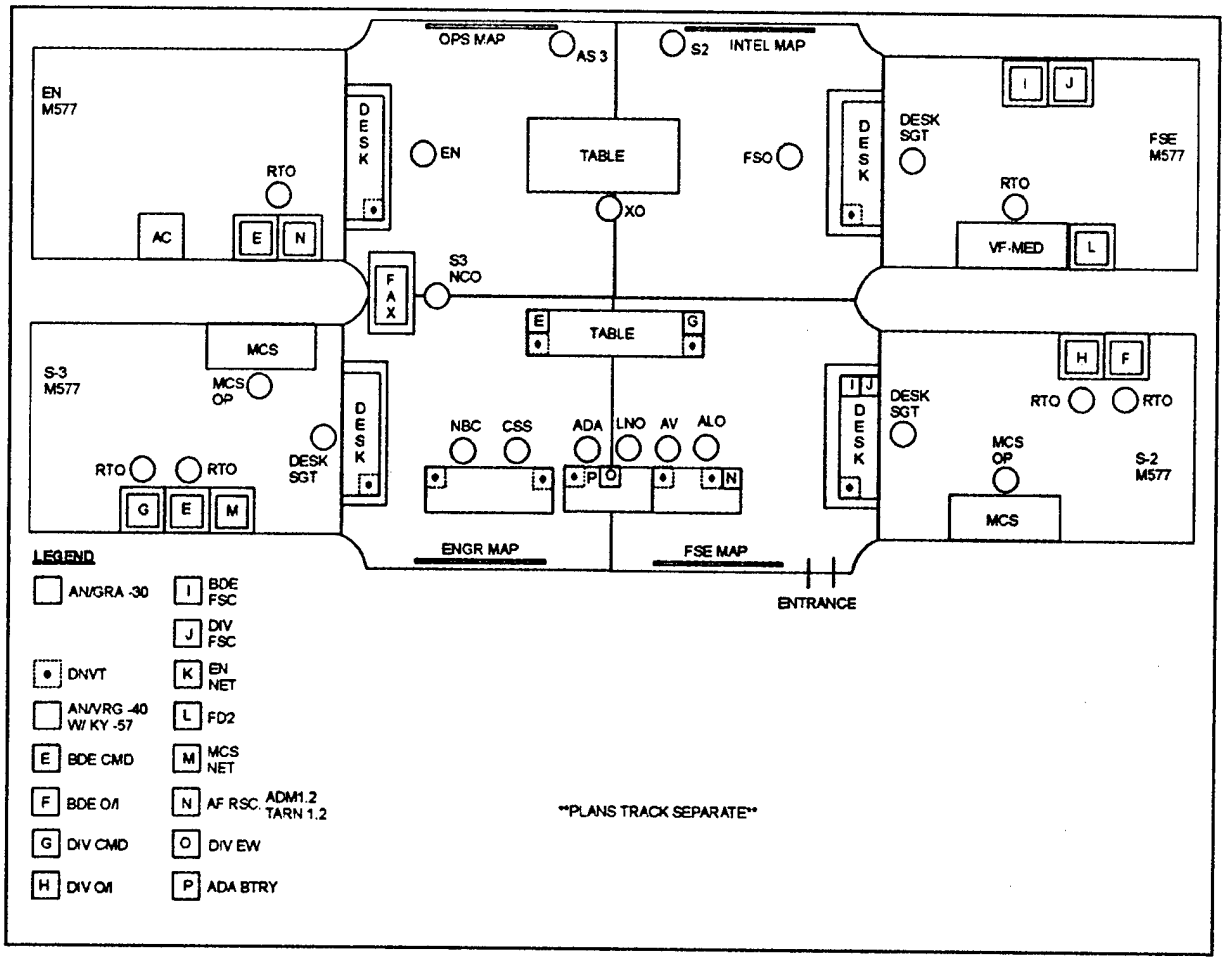

Figure B-1. Conventional Main Command Post.

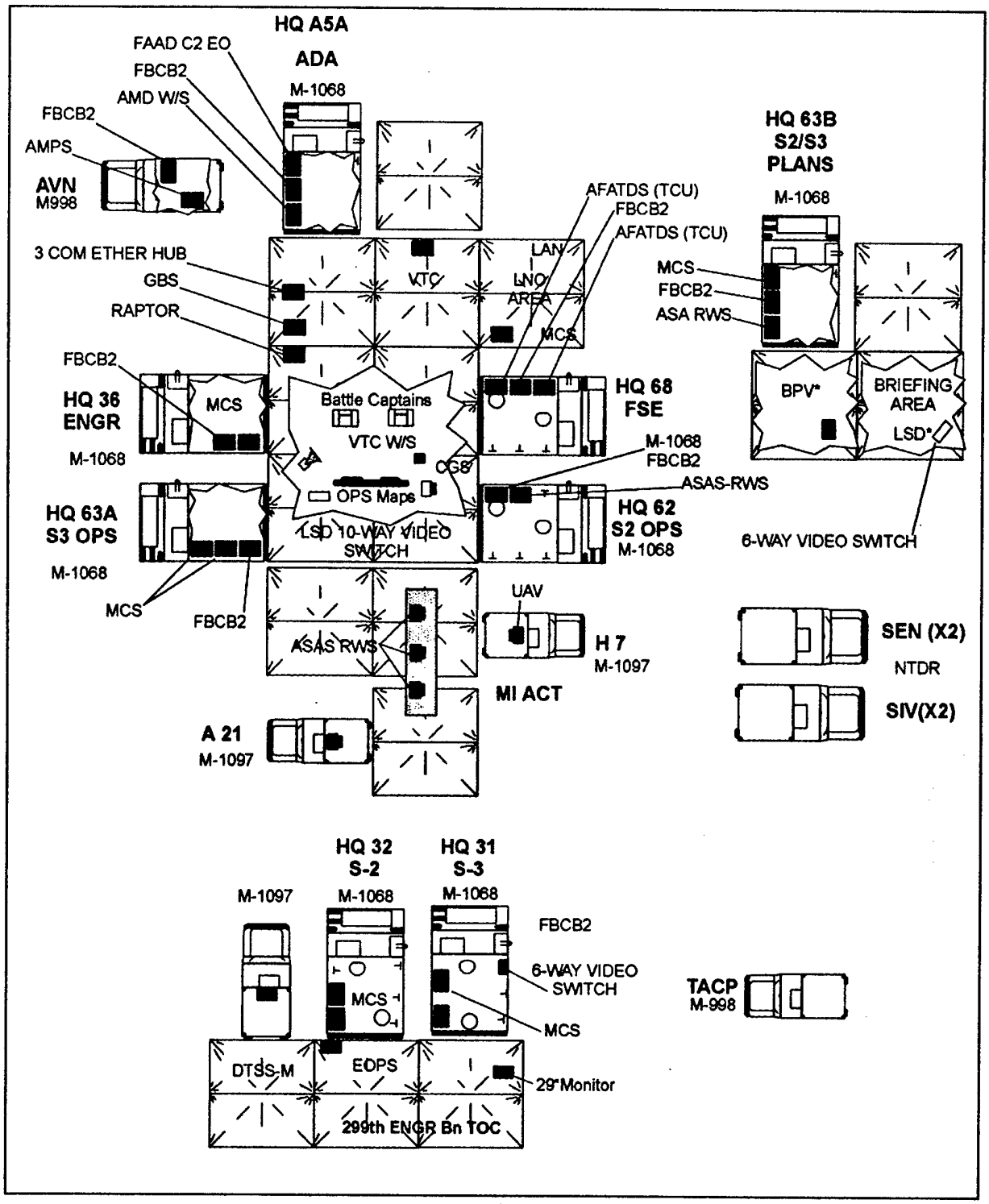

Figure B-2. Digital Brigade Main Command Post.

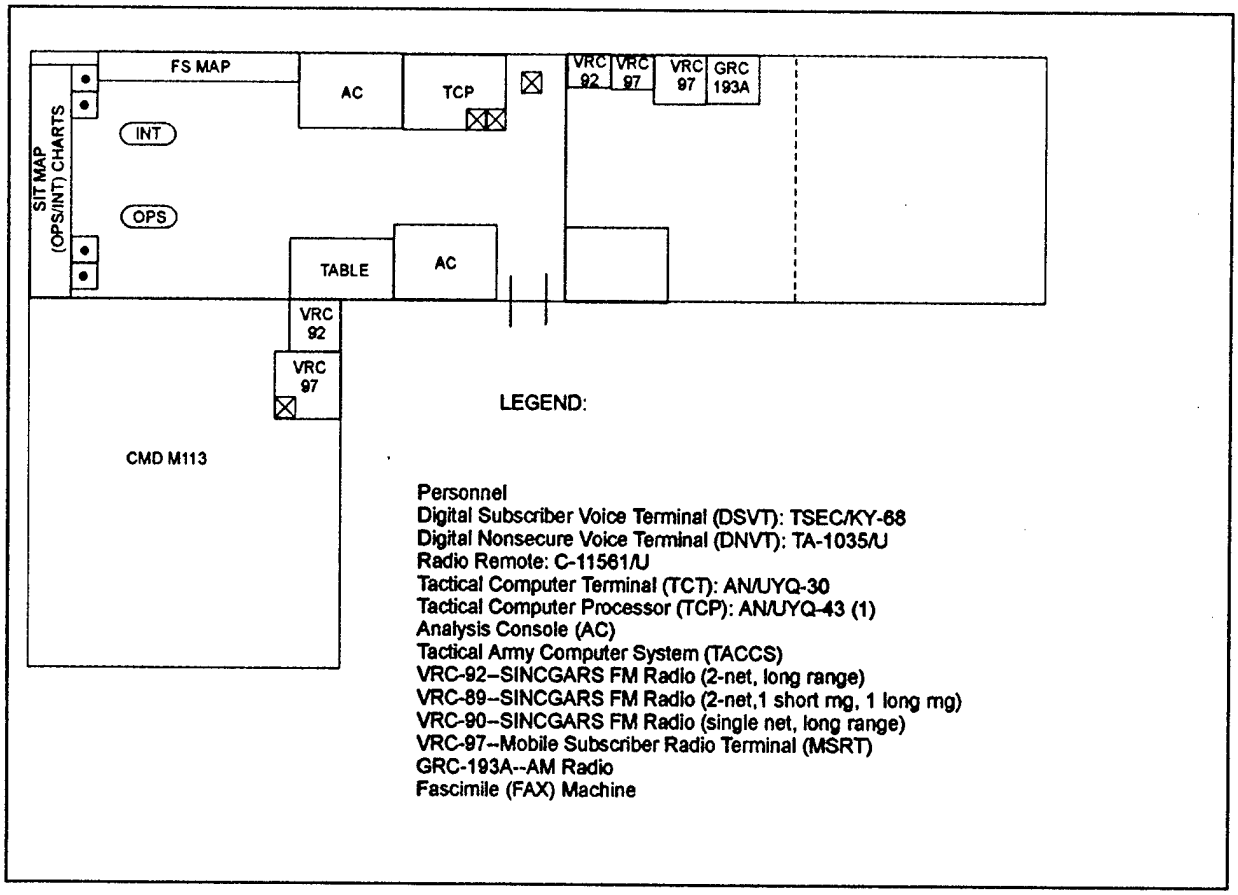

Figure B-3. Conventional Brigade Tactical Command Post.

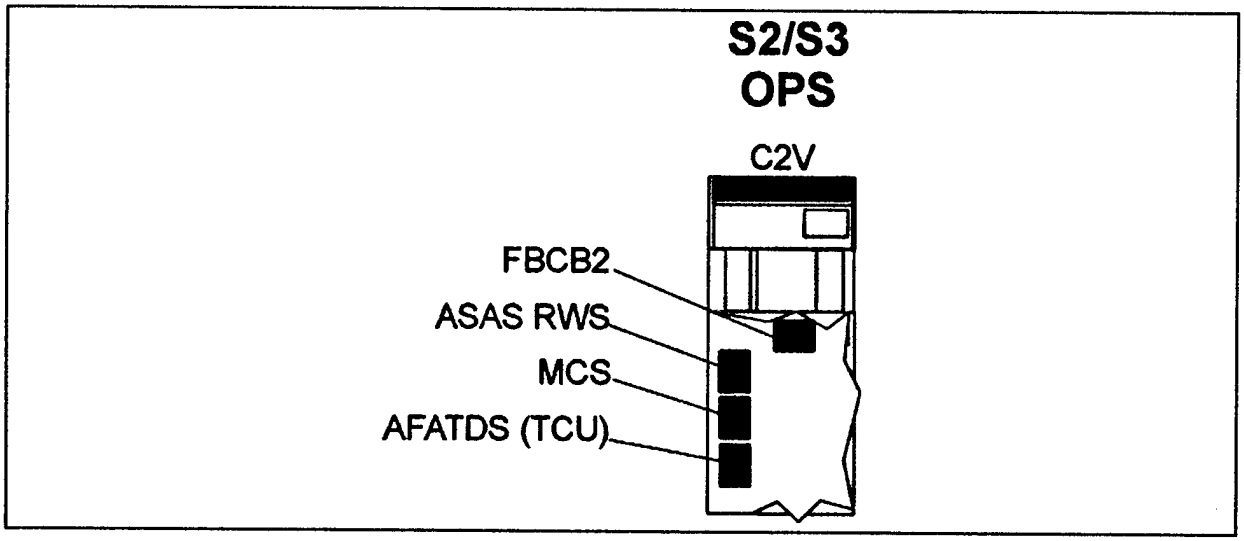

Figure B-4. Digital Brigade Tactical Command Post (Staff Leader's Guide variant).

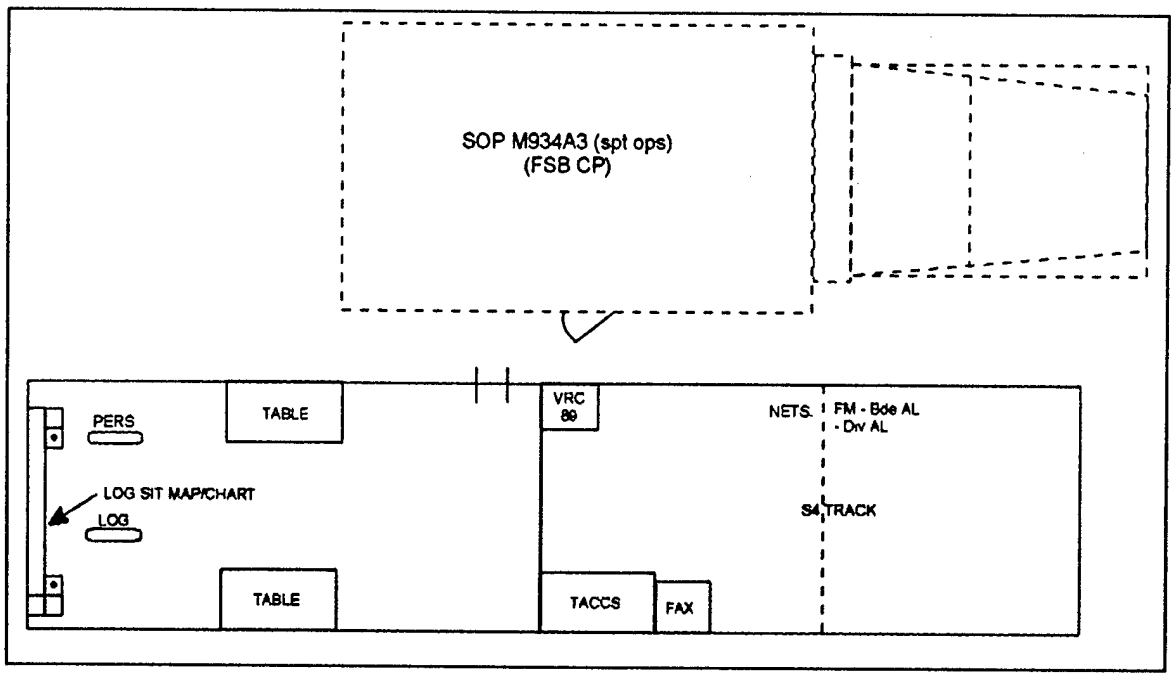

Figure B-5. Conventional Brigade Rear Command Post.

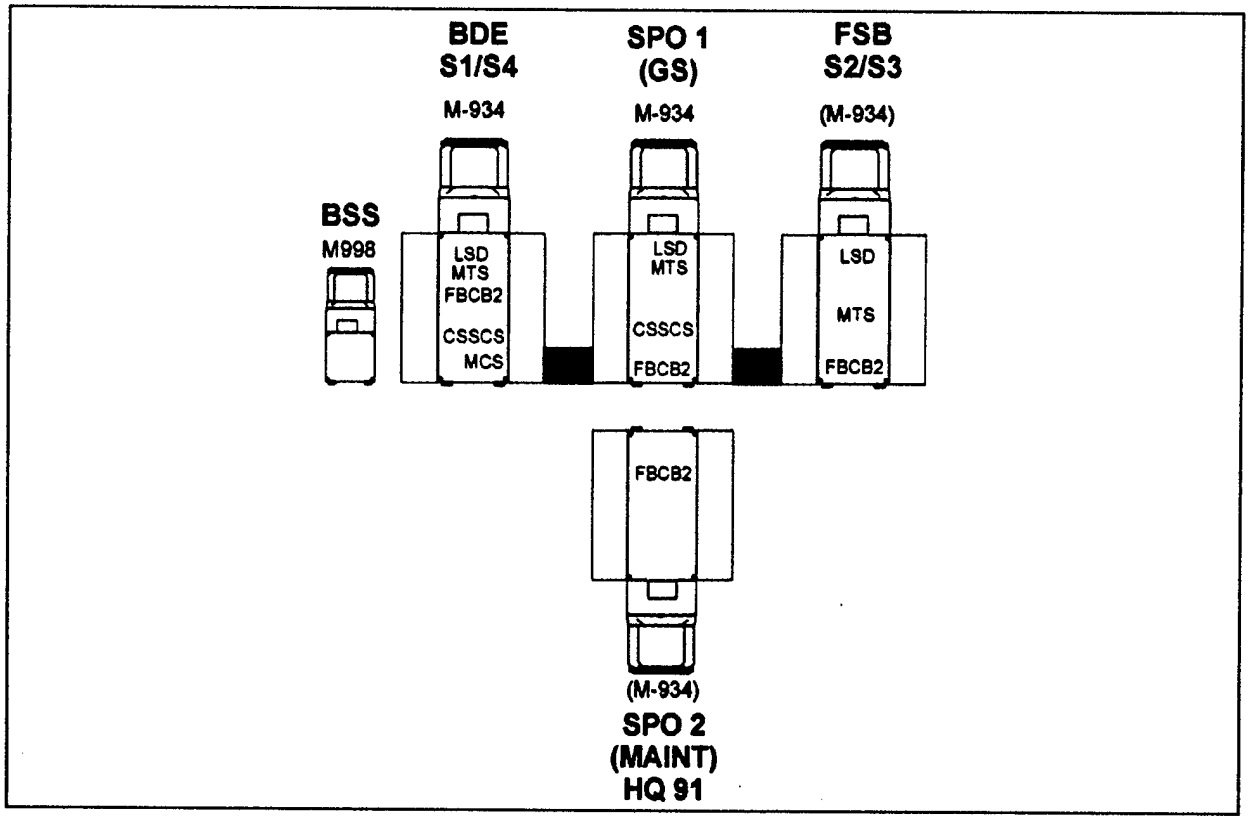

Figure B-6. Digital Brigade Rear Command Post.

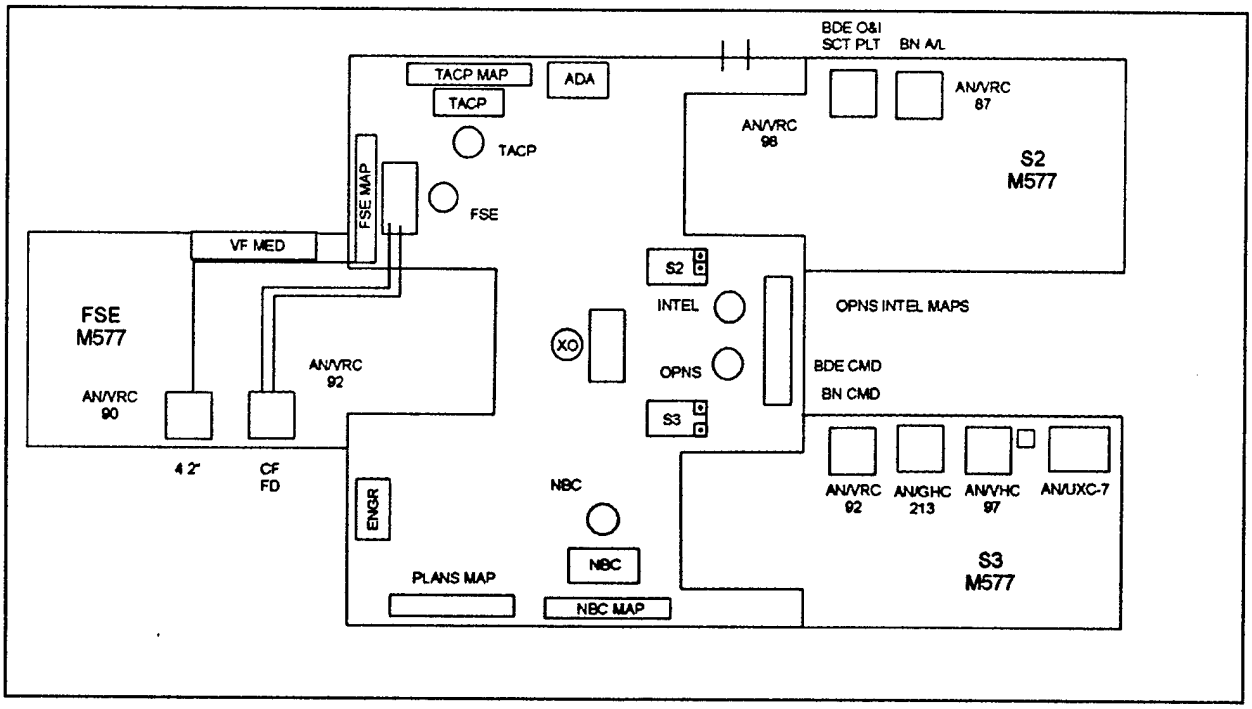

Figure B-7. Conventional Brigade Main Command Post.

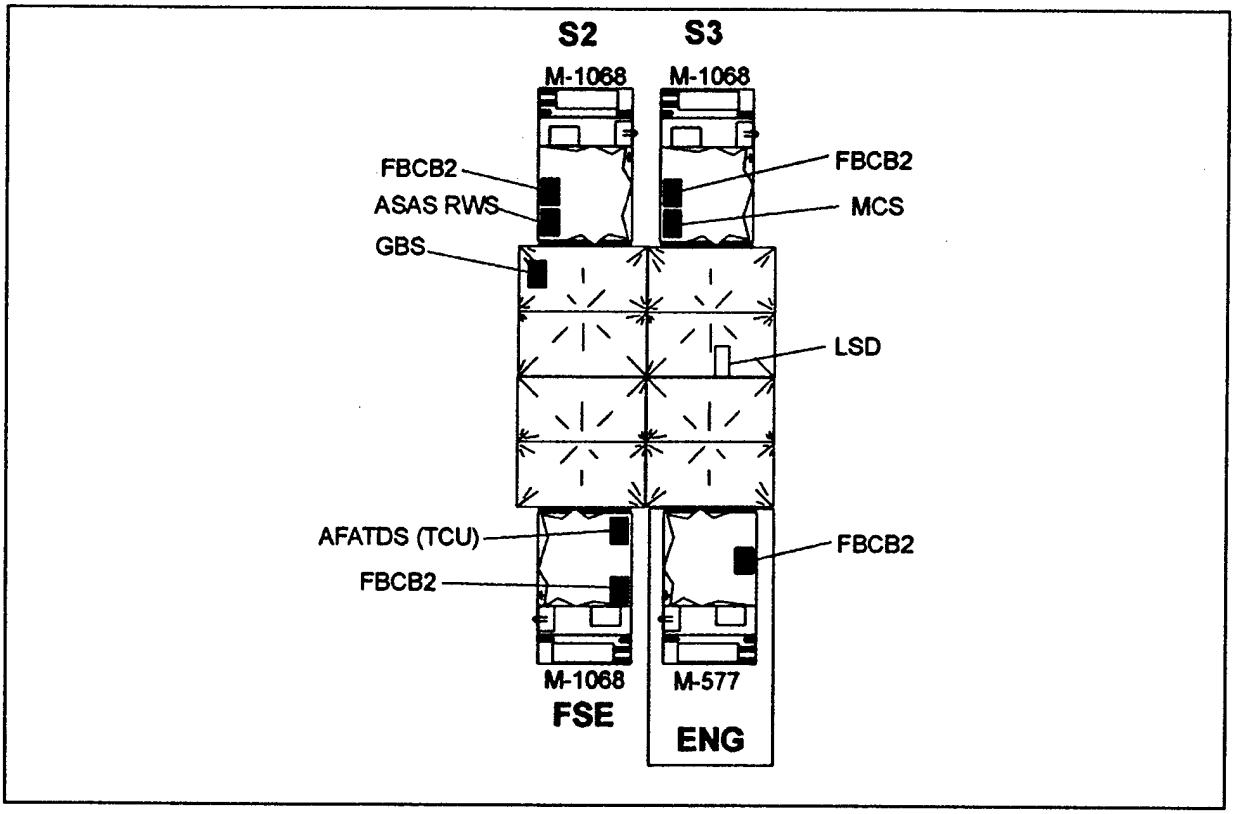

Figure B-8. Digital Battalion Main Command Post

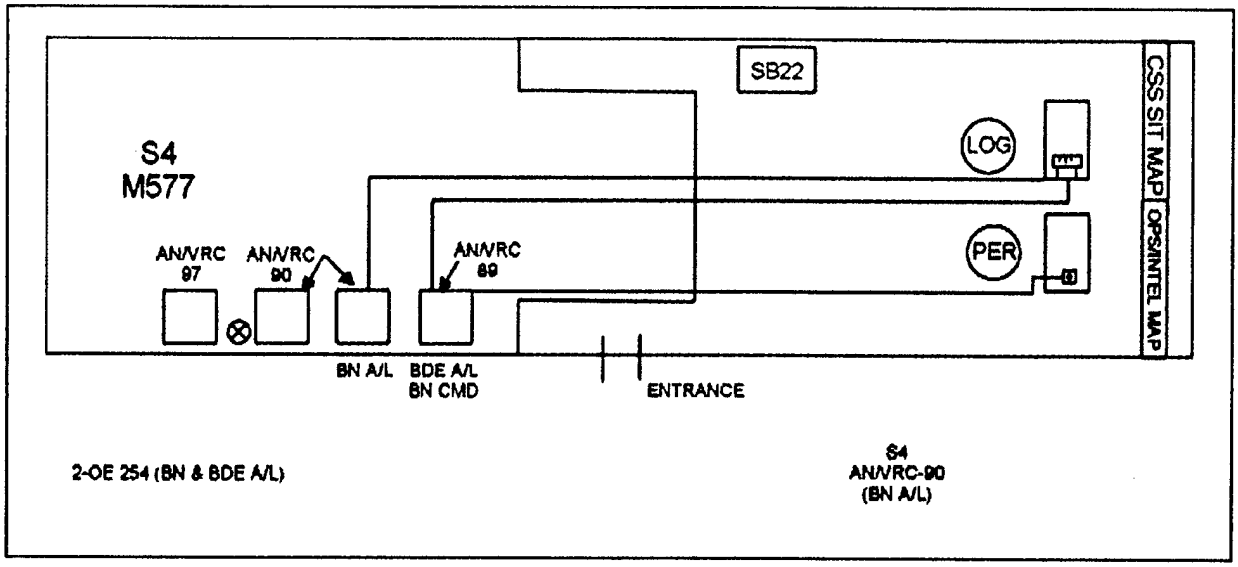

Figure B-9. Conventional Battalion Combat Trains Command Post.

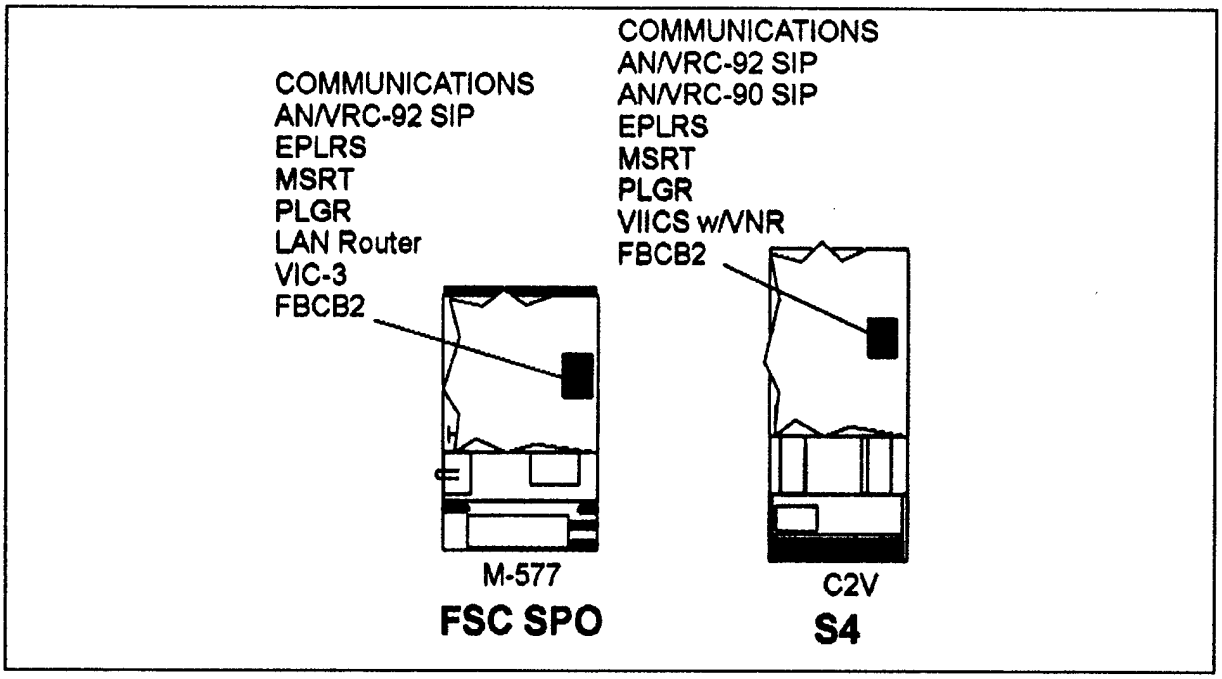

Figure B- 10. Digital Battalion Combat Trains Command Post.

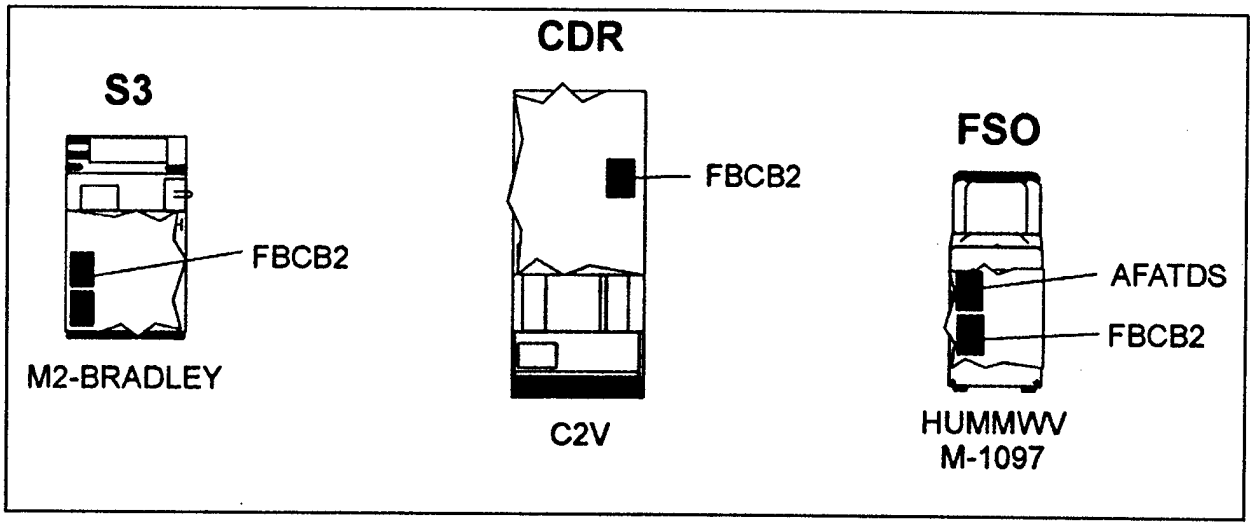

Figure B-11. Digital Mechanized Battalion Command Group.

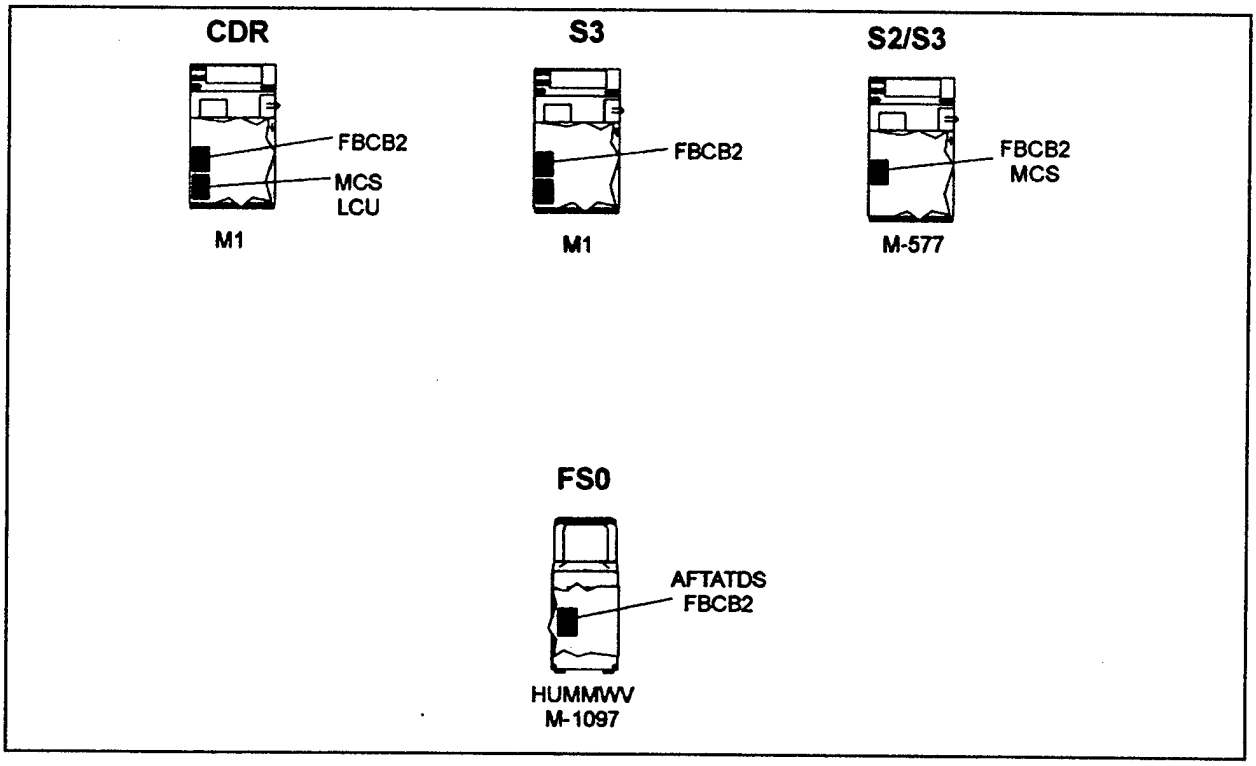

Figure B- 12. Digital Armor Battalion Command Group.

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Appendix C
Lists of Tasks Required To Convert Brigade/Battalion Battle Simulation-Supported Products into Janus-Supported Products

This appendix describes the tasks required to convert Brigade/Battalion Battle Simulation (BBS)-supported Force XXI Training Program products into Janus-supported products. The appendix begins with an explanation of why the BBS simulation was chosen over the Janus simulation and Simulation Networking (SIMNET) for the Brigade Staff Exercise (BSE) and Brigade and Battalion Staff Exercise (BBSE). Following this explanation, the section presents a synopsis of the effects that a simulation conversion of the BSE and BBSE would have on the intents and designs of those products. The section concludes with a set of tables that contain conversion task lists for the BBSE, BSE, and BBS-supported vignettes. The tasks identify the actions to take on the individual components of the product training support packages and a rough estimate of developer-hours required by each action.

Selection of the Brigade/Battalion Battle Simulation

During the *Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation* (COBRAS) projects, the BBS was selected as the simulation of choice over Janus and SIMNET primarily due to the capabilities of BBS in supporting brigade-level exercises that focused on combat support (CS) and combat service support (CSS) operations. Selection criteria included:

- Functional representation: the simulation(s) chosen had to facilitate operations within all brigade functions, especially the selected CS and CSS operations.
- The size of the terrain database: The terrain databases(s) of the simulation(s) chosen had to be large enough to allow for brigade-level operations.
- The ability to generate combat, CS, and CSS report information: Printed reports were estimated to be important to providing thorough, accurate, and timely combat reports to the staff.
- Operator requirements: The COBRAS project sought to maximize training value while minimizing personnel support requirements.
- Brigade asset representation: The simulation(s) had to represent brigade assets at a level that would stimulate the reporting of detailed combat and status information, in order to drive CS and CSS operations.

Effects of Simulation Conversion on Exercise Scope and Purpose

Changing simulations from BBS to Janus for the vignettes, BSE and BBSE should have the following impacts:

The Janus CSS functions do not permit the depth or detail of CSS play that is supported by the BBS. Thus, Janus would not allow for the robust portrayal of CSS play unless a significant amount of scripting is employed. Currently, the exercise uses BBS to generate the building of combat power over time, from a degraded status. During this regeneration of combat power, CSS participants are actively involved with the simulation to manage various classes of supply and services. Due to the amount of interactive use of BBS by the CSS personnel during combat power regeneration, very realistic training can occur for the S1/S4 and CSS elements.

Scripting CSS actions would be necessary not only to compensate for the lower CSS capability of Janus, but also for CSS actions such as maintenance and medical, occurring over time. Janus allows for approximately 16 hours of simulation time per exercise. The existing BSE is structured to occur over 48 hours (planning through execution), and a significant portion of the CSS actions occurs during the first 24-36 hours of the exercise. This limitation leads to the need to not begin use of the simulation until well after the majority of CSS actions ought to be completed.

Associated with the 16 hour limitation is the "carry over" of the brigade's readiness status following execution. Since the simulation "expires" at the end of 16 hours, combat power cannot be regenerated for the follow on exercise by interactive play by the CSS personnel. This may lead the training audience relegating post battle CSS functions to minor importance since recovery and maintenance functions will have no impact on the following mission in Janus.

If a subsequent scenario is executed, it will have to start with a pre-determined readiness status unrelated to the previous mission, even though the story line for the series of missions may be continuous in nature. The training audience will need to be informed to suspend logic regarding previous battle results for CSS as each mission will be starting with "new" forces. If the new force is degraded for the following mission, additional combat power will have to be added or given to the units by the exercise controller as scripted CSS actions are completed by the training audience.

Mine and obstacle employment with Janus will be less realistic than BBS due to the differences in how the simulations emplace them. The BBS allows near full play, to include the time factors for transporting construction and barrier materials to the minefield or obstacle location and the work factors required for emplacing the minefield or obstacle. As a result, logistical requirements and preparation time for engineer effort is realistic. However, with Janus preparation time is artificial since the workstation operator only has to arrange the planned minefield or obstacle by using a mouse. No time or work factors are incorporated by Janus during the engineer effort. Additionally, once Janus has started its simulation run, only Family of Scatterable Mines obstacles can be emplaced, which could constrain the unit's planning.

Nuclear, biological, and chemical operations are precluded from decontamination operation within Janus. Once a unit is contaminated, there is no capability to recover the unit. While decontamination elements can be built and included in the simulation, they will maneuver, but not function in their primary role.

Effects of Simulation Conversion on Exercise Performance Objectives

Changing simulations appears to impact, in varying degrees, two of the performance objectives for the BBSE: *Integrate Logistics Estimates in Decision-Making* and *Develop and Execute the Brigade Concept of Mobility/Survivability.* The remaining performance objectives do not appear to be influenced by the particular simulation used for the BBSE.

The Janus impact on the *Integrate Logistics Estimates in Decision-Making* Performance Objective should not detract from the value of this performance objective. Because of the 16-hour run time limitation, the continuing development of the estimate after the first mission will be interrupted, and new or artificial data will have to be injected into the CSS estimate. The magnitude of this impact can be lessened if likely starting point data can be developed through trials for follow-on missions. While all battle results are different in simulation, such trials could present a data set that would fit within an expected window. These "given" battle results would match the actual results only by coincidence, but should be within reasonable expectations of the training audience. The CSS estimate could be adjusted with these results and planning for follow-on missions continued. While this data adjustment is an artificiality generated by the exercise, it has no effect on the performance objective during the first mission and should not significantly affect the training value of the performance objective during subsequent missions.

Because the 16-hour limit requires subsequent missions to start with a new force, it may require development of cues to reflect this new CSS data during the parallel planning process. A procedure exists to eliminate confusion about the future Red force for intelligence players since the Red force has always been a "new" enemy in the BBSE. What should result from this procedure is that CSS players are able to adjust to the introduction of any needed cues to set the stage for the new CSS data forming the basis for their continuing estimate process.

The *Develop and Execute the Brigade Concept of Mobility/Survivability* Performance Objective appears to be subject to only one aspect of the change in simulation system. One of the observable actions for the brigade engineer in this performance objective is the tracking of the engineer work effort. While this was realistic in terms of time lapse and attained effort in BBS, it will have to be artificially managed in Janus if this particular observation is retained in this performance objective.

Additional Effects of Simulation

Integrating digital systems into the BSE or BBSE based on the Janus simulation will require several significant tasks. First, the tactical materials will need to be restructured to reflect the 4 Infantry Division (Mechanized) unit names to function within the existing master address book used in the database. Second, tactical materials will need a major rewrite and volume reduction if the new software for Maneuver Control System is no more effective than was available during the *Force XXI Training Program–Digital* project. Third, supporting materials used by Exercise Control will need to be converted from a paper Master Events List to electronic messages for transmission via the appropriate Army Tactical Command and Control System. These issues were encountered in the conversion of the brigade vignette, and methods to address the problem are discussed in Section 3 of this report.

A digital BBSE will include Force XXI Battle Command Brigade and Below (FBCB2) to allow the task forces to communicate with the company/team roleplayers in the simulation room. Because of some of the peculiarities regarding aggregation of icons associated with the FBCB2 and Janus interface, it is likely that the force files would differ between a Janus BBSE and a digital BBSE. This will occur because there are aggregation differences between the Army/Advanced Research Projects Agency training version and the Research and Development digital version. Due to aggregation problems with Janus when forces are replicated by an FBCB2, it is likely that developers would tend to produce aggregated forces in the Janus BBSE and a mix of aggregated and non-aggregated forces in a digital BBSE.

The specific tasks required to convert the BSE, BBSE, and simulation-supported vignettes are contained in Tables C1, C2, and C3, respectively.

Table C1
Brigade Staff Exercise Conversion Requirements–Brigade/Battalion Battle Simulation to Janus

Brigade Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Brigade Orientation Guide	Edit to reflect Janus.	3	40	
Exercise Guide for the Exercise Director, with appendixes	Edit all references to Brigade/Battalion Battle Simulation–change to Janus requirements. Each scenario limited to 16 hours simulation time–Compress time or time warp–Modify story lines and modify exercise schedules. Modify discussion and emphasis about combat service support (CSS) play. Modify support personnel requirements. Stockage supply lists needs relook as to level of CSS play retained. Update exercise briefing.	1	400	Exercise design, linked scenario, how many entry points? Training support package model. CSS play need resolution before beginning conversion. Staff hours include the analysis required on exercise design.

(table continues)

Table C1 (continued)

Brigade Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Tactical Products	Review/edit for any doctrinal changes. Adjust to 3-x task force (TF) Brigade Combat Team. Update opposing force (OPFOR) graphics.	1	360	Enhanced brigade or a 3-x TF brigade.
XO Guide to Unit Preparation and Materials Distribution	Edit to reflect Janus manning and add Janus Table of Organization and Equipment (TOE) files.	4	12	
Training Audience Guides	Edit guide portion to reflect Janus.	3	64	Staff hours could be reduced to 16 if we use generic guide as in Brigade and Battalion Staff Exercise (BBSE).
EXCON Roleplayer Guide	Casualty play only at unit level. No non-battle injuries. Startex personnel at 100% manning of weapon systems. Maintenance play would require extensive scripting to have full CSS play. Update Exercise Control (EXCON) activity list to account for Janus requirements. Repair parts and components tracking must be totally scripted. Total rewrite of guidelines for workstation team to reflect Janus. Total rewrite of guidelines for workstation team job aids to reflect Janus.	1	320	Determination of how much CSS is necessary prior to updating activity list and changing scripting.
OPFOR Controller Guide	All the roleplayer guide changes apply plus updating tactical descriptions to reflect current organization.	3	80	Design issue. Keep the same enemy or upgrade?

(table continues)

Table C1 (continued)

Brigade Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Blue Forces Roleplayer Guides	Rewrite/edit to reflect Janus manning and functions, capabilities of Janus. Rewrite Job Aids section–TOE documentation, operational states, terminal checklists, procedures charts.	3	80	Should consider making work-station team guides as in BBSE.
Interactor Guides–EXCON, Red and Blue	Rewrite to reflect Janus manning and functions, etc as in roleplayer guide.	3	80	See above
Observer Guides	Minor edits in the guide. Performance objectives OK.	5	8	
Task Lists	Minor edits.	4	4	
Sample Products	Edit to reflect doctrinal changes and any design changes.	3	80	
Initial Situation Package (ISP)	Edit/replace tactical materials and Order of Battle materials.	1	280	Design issue due to simulation limitations and no regenerating combat power. Tactical products are used here. Effort mainly arriving at the CSS levels and compiling the ISP.
Site Manager Guide	New guide needed due to Janus. Format only remains.	4	40	
TOE and Initialization Book	Edit to reflect Janus. Change TOE files to reflect data built in Janus files.	1	240	Same as above. Done concurrently with archive.
Archive Book	Edit instructions to reflect Janus. Simulation data requires complete rebuild and documentation.	1	480	Includes building scenario on Janus simulation.

*1 = significant (200+ hrs), 2 = moderate (100-200 hrs), 3 = some (40-100 hrs), 4 = minimal (<40 hrs), 5 = none

Table C2
Brigade and Battalion Staff Exercise Conversion Requirements–Brigade/Battalion Battle Simulation to Janus

Brigade and Battalion Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Brigade and Battalion Orientation Guide	Edit to reflect Janus.	3	40	
Exercise Guide for the Exercise Director	Edit all references to Brigade/Battalion Battle Simulation–change to Janus requirements. Each scenario limited to 16 hours simulation time. Compress time or time warp–modify story lines. Update exercise briefing.	1	400	Exercise design–combat service support (CSS) play needs resolution before beginning conversion. Staff hours include the analysis required on exercise design.
Tactical Materials	Materials are sound. Review for any doctrinal changes that may have occurred.	4	120	
XO Guide to Unit Preparation and Materials Distribution	Edit to reflect Janus manning and add Janus Table of Organization and Equipment (TOE) files.	4	12	
Training Audience Guides	Edit guide portion to reflect Janus.	4	8	

(table continues)

Table C2 (continued)

Brigade and Battalion Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
EXCON Roleplayer Guide	Casualty play only at unit level. No non-battle injuries. Startex personnel at 100% manning of weapon systems. Maintenance play would require extensive scripting to have full CSS play. Update Exercise Control (EXCON) activity list to account for Janus requirements. CL IX tracking must be totally scripted. Total rewrite of guidelines for workstation team to reflect Janus. Total rewrite of guidelines for workstation team job aids to reflect Janus.	1	320	Determination of how much CSS is necessary prior to updating activity list and changing scripting.
Opposing Forces Guide	All of the workstation guide changes apply plus updating tactical descriptions to reflect current organization.	3	80	
Workstation Team Guides	Rewrite/edit to reflect Janus manning and functions, capabilities of Janus Rewrite Job Aids section–TOE documentation, operational states, terminal checklists, procedures charts.	3	80	
Observer Guides	Minor edits in the guide. Performance objectives OK.	4	8	
Performance Objectives	No change.	5	0	
Initial Situation Package	Edit/replace tactical materials and Order of Battle materials.	3	120	

(table continues)

Table C2 (continued)

Brigade and Battalion Staff Exercise Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Initial Situation Package– Observers	Replace materials (using updated material from the Initial Situation Package).	4	40	
Site Manager Guide	New guide needed due to Janus. Format only remains.	4	40	
TOE and Initialization Book	Edit to reflect Janus. Change TOE files to reflect data built in Janus files.	1	240	Included with TOE and Initialization
Archive Book	Edit instructions to reflect Janus. Simulation data requires complete rebuild and documentation x 3.	1	480	Includes time on Janus.

*1 = significant (200+ hrs), 2 = moderate (100-200 hrs), 3 = some (40-100 hrs), 4 = minimal (<40 hrs), 5 = none.

Table C3
Simulation Supported Vignette Conversion Requirements–Brigade/Battalion Battle Simulation to Janus

Vignette Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Training Coordinator Guide	Edit text to reflect Janus. Modify roleplayer and interactor roster. Modify to 3-x task force (TF) Modified Table of Organization and Equipment (MTOE).	4	32	
Attachment 1, Participant Guide	Edit text to reflect Janus.	4	24	
Attachment 2, Preparation Materials	Edit tactical materials to reflect doctrinal changes, orders format, and 3-x TF brigade.	2	120	
Attachment 3, Execution Materials	Edit tactical materials to reflect doctrinal changes, orders format, and 3-x TF brigade.	3	72	
Attachment 4, Job Aids	Edit to reflect current military decision-making process doctrine.	4	12	
Support Coordinator Guide	Edit text to reflect Janus. Modify roleplayer and interactor roster. Modify to 3-x TF MTOE.	2	40	
Attachment 1, Site Manager Guide	Complete redo as a result of changing to Janus, i.e., archives, MTOE, initialization, training.	1	200	
Attachment 2, HICON/EXCON Guide	Change to reflect interactor instructions and preparation materials.	4	16	
Attachment 3, Task Force Interactor and Roleplayer Guide	Change to reflect interactor instructions and preparation materials.	4	24	
Attachment 4, Fire Support Interactor and Roleplayer Guide	Change to reflect interactor instructions and preparation materials.	4	16	

(table continues)

Table C3 (continued)

Vignette Component/ Activity	Conversion Requirements	Level of Effort*	Estimated Staff Hours to Complete	Remarks/ Issues
Attachment 5, Forward Support Battalion Interactor and Roleplayer Guide	Change to reflect interactor instructions and preparation materials.	4	12	
Attachment 6, Engineer/Air Defense Artillery Roleplayer and Interactor Guide	Change to reflect interactor instructions and preparation materials.	4	12	
Attachment 7, Brigade Troops Roleplayer and Interactor Guide	Change to reflect interactor instructions and preparation materials.	4	12	
Attachment 8, OPFOR Guide	Change to reflect interactor instructions and preparation materials.	4	32	
Attachment 9, Preparation Materials	Update to reflect doctrinal changes, MTOE 3-x TF, start of exercise materials for simulation materials.	2	120	
Janus Inputs	Build new force files and command and control graphics for each scenario. Record new documentation and make tapes.	2	160	Some documentation will be used for other books. A force file will be required for each scenario due to the low fuel allocations and personnel replacement limits.

*1 = significant (200+ hrs), 2 = moderate (100-200 hrs), 3 = some (40-100 hrs), 4 = minimal (<40 hrs), 5 = none.