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Structured Simulation-Based Training Programs: History and Lessons Learned

Theodore M. Shlechter and Dorothy L. Finley
U.S. Army Research Institute

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14. ABSTRACT (Maximum 200 words):

This report provides an historical account and analysis of the U.S. Army Research Institute's (ARI) research and development (R&D) efforts on structured simulation-based training (SST). These R&D efforts have led to the development of 30 research reports, 14 conference papers, and over 200 training support packages (TSPs). The developed TSPs focused on optimizing the simulation-based training opportunities for armor and mechanized infantry platoons and companies, and their battalion and brigade staffs. The TSPs have also been developed for representatives of a battalion's or a brigade's combat support and combat service support elements. This report's findings indicate that the developed TSPs would, if utilized properly, help the U.S. Army more fully exploit its advanced simulation-training systems. In addition, 43 lessons learned have been derived from these SST projects. The present report provides a central information source on ARI's SST efforts, and has important implications for future SST research and development efforts.

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Research Report 1755

Structured Simulation-Based Training Programs: History and Lessons Learned

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FOREWORD

Post cold-war pressures upon U.S. military forces led to the research and development (R&D) of innovative instructional programs to train military personnel in a timely cost-efficient manner. To help the U.S. Army meet their pressing training needs, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) Unit at Fort Knox, KY, initiated a series of R&D efforts dealing with structured simulation-based training (SST). These SST efforts were designed to provide armor and mechanized infantry platoons and companies, and their battalion and brigade staffs with relatively low-cost and standardized collective training opportunities. Also included as members of the intended training audience for several SST programs were combat support and combat service support elements. The developed SST programs were designed to help the U.S. Army more fully exploit its advanced simulation-training systems.

The present research effort involved analyzing the research and training products associated with the SST R&D efforts. This analysis led to a detailed account of each SST program's design methodology, instructional characteristics, and training products. This analysis also discerned the key lessons learned from these R&D efforts. The present report thus provides a central source of information concerning ARI's efforts in the area of SST.

The present effort falls under the umbrella of ARI's Armored Forces Research Unit Work Package 205, Assessment of Force XXI Training Tools and Techniques (AFT3). It has been completed pursuant to a Memorandum of Agreement with the U.S. Army Armor Center and Fort Knox: Manpower, Personnel and Training Research, Development, Test, and Evaluation for the Mounted Forces, 16 October 1995. The reviewed SST efforts, such as the Virtual Training Program, were completed under two programs: Strategies for Training and Assessing Armor Commanders' Performance with Devices and Simulations (STRONGRARM) and Force XXI Training Methods and Strategies(FASTTRAIN) Work Packages.

The information in the present report has been provided to training developers and instructors at the U.S. Army's Armor School at Fort Knox. This report also has ramifications for the development and implementation of future SST programs.

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Structured Simulation-Based Training Programs: History and Lessons Learned

EXECUTIVE SUMMARY

Research Requirement:

In response to pressing U.S. Army needs, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) initiated a series of research and development(R&D) efforts dealing with producing structured-simulation-based training (SST) programs. These R&D efforts addressed a variety of collective training requirements for combined arms forces, including the training of armor platoons and companies and their parent battalion and brigade staffs. Several R&D efforts also developed training materials for members of a battalion's or a brigade's combat support and combat service support elements. The requirement of the present effort was to provide a comprehensive and integrated account of these different R&D efforts and the key lessons learned from them.

Procedure:

To accomplish the stated effort, the authors analyzed the training products resulting from numerous SST R&D efforts. These products consisted of: (a) 30 ARI publications, (b) 14 conference papers, and (c) over 200 training support packages(TSPs).

Findings:

This effort has provided a history of the R&D efforts associated with developing ARI's SST programs. As such, this effort documents a seven-year period of intensive R&D by a consortium of instructional designers, military subject-matter experts, research psychologists, and military and civilian Department of Defense training support personnel. Their efforts led to the development of prototype TSPs, which contain such training materials as feedback guides for the training support personnel.

Evidence from trial evaluations of the prototype TSPs indicate that these training materials can achieve their training goals, if properly utilized. These goals include helping the U.S. Army to more fully exploit its advanced simulation-based training systems. They also include providing combined arms units with much needed standardized collective training opportunities.

This review has also discerned 43 key lessons learned concerning the SST efforts. These lessons have dealt with the SST efforts' (a) R&D process, (b) instructional design methodology, (c) key instructional characteristics, and (d)

implementation strategies. One notable lesson learned has involved the benefits of a programmatic approach to R&D, which had not been the original intention of these R&D efforts. Later SST efforts have been built upon the lessons learned and TSPs developed in earlier programs.

Utilization of Findings:

This report has ramifications for the military training and instructional design communities. For both, its content serves as a central source for obtaining information concerning ARI's developed SST programs. This report's content also serves as a building block for future SST efforts. The stated lessons learned provide valuable inputs to future SST R&D teams and training personnel dealing with SST products.

Structured Simulation-Based Training Programs: History and Lessons Learned

CONTENTS

Page

SECTION 1: INTRODUCTION 1

Objectives of the Present Report 1
Approach of the Present Report 1
Organization of the Present Report 2

SECTION 2: OVERVIEW OF THE SST EFFORTS 3

The Different Sets of R&D Efforts 3
Personnel Associated with the R&D Efforts 3
Targeted Training Audiences 4
Genesis of the SST Efforts 4
The Structured Training Concept 5
Instructional Underpinnings 6
Key Instructional Features 6
Training Support Packages (TSPs) 7
The Simulation-based Training Systems 7
Training support personnel 8
The SST Instructional Design Framework 8
The TSP Phase 9
Relationships to Other Instructional Design Methodologies 10
Summary 10

SECTION 3: THE SIMUTA R&D EFFORTS 11

Overview 11
R&D Efforts 11
Distinguishing Characteristics 11
The VTP 12
Tables/Exercises 12
Instructional Support Personnel 13
TSP(S) 15
Evaluation Process 16
ARI's Researchers 16
The SIMBART Program 17
Instructional Design 17
Training Support Personnel 19
Evaluation Process 19
The SIMUTA-B Project 20
Exercises 21
Instructional Design Process 21
Development of the TSPs 21
Evaluation Process 22
Unresolved Issues 23
Addition of CS and CSS Elements 23

CONTENTS (Continued)

Page

Concluding Comments 24
The SIMUTA-D Project 25
Overview 25
Initial Decisions 25
TSPs 26
Evaluation Process 26
Concluding Comments 27
Summary and Reflections 27
Summary 27
Reflections 28

SECTION 4: THE STRUCCTT R&D EFFORTS 29

Overview 29
R&D Initiatives 29
Background 29
STRUCCTT 30
Initial Decisions 30
Designation of Training Objectives 31
Tables/Exercises 32
TSPs 32
The Evaluation Process 33
Concluding Comments 35
STRUCCTT-2 35
Designation of Training Objectives 35
Exercise Development 36
TSPs 36
Evaluation Process 38
Concluding Comments 39
The CITT 39
Overview 39
The Instructional Design and Development Process 40
The Evaluation Process 42
Concluding Comments 43
Summary and Reflections 44
Summary 44
Reflections 44
Concluding Comments 45

SECTION 5: THE SGT SET OF R&D EFFORTS 46

Overview 46
The R&D Efforts 46
The SGT's Hardware Configuration (suite) 46
Instructional Design Approach 46
The Prototype System 47

CONTENTS (Continued)

Page

Design Considerations 47
Design of Training Objectives 48
Training Activities 48
Overview of the SGT Library of TSPs 51
Evaluation Process 52
Concluding Comments 53
The Refined System 53
Initial Design Decisions 53
Designation of Training Objectives 54
Training Activities 54
Proposed Training Team Roles 55
The TSP Library 55
Evaluation Process 56
Concluding Comments 56
Summary and Reflections 57
Summary 57
Reflections 57
Concluding Comments 58

SECTION 6: THE COBRAS SET OF R&D EFFORTS 58

Overview 58
Background of the COBRAS R&D Efforts 58
COBRAS I 59
SOW Directives 59
Developing the Scenario's Story Line 60
Designation of the Training Objectives 61
Selection of the Training Systems 63
Training Support Requirements 64
Development of the TSPs 65
Evaluation Process 66
Results of the BSE's Trial Implementation 66
Concluding Comments 67
COBRAS II 67
The Development Process for Enhancing the BSE 67
Evaluation of the Enhanced BSE 70
The Vignettes 71
Concluding Comments 72
The COBRAS III R&D Effort 73
The BBSE's Design Features 73
Developmental Process 74
Evaluation Process 77
Concluding Comments 78
Summary and Reflections 78
Summary 78
Reflections 79
Concluding Comments 80

CONTENTS (Continued)

Page

SECTION 7: LESSONS LEARNED 80

Overview of the SST Efforts 81
Potential Value of the SST Efforts 81
Evolutionary Trends 81
Key Instructional Characteristics 84
The SST design framework: Generic Issues 84
Utility of the SST Framework 85
Modifications to the SST Framework 85
The Evaluation Process 86
The SST Design Framework: Phase-Specific Issues 87
Making Initial Decisions 87
Designing the Objectives 88
Designing the Exercise/Scenario 90
Developing the TSP(s) 91
Implementation Strategies 92
The Users' Acceptance 92
The Training Support Personnel 93
Miscellaneous Implementation Issues 94
Reflections 95

SECTION 8: CONCLUSIONS 95

Focal Point of Information on the SST Projects 95
Building Blocks for Future SST Efforts 96
Key Instructional and Design Features of an SST Program .. 97
Final Thoughts 99

REFERENCES 101

APPENDIX A. LIST OF ACRONYMS A-1

B. BIBLIOGRAPHY OF THE STRUCTURED-BASED SIMULATION TRAINING PROGRAMS' REPORTS, AND CONFERENCE PAPERS B-1

C. TRAINING SYSTEMS UTILIZED IN THE STRUCTURED SIMULATION-BASED TRAINING PROGRAMS C-1

D. CONSTRUCTIVISM AND BEHAVIORIST AS INSTRUCTIONAL DESIGN PARADIGMS D-1

E. LIST OF THE SAMPLE SET OF TRAINING TABLES FOR THE VIRTUAL TRAINING PROGRAM E-1

E. MEMBERS OF THE TRAINING AUDIENCE FOR THE STAFF GROUP TRAINER PROGRAM F-1

Page

F. VIGNETTES FOR THE COMBINED OPERATIONS AT BRIGADE LEVEL, REALISTICALLY ACHIEVED THROUGH SIMULATION TRAINING PROGRAM G-1

TABLE

Table 1. Training Objectives for Battalion and Brigade Training Programs 49

Table 2. Final Set of Performance Objectives for COBRAS III R&D Effort 76

Table 3. Summary of the SST Developmental Efforts 98

LIST OF FIGURES

Figure 1. The SST design framework 09

Figure 2. Brigade Staff Training Program 50

Figure 3. The SST design framework for the BSE and BBSE ... 86

Figure 4. The SST design framework for the vignettes 86

STRUCTURED SIMULATION-BASED TRAINING PROGRAMS: HISTORY AND LESSONS LEARNED

Section I: Introduction

The present report provides a comprehensive description and analysis of a series of research and developmental (R&D) efforts on structured simulation-based training (SST). The reviewed SST initiatives occurred under the auspices of the United States Army Research Institute for the Behavioral and Social Sciences (ARI) Unit at Fort Knox, KY. The time frame for these SST efforts was from fiscal year 1994 to fiscal year 1999. (Appendix A contains a listing of the acronyms and abbreviations found in this report.)

Objectives of the Present Report

This account of ARI's SST efforts has been designed to:

- Serve as a focal point for information to military policy-makers and training personnel concerning the history of ARI's efforts in the area of SST.
- Serve as a building block for future SST efforts.
- Provide needed information to instructional designers concerning the key instructional and design attributes of the SST programs.

Approach of the Present Report

To meet the above mentioned objectives, the authors systematically examined the following products of the different SST's R&D efforts: (a) ARI publications, (b) conference papers, and (c) instructional materials.[1] (These products are listed in Appendix B.) This examination focused upon:

- Identifying the common threads found across the SST series of R&D efforts.
- Analyzing the instructional development framework for the SST series of R&D efforts.
- Identifying and analyzing the key instructional features of each SST program, including the accompanying evaluation data.

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[1] A companion report is being written/prepared, which draws upon information obtained from key players in the development of the SST programs through interviews and questionnaires (Finley, Shlechter & LaVoie, in preparation)

♦ Identifying and analyzing the salient lessons learned from each SST program.

Search of the instructional development literature. A search of the simulation-based training literature was also conducted. This search involved examining the Defense Technology Information Center and the Educational Resources Information Clearinghouse. It also involved contacting Professor Steven Alessi of the University of Iowa, a leading expert in the area of developing simulation-based training programs. This search provided little information concerning the development and fielding of previous SST-like programs.

This search did reveal that optimizing the instructional potential of simulation-based training systems has been a focus of the instruction design/training development literature in the late 1990s (e.g., Alessi, in preparation; Salas, Prince, Bowers, Stout, Oser, & Cannon-Bowers, 1999). Alessi (in preparation) suggests that certain design variables (e.g., instructional supports) are of special concern for developers of simulation-based training programs. Instructional supports, as discussed in Section 2 of the present report, are a hallmark of a structured approach to training. Yet, Alessi argues that clear research evidence is needed to delineate the salient instructional supports for simulation-based training programs.

The Joint Simulation System (JSIMS) Learning Methodology Working Group consisted of noted developers of military training programs. This group's report provided guidelines for developing a new large-scale military training system (JSIMS Learning Methodology Group, 1999). These guidelines were largely based upon a structured approach to training. As stated on page 16 of JSIMS report, "(without the appropriate structuring) learning will not occur effectively." These guidelines, however, were not based upon findings from the SST or SST like-programs.

The present report, by documenting the SST programs, provides insights into the veracity of the above mentioned assumptions about developing a viable (i.e., capable of success or ongoing effectiveness, [Webster, 1994]) simulation-based training program. The present report thus provides needed information to instructional designers concerning the key instructional and design attributes of such programs. Please note that the SST R&D efforts were not based upon the literature cited previously in this section. As indicted in Section 2 of the present report, these R&D efforts were either completed or nearly completed by the time the cited works were published.

Organization of the Present Report

This report consists of eight sections; the first provides an introduction and the second provides an overview of the SST efforts. Sections 3 through 6 describe the different SST efforts. Section 7 is comprised of the salient lessons learned

from these programs. Section 8 concludes this report with a discussion of this report's importance to military policy makers and training personnel, and to instructional designers.

Section 2: Overview of the SST Efforts

The Different Sets of R&D Efforts

The development of SST materials consisted of four sets of R&D initiatives, with each set consisting of two or more R&D efforts. As discussed in Sections 3 through 6, each set of R&D efforts addressed qualitatively different training requirements. Each set was accomplished by a different R&D team. Yet, as discussed in the remainder of this section, the different R&D efforts have much in common.

The four sets of R&D efforts are as follows:

- The "Simulation-based Multiechelon Training Program for Armor Units (SIMUTA)," which occurred during fiscal years 1993 through 1996.

- The "Structured Training for Units in the Close Combat Tactical Trainer (STRUCCTT)," which occurred during fiscal years 1997 through 1999.

- The Staff Group Trainer (SGT), which transpired during fiscal years 1997-1998.

- The "Combined Arms Operations at Brigade Level, Realistically Achieved through Simulation (COBRAS)", which took place during fiscal years 1995-1998.

Personnel Associated with the R&D Efforts

Each SST effort involved the concerted efforts of military personnel, civilian Department of Defense personnel, and non-government contractual personnel. The military personnel included the program's proponent and the instructional support staff. The civilian government personnel were primarily ARI research psychologists at Fort Knox, KY, who served as the contracting officer's representatives (CORs). In this capacity, they wrote the contractual statements of work (SOW), which the civilian contract (R&D) teams based their bids upon. These ARI personnel monitored the performance of the different R&D efforts.

The R&D teams consisted of subject matter experts (SMEs), instructional designers, evaluators, and technical support personnel. The SMEs for the SIMUTA efforts, for example, included former officers and high-ranking non-commissioned officers (NCOs) who had substantial military field experience.

They were thus well versed with regard to the military doctrine associated with the training requirements for the SIMUTA efforts.

Targeted Training Audiences

The primary targeted training audiences for the SST R&D efforts were:

- Armor units, which are equipped with M1A1 and M1A2 Abrams main battle tanks.

- Mechanized infantry units, with the Bradley infantry vehicles as the maneuver elements.

Within these branches, training materials were produced for brigade, battalion, company, and platoon echelons.

Training materials were also developed for:

- Cavalry units, which are equipped with Bradley and Abrams vehicles. These units typically function as reconnaissance elements for an armor or mechanized infantry unit.

- Combat support (CS; e.g., an engineer unit) and combat service support (CSS; e.g., a transportation unit) elements of an armor or mechanized infantry unit. The CSS and CS activities occur, predominantly, prior to and immediately after a battle.

Genesis of the SST Efforts

The SST efforts originated in an environment of post-cold war realities, which forced the U.S. military to develop and maintain battle readiness with shrinking resources. During the last decade, there has been a reduction in the U.S. Army's fiscal allocations for such personnel as instructors, unit trainers, and training developers. There has also been a sharp reduction in fiscal allocations for such training supplies as ammunition and fuel (Department of the Army, 1999). The U.S. military thus needs to develop training programs requiring fewer resources to help their combat forces remain battle ready.

To meet this post cold-war training challenge, the U.S. military has increasingly relied on simulation-based training systems to train its combat forces. Simulation-based training systems promise to be less resource intensive than traditional military field exercises, while still retaining much of the realism found in the live field exercises. For example, the Simulation Networking (SIMNET) system is composed of M1 and Bradley simulators that have been programmed to function under constraints similar to those for actual vehicles.

Army training personnel, however, may not have fully exploited the instructional potential of these virtual and constructive simulation-based training systems (Bessemer, 1991; Shlechter, Bessemer, & Kolosh, 1991). Standardized training programs have not been included with the fielding of these programs. The SIMNET's reported training effectiveness could then vary from training unit to training unit (Bessemer). In addition, SIMNET training participants tend to spend a sizable portion of their valuable training time in preparing their missions rather than in executing them. Hence, a need exists to more fully exploit the U.S. Army's simulation-based training systems. (A mission is the primary set of tasks assigned to an individual, unit, or force. It usually contains the elements of who, what, when, where, and the reasons therefore, but seldom specifies how[Department of the Army, 1988a]).

There are few standardized training programs available for the collective training of combat forces. Collective training involves preparing units to perform collective tasks on the battlefield. An example of a collective task is an armor platoon moving in a wedge formation to a location on the battlefield. (Portions of any collective task may be individual-specific, such as, the task of driving a tank.) Combat forces (e.g., armor platoons) may not be receiving the appropriate training opportunities for maintaining combat skills at required levels. (Information concerning collective training and tasks has come from the U.S. Army Training and Doctrine Command [TRADOC] Regulation 350-70 [Department of the Army, 1995]).

The U.S. Army is thus facing the following interrelated instructional challenges:

- Maintaining a battle-ready force in an era of dwindling resources.
- Exploiting the full potential of its simulation-based training systems.
- Developing standardized collective training opportunities for its combat forces.

The SST programs have been developed to meet these three instructional challenges.

The Structured Training Concept

To meet these instructional challenges, the different R&D teams adopted a structured approach to training, which was used to design non-simulation based training materials. A structured training program involves embedding a predetermined scenario (i.e., tactical situation, including other friendly forces, enemy forces, weather conditions, and terrain conditions) with cues or "trigger events" that prompt training participants to

perform the task(s) associated with specified training or performance objectives (Campbell, Campbell, Sanders, & Flynn, 1995; Campbell & Deter, 1997; JSIMS Learning Methodology Working Group, 1999). As indicated in Section 1, such purposeful structuring within the context of training simulation systems has rarely, if ever, been done before.

Instructional Underpinnings

Key Instructional Features

Structuring the SST programs has involved incorporating the following instructional features into them:

- The developed training materials focus on specified training or performance objectives.

- The developed exercises contain standardized exercise controls to cue performance. These controls include the aspects of Mission, Enemy, Time, Troops, and Terrain (METT-T) embedded in any tactical task (Department of the Army, 1996). For example, an armor platoon should travel in a wedge formation when maneuvering in an open terrain without the threat of opposing forces (OPFOR). The program's instructional support personnel can cue the need to change to a line formation by, for example, informing the unit of an approaching enemy vehicle.

- The developed exercises immerse participants in the training situation.

- Performance feedback follows a number of developed guidelines.

- The developed exercises let participating units focus on completing the training requirements (turn-key exercises). Little training time, if any, is spent on such administrative matters as initializing the simulated exercises.

- Each program has a standardized library or menu of exercises with a recommended sequence rather than a prescriptive training matrix.

- The standardized library of exercises contains a progressive crawl-walk-run instructional sequence. According to Army training doctrine, an instructional program should begin with easy or fundamental tasks and then proceed to the more difficult or complicated tasks (Morrison & Holding, 1990).

Training Support Packages (TSPs)

TSPs are the exercise support materials developed for each SST program. (Please note that some SST programs contain only one TSP, while others contain sets of TSPs). They include:

- Tactical materials, which include such mission specific materials as the Operation Orders (OPORDs) for the different missions.

- Unit preparation materials, which contain guidelines to be used by the participating unit in preparing at its home station for its SST rotation.

- Guidance for other participants, such as instructions for the instructional support personnel in operating the simulation components.

- Administrative guidance for managers, which includes instructions for controlling scenario events. (A scenario is a tactical situation; as such it includes either all or some of the different factors of METT-T.)

- Simulation tapes and documentation, which include the electronic start-up (program) files for the chosen training system. Designated personnel, such as the Battle Master for the SIMNET system, are responsible for entering these files into a training system's computer(s).

Except for the electronic program files, these products come in the form of hard-copy manuals and compact discs. A library of TSP hard-copy manuals exists per SST program.

Campbell and Deter (1997) have suggested that a shelf/master set and a distributed set of this library be created for packaging and distributing the TSP materials. The master set, which the R&D team develops, serves as reference and copy-ready materials for a program's instructional support personnel. This set, however, rarely gets distributed to the users. The instructional personnel do send the relevant distribution set of materials to the exercise participants. As indicated, the distribution set of materials is comprised of materials copied by the training support personnel from their master set. Hence, an SST program's distribution set of TSP manuals is available from the support personnel at the program's implementation site.

The Simulation-based Training Systems

The SST programs utilize the currently fielded virtual and constructive simulation systems for armor and mechanized infantry units. Virtual systems immerse the training audience in tactical situations that approximate actual battlefield

conditions. The SIMNET and the Close Combat Tactical Trainer (CCTT) are the selected virtual systems for the SST programs.

Constructive simulations provide training participants with tactical scenarios based upon complex computer-driven models of the battlefield. These computer-driven models also serve to determine the training participant's performance (Turecek, Campbell, Myers, & Garth, 1995). In addition, the system's interactors encode the information provided by the participating units into the computer system (Koger et. al., 1996). Janus and the Brigade/Battalion Battle Simulation (BBS) are the constructive training systems for the SST programs. (Further information concerning the training systems for the SST programs is presented in Appendix C and in the ensuing sections of this report.)

Training support personnel

Training support personnel are another essential element of an SST program. They are responsible for a program's implementation.

The SST programs contain the following types of training support personnel: (a) observer/controllers (O/Cs); (b) exercise controllers (ECs); and (c) controllers and interactors. The O/Cs have primary responsibility for overseeing the participants' training. This responsibility includes helping the participants to select their training exercises, monitoring the participants' training at the simulation system, and leading the after-action reviews (AARs) associated with each mission/ exercise. The ECs have the primary responsibility of operating the training system's O/C workstations. For some systems and programs, they are also responsible for troubleshooting problems with the workstation and assisting the O/C with conducting the training. Interactors play an integral role in the utilization of the constructive training systems that require the use of personnel to role-play missing elements of the participants' unit. Interactors must also interact between the unit and the appropriate EC.

The SST Instructional Design Framework[2]

The developmental process for the different SST efforts has involved utilization of an SST instructional design methodology or framework. Both terms denote a recommended set of procedures. This framework and its variant forms consist of four phases (see Figure 1). Each phase contains developmental and evaluative (or quality review) activities (Shlechter & Burnside, 1996).

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[2] From now on, the term, "SST instructional design framework," will be shortened to the "SST Design Framework" or the "SST Framework."

The next few paragraphs provide a description of the developmental and evaluative activities for the "Develop TSP Phase." As described previously, TSPs are the SST training materials. Hence, they are the culmination of each SST effort's developmental process.

The TSP Phase

There are two interrelated developmental activities associated with this phase.

- The R&D team must design the TSP(s) structure. This activity includes determining the contents of the instructional manual(s).

- The developmental team must then develop the master set of TSP volumes and the electronic data files.

Formative evaluation. The formative evaluation for this phase involves a comprehensive developmental trial of the developed instructional materials. These trials occur under implementation conditions. They involve having a representative sample of the targeted training audience complete a representative set of exercises (Flynn, Campbell, & Burnside, 1995).

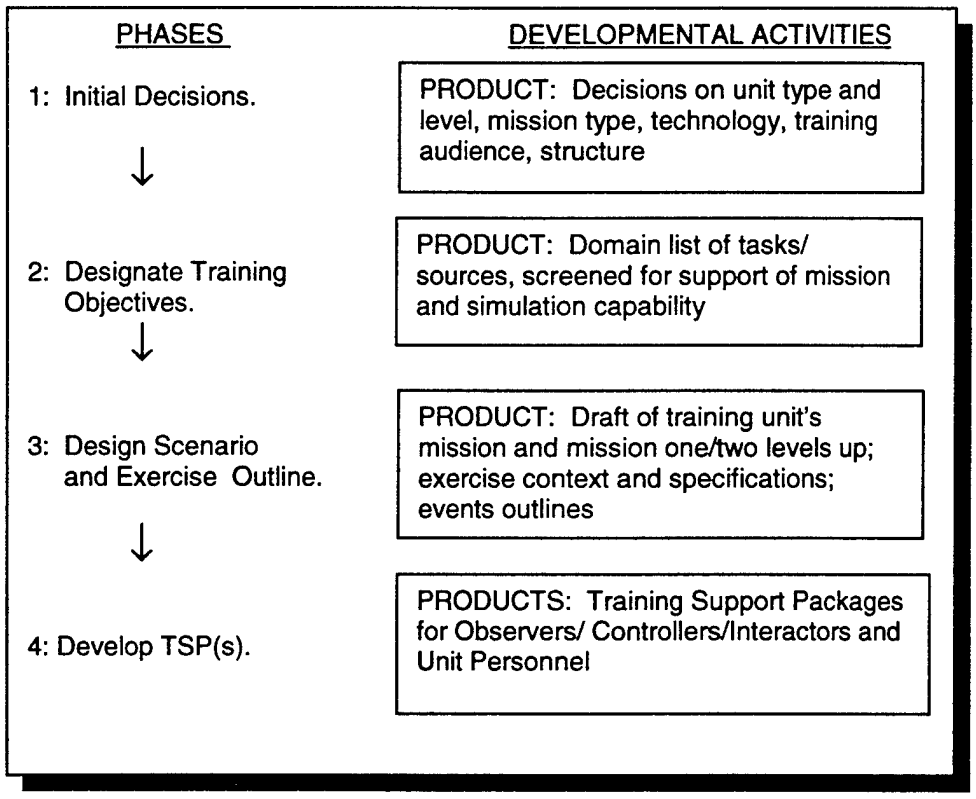

Figure 1. The SST design framework

According to Hoffman, Graves, Koger, Flynn & Sever (1995), these evaluation trials have several purposes:

- To check that the simulation's equipment is operating as planned.

- To check that the TSP(s) contain(s) adequate and clear instructions for the O/C and other instructional support personnel.

- To examine the effectiveness of the training materials in relation to the performance of and feedback from actual training participants.

Relationships to Other Instructional Design Methodologies

The SST's instructional design framework is based upon the Interservice Procedures for Instructional Systems Development (IPISD [Branson et al., 1975]). The IPISD framework follows a behavioral approach to instructional design. A behavioral approach involves an emphasis on designing training programs in relation to training objectives. Furthermore, the instructional designer(s) specify the training objectives. As mentioned above, the SST materials have been based on specified objectives. Correspondingly then, the SST design framework contains key elements of a behavioral approach to instructional design.

The SST instructional design process also contains elements of a contrasting instructional design approach--constructivism (see Duffy and Jonassen, 1992; Willis, 1995). A key conceptual assumption of the SST programs involves the immersion of training participants in scenarios containing real-life cues, which is also a key element of a constructivist learning environment. Constructivists also believe that this immersion affords training participants with the opportunity to determine their particular set of training objectives. The constructivists' design notions may be particularly suited to simulation-based systems, because such systems have been especially developed to immerse students in a learning situation. (Appendix D contains a listing of the elements of behaviorist instructional and constructivist design methodologies.)

Summary

This section has delineated the: (a) four sets of R&D efforts, (b) composition of the R&D teams for the SST efforts, (c) genesis of the SST efforts, (d) key instructional features of the SST programs, and (e) SST design framework.

In addition, this section has indicated that the goals of the SST R&D efforts have been to help the U.S. Army meet the following pressing training needs:

- Maintain a battle-ready force in an era of dwindling resources.

- Exploit the full potential of its simulation-based training systems.

- Develop standardized collective training opportunities for its combat forces.

Another goal of the SST efforts involves providing the Army with the tools for addressing the above mentioned training needs in the future. The ensuing sections of this report describe and examine the different R&D efforts' quest to meet the cited goals.

Section 3: The SIMUTA R&D Efforts

Overview

R&D Efforts

The SIMUTA R&D efforts were comprised of the following R&D initiatives:

- SIMUTA (Hoffman et al., 1995).

- Simulation-Based Mounted Brigade Training Program (SIMBART [Koger et al. 1996]).

- SIMUTA-Battalion Expansion(SIMUTA-B [Graves & Myers, 1997]).

- Combat Support and Combat Service Support Expansion to the Virtual Training Program SIMNET Battalion Exercises (Hoffman, 1997).

- SIMUTA-Digital (SIMUTA-D[Winsch, Garth, Ainslie, & Castleberry, 1996]).

These R&D efforts led to the development of the Virtual Training Program (VTP), with the SIMUTA effort's leading to the development of an initial set of VTP training materials.

Distinguishing Characteristics

The distinguishing characteristics of these SIMUTA programs are as follows.

- They were developed in relation to the previously discussed conceptual underpinnings and the SST methodology.

- The SOWs compelled the R&D teams to use the available training simulation systems at Fort Knox, KY, such as the SIMNET system.

- These programs focused on training units to execute or perform warfighting missions as a cohesive combat force.

- Task selection procedures included utilizing a modified version of Burnside's (1990) task selection methodology for the SIMNET system.

- The AARs were designed for these programs to occur with very little delay after the unit had executed the exercise (Hoffman et al., 1995).

- The standardized performance feedback system also included take-home packages (THPs). These packages contained an O/C's summative feedback observations about a unit's training rotation, and were sent to a unit's home station (Turecek et al., 1995).

- These programs had a dedicated O/C team.

The VTP

The VTP was the product of funds provided by the U.S. Congress for a Reserve Component Virtual Training Program at Fort Knox, KY. Active maneuver units (e.g. armor, and mechanized infantry units) have also utilized the Reserve Component Virtual Training Program resulting in it being renamed the VTP. The SIMNET and Janus are the training systems associated with the VTP set of programs.

Tables/Exercises[3]

The VTP's main focus is to provide maneuver units with structured SIMNET practical exercises called "tables." There are four sets of VTP SIMNET tables: (a) platoon tables, (b) company/team tables, (c) cavalry troop tables, and (d) battalion exercises. (A cavalry troop is equivalent to an armor company.) The VTP program also includes a set of Janus exercises, which provide a brigade or battalion staff with staff-specific training opportunities. Five sets of VTP tables thus exist. (A sample of the platoon and company/team tables is found in Appendix E.)

Number and sequence. The platoon-level and company-level tables are the primary focus of this program. Approximately 100 platoon-level and company-level tables were developed. These

[3] The term "exercise" denotes an event or series of linked events used to practice, evaluate, and sustain proficiency in individual and collective tasks (paraphrased from Army Training and Evaluation Program(ARTEP) 7-8-MTP; Department of the Army, 1994). For the SST efforts, an exercise involves completion of an operation, while a table involves a completion of a specified segment within the larger operation.

tables include a set of: (a) fundamental exercises, (b) offensive missions, and (c) defensive missions. The platoon-level and company-level tables progress in a crawl-walk-run sequence across the fundamental and offensive/defensive tables with units facing more challenging critical subtasks as they progress from the fundamental (mostly crawl) training tables to the more complicated offensive and defensive (mostly walk) tables.

Furthermore, O/Cs are supposed to provide more coaching for the crawl exercises than for the walk or run tables. For example, armor platoons tend to practice their basic movement techniques under more careful O/C supervision. The O/Cs give more verbal guidance for the fundamental exercises than they do for either the offensive or defensive engagements. Hoffman et al. (1995) refers to this O/C practice as a teach/coach/mentor approach in overseeing participants' training.

However, this crawl-walk sequence across the fundamental and the offensive/defensive tables is not as straightforward as described above. There is also a crawl-walk sequence within the offensive and defensive tables. In addition, repetition of crawl-level, fundamental, critical subtasks is found in the walk/run tables, while the fundamental tables are designed to include some walk-level critical subtasks. The VTP participants should then have the opportunity to repeat training on selected subtasks.

Different phases within a table. Each table consists of a preparation phase, which includes an O/C-led terrain reconnaissance of the tactical situation (table preview), an execution phase and an AAR. The participating units should spend one half-hour on preparing for the mission, one hour on executing the mission, and another half-hour on participating in an AAR of the exercise. A unit's mission preparation and the AAR time may vary depending upon the mission. The AAR process for a company table, for example, lasts up to 45 minutes.

The Familiarization Course. Since participating VTP units may either not be familiar or are out of practice with regards to operating the SIMNET simulators, a SIMNET familiarization course was developed. Upon completion of this course, crews should have developed the ability to (a) locate a simulator's switches and knobs; (b) navigate in the SIMNET terrain database; (c) identify friendly and enemy maneuvers in the SIMNET database; and (d) engage enemy elements with direct and indirect fire. This course is embedded in the platoon tables.

Instructional Support Personnel

Type of personnel. The VTP instructional personnel consist of two distinct cadres of dedicated O/C personnel at Fort Knox, KY-the VTP O/C Team and a Senior Observer/Controller Team (SOCT). The VTP's O/C cadre was instituted during the VTP's

developmental process, while the SOCT was formed after this program had been implemented.

These two cadres also differ with respect to their responsibilities and compositions. The VTP's O/C cadre has the primary responsibility for overseeing the platoon-level and company-level portions of the VTP. It consists of, primarily, active military personnel, ranging in rank from Lieutenant Colonel to Sergeant First Class. Since these O/Cs are active military personnel, they tend to stay in this duty position for approximately two years. The VTP's O/C cadre also consists of ECs who are permanent governmental employees. Most of these ECs have been either officers or senior NCOs.

The mission for the SOCT cadre primarily involves training staff battalion and brigade echelons. This cadre consists of contract personnel who have been either officers or senior NCOs. The former officers are more likely to be a mission's O/C with a senior NCO as their EC.

O/C Duties. The O/C's duties for both cadres consist of:

- Preparing VTP participants for their training by visiting them at their home station. During such visits, the O/Cs provide the unit with all required training support materials, including overlays and operation orders associated with the selected VTP tables. They also help the unit leaders to select the appropriate VTP tables for their unit's training rotation. This visit thus helps make a unit's VTP rotation as "turn-key" as possible.

- Providing units with a table preview at the O/C's workstation. (See Appendix C for a description of the O/C's workstation at the SIMNET facility.) This activity includes presenting units with a quick overview of the battlefield situation, and answering their questions about the mission.

- Monitoring the unit's table execution at the O/C's workstation. This activity involves following the "event guides" that are detailed in the O/C's TSP.

- Role playing higher and adjacent elements at the O/C's workstation.

- Facilitating the unit's AARs at the O/C's workstations. These AARs are supposed to follow a specific pre-planned agenda and utilize the technological capabilities built into the O/C's workstation.

- Completing the THPs after the units have left the training site. This activity is based upon the O/C's observations concerning the participating unit's VTP performance.

Two additional points must be noted about the O/C's duties. One, each unit, regardless of its echelon-level, reports to an O/C in-charge (OCIC). For instance, a battalion-level exercise would have an OCIC who facilitates the battalion's AARs. Two, when appropriate, selected O/Cs play the role of slice elements for the participating units. Because of constraints associated with SIMNET, an O/C was required, for example, to play the role of fire-support person who provides artillery expertise to the unit.

TSP(s)

A TSP set of volumes exists per table/exercise set. The Platoon Exercise Package, for example, consists of the following 11 volumes:

Volume I: Handbook for Observers/Controllers and Training Analysts for Platoon Exercise, which is a guide to the proper execution of VTP tactical tables. This guide contains information about all aspects of the VTP's platoon-level exercise package, including a library or menu of the platoon-level tables.

Volume II: Tools and Reference Materials, which contains such tools as the unit data sheets to be used for platoon-level training. This volume also contains a description of each critical task and subtask by table.

Volume III: Advance Materials, which contains guidelines for the O/C's visit to the unit's home station. This volume contains needed materials, such as an OPORD narrative, for the unit's home station rehearsal.

Volume IV: Take-Home Package Materials, which are comprised of camera-ready masters of pages for platoon-level THPs. Based upon standardized procedures, an O/C indicates in the THP those subtasks which units need either to "train to sustain" or "train to improve," representing satisfactory or unsatisfactory performance, respectively.

Volume V: Familiarization Course Handbook. Since only mounted vehicle crews are required to complete this familiarization course with the SIMNET simulator modules and terrain database, this handbook only exists for this volume.

Volumes VI, VIII, and X, provide the O/Cs with the "event guides" associated with the armor platoon, mechanized infantry platoon, and scout platoon tables, respectively. The "event guides" contain details about the events that require O/C actions and communications. These volumes also contain an AAR worksheet per table, which the O/C is supposed to complete as the unit completes its table. The

O/Cs are to indicate on these worksheets the tasks that should be emphasized in the AARs.

Volumes VII, IX, and XI, provide the ECs with the "event guides" and "SIMNET Plan Sheets" for the platoon-level tables. The "SIMNET Plan Sheets" contain the initialization route specifications for a unit's and OPFOR's vehicles as found in the electronic start-up files.

Evaluation Process

The VTP's evaluation process consisted of assessing the products produced by the R&D team at each development phase. During the scenario design phase, for example, the R&D team members spent countless hours in the SIMNET facility scrutinizing the feasibility of training participants' being able to complete the proposed tables. This evaluation process concluded with a comprehensive developmental trial of the training materials.

The VTP's R&D team conducted two sets of implementation trials. Information obtained in the first set of trials led to table and procedural revisions that were examined in the second or refined sets of trials. The two sets of trials each involved a representative but different sample of training participants. Each sample completed a representative set of tables under anticipated implementation conditions (Flynn et al., 1995). Both sets of trials also involved members of the R&D team monitoring the performances of the training units and the O/C personnel.

ARI's Researchers

The ARI personnel conducted four evaluations of the VTP's instructional value (Bessemer, Shlechter, Nesselroade & Anthony, 1995; Shlechter, Bessemer, Nesselroade, & Anthony, 1995; Shlechter, Kraemer, Bessemer, Burnside, & Anthony, 1996; Shlechter, Shadrick, Bessemer, & Anthony, 1997). Each evaluation employed a different methodology to examine a different aspect of the VTP's instructional value. For example, Shlechter et al.'s (1995) initial evaluation of the VTP's training effectiveness involved gathering data from trained observers, the VTP's instructional personnel, and the participants for the VTP's trial implementation. (p 16. of the reviewed report)

In addition, each evaluation obtained positive data concerning the VTP. The units participating in Shlechter et al.'s (1995) investigation further developed their collective tactical skills as a function of their VTP training. Bessemer et al. (1995), furthermore, showed that VTP participants tended to complete two-to-three more SIMNET exercises during a given period of time than did SIMNET participants in relatively unstructured training programs. The VTP was shown to be an effective and efficient training program.

Caveats. Data from several studies have, for one thing, suggested that units and unit leaders improved from a novice level to an intermediate level of tactical proficiency during the course of their VTP rotation (e.g., Shlechter et al., 1995; 1997). Rotation periods normally last no longer than one weekend for National Guard units or one week or less for active units. Even with this limited time, the O/Cs sampled by Shlechter et al. (1997) have indicated that sampled units and unit leaders improved from poor to a modestly good level of tactical proficiency.

The VTP, as currently utilized, is not an instructional panacea for shaping units to achieve an "expert" level of tactical proficiency. Rather, it appears to be an effective program for helping units to master the fundamentals of tactical proficiency. Providing units with additional VTP training time might help them achieve higher-levels of tactical proficiency. This possibility remains to be seen.

Another caveat concerning the VTP's evaluation data pertains to the VTP's intended training audience. As stated, the VTP was, initially, intended to train platoon-level to battalion-level maneuver echelons. However, data collected by Shlechter and his colleagues (Shlechter et al., 1995; 1996; 1997) suggested that platoons and companies were more likely to benefit from the VTP experience than would battalion staffs.

The SIMBART Program

The SIMBART R&D effort expanded the VTP by developing brigade-staff training exercises for the following missions: (a) movement-to-contact, (b) deliberate attack, and (c) area defense. These missions involved utilizing the Janus training systems located at different Army posts, including Fort Knox, KY.

The goal of the SIMBART R&D team involved producing training materials that would develop greater cohesion among a brigade staff's personnel (Koger et al., 1996). Staff cohesion is supposed to be related, positively, to its ability to function successfully (Olmstead, 1992 as cited by Koger et al.). For an Army brigade, successful staff function requires that the staff work closely together in order to process information from a lower echelon.

Instructional Design

The SIMBART exercises have been designed in relation to the instructional precepts and methodology discussed for the VTP. The following passages discussed the salient differences in designing the VTP and the SIMBART expansion to it.

Structuring the Exercises. An important aspect of the SIMBART design process has involved structuring the SIMBART

exercises around a brigade commander's decision points, with each mission containing approximately five decision points. Each mission thus contains cues that trigger a need for the brigade commander to make a decision. Based on these decisions, the brigade staff would function in a defined manner (Koger et al., 1996).

Developing the TSPs. (The development of the SIMBART TSPs reflected a cooperative effort between the SIMBART and SIMUTA-Battalion (SIMUTA-B) R&D teams. Hence, portions of this discussion also come from the SIMUTA-B report (Graves & Myers, 1997).

The SIMBART and SIMUTA-B R&D teams devised a TSP structure that lends itself to the addition of new training exercises and missions (Graves & Myers, 1997). This structure is exemplified by the TSP organization for the SIMBART program, which is as follows.

- *Volume I: Training Guide for Observer/Controller Team*, which contains guidance for the instructional personnel team on managing the SIMBART staff's instructional program, including the standardized library of SIMBART exercises.

- *Volume II: Unit Pre-Exercise Materials*, which provides the brigade's commander and Training Officer with everything that they would need to prepare their staff for its SIMBART training.

- *Volume III: Movement To Contact-Orders and Controller Instruction*, which includes the OPORDs, the decision points and corresponding behavior cues, for the movement-to-contact set of missions. (Volumes IV and V contain the similar materials for the area defense and deliberate attack missions, respectively.)

Along with the organizational change came a need to make the TSPs' content more accessible to their readers. Based upon a TRADOC administrative regulation (Department of the Army, 1993 as cited by Koger et al., 1996), the revised set of TSPs was written by means of a structured writing approach (i.e., Information Mapping®; Horn, 1973 as cited by Koger et al.). This approach produced TSPs in which each chapter commences with a set of concise advance organizers. Each advanced organizer is segmented into small units and contains the location(s) of the corresponding instructional materials.

The structured writing approach also allowed the SIMBART and SIMUTA-B R&D teams to make significant content changes to the previously developed TSPs. One notable change involved the incorporation of related information into one streamlined manual. For example, the volume dealing with a brigade's pre-exercise preparation now contains all the information needed by a brigade's staff to prepare for any exercise, instead of only

partial information being in the O/C's handbook. Because of the mentioned benefits of the structured writing approach, the R&D teams for the remaining SST programs used it for writing their TSPs.

Training Support Personnel

The SIMBART program and the VTP also differed with regards to the use of the instructional support personnel. A SIMBART training rotation requires approximately 60 instructional support personnel compared to a maximum of nearly 25 instructional support personnel for a battalion-level VTP training rotation. The O/C's staffing requirements for the SIMBART exercises consist of:

- Brigade Staff Observers. These personnel must focus on observing the collective behaviors of a particular section within the participating brigade's staff in order to facilitate the AAR for that section. Observers are also supposed to role play the brigade's higher headquarters and adjacent units. Each observer must then have the appropriate brigade staff experience (Koger, et al., 1996). There is then a staffing requirement for an observer per brigade staff section.

- Controllers. These personnel are responsible for operating the training system's equipment. The Janus system requires a controller or controllers to input information into the Janus computer for each of the following activities (cells): (a) exercise controller, which includes the exercise director; (b) fire support; and (c) OPFOR.

- Interactors. These personnel serve as an interface between the controllers and the participating brigade staff. A set of interactors are needed for the following functions: (a) higher and adjacent echelon control cells, (b) field artillery, (c) combat service support elements, (d) engineers, and (e) the remaining elements of the task force. These interactors must then relay the behavioral cues, without identifying them, to the brigade.

Evaluation Process

The evaluation process for the SIMBART effort followed the formative evaluation structure discussed for the VTP. Each developmental phase contained a quality assurance exercise (QAX). The SIMBART evaluation process thus consisted of four levels of QAXs, with the fourth level resembling the VTP's developmental trial.

A level 4 QAX was only conducted for the area defense mission. (Because of problems with scheduling personnel resources, the SIMBART R&D team could not conduct a Level 4 for the movement-to-contact and deliberate attack missions.) The VTP

O/C team oversaw this exercise, with Army National Guard brigade staff serving as the training participants. Members of the SIMBART R&D team were assigned to observe specific aspects of this QAX. At the conclusion of this QAX, these observers gave their observations to the SIMBART R&D team's evaluator. In addition, the training participants completed questionnaires and were interviewed about various aspects of the program, including their perceptions concerning the program's training benefits.

The R&D team reported positive results for this QAX (Koger et al., 1996). Participants indicated that they received outstanding training. The observers noted only a few serious problems with the implementation process. The R&D team thus argued that "the SIMBART training program has the potential for providing outstanding training for the participants." (P. 22)

Caveats. However, the R&D team reported problems with the interactors who had limited experience with operating the Janus equipment. These interactors thus had difficulty in serving as the interface between the brigade staff and the Janus equipment. Consequently then, the interactors failed to report needed Janus information to the brigade staff, resulting in the SIMBART's potential for training the participating staff not being fully realized (Koger et al., 1996).

Another caveat is that problems with the AAR process might have limited the SIMBART's potential for training the participating staff (Koger et al., 1996). Most notably, the brigade staff AAR concentrated on tactics and command decisions as opposed to the staff's performance, which should have been the focus of this AAR. Koger et al., furthermore, suggest that there may be several reasons for this problem. One such explanation involved the O/Cs not being comfortable with the developed observational form.

Koger et al. (1996) also noted problems with the acceptance of structured training by the participating brigade unit. The participating brigade wanted to develop its OPORD, because commanders of a higher echelon expect such latitude in a training program. Koger et al. believed that this clash can be mollified by the developers conveying more information about the structured training concept in the TSPs or by making sure that the participants receive the TSPs.

The SIMUTA-B Project

The SIMUTA-B R&D effort led to another expansion of the VTP's set of exercises by increasing the number of battalion-level exercises. This expansion also involved identifying the existing VTP company team and platoon exercises that would complement the newly developed battalion missions (Graves & Myers, 1997). Also enhanced during the course of this R&D effort was the VTP's set of TSP manuals.

Exercises

The SIMUTA-B Team developed the following battalion-level exercises:

- Deliberate attack for a battalion staff/task force staff without engineer elements; SIMNET. (A task force is a battalion organization consisting of units from several Army branches.)

- Deliberate attack for a battalion/task force staff; Janus (training system).

- Deliberate attack for a battalion/task force staff with engineer elements, Janus.

Also developed were deliberate attack exercises for an armored platoon, mechanized infantry platoon, and company team, which utilized the SIMNET training system.

In addition, the SIMUTA-B R&D team modified the following previously developed exercises:

- Movement-to-contact for a battalion/task force staff; Janus.

- Defend-in-Sector for a battalion/task force staff; Janus.

- Movement-to-contact for battalion/task force staff without engineer elements; SIMNET.

- Defend-in-sector for a battalion/task force staff without engineer elements; SIMNET.

Instructional Design Process

A significant difference between this project and the previous SIMUTA efforts involved the initial decision stage. The SIMUTA-B R&D team did not have to make many initial decisions concerning the design of this program (Graves & Myers, 1997). As stated by Graves & Myers:

> The sponsor specified the story line, the unit type, and echelon to be trained, the simulations, and the execution time. (p. 6)

(A story line is the narrative associated with the tactical scenario.)

Development of the TSPs

As discussed, the architecture of these TSPs resembled the architecture of the TSPs for the SIMBART program. For instance,

the revised volume structure for the SIMNET's battalion TSP is presented below:

- *Volume I, SIMNET Battalion Task Force Training Guide.* This guide is more streamlined than the one developed for the VTP.

- *Volume II, SIMNET Battalion Task Force Exercise Unit Pre-Exercise Materials.* This volume contains the information that a unit needs to prepare for any exercise, minus OPORDS and overlays.

- *Volume III, SIMNET Battalion Task Force Exercise Package for the Movement-to-Contact Mission.* This volume contains the information needed by the VTP O/C team to conduct the battalion-level movement-to-contact mission in SIMNET.

- *Volume IV, SIMNET Battalion Task Force Exercise Package for the Defend-in-Sector Mission.* This volume contains the information needed by the VTP O/C team to conduct the battalion-level defend-in-sector mission in SIMNET.

- *Volume V, SIMNET Battalion Task Force Exercise Package for the Deliberate Attack Mission.* This volume contains the information needed by the VTP O/C team to conduct the battalion-level deliberate attack mission in SIMNET.

Changes were also made to the TSPs concerning the VTP's observational and feedback system for the battalion-level exercises. For example, each O/C is to observe only a subset of the activities that occur within the entire exercise. The OCIC, who is responsible for the battalion AARs, is to consolidate these observations into an integrated picture of the staff's functioning. Hence, the O/C team should not experience cognitive overload by having too many activities to observe (Graves & Myers, 1997).

Evaluation Process

The R&D team adopted a tryout-level evaluation strategy similar to the QAX system devised for the SIMBART project. At each phase, the team's accomplishments (e.g., devising a feasible exercise scenario) were evaluated vis-a-vis either a pilot or trial set of tryouts. Pilot tryouts were utilized for the first two developmental phases and involved members of the developmental team. The trial set of tryouts was conducted for the last developmental phases and involved participation by members of appropriate Army units or battalion staffs. The tryout for the last phase resembled the VTP's developmental trial. (Because of resource limitations, only the deliberate attack armor platoon, mechanized platoon, and battalion/task force exercises were tried out.)

The trials provided positive results concerning the SIMUTA-B program's instructional elements. Developers observed that the new O/Cs implemented the training program in closer correspondence to the TSP guidance than had O/Cs for previous training programs. In addition, the O/C team claimed to like the new TSP format. The training participants were, correspondingly, very pleased with this program. As one battalion staff member stated, "the (SIMUTA-B) training was the best multiechelon training we have ever received" (p. 21[Graves & Myers, 1997]).

Unresolved Issues

Developmental issues, however, exist with this program. One such issue centers on the observational and performance tools. The SIMUTA-B R&D team noticed that most O/Cs tended to rely on 3X5 inch cards to record observations, rather than use the developed Observation Forms. Consequently, the battalion AARs were less than optimal as the OCIC focused his AARs on tactics. Questions thus remain about ways of compelling military O/Cs to focus the AAR discussion on task performance.

Another important issue involves the integration of CS and CSS elements into the SIMNET set of battalion exercises (Graves & Myers, 1997). Implementing such CSS operations for the VTP's SIMNET battalion exercises is problematic because the periods of intensive actions for combat and CSS functions are not congruent. The CSS functions (e.g., re-organization and consolidation) tend to occur between battle missions (Hoffman, 1997). Hence, executing CSS tasks at a SIMNET site requires continuance of an exercise, even after the maneuver units have achieved their training objectives. The participating platoons and companies may then lose valuable training time waiting to begin their next table after the re-organization activities are completed (Graves & Myers, 1997).

Addition of CS and CSS Elements

Overview. The inclusion of CS and CSS elements into the SIMUTA-B exercise involved a supplemental research effort (Hoffman, 1997). This research effort thus had the following objective: To develop a prototype battalion-level training exercise that incorporates such CS and CSS elements as mortar, medical, maintenance, and transportation components into the SIMNET portion of the SIMUTA-B exercises (Hoffman, 1997).

Training audience. The training audience for these exercises includes the leadership personnel from the following platoons: (a) mortar, (b) medical, (c) maintenance, and (d) support/transportation. The first sergeants from the different companies within a battalion were also included as prospective training participants, because they are the linkage between the companies and the battalion (Hoffman, 1997).

Training system. SIMNET was the chosen training system. Its semi-automated force (SAF) technology afforded the training developers with the capability to simulate such CS assets as the medical vehicles. (See Appendix C for a description of the SAF technology.) Since SIMNET did not have the capability to simulate brigade-level and forward support battalion assets, the VTP O/C team members' had to role-play them.

Instructional design process. As described by Hoffman (1997), developing the CS and CSS additions to the SIMUTA-B training program was comprised of a nine-step developmental process, with the first five steps occurring simultaneously rather than sequentially. Except for its non-linear aspects, this developmental process closely resembled the developmental framework as prescribed by the SST's instructional design methodology. For instance, the R&D team conducted several formative evaluations, which culminated with a set of developmental trials.

Findings from the developmental trials. These trials produced favorable results concerning this expansion of the SIMUTA-B training program to include CS and CSS training activities. The training participants viewed, as indicated on post-trial interviews, the exercises as beneficial. They were especially pleased with the CSS activities for the movement-to-contact mission. In addition, the participants indicated on questionnaires that their unit improved with regards to its ability to perform an array of coordinating and reporting tasks.

Concluding Comments

The SIMUTA-B and its supplemental R&D efforts provided important findings for future SST efforts.

- The SIMUTA-B project demonstrated the battalion-level participants did accept the SST approach.

- The CS and CSS expansion established the feasibility of integrating CS and CSS activities into an SST program (i.e., the VTP) that involved execution of tactical tasks.

However, participants had problems with the expansion of the SIMUTA-B program. On both the interviews and questionnaires, they expressed dissatisfaction with the level of activity for practicing "leader tasks." Hoffman (1997) has thus noted that:

> Extending the exercise into the consolidation and reorganization phase will be important in order to provide these (leadership) positions with more active practice in controlling their assets. (P. 18)

This extension was a primary focus of the COBRAS set of R&D efforts.

The SIMUTA-D Project

Overview

The SIMUTA-D effort focused on developing battalion/task force TSPs for training participants to use digitized battlefield technologies, as available in 1996, for battlefield command and control (C2) tasks. Devising TSPs for automated command, control, and communication (C3) systems is important because such systems are to become an integral component of Force XXI.

Training systems. Since the SIMUTA-D program involved developing digitized battalion/task force TSPs, the training systems for this program involved those used for the previously developed battalion/task force exercises—SIMNET and Janus. However, the SIMNET systems for the SIMUTA-D exercises were equipped with the following digital devices:

- Intervehicular information system (or IVIS): an automated C3 system that provides preformatted digital graphic combat reports and graphic overlays between command posts (CPs) and individual combat vehicles.

- Brigade and Battalion Command and Control: an automated C3 system that affords the exchange of free-text messages and logistics information among higher and adjacent units. The system has been primarily used for C2 and CSS functions.

- All Source Analysis System: an automated intelligence system that affords the exchange of information between a brigade's main command post and a task force's main CP.

- Improved Fire Support Automated Systems: an automated fire support system that provides a digital message capability.

While the SIMNET system has been equipped to contain these options, the Janus system has not (Dr. Kathleen Quinkert, personal communication, September 17, 1999). Hence, the Janus digital components are external to its operating system.

Initial Decisions

The SOW directed the SIMUTA-D R&D team to focus its efforts on upgrading the SIMUTA-B's battalion/task force TSPs. Upgrading these TSPs involved conducting an especially rigorous front-end analysis (FEA). The SIMUTA-D personnel reviewed the key military and research documents, which included the relevant tactics, training, and procedure manuals of the U.S. Army for digitized maneuver units and the published SST reports (e.g., Hoffman et al., 1995). After this review, the SIMUTA-D personnel then conducted structured interviews concerning the digitized C2 tasks with military SMEs at Fort Knox, KY.

The FEA revealed that the conversion from a conventional training to a digital training situation did not necessitate the development of any additional collective training tasks or subtasks. Hence, those collective battalion/task force sub-tasks chosen for the SIMUTA-B training program were applicable for the SIMUTA-D training. However, digitization would effect the procedures for completing those previously selected battalion/ task force collective training tasks (Winsch et al., 1996).

Based on this FEA, the SIMUTA-D team made its initial decisions concerning a critical task list for each mission. These critical task lists were the initial products in the SIMUTA-D developmental process. However, before this process could further proceed, the SIMUTA-D team had to make decisions about the order of TSP development. These decisions were driven by such factors as the SIMUTA-D team's access to the SIMNET and Janus facilities and its strategies for capitalizing on the ongoing SIMUTA-B and SIMBART efforts (Winsch et al., 1996).

TSPs

The central differences between the TSPs for SIMUTA-D and the SIMUTA-B program are noted below.

- The SIMUTA-D TSPs included a list of digitized tasks and objectives. These lists accounted for the technological upgrades within the training systems, and the advantages and limitations of the digital devices (Winsch et al., 1996).

- Digital requirements required a revamping of the AAR and THP tools. This revamping involved, for example, highlighting the digital tasks on the O/C's observational forms (Winsch et al., 1996).

- The SIMUTA-D TSPs included a more extensive set of training-the-trainer materials. These materials, for example, provided the VTP O/Cs with detailed guidance concerning the VTP teach/coach/mentor approach of intervention.

Evaluation Process

The SIMUTA-D developmental process involved using a formative evaluation scheme similar to the one employed for the SIMBART project. Each TSP, thus, went through four levels of quality review exercises.

Level 4 evaluation. This evaluation consisted of a full-scale trial of the developed instructional materials. Thirty-one members of an armor task force used the cited automated C3 equipment while completing the SIMUTA-D set of Janus exercises. Twenty-four O/Cs took on such varied roles as interactors, OPFOR, and CP observers.

Data collection consisted of the SIMUTA-D R&D team members observing the performance of the task force and seven O/Cs (e.g., the O/Cs for the main CP). Twelve key members of the task force (e.g., task force commander) and the seven O/Cs completed questionnaires. Members of the SIMUTA-D R&D team also interviewed these 19 respondents.

This trial's data produced mixed results concerning the SIMUTA-D program. Only two task force participants indicated that this training led to their units becoming more proficient in the digitized battlefield. Yet, nearly all of them felt that the OPORDS and graphics provided the necessary information to execute the orders. The O/Cs indicated problems with conducting the AARs; yet, nearly all of them indicated that the TSPs were easy to use.

Concluding Comments

The SIMUTA-D R&D team had mixed success with developing instructional materials for training battalions/tasks forces to use digitized battlefield technologies. The reported problems with these materials seemed to be more a function of difficulties with the digitized system rather than the developed TSP materials. Problems with device reliability, which happens with most newly implemented hardware components, negatively impacted the training participants' ability to use the digital equipment (Winsch et al., 1996). Despite these problems, the participants provided favorable comments about the developed TSP materials. Hence, the SIMUTA-D program was a good initial step in the development of SST materials for training Army combat forces to operate in the digitized battlefield.

Summary and Reflections

Summary

The SIMUTA set of R&D projects consisted of five initiatives, including a supplemental effort. The developed training programs resulting from these R&D efforts consisted of the VTP and several expansions of it. These expansions included developing a training program for brigade staff functions and increasing the number of battalion-level exercises. This set of R&D efforts also included the development of a set of prototype exercises that incorporates CS and CSS activities into a combat force mission and a set involving a digital battlefield.

These R&D efforts were linked in a number of ways.

- Each program contained structured and standardized set(s) of exercises.

- Each of these structured and standardized exercises, including those for the CS and CSS activities, focused upon tactical execution.

- A dedicated O/C team was responsible for implementing each program.

In addition, the SIMUTA, SIMBART, and SIMUTA-B developmental process involved already developed simulation-training systems (i.e., SIMNET or the Janus system).

Reflections

The following reflections concern the preceding review of the SIMUTA R&D efforts.

- The R&D efforts produced, seemingly, viable instructional materials. The results of the different developmental trials indicated that the training participants and O/Cs had little trouble with utilizing the developed materials. In addition, the participants tended to report training benefits associated with these materials.

- An evolutionary trend was evident in these R&D efforts (Hoffman, 1997). Each successive program was an expansion of the initial VTP. Also, the TSPs' format and content were continually enhanced during the course of these R&D efforts. These enhancements (e.g., changes in the observational forms and coaching guidelines) were a function of the lessons learned from a previously developed SIMUTA program.

- As postulated, the SST developmental process represented a hybrid of the behaviorist and constructivist approaches to instructional design, with more of an emphasis on the former approach. Regarding its behaviorist aspects, the SIMUTA R&D efforts centered on objectives determined by the R&D team. Regarding its constructivist aspects, each program consisted of immersing participants in scenarios containing actual battlefield events and cues.

- Formative evaluation has played an integral role in developing the instructional materials.

- Personnel external to the R&D team made many of the key instructional decisions. For example, the SOW for the SIMUTA program directed the R&D team to design tactical execution tasks for the SIMNET system.

- These externally imposed instructional requirements also affected the SST instructional design process (Hoffman, 1997). The most exacting FEA occurred for the SIMUTA-D project with its focus on developing instructional materials for digital training battlefield requirements.

Concluding comments. The preceding reflections lead to several conclusions concerning the SIMUTA R&D efforts. Most

significantly, the VTP, including its expansions, was seemingly a creditable training program. Consequently then, the SST developmental process was a viable framework for developing simulation-based collective training opportunities for combat forces. Developers of future Army SST programs should thus use this instructional design framework.

However, conclusions about the SST developmental process reached in this section could be premature. Hoffman et al. (1995) reported problems with developing the VTP instructional materials in relation to emerging components (e.g., a modified version of the SAF[ModSAF]) of the SIMNET system. Perhaps then, the SST design framework would be more problematic than reported for emerging instructional conditions and requirements? This question is examined in the next section.

Section 4: The STRUCCTT R&D Efforts

Overview

R&D Initiatives

This set of R&D projects consisted of the following initiatives:

- STRUCCTT (Flynn, Campbell, Myers & Burnside, 1998).
- STRUCCTT-2 (Deatz et al., 1998).
- The Commanders' Integrated Training Tool (CITT: Gossman et al., 1999).

Background

The STRUCCTT R&D efforts extended the SST approach by developing instructional materials for the CCTT, which is an emerging generation Army virtual training system. As noted below, the CCTT's instructional capabilities are vastly enhanced from those of its predecessor-SIMNET. However, the CCTT system does not have a dedicated indicated O/C team. Members of a participating unit's higher echelon or adjacent units must serve as the unit's O/C(s) for the STRUCCTT missions. This change has occurred because of financial constraints, rather than for pedagogical reasons. The instructional requirements for the STRUCCTT set of developmental efforts thus differed significantly from those reported for the SIMUTA set of developmental efforts.

CCTT features. The enhanced features of the CCTT system and their corresponding training impact are as follows.

- The CCTT's terrain database can represent a variety of environmental conditions (e.g., night or inclement weather conditions). The STRUCCTT R&D team by altering such environmental conditions could thus create a variety of

conditions with various levels of difficulty. Such flexibility is not possible with the SIMNET system, as its terrain database can only represent ideal daytime conditions.

♦ The CCTT simulators contain such visual add-ons as an open-hatch capability for the track commanders and thermal and image intensifier sights. Visual cues can thus be presented at greater distances from the track vehicles than for the SIMNET system.

♦ The CCTT contains a semi-automated force (SAF) system of workstations for the friendly and OPFOR elements. The friendly workstation, for example, provides the unit with the capability of conducting dismounted infantry activities. Such activities are difficult to conduct in the SIMNET environment, with its orginal SAF technology.

♦ The CCTT also contains unit support workstations. These workstations emulate the function of the following CS and CSS activities: (a) fire direction centers, (b) field artillery battalion tactical operation center, (c) fire support element, (d) combat engineer support, (e) tactical air control party, (f) combat trains CP, and (g) unit maintenance collection point.

♦ A set of control consoles also exists. This set is comprised of a master control console and a maintenance console. It also, typically, contains five AAR workstations that contain the same AAR components as found in the SIMNET system at Fort Knox, KY.

The CCTT's site personnel control the SAF workstations and the control consoles. Like the ECs for the VTP, these site personnel tend to be retired military non-commissioned officers. A participating unit's personnel operate the unit support workstations.

STRUCCTT

The initial STRUCCTT effort utilized the previously discussed SST methodology to develop VTP-type tables for the CCTT. Accordingly then, the STRUCCTT's instructional design methodology consisted of the four SST instructional design phases. The key activities for these phases are discussed below.

Initial Decisions

Personnel external to the R&D team made many of the key initial decisions for this project. One such key decision involved developing the training materials concurrently with the CCTT's development. The Army proponent made this decision before the SOW was issued (Flynn et al., 1998). Flynn et al. claimed that this decision was correct for a number of reasons. This

developmental approach, for example, helped to shorten the time for incorporating the CCTT into unit training programs.

In addition, the project's SOW compelled the STRUCCTT's instructional design team to base its efforts upon the SIMUTA and SIMUTA-B efforts with respect to the:

- Focus on tactical execution.
- Targeted training audiences, which were to be platoon (tank and mechanized infantry), company (tank heavy, mechanized heavy, and balanced), and battalion echelons.
- Set of exercises and missions (i.e., movement-to-contact, defend-in-sector, and deliberate attack).
- Set of OPORDs and overlays for the selected missions.
- Selected terrain database, representing an area at the National Training Center (NTC).
- Configuration of the platoon-level and company-level exercises as tables, representing a segment of the battalion's mission.
- Configuration of the battalion-level mission as an exercise, with predetermined break points for purposes of conducting an AAR. (The STRUCCTT team was only required to develop a movement-to-contact exercise for this echelon.)

Designation of Training Objectives

Completing this activity for the STRUCCTT program initially involved utilizing the task lists from the SIMUTA and SIMUTA-B exercises. These lists did contain doctrinally correct tasks that could be executed and observed at a CCTT facility. However, as stated, the CCTT system could accommodate a larger number of training tasks than could the SIMNET system. Hence, the STRUCCTT R&D team had to come up with a more comprehensive list of CCTT training tasks.

The selection process for determining the additional CCTT tasks for the STRUCCTT program contained elements of the task selection procedures used by the SIMUTA R&D teams. Like the SIMUTA R&D teams, the R&D team delineated an initial list of tasks from the doctrinal literature (e.g., current Army field manuals). And, like the R&D teams for the different SIMUTA efforts, the STRUCCTT R&D team used a modified version of the Burnside (1990) task selection methodology to narrow this list down to suitable tasks.

Several differences, however, existed between the STRUCCTT task selection procedures and those used previously. For example, the task selection also consisted of the R&D team's

role playing the different tasks on the CCTT. The STRUCCTT task selection procedures thus provided the R&D team with a clear indication of the tasks that could be executed and observed at a CCTT facility (Flynn et al., 1998).

Tables/Exercises

As delineated by Flynn et al. (1998), the STRUCCTT R&D team developed the following sets of tables.

- Eleven tank platoon tables, including day and night exercises for fundamental, movement-to-contact, and defend-in-sector missions.
- Eight mechanized infantry platoon tables, including the same type of tables as mentioned for the tank platoons.
- Eight tank heavy company tables, including day and night exercises for three types of fundamental missions. This set also consisted of a day and fog exercise for a defend-in-sector mission.
- Eight mechanized heavy team tables, including the same type of tables as discussed for the tank heavy company tables.
- A balanced company team exercise for a breach of obstacle (day) deliberate attack mission.

The R&D team also developed a battalion/task force exercise for a movement-to-contact mission, which should take a unit four-to-six hours to complete (Flynn et al., 1998). The tasks for this exercise ranged from a tactical movement from an assembly area to activities at a designated objective.

The CCTT's functional capabilities also allowed the R&D team to develop more complex tables/exercises than were created for the VTP. Each mission set contained a common tactical scenario, task organization, and slice elements. The tasks for the movement-to-contact mission for example, started with a tactical road march and concluded with consolidation and re-organization activities at the designated objective. In addition, each echelon would be working with the same friendly slice elements. The STRUCCTT R&D team referred to this exercise outline as the "nested tables concept."

TSPs

Overview. These TSPs were similar to those discussed for the SIMUTA training programs in two major ways. One, the structured writing approach was utilized. Two, the STRUCCTT R&D team based its initial decisions concerning the organizational scheme for the platoon and company TSP manuals on the scheme discussed for the SIMUTA-B project.

However, the TSPs for the STRUCCTT battalion/task force exercise differed significantly from the TSPs for the SIMUTA-B task force exercises. This change in the TSPs reflected the indicated differences in the complexity level between the STRUCCTT and the SIMUTA-B exercises. Hence, the STRUCCTT TSPs for the battalion/task force exercises contained volumes concerning the (a) training unit's roles and responsibilities, (b) CCTT sites roles and responsibilities (e.g., operating the AAR workstation), and the (c) O/C team's roles and responsibilities. A battalion O/C team is composed of members of a participating unit's higher echelons and/or an adjacent unit.

Train-the-trainer materials.[4] A salient content difference between the STRUCCTT TSPs and those for the VTP dealt with the train-the-trainer materials. As stated, members of a unit's higher echelons (e.g., battalion commander for the company tables) or adjacent units had to perform the O/C duties for the STRUCCTT tables. The STRUCCTT TSP materials thus had to contain a detailed train-the-trainer manual for the company team platoon tables and a manual for battalion/task force exercise. These manuals included a detailed description of the O/Cs' roles and responsibilities for each set of tables/exercises. They also contained such AAR instructional tools as the observational forms. In addition, these TSPs included a detailed event guide, with an account of the specific cues to prompt the appropriate tactical responses from the participants. These guides resemble those produced for the SIMUTA TSPs.

The STRUCCTT train-the-trainer manual for the company team and platoon tables was also comprised of detailed "execution guidelines" for the workstation operators. The selected workstation operators would, in all likelihood, have little or no experience with operating the assigned workstation. The "execution guidelines" delineated the responsibilities of workstation operators in relation to a table's or an exercise's battle flow, as predicted by the mission's OPORD and the O/C's corresponding event guide (Flynn et al., 1998).

The Evaluation Process

The evaluation process for this project was similar to those for the SIMUTA set of R&D efforts. The formative evaluation for this project was an iterative revision process.

[4] In addition to these TSP materials, a unit's support personnel could receive training by completing an initial CCTT familiarization-training program. Four such programs exist, including a computer assisted training program. Personnel associated with the CCTT's Program Manager developed these programs.

Furthermore, the STRUCCTT evaluation process concluded with a full-scale trial of the developed TSPs. However, the developmental trials for the CCTT's platoon and company tables differed from those for VTP's platoon and company trials. The CCTT's platoon and company trials were conducted in relation to a "Limited Users Test" (LUT), which was managed by an Army agency (the Test and Experimentation Command [TEXCOM]) external to the STRUCCTT R&D team and ARI.

The LUT. Because the TEXCOM agency was responsible for conducting the LUT, the R&D team experienced several data collection problems. The LUT did not include all of the CCTT tables. In addition, the STRUCCTT R&D team was not able to gather participants for group interview sessions if TEXCOM required them for other evaluation activities. Hence, the LUT data were not as complete as desired by the STRUCCTT R&D team.

Despite these problems, this LUT provided useful information concerning the developed STRUCCTT TSPs. The training participants for this LUT consisted of active army tank platoons and companies as well as active army mechanized infantry platoons and companies. These participants completed the assigned tables during a two-week period at Fort Hood, TX.

The LUT's training participants and "O/C" personnel viewed the STRUCCTT program favorably in the following ways.

- ♦ Fifty-six percent of the training participants who completed a questionnaire declared that the CCTT execution activities were either considerably or extremely useful.

- ♦ Respondents felt that there was an increase in their units' proficiency. Approximately 23% of the respondents indicated that their units tended to increase two levels of unit proficiency (e.g., from marginally to considerably proficient) during the training period.

- ♦ Seventy-two percent (45/63) of the "O/C" personnel who completed a questionnaire felt that the format for AAR discussion did not need to be revised.

Interviews with participants and observations of unit performance also indicated a few needed table modifications. Such table modifications included resetting the night mission parameters from a "full moon" to a "half moon" condition and changing the OPFOR competency level from "novice" to "competent." The R&D team had little trouble making these minor revisions.

Battalion/task force trial. Upon completion of the LUT, the STRUCCTT R&D team attempted to conduct a full-scale trial of the battalion/task force exercise. However, events precluded the STRUCCTT R&D team from conducting such an evaluation. For instance, the participating battalion received notification to be the trial unit only a few weeks before the exercise, which

led to the battalion commander and his staff not being totally familiar with the pre-exercise materials.

The STRUCCTT R&D team was still able to collect some useful data concerning the battalion/task force exercise. Results of interviews with the participants and observations by the STRUCCTT team demonstrated a need to make a few revisions to the battalion/task force table. For instance, the R&D team decided to increase the staff requirements for the higher headquarters to operations, intelligence, and CSS personnel.

Concluding Comments

Two major inferences can be drawn about the STRUCCTT instructional materials from the discussion on the evaluation process. One, these instructional materials were suitable for training platoons and companies at the CCTT; however, the platoon and company STRUCCTT materials still needed some fine-tuning. Two, the battalion exercise needed to be modified.

Regarding modifications to the STRUCCTT TSPs, Flynn et al. (1998) suggested a need to augment these materials. Additional task force exercises on defense and attack should be developed. Flynn et al. also noted the necessity to complete the library of platoon and company tables with the addition of more walk/run tables (Flynn et al.).

STRUCCTT-2

The SOW for the STRUCCTT-2 project included the following stipulations:

- The R&D team had to augment the STRUCCTT training materials by developing a battalion/task force defend-in-sector exercise and heavy cavalry troop exercises for various missions.

- The instructional design process had to be comprised of the four previously discussed phases of the SST's instructional design phases.

The Project Manager for the Combined Arms Tactical Trainer (PM CATT) identified an additional requirement for developing a set of CCTT orientation exercises. These exercises had to be administered to participants prior to their execution of the tactical exercises. The SOW was modified to include the development of these orientation exercises.

Designation of Training Objectives

The R&D team had to develop training objectives for the battalion/task force exercise, the cavalry troop and scout platoon exercises, and the orientation exercises. The procedures for the latter two sets of exercises involved

examining the relevant doctrinal lists. For example, determining the training objectives for the workstation orientation involved a detailed analysis of the operator guides developed by the PM CATT and his colleagues.

The procedures for designating objectives for the defend in-sector exercise, initially, consisted of reviewing the tasks trained in the STRUCCTT's movement-to-contact exercise. This analysis revealed that many of these tasks for movement-to-contact exercise were suitable for the projected defend-in-sector exercise. After this examination, the R&D team examined a list of task force defensive tasks as delineated in Army Training and Evaluation Programs 71-2 Mission Training Plan (Department of the Army, 1988b as cited by Deatz et al., 1998).

Exercise Development

The R&D team decided to:

- Develop a battalion/task force exercise segmented by different starting points and levels of difficulty.

- Create five parallel exercises for the cavalry troop and scout platoon elements.

- Employ a crawl-walk-run sequence within the two cavalry troop/scout platoon sets of exercises by varying the underlying mission's complexities.

- Create five orientation exercises: three for the combat Bradley vehicle crews, one for the dismounted infantry troops, and one for the unit support workstation operators.

TSPs

Battalion/task force exercise. Based upon directives from the COR, the STRUCCTT-2 R&D team revised the STRUCCTT library of TSPs. This effort involved:

- Restructuring the STRUCCTT battalion/task force volume, with an additional section on the defend-in-sector exercise.

- Reducing the redundancy found in the battalion/task force volume.

- Redesigning the observation forms for the battalion/task force exercise to record more detailed information about task performance.

- Revising the distribution set of TSPs. The STRUCCTT-2 R&D team proposed, for example, to create an electronic distribution set from the shelf set TSP.

Cavalry troop and scout platoon exercises. Another revision to the STRUCCTT library of TSPs was the development of a volume on the cavalry tables. This volume contains several features that are not found in the STRUCCTT TSPs on the platoon and team training tables. For example, the first part of this volume contains guidance to the unit trainers on the methodology for changing the tables in relation to changes in such training variables as environmental conditions (e.g., day and night) and engagement parameters (e.g., lethality probabilities).

Orientation exercises. The STRUCCTT-2 R&D team created separate orientation materials for the: (a) vehicle crews; (b) dismounted infantry troops, and (c) unit support workstation operators. The three combat maneuver orientation exercises were patterned after those for the VTP's familiarization course. Unlike the SIMNET familiarization course, the training audience engages in both day and night operations.

The infantry orientation exercise involves the use of a dismounted infantry module. The operators for the dismounted infantry module, who are the infantry squad leaders, must complete the computer-based instruction for operating these simulators prior to their participation in this exercise. Other requirements for this exercise include conducting it independently of the infantry fighting vehicle mounted crew exercise. The training audience for the dismounted infantry orientation exercise includes the unit's: (a) infantry platoon leaders, (b) infantry squad leaders, (c) forward observers, and (d) dismounted scouts.

The workstation exercise contains several orientation activities or scenarios (e.g., logistics orientation scenario). The training audience for this exercise package consists of the workstation operators for the following elements:

- Fire support workstations, which include the fire support element, fire direction center, and the tactical air control party.
- CSS workstations, which include the Combat Trains CP and the Unit Maintenance Collection Point.
- Engineer workstation, which contains a combat engineer support module.
- Fire Support Team Module, a M981 simulator.
- Motor Sergeant Module, a M113A3 simulator.
- First Sergeant Module, a High Mobility Multi-Purpose Wheeled Vehicle simulator.

The STRUCCTT-2 R&D team decided to include the orientation exercise materials in a separate TSP manual. A TSP, which is

entitled *Orientation Exercise Guide*, thus exists with a chapter per exercise package. Since this TSP only contains the train-the-trainer materials specific to the orientation exercises, unit support personnel are instructed to review the more general train-the-trainer materials. These latter materials are located in the platoon, company-team or task force TSPs.

Evaluation Process

The SOW limited the developmental trial to a single external test for each of the newly developed sets of exercises. To minimize possible problems due to this limitation, the R&D team relied heavily on expert reviews prior to these trials.

Battalion/task force results. Fifty active army personnel participated in this trial. However, surveys were only distributed to platoon leaders and above, resulting in a total of 27 respondents. In addition, this trial consisted of 10 O/Cs.

Mostly favorable results were obtained concerning the developed instructional materials. Of the 21 training participants who responded to post-exercise surveys, 62% indicated that their units had improved as a function of completing this exercise. In addition, 87% of the O/Cs felt that the exercise represented a complete set of events and tasks for the mission. (The R&D team did not indicate the number of these O/C respondents.) All of the O/Cs who received the exercise observation forms and the exercise AAR materials claimed to have used these materials.

Cavalry and scout platoon results. Participating units completed the developed cavalry and scout platoon tables over a two-day period. Scout platoon and cavalry surveys were administered at the end of each training day to 44 members of the participating units.

The participants' survey responses tended to be favorable concerning the developed instructional materials. Approximately two-thirds of the respondents to both surveys indicated that coordination between ground and air troop elements improved as a function of these exercises. Furthermore, approximately three-quarters of the respondents to both the scout platoon and cavalry troop surveys claimed that the tables' difficulty level was about right.

The developed materials did contain some flaws. The STRUCCTT R&D team observed that the participating units spent too much time on the fundamental tables. The R&D team was easily able to remedy this problem by changing the corresponding tactical situations for the fundamental tables to contain a time parameter.

Infantry orientation exercise results. Since this trial focused on the infantry orientation exercise, its participants

were the same cavalry troop participants for the cavalry troop and scout platoon trial. These participants had a favorable impression of this exercise. Over 92% of them claimed that upon completion of this exercise they were prepared to conduct the scout platoon and troop exercises in the CCTT, and that everyone preparing to train in the CCTT should participate in this type of exercise. Moreover, 82% of the respondents indicated that the route execution guide should not be revised.

Concluding Comments

The STRUCCTT tables were expanded to include a suitable:

- Battalion/task force defend-in-sector exercise.
- Set of cavalry and scout platoon tables.
- Set of orientation exercises.

The STRUCCTT set of training exercises is not, however, problem-free. For example, problems still exist concerning the distribution sets of TSPs, especially those dealing with the battalion/task force exercises. Some of the training participants and O/Cs for the battalion/task force trial did not receive all the necessary pre-exercise materials. This problem might have been due to the mode of distributing the materials. As stated by Flynn et al. (1998).

> The team did not directly control the distribution of the materials to the specific individuals. (p.34)

Wilkinson, (in preparation as cited by Gossman et al., 1999) has discussed another possible problem with the distribution of TSP materials. He has suggested that the current piecemeal approach of distributing TSP materials does not allow unit commanders to fully exploit the CCTT's training capabilities. Unit commanders should thus have, according to Wilkinson, direct and complete access to the TSP materials.

The CITT

Overview

The CITT R&D effort involved devising a prototype TSP distribution system in relation to the discussed notions of Wilkinson (in preparation). Such a system, according to Wilkinson as cited by (Gossman et al., 1999), should serve the following functions.

- Assist unit commanders and unit trainers in selecting the existing STRUCCTT tables/exercises that would match their unit's training needs.

- ♦ Assist unit trainers in tailoring the existing STRUCCTT tables/exercises to more closely match their unit's training needs.

- ♦ Assist unit trainers in creating structured tables/exercises, if the existing tables/exercises cannot meet their unit's training needs.

- ♦ Provide unit commanders with the same level of information concerning the CCTT's capabilities that the STRUCCTT R&D teams had when developing the existing library of STRUCCTT exercises/tables.

Another function of the CITT is to help unit commanders and other training personnel understand the basic concepts of structured training in order to develop their own structured exercises (Gossman et al., 1999). Otherwise, the customization of exercises by a unit's training personnel would not lead to a structured training program.

The SOW's task requirements. Based on the preceding discussion, the SOW's task requirements for the R&D were as follows.

- ♦ Design a CCTT instructional overview, which includes information about the CCTT training capabilities and methods (e.g., STRUCCTT) for exploiting them.

- ♦ Design and develop a prototype CITT system, which would serve the functions listed above.

- ♦ Refine the prototype CITT system though formative evaluation.

Hence, like the other STRUCCTT R&D efforts, the SOW determined many of this R&D team's initial decisions.

The Instructional Design and Development Process

The R&D team utilized the SST methodology to complete the SOW requirements, especially for the development of the prototype CITT. However, unlike the previously discussed R&D efforts, the CITT R&D effort did not involve developing a set of TSPs. The prototype CITT was thus the ultimate product of this R&D process.

The R&D team initially focused its efforts on designing the instructional overview materials and the prototype CITT system. As the project progressed, developing the prototype CITT system became the central task. The ensuing discussion follows this cited progression, starting with a brief discussion of the R&D efforts in designing the instructional overview materials.

Designing the CCTT's instructional overview materials. The SOW compelled the R&D team to develop two versions of an instructional overview videotape for the CCTT. One version would be for brigade commanders and above--*The Senior Leader's Guide to CCTT System and Training Capabilities* (Senior Leader's Guide). Anther version would be for unit commanders and other unit training personnel of brigade-level and lower echelons--*The Unit Leader's Guide to Training in the CCTT* (known as the Unit Leader's Guide).

The initial step in designing these instructional overview tapes consisted of conducting an FEA. This analysis involved examining the manuals for the CCTT workstation operators, interviewing CCTT SMEs, and reviewing the appropriate military doctrine, such as FM 25-100 (Department of the Army, 1997 as cited by Gossman et al., 1999). In addition, the R&D team obtained needed information by interviewing members of the previous SST design teams (e.g., the STRUCCTT's), and by scrutinizing the STRUCCTT documentation (e.g., Flynn et al., 1998). The R&D team found the latter sources of information to be particularly helpful in understanding the lessons learned from the STRUCCTT efforts.

Based on the SOW and the FEA, the R&D team then developed the videotapes. Both tapes contain basic information about the CCTT system and the principles of structured training. The *Senior Leader's Guide* also contains such information of interest to brigade commanders as the use of CCTT in support of the brigade's annual training strategy.

The *Unit Leader's Guide* also provides unit commanders with information pertaining to: (a) planning and preparation aspects of their unit's CCTT rotation; (b) overseeing their unit's execution of the STRUCCTT exercises; and (c) completing the unit's post-training reports.

Designing the prototype CITT. An experienced team of training developers, instructional designers, and simulation system SMEs identified 12 design requirements for the prototype CITT. These requirements included such items as:

- An introduction to the capabilities and limitations of the CCTT. This introduction includes a description of the structured training concept.

- Instructions and tools for the use of the STRUCCTT TSPs, modification of them, and creation of new TSPs.

- Instructions and tools for building exercise files based upon these TSPs, including the appropriate exercise management tools.

- Help files for navigating in the CITT database.

Based on these requirements, the team then designed a single system with two components—a learn about the CITT module and interactive tool component. The learn about the CITT module, which was based upon the materials contained in the two instructional overview videotapes would provide unit trainers with detailed information about the CCTT and the CITT systems. The interactive TSP tool would, as indicated, allow users to review and modify the existing STRUCCTT TSPs. It would also allow them to develop new TSPs.

Based on these two components, the team designed a prototype CITT that consisted of the following modules:

- Navigating the CITT, which includes help files.
- Learning about the CCTT.
- Producing training materials.
- Using the exercise management tools.

This design concept also included the existence of nodes within each module. The *Learn about CCTT* module included such nodes as "Learn about Structured Training."

Developing the prototype CITT system. The project's SOW and the FEA data were also instrumental in the design of the prototype CITT. The SOW stipulated a need for building a portion of the designed CITT system as a proof of principle concerning the underlying design. A complete *Learn about CCTT* module and portions of the other modules were then produced.

The SOW also required the R&D team to build a standalone (personal computer) version and a distributed (Internet/World Wide Web) version of this module. Instructional materials were initially developed for the standalone version. This developmental process involved the use of such Microsoft products as the Microsoft Active Server Page and PowerPoint®. After completing the standalone version of the prototype CCTT system, the R&D team then used the standalone materials to generate this prototype's distributed version.

Because of delays in starting the developmental process for the distributed version, the R&D team was not able to complete the distributed prototype. Consequently then, this prototype does not include some of the integral components found in the CITT standalone version. For example, the tools to modify the already existing set of training objects are contained in the standalone version but not in the distributed version.

The Evaluation Process

The CITT project consisted of a continuous formative evaluation process. This process utilized such evaluation techniques as internal software testing and user jury reviews to

determine possible problems with the developing materials. The user jury consisted of as many as seven individuals who were representative of the intended CITT user population. As the prototype CITT system was being developed, these individuals were asked to provide reactions concerning certain aspects of the standalone system. Areas found to be problematic were then refined and re-tested.

Formal user's test. The final formative evaluation of the developed portions of the CITT-standalone consisted of a formal user's test. This test consisted of giving 12 participants[5] a CITT test case to work. A participant might, for example, be asked to create a CCTT exercise. Except for two participants, completing the assigned test case occurred during one three-hour session. The two exceptions needed two sessions to complete their assignment.

Trained observers took notes as participants completed their assigned test case. Participants were also interviewed and completed questionnaires concerning their reactions to the CITT materials. The observers identified 29 shortcomings with the CITT system. These shortcomings ranged from typos (e.g., "sheath" instead of "sheaf") to minor design problems, such as making an exit button more obvious.

This formative evaluation produced positive data concerning the system's design. As stated by Gossman et al. (1999):

> Only one individual was not able to complete the test case. That, in itself, is a very positive indication of the system's usability. The CITT is a relatively complex system and the fact that almost all participants were able to use it on their first attempt is significant. (p. 69)

Nearly all of the questionnaire respondents thus indicated that system navigation was either easy or very easy.

Concluding Comments

This R&D effort developed two versions of a prototype CITT system, a standalone and a distributed version. Although both versions only contain portions of the CITT system as envisioned by the R&D team, the standalone version contains more features than does the distributed version. The R&D team also produced two instructional overview videotapes. This R&D effort thus represents a good start in developing a tool for helping unit commanders and other unit trainers to select, modify, and develop structured training materials for use in the CCTT.

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[5] Participants included nine military personnel and a civilian workstation operator from Fort Knox, KY, and four civilian workstation operators from Fort Hood, TX. Since the four Fort Hood workstation operators worked in pairs, the R&D team considered them as two participants, not four participants.

Summary and Reflections

Summary

The STRUCCTT R&D efforts expanded ARI's SST program to include approximately 60 CCTT tables/exercises. These tables/exercises were designed to provide maneuver units, including their staffs and CS/CSS elements, with standardized training opportunities at the CCTT. In addition, the developed tables covered a wide-range of tactical battle situations, including several offensive and defensive missions that occur under different environmental conditions (e.g., daytime and nighttime maneuvers).

The STRUCCTT efforts also included the development of the CITT, which utilizes advanced technologies for distributing the SST instructional materials to a unit. Unit commanders and training personnel can use the CITT as a tool for selecting, modifying, or creating appropriate CCTT training tables/exercises for their units. The CITT is also a train-the-trainer system, with detailed information about the CCTT system and the structured training concept.

Reflections

The following reflections concerning ARI's SST efforts have emerged from the preceding review of the STRUCCTT R&D efforts.

- A suitable set of SST instructional materials were developed for the CCTT, which is an emerging simulation-based system for training the U.S. Army's maneuver units.

- SST programs can be fielded for training systems that do not have a dedicated instructional support team. Because of increasing financial constraints, emerging generations of Army training systems will, most likely, not have a dedicated O/C team.

- The CITT R&D effort demonstrated the possibility of developing an instructional tool (i.e., CITT) for facilitating a unit commander's ability to structure his unit's CCTT rotation.

- The CITT allows a unit's training personnel to tailor a SST program to better meet their unit's needs and conditions.

The review of STRUCCTT R&D efforts also evoke reflections similar to those for the SIMUTA R&D efforts.

- An evolutionary trend was manifested in these R&D efforts. The STRUCCTT and STRUCCTT-2 projects were built upon the TSPs developed for the VTP. Also, the lessons

learned concerning the distribution of the TSP materials for the STRUCCTT programs laid the foundations for the CITT effort.

- The developmental process for the STRUCCTT and STRUCCTT-2 programs represented a hybrid of the behaviorist and constructivist approaches to instructional design, with more of an emphasis on the former approach. Like the SIMUTA R&D efforts, these STRUCCTT efforts centered on objectives determined by the R&D teams.

- Formative evaluation played an integral role in the STRUCCTT R&D efforts. Like the SIMUTA R&D efforts, formative evaluation occurred at each phase of each STRUCCTT R&D effort. As a result, the developing instructional materials were continuously being revised.

- Personnel external to the R&D team made many of the key instructional decisions. For instance, the PM CATT influenced many of the CITT R&D team's decisions concerning the design of the prototype system.

Concluding Comments

The preceding reflections lead to several conclusions concerning these efforts. Most significantly, the STRUCCTT R&D efforts have achieved their goal of developing suitable SST materials for the CCTT. Consequently then, these efforts provide positive answers concerning the viability of developing and fielding an SST program for an emerging training system.

Questions, however, still remain about the utilization of the SST framework for developing simulation-based collective training opportunities for combat forces. Perhaps, for example, the SST developmental framework is not suitable for developing exercises for training brigade staffs? The SIMUTA R&D and STRUCCTT tables concentrated on training lower-level echelons (i.e., platoons and companies), which have a different set of tactical requirements than do higher-level echelons, (battalion and brigade staffs). A lower-level echelon is responsible for conducting the fight, while higher-level echelons, especially brigade and higher staffs, are responsible for managing the battle. Conducting the fight, primarily, involves a unit reacting to the factors of METT-T, while managing the battle involves a more complex set of interactions between environmental conditions and staff actions (e.g., processing incoming information from the field).

Questions thus exist about the SST design framework's suitability for structuring the training situation to meet the tactical requirements of brigade staffs. Answers to these questions should be forthcoming in the next two sections of this report, which contains a review of SST programs developed for such training.

Section 5: The SGT Set of R&D Efforts

Overview

The R&D Efforts

As suggested by Sterling and Quinkert (1998), the SGT is an instructional bridge between new or relatively inexperienced battalion or brigade staff members' mastering of duty-specific skills[6] and their ability to engage in staff operations. Development of this instructional bridge consisted of the following R&D efforts:

- A prototype SGT system (Koger et al., 1998).
- A refined SGT system (Quensel et al., 1998).

The SGT's Hardware Configuration (suite)

Based upon a SOW directive, the SGT's hardware suite consisted of a local area network of eight computer terminals (workstations). This suite afforded the participating battalion or brigade staff the capability to simulate the command and control activities of its main CP. One workstation, the commander's workstation, was used to send pre-scripted messages to the other workstations. Different staff members for the participating battalion or brigade occupied five workstations, with one staff member per workstation. One or two workstations were allocated for training support personnel to role-play subordinate units/staff and higher headquarters. All players in this simulation were able to receive, store, recall, compose, or transmit messages at their workstation.

Instructional Design Approach

The two SGT R&D efforts involved the utilization of the previously discussed SST conceptual underpinnings and design methodology. Most importantly, the instructional materials were embedded with response cues. In addition, these R&D efforts involved the following developmental phases, which were similar to those discussed for the previous SST efforts.

- Design Decisions (Considerations).
- Software Development, which is not discussed in the present report.

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[6] Under the Battle Staff Training System Project, ARI has also developed a computer-based instructional package for helping battalion and brigade staff members to refine their duty-specific skills (Koger et al., 1998). Since the Battle Staff Training System Project was not directly associated with the SST series of efforts, the present report does not discuss it.

- Exercise Design and Development.

- TSP Development.

Formative evaluation was an integral part of both SGT efforts.

Changes to the SST design framework. The R&D team had to tailor the SST design framework to meet the SGT's training requirements. As noted by Koger et al. (1998):

> In previous projects (SIMUTA, SIMUTA-B, and SIMBART), exercise material development was not required to the extent that it was in the Staff Group Trainer Project. (p. 34)

The TSP developmental phase was thus split into a(n): (a) "Feedback Materials Development Phase" and (b) "Exercise Materials Development Phase." The latter phase involved developing message traffic flow and start/end exercise graphics.

The Prototype System

The SOW defined this project's technical objective as the development of staff and staff/group training modules for new and relatively inexperienced battalion and brigade staff members. The R&D team was to design these modules for movement-to-contact, deliberate attack and area defense missions.

Design Considerations

Instructional requirements. This program was designed with the intention of helping battalion and brigade staff members acquire the skills necessary to be effective members of a proficient staff. Based on the team-training literature, Koger et al. (1998) suggested, that effective battalion and brigade staff members must:

- Process quickly the information from a lower echelon.

- Send the processed information to the commander in a form that can facilitate his decision making.

- Implement the commander's decision.

Training audience. The R&D team decided to include as the SGT's prospective training audience those staff members, including NCOs and officers, who routinely work in their echelons' CPs. For example, training audience members for battalion mission would include a battalion's: (a) executive officer (XO), (b) fire support NCO, and (c) personnel officer. Omitted from the training audience were enlisted personnel who would normally have a support role in a field command post. (More information about the training audience members can be found in Appendix F.)

Two points must be noted about the SGT's training audience. One, this audience includes more members of the battalion's and brigade's staff members than does the SIMBART program, which only deals with the section leaders (e.g., the S2 officer). Two, the battalion commander, brigade commander, and the battalion/ brigade S3 serve as the principal trainers for the SGT set of tables.

Designation of Training Objectives

The SGT's design considerations set the conditions for the R&D team's selection of an initial set of training objectives. The SIMBART R&D team's experience in developing instructional materials for a brigade staff's activities was another key factor in this selection process. The SIMBART R&D team, as discussed, developed instructional materials that were structured around a battalion's and brigade commander's decision points. The initial set of objectives was as follows:

- Processing incoming information and messages,
- Analyzing the messages,
- Coordinating information and intelligence with other sections,
- Integrating staff input, and
- Recommending a course of action.

These objectives were utilized for both the battalion and brigade training portions of the SGT program.

As the SGT developmental process evolved, five additional training objectives were included. These objectives also dealt with a commander's decision points. The R&D thus specified ten objectives that were utilized for both portions of this training program. (See Table 1 for more information concerning these 10 objectives.)

Training Activities

As shown in Figure 2, the hierarchy of the SGT training activities is tables, modules, and exercises. Based on the SOW and the R&D team's analysis of the SIMBART program, the following types of tables have been developed:

- Staff Section Table. This table deals with the collective training of a staff section.

Table 1. Training Objectives for Battalion and Brigade Training Programs (Taken from Koger et al., 1998).

Training Objective	Description
Monitor unit operations	**Each section** actively seeks information about • higher, • adjacent, • support and • subordinate units.
	Each section acquires information by listening to reports and asking for needed information.
Process information and messages	**Each section** • collates, • transforms, and • organizes information.
	Each section stores information on • maps, • situation boards, • journals, and • files. All information can be retrieved and used.
Analyze/evaluate information	**Each section** attaches meaning, either speculative or confirmed, to information that has been acquired.
Communicate mission critical information	**Each section** transmits information or intelligence to those who must make decisions about or act on it. This includes initial transmittal of sensed information; relaying; and disseminating throughout the • staff, • CPs, • subordinate units, • supporting units, and • higher headquarters.
Coordinate information and intelligence	**Each section** exchanges and discusses information and intelligence with others outside the section to clarify meaning and determine implications.
Integrate staff input	The **XO/Battle Captain (BATTLE CAPTAIN)** aids the commander's battlefield awareness by: combining information and intelligence from all staff sections, putting information and intelligence into a useable format, and passing information and intelligence to the commander.
	The **XO/BATTLE CAPTAIN** identifies areas requiring staff sections to combine efforts to support the commander's intent.
Recommend a course of action	**XO/BATTLE CAPTAIN** and **staff sections** develop and analyze courses of action.
	XO/BATTLE CAPTAIN recommends a course of action to the commander.
Disseminate commander's decision	The **staff** prepares and issues orders or fragmentary orders (FRAGOs) to inform units and staff of commander's decision.
Synchronize activities of subordinate and supporting units.	The **XO/BATTLE CAPTAIN** and **each section** monitor unit and Battlefield Operating Systems (BOS) assets to ensure their efforts are aligned to execute the commander's intent or direction.
Direct BOS assets to support commander's intent	The **XO/BATTLE CAPTAIN** and **each section** track activities of BOS assets and intervene, if required, to ensure their activities support the commander's intent.

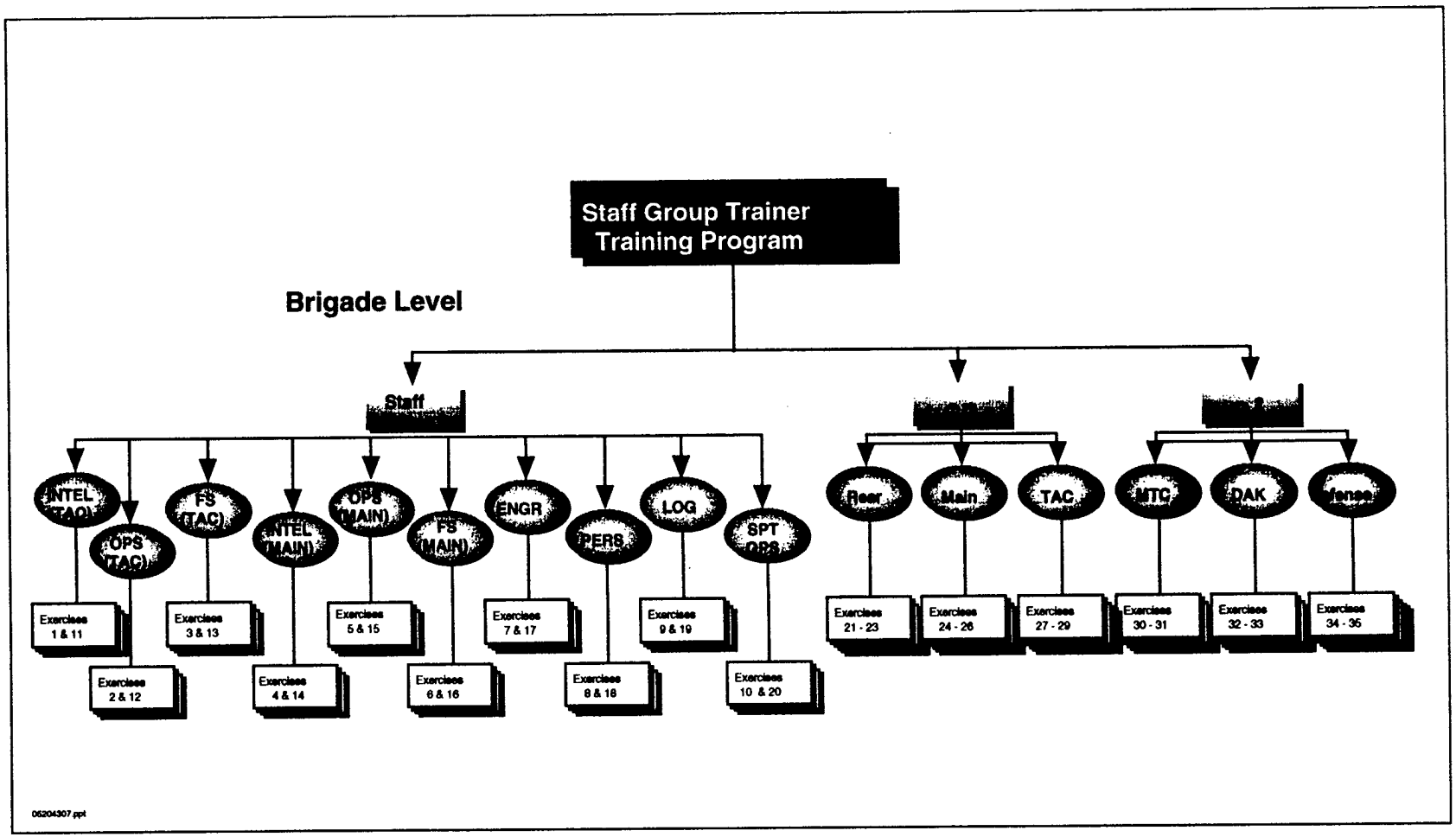

Figure 2. Brigade Staff Training Program

(Taken from Koger et al., 1998.)

- CP Table. This table is designed for collective training of the different CPs training of the battalion and brigade elements.

Each of these tables contains several modules, such as the movement-to-contact, deliberate attack, and area defense modules for the C2 table. Each module is comprised of two or three exercises.

Exercises. Each exercise is embedded with a limited number of training objectives. For example, the last set of exercises for the CP tables only deals with such objectives as synchronizing and directing the activities of subordinate units. Exercises can then be viewed as vignettes.

In addition, each exercise is composed of different segments and a tactical scenario. These segments are similar to those discussed for the VTP tables (e.g., a preview segment). However, the implementation of the segments for SGT exercises and VTP tables differs. For example, a participating battalion's or brigade's staff section leader rather than instructional support personnel conducts the preview for the exercises embedded in the SGT's staff section table.

Training Support Personnel. The battalion tables required 12 training support personnel, serving in the following roles:

- An exercise director, who worked with the commander during, before and after each exercise.

- A system administrator, who was responsible for loading the exercise data files.

- Two interactors, who role played the battalion's higher, lower and adjacent units.

- Observers, who were assigned per section and per CP.

The brigade tables called for the use of 15 observers as a brigade staff operation involved the use of additional CPs (e.g., a rear CP for the brigade exercises) and sections.

Overview of the SGT Library of TSPs

A battalion set and brigade set of TSP hard-copy manuals were created. Based upon the instructional methodology and the experiences of the VTP and SIMBART R&D teams, the organization of these manuals is as follows:

- Training Guide.

- Unit Preparation Materials.

- Staff Section Table.

- CP Table.
- C2 Table.

This library also contained these supplementary manuals:

- Tactical Materials, (e.g., battalion or brigade staff's battle orders).
- Workstation Operator's Guide.
- System's Administrator's Guide.
- Train-the-Trainer Guide.
- Program Highlights.

The previously discussed structured writing approach was used in preparing this library of TSP materials.

Evaluation Process

The SGT's instructional materials were analyzed after each developmental phase. This evaluation process consisted of:

- Prototype Reviews, with potential users reviewing the training programs and materials.
- Pilot Tests, which were used to scrub all exercises and materials scheduled for the trials. In addition, these tests helped prepare the training team for the implementation trials.
- Implementation Trials.

The battalion implementation trial. This trial consisted of two phases. Phase 1 was a train-the-trainer phase for the training team. Phase 2 involved a surrogate battalion staff executing the staff section table, the main CP module in the CP table, and the movement-to-contact module in the C2 table.

This trial produced mixed results. The R&D team reported that interactions among sections within a CP improved during the course of this trial. However, feedback from members of the training team and training participants indicated a need to augment the train-the-trainer program, and to develop a more structured assessment and feedback system.

The brigade implementation trial. This trial also consisted of two phases. Phase 1 involved a train-the-trainer phase, which was augmented on the basis of information gained from the battalion trial's results. Phase 2 consisted of an ad hoc brigade staff that was assembled from brigade units at Fort Knox, KY, and elsewhere. This staff completed the C2 table. In

addition, the R&D team developed a multimedia end-of-module AAR presentation to help the commander and the exercise director to focus the AARs upon the training objectives.

Like the battalion trial, the brigade trial produced mixed results. The R&D team reported that staff performance did improve, especially with regards to monitoring unit activities. However, members of the training team stated that the training program contained an overly complicated OPORD. In addition, training participants and members of the training support team voiced concerns about the adequacy of the instructional materials pertaining to the use of the workstations.

Concluding Comments

This R&D effort developed a prototype SGT system for battalion and brigade staff training. The implementation trials associated with this effort demonstrated potential benefits for the SGT's targeted training participants. This R&D project thus represented a solid foundation in ARI's efforts to develop SST materials that train new and relatively inexperienced military staff members.

Like any prototype system, the developed SGT required revisions. The most prominent of these revisions are as follows:

- The exercises for the brigade-level tables needed to be simplified.
- The train-the-trainer program needed to be expanded.
- Training materials for the SGT needed to be developed so that they could be implemented by a battalion commander or brigade commander at his home station, with minimal assistance from a dedicated or external training team (Koger et al., 1998).

The Refined System

The requirements delineated above led to the development of a refined SGT system. To better define the requirements for this refined system, the R&D team initiated an FEA. This analysis also provided the R&D team with an understanding of the unit staff constraints in a typical training environment for an Army battalion and brigade.

Initial Design Decisions

The FEA, primarily, consisted of reviewing information from such Army agencies as The Center for Army Lessons Learned. The FEA also included interviewing Army officers who were either then serving as or had recently served as a brigade commander. Its results led to the following design recommendations:

- Design the hardware suite to be compatible with the computer hardware found at a brigade's headquarters. Ultimately then, the SGT program should be administered from a local area network computer system in a brigade's headquarters.

- Focus the training program on the brigade staff members who conduct their duties in the main CP.

- Devise OPORDs that only contain the essential information for completing the exercises.

- Revise or develop products to support an enhanced feedback process.

In addition, the FEA indicated that the SGT should contain the following library of brigade-level tables:

- Staff Transition Table. This table includes exercises such as the S3 section's monitoring the execution of security forces.

- Staff Integration Table. It contains exercises such as the execution of integrated fires and maneuver activities, which would require coordination among the S2 section, S3 section, fire support element and the battle captain.

- Main Brigade CP Table. This Table consists of such exercises as identifying counterattack options, which involves the entire main CP's staff.

The R&D team also decided to devise these exercises in relation to the area defense mission. This decision was made because the training participants for the prototype system had trouble completing more than one brigade mission in the allotted training time.

Designation of Training Objectives

Training objectives were identical to those described for the earlier SGT effort. These objectives are presented in Appendix F.

Training Activities

Because of temporal constraints, this R&D effort developed a limited set of prototype SGT training activities (Quensel et al., 1999; Sterling & Quinkert, 1998). Hence, the R&D team was unable to develop a fully exportable SGT system.

This prototype set of exercises consisted of:

- Four exercises were selected from the proposed Staff Transition Table of exercises.

♦ One exercise was tapped from the proposed Staff Integration Table of exercises. The chosen exercise was an execution engagement dealing with the integration of fires and maneuver.

♦ One exercise was chosen from the proposed Main CP Table of exercises. The selected exercise involved the identification of counterattack options.

Revised features. This set of SGT exercises also differs from the previous set of SGT exercises in a number of ways. The most pronounced of these differences are delineated below.

♦ The preparation segment contains a pre-execution staff huddle.

♦ The tactical materials (e.g., OPORDs) have been simplified.

♦ The training equipment has been upgraded. Workstation operators, for example, are able to place units on the map without having to choose between doing that or doing another operation, such as opening messages (Sterling & Quinkert, 1998).

♦ New hardware features (e.g., menu driven graphic user's interface) have been added that simplify the exercise administrator's and training team's jobs.

Proposed Training Team Roles

As mentioned, a fully fielded SGT would, most likely, not have a dedicated training team. The R&D team thus proposed that the key training positions for such SGT use would be filled by the brigade's command structure. The brigade's commander or XO would, for example, serve as the training program's exercise director.

The TSP Library

As indicated, these TSPs are qualitatively different from those from previous SST programs. A significant change revolves around the new train-the-trainer course.

Train-the trainer materials. This course consists of electronic and hard copy materials. The electronic materials present these assets with a concise and intensive set of instructions on operating the workstations and implementing the training program. The hard-copy manual contains guidelines for most effectively administering and facilitating the brigade exercises. These materials, if viable, would also make the SGT exportable to a participating unit's home-station.

Other refinements. The TSPs for the refined SGT consist of other significant instructional refinements. These TSPs, for example, contain detailed directions for commander and XO regarding the procedures for conducting the pre-execution huddle. This guidance should help the brigade staff to develop a shared mental model concerning their leadership expectations and intentions (Quensel et al., 1998).

Evaluation Process

This R&D team's evaluation process paralleled the evaluation process as discussed for the SGT prototype, which included prototype reviews, a pilot test, and an implementation trial. The quality reviews for this R&D process consisted of a user panel. This panel was comprised of four military personnel who had served in a variety of brigade-level functions.

The research participants for the implementation trial came from an Army National Guard unit. The R&D team evaluated the preparation materials at the unit's home station three weeks prior to its training at Fort Knox. Members of the SGT R&D team also had to serve in most of the principal trainer positions during the Fort Knox portion of this trial.

This trial produced positive results concerning the refined SGT materials. The trial participants indicated through data obtained via questionnaires and group interviews that the prototype tables provided effective training with discernable training benefits. They also claimed that exercises focused on the correct tasks for the participants' staff sections. In addition, the participants indicated that their training on using the workstations was satisfactory.

Concluding Comments

A viable SGT system was developed for training new or relatively inexperienced brigade staff members. In addition, the refined SGT system contained a usable train-the trainer package that would allow a battalion commander or brigade commander to field a SGT at his home station, with minimal assistance from a dedicated training support team. This R&D effort thus achieved many of its technical goals.

Even though this R&D effort made strides toward making the SGT exportable, this goal was still not fully achieved. Because of contractual limitations, the R&D team was unable to convert the TSPs to electronic files that could run on computers with commercially available operating systems (Quensel et al., 1999). Battalions and brigades would thus not be able to make use of the SGT at their home station.

Summary and Reflections

Summary

The SGT set of R&D efforts has advanced the SST efforts. A viable set of computer-driven materials was developed for the collective training of new or relatively inexperienced battalion and brigade staff members. The SGT program would provide them with needed practice opportunities on staff-level information processing and decision making.

Reflections

Emerging from the SGT Efforts. The following reflections concerning ARI's SST efforts have emerged from the materials reviewed in this section:

- A suitable set of SST instructional materials can be developed for collective information-processing and decision-making tasks.

- These R&D efforts have demonstrated the feasibility of developing instructional materials (i.e., the pre-execution huddle) that can help a battalion or brigade commander facilitate his staff's mental model of his expectations and intentions.

- The R&D teams have had to modify the SST design framework to meet their instructional design conditions. However, the basic tenets of the original SST design methodology remained intact.

This review of SGT developmental efforts also evokes reflections similar to those for the previous SST efforts.

- The SGT's developmental process represents a hybrid of the behaviorist and constructivist approaches to instructional design, with more of an emphasis on the former approach. Like the previous efforts, the SGT efforts have centered on training objectives. In addition, the R&D teams have determined these objectives.

- The SGT's developmental efforts reflect the evolutionary nature of ARI's SST efforts. For example, the specified selected training objectives have been rooted in decisions made by the R&D team for the SIMBART effort.

- Personnel external to the R&D team have been very influential in the team's decision-making process. The SOW directives, for instance, have helped shape the SGT's hardware suite.

Concluding Comments

The SGT efforts represent a good initial step in ARI's efforts to develop a training program that bridges the gap between individual and integrated staff training. These efforts have provided positive answers to questions concerning the feasibility of developing a viable SST (or SST-like) program that can help members of a battalion or brigade staff to develop the fundamental collective skills associated with managing the battle.

Questions, however, exist about the utility of the SST approach for helping members of a battalion and brigade staffs develop their collective battlefield-managing skills. Managing the battlefield effectively requires that a brigade staff must work, in concert, to solve problems and help its leadership make the proper command decisions. The ensuing section on the COBRAS R&D efforts could provide answers to this question.

Section 6: The COBRAS Set of R&D Efforts

Overview

The COBRAS R&D efforts consist of the following initiatives:

- COBRAS I (Graves, Campbell, Deter, & Quinkert, 1997). This project entailed the development of a prototype large-scale brigade exercise and a set of short SGT-like vignettes.

- COBRAS II (Campbell, Graves, Deter, & Quinkert, 1998). This project refined and augmented the materials developed in the COBRAS I R&D effort.

- COBRAS III (Campbell et. al., 1999). This effort augmented the COBRAS II R&D effort by developing an additional training exercise.

Background of the COBRAS R&D Efforts.

Training goal. These R&D efforts involved developing SST materials for helping brigades or brigade combat teams[7] to become battle ready. The SOW for the COBRAS I R&D effort delineated this goal in relation to recognized Army needs.

Accomplishing this goal required the development of training exercises that would:

[7] A brigade combat team is a brigade organization consisting of units from several Army branches. For this report, the term, brigades refers to both types of brigade organizations.

- Provide opportunities to brigade command staffs for practicing their collective information-processing and decision-making skills in a dynamic and complex simulation-training environment.

- Provide opportunities to brigade command staffs for practicing their collective information-processing and collective decision-making skills vis-a-vis different mission phases and activities, including those activities associated with CS and CSS elements.

The COBRAS R&D efforts and the SIMBART R&D effort. The COBRAS R&D efforts were linked to the SIMBART R&D effort. The COBRAS and SIMBART efforts involved developing brigade-level exercises for a dynamic and complex simulation-training environment. The SIMBART and COBRAS efforts were also linked in that the SIMBART and COBRAS I efforts were developmentally intertwined, with both R&D efforts taking place during the same approximate time-period.

However, the initial constraints for the COBRAS R&D efforts differed significantly. As stated by Graves et al. (1997):

> Unlike the VTP (including the SIMBART portion), the COBRAS exercises were to be completely exportable without the benefit of a dedicated O/C team. This meant that all participants including O/Cs would come from within the training brigade or its division, or from a sister brigade. It also meant that the TSP would be completely self-contained, requiring no contractor support team to explain how to implement an exercise or set of exercises. (p. 13)

COBRAS I

Like the previously reported SST efforts, the initial decision phase was of paramount importance in the COBRAS I R&D effort. Like many of the other SST R&D efforts, SOW directives determined many of these initial decisions.

SOW Directives

The SOW compelled the R&D team to:

- Create a prototype Battle Staff Exercise (BSE), which would embrace all phases and segments of a brigade-level mission: planning, preparation, execution, including the reorganization and consolidation segments. This exercise would emphasize a staff's planning and decision-making activities.

- Create a series of 12 self-contained vignettes. Each vignette would consist of structured tactical problem-solving exercises for segments of a brigade's staff. Each program would deal with the same list of training

objectives. Each vignette would be composed of small, "snapshots," of a brigade-level mission. (Because the vignettes deal with staff subgroups, some Army personnel refer to them as a small-group brigade exercise.)

- Incorporate the developed BSE and vignettes into the appropriate training aids, devices, simulators located at Fort Knox, KY.

- Generate a single tactical scenario (i.e., divisional orders, unit locations, and METT-T factors) for both the BSE and vignettes.

- Base this tactical scenario on scenarios that were being developed for the SIMBART set of exercises. Because of this requirement, the COBRAS R&D team developed the scenario's storyline before determining its training objectives.

- Include in this tactical scenario a movement-to-contact mission, an area defense mission and a deliberate attack mission, which were also being developed for the SIMBART set of exercises.

Members of the training audience. Also, the SOW stated that the training participants for the BSE and the vignettes were to include the following 11 types of active component personnel for a brigade:

- Brigade commander.

- Brigade's primary staff, which consists of the following six officers: XO, S1 (personnel and administration officer), S2, S3, S4 (supply officer), and fire support officer.

- Four key individuals who link the brigade's primary staff with its: (a) fire support element, (b) air defense element, (c) engineering element, and (d) logistics system.

Summary. Based on these directives, the COBRAS I R&D effort consisted of developing two TSPs--a TSP for the BSE and a TSP for the vignettes. Both TSPs contained exercises dealing with the same scenario story line (i.e., series of events), missions, and training objectives. Also, the targeted audience for both TSPs was the same key members of a brigade staff. However, the BSE covered all aspects of the scenario's story line, while the vignettes focused on slices of the scenario that dealt with discrete events and staff subgroups.

Developing the Scenario's Story Line

The COBRAS R&D team had to design the scenario's story line in tandem with the SIMBART R&D team, which was designing a program for both active component and reserve component

organizations. This requirement led to a few design issues for the COBRAS R&D team. One issue involved creating a story line to accommodate a brigade with four maneuver battalions (two mechanized infantry and two armor battalions) and a cavalry troop. A reserve component brigade organization usually contains three maneuver battalions and no cavalry troop.

Still other design issues for the COBRAS R&D team involved:

- Developing a continuous set of missions within the scenario. Continuity among missions is an essential requirement of the COBRAS training program, because it reflects brigade-level operations for a war situation. Such operations include CS/CSS activities. As stated in the description of the SIMBART effort, the preponderance of CS and CSS activities occur prior to and immediately after a battle.

- Structuring the scenario with cues that would induce the brigade staff to engage in certain types of decision-making activities. The R&D team, for example, decided to embed a mission's planning phase with cues (i.e., time-marks) that would prompt the participating brigade to engage in either a deliberate decision-making process or a time-constrained decision-making process.

- Developing a more complete set of orders, which triggers concurrent mission planning and preparation among the brigade staff's elements.

- Preparing tactical products that contain ancillary information, such as a mission intelligence summary.

Producing this revised scenario would also involve the identification of an additional set of objectives for the collective training of brigade-level staffs. The selected objectives would, for example, determine the location of the time-marks within the scenario's planning segments.

Designation of the Training Objectives

Task analysis. The COBRAS R&D team's task analysis, initially, involved examining such standard doctrinal sources, as The Mission Training Plan for Heavy Brigade Command Group and Staff, ARTEP 71-3-MTP (Department of the Army, 1988c as cited by Graves et al., 1997). However, the information contained in these sources proved to be insufficient for providing a well-defined list of staff processing tasks. Furthermore, the cited ARTEP manual was outdated.

Other traditional methods for conducting a task analysis also proved to be inadequate. Structured interviews with SMEs could not supply sufficient details concerning the complicated interactions that occur among members of an effective brigade

staff. The R&D team thus had to invent a task-analysis procedure for ascertaining the COBRAS I's training objectives. (The term, "living tasks," was coined by MG Maggart in a 1994 briefing on a proposed virtual brigade training program(Graves et al., 1997).

Staff performance analysis. This new task-analysis procedure consisted of conducting a staff performance analysis (SPA). As stated by Ford and Campbell (1997):

> The SPA is an event-driven experiential analytical approach, designed to systematically explore the occurrences with a brigade headquarters as they (the brigade staff) prepare for and conduct a specified mission. (p. 15)

"Events" are discrete segments of staff activities that involve the interaction of two or more staff members. Mission analysis is an example of a discrete brigade-level preparation event as it starts with the receipt of division orders and ends with a briefing to the commander. After carefully analyzing the COBRAS missions, Ford and Campbell (1997) concluded that these missions contained 18 segments: (a) eight for the movement-to-contact mission, (b) four for the area defense, and (c) seven for the deliberate attack mission.

The SPA involved military SMEs from the COBRAS R&D team in enacting the roles of the different audience members(see page 58)for the COBRAS movement-to-contact, area defense and deliberate attack missions. Training analysts closely observed the SMEs' role playing activities. Upon completion of a mission event, members of the R&D team asked the SMEs probing questions about their activities. These questions dealt with the who, what, when, why, and how of the SMEs' actions in response to the conditions of the METT-T that were embedded in the event.

The SPA led to a list of brigade collective and duty-specific tasks(Ford & Campbell, 1997). The collective tasks are composed of a time-line per event, which consists of an event's starting point, interaction nodes (i.e., collective staff activities), and decision points. For example, the event, "Conduct Mission Analysis and Refine Course of Action," involves the following time-line:

- Starting point: brigade receives division order.
- Interaction node for the mission analysis subtask: Members of the command staff (e.g., XO, S1, & S4) identify such items as the specified, implied, and essential tasks in the division orders.
- Interaction nodes for the refined course of action subtask, which occurs concurrently with the mission analysis subtask: the Brigade Commander briefs his

initial course of action to a select group of command staff members (e.g., S2, and S3). After this briefing, the Brigade Commander and the selected staff members refine the Commander's initial course of action by discussing or wargaming it.

- Decision points: Event concludes with the development of such written products as a refined course of action and a list of specified, implied and essential tasks for brigade.

The ascertained duty-specific task list consists of 253 pages, which contain the tasks, subtasks with cues, interactions, and actions for the 11 targeted brigade positions per mission and event.

The COBRAS-I R&D team used this task list for a number of purposes. Most notably, the R&D team used it for generating sets of collective and duty-specific training objectives that dealt with staff processes. The designated training objectives were used to structure the scenario with cues that would induce the brigade staff to engage in certain types of team processes and corresponding actions.

Selection of the Training Systems

BSE. The choice of the BBS (defined in Section 2) as the training system was made in relation to the following criteria:

- Functional representation (i.e., the system's capacity for facilitating operations within all brigade functions).
- Size of terrain database appropriate for brigade-level exercises.
- Message generation capability of the system.
- Training support requirements of the systems.
- Asset representation.

The BBS had a higher rating on these criteria than did the other available systems, Janus and SIMNET. Most importantly, the BBS was the only system that could support CS/CSS activities (personal communication, Dr. Kathleen Quinkert, September 17, 1999). However, even this system is not ideal. It does require, for example, a relatively high number of training support personnel.

Vignettes. The R&D team settled on a "live simulation" as the training mode for most of these vignettes. A live system would require only a few training support personnel, without jeopardizing the vignettes' integrity. Training participants

could "act out" situations, in an office area resembling a CP, from cues provided in print-based or orally presented materials.

The COBRAS I R&D team also decided to use Janus and the BBS for vignettes that did not require many additional training support personnel. Janus was the training mode for two vignettes dealing with coordinating mission operations. Two vignettes on coordinating the transition from offense to defense utilized the BBS. (See Appendix G for the list of vignettes developed by the COBRAS R&D teams.)

Training Support Requirements

The training support personnel must come from within the training brigade or from a sister brigade. It is thus up to the participating brigade staff to provide the training support personnel who are described below. Also provided below are the recommended brigade staff or external assets per training support function.

BSE. The BSE training support requirements involved approximately 100 people, with each support person functioning in one of the following capacities.

- Exercise Management: An Exercise Director, COBRAS Coordinator, and a Blue Forces (friendly) Controller are needed. Senior military personnel, most likely from the unit's support brigade, must perform these duties.

- Observers: Six are required, including a senior observer, fire support observer, CSS observer, and CS observer.

- Role players: Subordinate and supporting unit role players must represent each major element. Role players are also needed to represent the division's staff, and the OPFOR elements.

- BBS Interactors: Five interactors are required, three to work the friendly unit's combat, CSS, and CS workstations, and two for the OPFOR's combat and CS workstations.

- Brigade Staff Support: Twelve members of the brigade staff section should be present who can perform, if needed, their normally assigned duty activities, such as operating the radiotelephone.

- Simulation Site Staff: At least one member of the BBS site's staff should be present throughout the exercise.

Preparation for performing the above duties can be extensive. The Exercise Director and COBRAS Coordinator should start preparing for an exercise approximately 12-16 weeks prior to the scheduled date. Observers need to spend approximately a

week in preparing to observe and provide feedback to the training participants. Training to be a role player and interactor should only take two or three days.

Vignettes. The training support personnel for the vignettes require the services of a training coordinator and a limited number of the brigade's support staff. The training coordinator, who should be the brigade's XO, is responsible for preparing and conducting the vignettes. His responsibilities also include facilitating the AARs. The support personnel are responsible for performing the less critical staff tasks, such as preparing overlays.

Development of the TSPs

The R&D team produced, independently, a separate TSP for the BSE and a set of TSPs for the vignettes. The development of these TSPs was based upon the previously discussed SOW directives and activities of the R&D team.

BSE. This set includes both system tapes and hard-copy manuals. The system tapes contain the materials and instructions required for the BSE site simulation team to initiate the BSE training. Forty-six hard-copy volumes were created. These volumes contain the necessary guidance and materials for the participating brigade's command staff to plan, prepare and conduct a BSE mission.

The R&D team assembled the 46 TSP volumes vis-a-vis the following categories:

- Exercise Management. This category of TSP materials is composed of a guide per exercise management position (e.g., Exercise Director) and a brigade orientation guide.

- Tactical Materials. These materials include the corps' concept of the different missions and such tactical materials as overlays. (A corps is two echelons higher than a brigade.)

- Participant Guides and Materials. These materials include a set of mission-specific task lists per member of the training audience. They also contains guides for each: (a) observer (e.g., AAR guidelines and briefing materials), (b) role playing team (e.g., an OPFOR controller guide), and (c) BBS interactor.

Vignettes. The R&D team developed the following TSPs for the 13 conceptualized vignettes:

- *Participant Guide* per vignette. These TSPs are composed of a general orientation to the vignettes, a list of tasks, preparation guidance, and necessary tactical materials (e.g., orders).

- *Training Coordinator Guide* per vignette. These TSPs contain a general orientation to the vignettes and specific guidance for different activities (e.g., a listing of AAR questions).

- *Support Coordinator* guides for the two simulation-based vignettes. The materials in this TSP include information concerning the procedures for conducting the vignettes and the simulation file tapes.

- *COBRAS Vignettes: A Guide to Use and Implementation*. This TSP contains background information and instructions concerning the vignettes.

Because of contractual constraints a complete set of assembled TSPs did not exist by the end of this R&D effort. In addition, two vignettes, those for the Janus system, were not completed. Hence, the entire set of vignettes was not ready for a formal trial evaluation.

Evaluation Process

This evaluation process consisted of:

- Quality reviews. The COBRAS R&D team informally collected information from SMEs concerning the draft instructional material for the BSE and vignettes. In addition, the quality reviews for the vignettes involved members of the R&D team enacting each of the "live vignettes."

- Pilot tests. The participants for BSE's pilot test consisted of the targeted brigade staff members. Because of conditions beyond the control of the R&D team, the training participants for the piloting the vignettes consisted of battalion-level personnel and COBRAS staff members. These participants did provide useful information to the R&D team, such as the need to reduce the amount of reading materials.

- Trial implementation. The BSE's trial implementation was conducted at the home station of an active component brigade and mechanized infantry division. The brigade's staff and the BBS site personnel were responsible for conducting this trial, which included all three of the BSE's missions. Members of the R&D team were at the site as observers.

Results of the BSE'S Trial Implementation

Positive results were obtained concerning the BSE. Training participants and support personnel were able to complete this exercise, indicating that the targeted training audience could utilize the TSP. In addition, as noted by Graves et al. (1997):

> The overall participant assessment of the training during the...BSE tryout was that it was beneficial. Some participant feedback obtained suggested that the COBRAS training offered no more (but no less) value to active component brigades than the optical unit-designed and implemented BBS exercises (but at a lower cost to the unit). (p. 137)

The trial's findings also indicated areas of needed improvement. One such area concerned the CSS activities. A majority of training participants indicated, when interviewed, that more CSS play was needed. In fact, one participant "did not observe any CSS play in the exercise" (p. 100[Graves et al., 1997). Since the BSE was partially intended to provide more CSS practice opportunities, future R&D teams must pay attention to these trial findings.

Concluding Comments

The COBRAS I R&D team had mixed success. As indicated above, they seemingly produced a viable BSE prototype. The R&D team also produced TSPs for vignettes. This R&D effort thus made strides in producing needed instructional materials for brigade-level training.

However, the development of the prototype BSE and vignettes was not problem-free. The fielded BSE must include more CSS play opportunities. In addition, an entire set of TSPs for the vignettes was not completed. Graves et al. (1997), furthermore, articulated a need to develop two vignettes that would focus on the links between brigade and battalion staffs.

COBRAS II

As indicated in the previous paragraph, this R&D effort involved expanding the COBRAS I R&D effort. This expansion consisted of developing a BSE, which would include more CSS activities than did the prototype version. In addition, the R&D team was to create additional vignettes to accommodate changes in BSE and to complete the two Janus-driven vignettes left unfinished from the COBRAS I R&D effort.

The Development Process for Enhancing the BSE

The initial set of decisions. Specifying members of the training audience was the initial and most crucial decision in developing the enhanced BSE. Nearly everything else in this developmental process flowed from this decision, which also had a huge impact upon the development process for the vignettes.

The R&D team had limited degrees of freedom in determining the training audience. Since this effort involved enhancing the prototype BSE, the training audience had to include the 11 staff positions who were designated previously. The training

audience, according to SOW directives, also had to include representatives of the following five CSS functions:

- Signal (Communications).
- Chemical.
- Military police.
- Army aviation.
- Military intelligence and electronic warfare.

The SOW directives also contained additional criteria for determining the CSS representatives for the training audience. The selected training audience members had to be actively involved in the staff's decision-making processes. In addition, their activities had to occur throughout most of the exercise.

Based upon these criteria, the R&D team conducted a thorough job analyses of the five cited CSS functions. The R&D team added, as the result of its job analyses, the following brigade staff personnel as part of the BSE's training audience:

- Signal Officer (the communications function).
- S3/Chemical Officer.
- Platoon leader for the military police section.
- Army Aviation Liaison Officer.
- Company Commander for the military intelligence section.

The training audience for the enhanced BSE would thus include 16 members, 11 members of the brigade's command staff, and the five cited representatives from the brigade's CSS elements.

(Re)designing the Tactical Scenario. This phase involved expanding the COBRAS I's scenario to contain events for the new training audience members. New events, thus, had to be included in the scenario that would reflect the five new training audience members' active participation in the staff process. However, these events could not reduce the training opportunities for the 11 other training audience members.

The R&D team conducted a thorough FEA to accomplish the goals set forth in the preceding paragraph. This analysis involved reviewing the relevant documentation for the five new positions and holding discussions with the appropriate SMEs. Based on this analysis, it was determined that the integration of events for the S3/Chemical Officer in the scenario would require the most attention. If the developers were not careful,

the enemy's use of chemical weapons could dominate the participating brigade staff's attention.

The BSE's tactical scenario was also redesigned in relation to findings obtained during the COBRAS I trial implementation. These findings led to 10 revisions to the scenario. The COBRAS II R&D team, for example, reduced the brigade's initial readiness levels in all missions in order to force more CSS activity.

Designating the training objectives. Adding new training audience members led to the need for additional training objectives from those designated in the COBRAS I R&D effort. The R&D team also had to obtain information concerning the impact that these new training audience members might have upon those objectives designated by the COBRAS I R&D team.

Since the original SPA was time- and labor-intensive, the COBRAS II R&D team chose to conduct a modified SPA (ModSPA: Deter, Campbell, Ford & Quinkert, 1998). The ModSPA method involved using the COBRAS I task list as its framework. It also involved having the military SMEs for the R&D team enact the scenario's set of events, as developed in the COBRAS I R&D effort. Otherwise, the ModSPA's procedures closely resembled those procedures described for the SPA in the write-up for the COBRAS I R&D effort. The ModSPA results did provide the COBRAS R&D team with task lists in support of enhancing the BSE (Deter et al.).

The R&D team thus used these task lists for two interrelated purposes. One purpose involved designating the training objectives for the enhanced BSE. The second purpose involved structuring the scenario with cues that would induce the brigade staff to engage in certain types of team processes and corresponding actions.

Developing the TSP. The TSP for the enhanced BSE was based on the previously discussed activities and lessons learned from the COBRAS I R&D effort. These major changes in these TSPs from those created for the prototype BSE were as follows:

- Expanding the participants' guides to include information for the new members of the training audience and a new configuration of training support personnel. The new configuration of training support personnel included the addition of: (a) 10 observers, with a single observer for several brigade staff members; (b) four new role players; and (c) five new interactors.

- Modifying the Exercise Guide to reflect the changed scenario.

- Revising the tactical materials, such as providing a modified division OPORD for the added scenario events.

- Developing a new set of AAR materials, which included more slides and textual information concerning the slides.

- Developing separate materials in the Interactor Guide for the combat, CS, and CSS workstation terminals.

- Developing the Simulation Site Manager's Guide, which included a description of the BBS tapes and other relevant documentation.

Evaluation of the Enhanced BSE

This process followed the same set of procedures as discussed for the COBRAS I R&D effort--quality reviews, pilot tests, and a trial implementation. Like the discussion for the COBRAS I R&D effort, this discussion deals with the trial implementation.

Trial implementation. This trial implementation took place at the home station of an active component brigade. This was not the brigade who participated in the trial implementation for the COBRAS I R&D effort.

The enhanced BSE's trial implementation consisted of several significant deviations from the R&D team's intended implementation strategy. These deviations were as follows:

- Because of time constraints, the participating brigade only had to complete the deliberate attack mission.

- The participating brigade could only perform a partial list of the CSS activities, because, as stated, the deliberate attack mission was the only one tested during this trial.

- The participating brigade employed only three task force units and no cavalry troop, rather than the requested four task forces and one cavalry troop. This change reflected the brigade's organization.

- The observers had little experience observing brigades.

- The simulation site staff did not follow the training plan as directed in the TSP. They preferred, for example, to use their own familiarization package, rather than the one designed by the COBRAS II R&D team.

These deviations did not compromise the integrity of the structured approach (Campbell et al., 1998). The R&D team did, then, report the trial's data.

This trial produced positive results concerning the new BSE version. Training participants and the training support personnel gave this exercise either a highly or moderately

favorable rating on post-trial questionnaire items pertaining to the BSE's training utility. As stated by the Brigade Commander during his post-trial interview session:

> COBRAS allowed me to maximize my training time with my staff with very little overhead. If I had run and resourced a BBS without COBRAS, the cost would be prohibitive. (p. 62; Campbell et al., 1998).

The Brigade Commander thus believed that the BSE would help his unit more optimally exploit the BBS.

The training participants and support personnel also tended to give the TSP high marks. Several of them claimed, when interviewed, that the TSP guides greatly helped them to understand their roles and contained clear instructional materials. The training participants and support personnel also felt that frequent feedback sessions were beneficial to the brigade's staff and that sufficient AAR preparation time was provided.

The Vignettes

The SOW obligated the R&D team to expand the COBRAS I set of vignettes in three ways. One, the R&D team had to create 12 new vignettes. These vignettes focused on the training events associated with the new group of training participants. Two, at least two of these new vignettes had to incorporate vertical linkages between a brigade and one of its maneuver battalions. Three, the R&D team had to finish the developmental work on the two vignettes that were not completed during the COBRAS I R&D effort. (Appendix G contains a listing of the developed vignettes.)

The SMEs, who were members of the COBRAS II R&D team, carefully reviewed each draft vignette. In addition, instructional designers from the COBRAS II R&D team reviewed each draft several times. The R&D team dropped one vignette from production because the SMEs and instructional designers found it to be too broad. The COBRAS II R&D team, thus, produced 13 vignettes, which included completing work on the two left unfinished by the previous COBRAS R&D effort.

The pilot implementation. The R&D team piloted the following five representative vignettes.

- Develop a Reconnaissance Order.
- Plan Deliberate Smoke Operations.
- Conduct Abbreviated Decision-Making Process.
- Conduct a Brigade Rehearsal.

- Plan a Combat Service Support Rehearsal.

The participants for this pilot implementation consisted of U.S. Army personnel who had the equivalent level of staff experience as the targeted training participants. Participants of this pilot also included contract personnel who were not associated with the R&D process.

The pilot implementation's findings indicated the following problems with the piloted vignettes.

- Participants often exhibited confusion about what they were supposed to do.
- The brigade commander's guidance was extremely vague.
- The TSPs contained an excessive amount of materials.
- The training objectives and tasks were poorly defined.

The training participants were able, with the help of the R&D team members, to overcome most of their difficulties with the vignettes. However, the R&D team felt that the cited problems warranted a careful review of the entire set of vignettes.

The final internal review. This review consisted of a series of workshop sessions. Each workshop consisted of SMEs and the instructional designers working in teams to overhaul the "live" vignettes. Four senior training developers guided these teams in their efforts. This internal review led to a revamped set of the "live" vignettes.

The final internal review also led to revamping the vignettes' TSPs, which were developed during the previous R&D effort. The most prominent change involved revising the TSPs' structure. For example, a *Training Coordination and Participant Guide* was devised per vignette.

Final observations about the vignettes. Producing these vignettes was not easy. As stated by Campbell et al., (1998):

> In retrospect, it is clear that carving a small segment of staff performance out of the context in which it is usually nested is very difficult. Deciding who is involved in the activity, as opposed to who might be involved, requires hard choices that are always subject to second-guessing. (p. 54)

Concluding Comments

This R&D effort expanded the COBRAS I R&D effort by devising a viable replacement for the prototype BSE and by

producing 13 vignettes. The BSE and vignettes could integrate five more members of a brigade staff into the training situation than could the prototype system. These new members were representatives of the brigade's slice elements. The enhanced BSE and the new vignettes also contained upgraded TSP materials.

The COBRAS R&D efforts have apparently produced training materials that can help brigade staffs meet some of their pressing training needs. These materials can, if properly implemented, allow brigade staffs to practice their decision-making, communications, and problem-solving skills among themselves and with other echelons (Campbell et al., 1999). The developed materials can thus help brigade staffs to practice their battlefield-managing skills.

Upon completion of its BSE training and vignette exercises, a brigade staff would still not be battle-ready. A brigade staff must also develop the ability to use those newly developed battlefield-managing skills under high-intensity battle conditions, such as those found at the NTC (Campbell et al. 1999). The trial brigade's leadership indicated a desire for such a training program. Accordingly, ARI initiated the COBRAS III R&D effort.

The COBRAS III R&D Effort

This R&D effort entailed developing a joint brigade and battalion staff exercise—the Brigade and Battalion Staff Exercise (BBSE). As indicated above, the BBSE was not designed to replace the BSE, but rather to provide brigades with a walk-run counterpart to the BSE. The BBSE would thus be designed to help brigades prepare for their NTC rotations.

The BBSE's Design Features

The SOW required the BBSE to contain design features similar to those discussed for the BSE. The BBSE was thus designed to contain area defense, movement-to-contact, and deliberate attack missions that were comparable to those developed for the BSE. The BBSE was also designed to cover all mission phases, and includes CS and CSS activities. In addition, the BBS was designated as the training system.

However, the BBSE contains design features that are significantly different from the BSE's.

- The BBSE is a large scale, multiechelon training exercise involving approximately 169 members of the brigade. These training participants include the: (a)brigade commander, (b)brigade commander's staff, (c) brigade commander's staff sections, and (d) one or more maneuver battalion commanders and their staffs.

- The BBSE's training support needs are extensive, involving 96 role players and interactors, approximately, 20 observers, and 32 exercise controllers.

- The BBSE requires the training participants and support staff to work in shifts, as 24-hour operations are conducted over a 5 to 6 day period.

- The BBSE contains overlapping missions, which force the brigade to plan for a mission while preparing for and executing another. This feature also helps structure the exercise by precluding multiple entry points into it.

- The BBSE affords a brigade with the flexibility to change a mission's scope or conditions during the planning or preparation phase.

- The BBSE contains performance objectives for the brigade commander and his staffs. Performance objectives are more process-oriented and less prescriptive than are training objectives.

Observational and feedback system. Like the other design features, the observational and feeback system contains elements similar to those for the BSE. Most significantly, the roles of the observers in the BBSE and the BSE are essentially the same. However, there seems to be more differences between these two systems than similarities. The significant differences between the BBSE's and the BSE's observation and feedback systems are as follows.

- BBSE observers are instructed to focus their attention on particular performance objectives, rather than on members of the training audience. Only two or three of these performance objectives are to be discussed in each AAR.

- Feedback to the BBSE's training participants also transpire in one-on-one sessions and small group sessions, while feedback for the BSE's training participants mainly transpires during the AARs.

- The AARs for the BBSE take place in the evening, about the time of the shift change; the AARs for BSE occur after each segment of a mission.

- The feedback sessions for the BBSE are more likely to be conducted by the participating unit than are those for the BSE.

Developmental Process

Initial decisions. Like the BSE developmental process, the first and most consequential decision in this developmental process involved designating the specific members of the primary

training audience. The R&D team decided to have the commanders and their staff leaders select the members of the primary training audience. After all, they should know their personnel the best. The R&D effort's proponents, the Force XXI Training Program and the United States Army Armor Center, concurred with this policy for determining the BBSE's primary training audience.

Designing the tactical scenario. The BBSE scenario was a revision of the previously discussed BSE scenario. This scenario was designed in relation to the following SOW requirements.

- It had to be continuous across missions, which would allow for the previously discussed concurrent planning of one mission while the unit is executing another.

- Most of its critical scenario events were to occur during the shift, usually the first, when the primary staff members are on duty.

- The OPFOR players would execute alternative plans of action, which would force the brigade staff to reassess the situation.

- It would contain the task organization changes reported from the COBRAS II effort, such as the elimination of the cavalry troop.

Designing a continuous story line across missions was the most difficult of these directives to achieve (Campbell et al., 1999). While the brigade staff could plan to execute a follow-up mission in a variety of ways, the training support personnel might not be able to respond accordingly. For example, the brigade's plans might not allocate the time that the CSS workstation operator needed to re-supply and re-arm the brigade. Since the R&D team wanted such CSS activities to occur, the developed story line required the brigade to perform sustainment activities (e.g., re-supplying the units) between missions at a designated assembly area.

Designating the performance objectives. Jenkins, Graves, Deter, and Quinkert (1999) claimed that generating a list of 15 performance objectives would serve the following functions.

- It would support a brigade commander's need to tailor the training emphasis to his priorities for the exercise, rather than to those of the instructional personnel, including the instructional design team.

- It would focus the BBSE's design on true high-payoff performances by a unit.

- It would focus on collective behaviors that require synchronization and collective decision making.

Designating the BBSE's performance objectives was a five-step process. Step one involved identifying the performance objective topics to be addressed by reviewing the pertinent military publications. Step two consisted of military personnel or the SMEs for the R&D team enacting the activities associated with the designated topics. This step also provided information concerning the selected objectives' techniques and procedures. Step three was composed of integrating the selected performance objectives, including their techniques and procedures, into the BBSE's TSP. Step four consisted of evaluating the listed performance objectives during the BBSE's external trial. Step five involved, reviewing, and if necessary, revising the list of performance objectives. This process produced 15 performance objectives (e.g., parallel planning within the brigade) for the BBSE. (Table 2 contains the list of the developed objectives.)

Table 2. Final Set of Performance Objectives for the COBRAS III R&D Effort (Taken from Jenkins et al., 1999)

1. Parallel Planning within the Brigade
2. Conduct Clearance of Indirect Fires Procedures
3. Plan and Manage Reconnaissance with the Brigade
4. Integrate Logistics Estimates in Decision-Making
5. Manage Information within the Brigade Command Posts
6. Plan and Implement Brigade Air Defense Early Warning
7. Develop and Execute the Brigade and Battalion Plan for Fires
8. Conduct a Combat Health Support Rehearsal
9. Decision-making in a Time Constrained Environment
10. Plan and Execute a Decision Point
11. Develop and Execute the Brigade Concept of Mobility/Survivability
12. Plan for and Commit a Company-Size Reserves
13. Plan, Integrate, and Manage Smoke Assets
14. Manage Information Within the Task force Command Post
15. Military Decision-Making Process in the Battalion

Developing the TSP. The BSE's TSP was rooted in the previously discussed exercise design features and developmental activities. The significant features of this developmental process were as follows.

- ♦ Tactical materials were designed to be overlapping, which involved devising methods for clearly distinguishing between the scripted missions for the current and future missions.

- ♦ Performance objectives were to be included in the training audience's preparation materials, along with unit guidance concerning these objectives.

- ♦ Observer materials and training audience materials were to contain a fuller description of the possible types of AARs.

Evaluation Process

The key evaluation event in the BBSE's developmental process was the trial implementation. This trial included the same brigade that participated in the trial implementation for the COBRAS II R&D effort. (The turnover of key staff positions within this brigade was not determined.) The data collection included structured questionnaires administered to training audience members, observers, role players and interactors. The data collection also included structured interviews with key participants, such as the Brigade Commander.

The BBSE's training value. Positive results emerged from this trial concerning the BBSE. Over 90% of the training participants who completed a post-trial questionnaire indicated the BBSE was an effective exercise for experienced brigade staffs, such as theirs. The sampled training participants furthermore tended to believe that their unit's proficiency on the eight performance objectives improved as a result of this training.

Further positive support for the BBSE comes from data provided by the 11 brigade observers and nine battalion observers. As one observer commented:

> I think that (the) BBSE has good potential/promise to train staffs at all levels. (p. 24; Campbell et al., 1999).

Use of performance objectives. Positive results also emerged about the use of the performance objectives. The Brigade Commander and Exercise Director were very positive about this approach. Campbell et al. (1999) cited the following comment from the Exercise Director:

> (performance objectives) provide a great resource of how specific battle functions should be executed. (p. 27)

The Brigade Commander liked the flexibility provided by this approach. He also believed that the performance objectives allow commanders to "lay the groundwork for a shared vision for tactical operations and commanders' intent."(pp. 26 and 27; Campbell et al., 1998).

The observers also provided mostly positive comments about the use of performance objectives. As one observer commented:

> I like the technique of using [performance objectives] for observing a unit, rather that the traditional method of "looking at everything." I recommend that we use this technique in all training events at all echelons (p. 27; Campbell et al., 1998)

Concluding Comments

Two interrelated findings have emerged from the trial results. One, the BBSE has promise as a "run-level" SST exercise for brigades. This exercise should thus help prepare such units to become battle ready as demonstrated by their performance at the NTC. Two, the performance objective approach seems to represent a potentially valuable new training method, especially for brigades.

However, the BBSE and the performance objective approach need to be refined. One observer for the battalion staff recommended avoiding performance objectives that require the staff to be on the ground. A number of suggestions came from the BBSE's training participants concerning ways of fine tuning this exercise. Four participants, for example, felt that the CSS portion of the exercise needed to be more realistic. In addition, Campbell et al. (1999) noted that parallel versions of the BSE and BBSE are needed for light-heavy units. Future R&D efforts should then be initiated to fine tune the BBSE and the performance objective concept.

Summary and Reflections

Summary

This section has described the development of three interwoven sets of COBRAS exercises, the BSE, the BBSE, and 24 small group vignettes—for the purpose of brigade staff training. Each set involves the same tactical scenario, which includes all phases of a brigade mission. Each set also contains movement-to-contact area defense, and deliberate attack missions. Furthermore, each set includes CS and CSS activities. The BBSE and BSE are also linked in that they utilize the BBS training system.

Each set of COBRAS exercises has focused upon a different brigade training requirement.

♦ The BSE provides a brigade staff with relatively uncomplicated planning and decision-making activities in a dynamic simulated battle training system.

♦ The BBSE represents a walk/run version of the BSE.

♦ The vignettes deal with providing brigade staff members with authentic problem-solving situations.

Reflections

Unique to the COBRAS R&D effort. These R&D efforts have generated the following reflections concerning the SST approach to training.

♦ Standardized sets of simulation-based TSP materials can be developed for higher-order cognitive tasks (e.g., decision-making).

♦ Simulation-based training materials can be structured by such instructional cues as time-marks.

♦ The SST approach can be used to produce instructional materials for a variety of brigade-level activities, including those for the brigade's CS and CSS elements.

♦ The COBRAS R&D efforts have produced new methods for determining training and performance objectives, such as the SPA approach.

♦ Alternative forms of the basic SST design framework have emerged from the COBRAS R&D efforts. For these R&D efforts, the scenario has been designed before the training or performance objectives have been determined. The converse has occurred for the SIMUTA and SGT efforts.

♦ An SST exercise or set of exercises can seemingly be exportable to a variety of settings (Campbell et. al., 1998).

♦ Producing vignettes has been more difficult than producing the large-scale BSE and BBSE.

Similar to those for other SST efforts. The review of the COBRAS R&D efforts, also, brought to mind reflections that were stated in the previous SST efforts.

♦ A unit's training personnel can tailor the instructional program to better meet their unit's needs and conditions.

♦ The COBRAS developmental efforts reflected the evolutionary nature of ARI's SST program. For example, the development of the BBSE was deeply rooted in the development efforts of its predecessor--the BSE.

- The COBRAS developmental efforts represented a hybrid of the behaviorist and constructivist approaches to instructional design.

- SST exercises can apparently be fielded for training systems that do not have a dedicated instructional support team.

- Personnel external to the R&D team were very influential in the team's decision-making process. For instance, the SOW directives for the COBRAS I R&D effort shaped the BSE.

Concluding Comments

As indicated, the COBRAS R&D efforts have enhanced ARI's sets *of* SST programs. The BSE, BBSE and vignettes provide brigade staffs, including representatives of their support elements, with needed training opportunities concerning the management of a large-scale tactical situation. Brigade commanders should thus be able to use the COBRAS training program to help their staff's progress towards a battle-ready status. Correspondingly, the COBRAS set of R&D efforts has further demonstrated the utility of the SST framework.

This section concludes the present report's description of the different SST R&D efforts. Military training personnel and instructional designers can use this description as a focal point concerning ARI's efforts in the area of SST. A central focus of this report has been achieved.

Questions, however, still remain about ARI's SST efforts. Most notably, what are the primary lessons learned from these R&D efforts? This question is examined in the ensuing section.

Section 7: Lessons Learned

This discussion of the lessons learned from the SST R&D efforts is primarily based upon information (findings) that has already been presented in this review. Additional findings also come from the lessons learned sections of the reviewed reports.

Two qualifications must be noted about this section. One, this section does not contain a listing of all possible findings and lessons learned. No single report could do that. Two, the cited lessons learned may be axiomatic to some readers. The ensuing discussion would still be of use to such readers, as it would make them mindful of these lessons when involved in the development of a training program.

Overview of the SST Efforts

Potential Value of the SST Efforts

A prominent theme in this review concerns the potential value of the prototype training materials. Nearly all of the discussed reports indicated that the training materials could benefit the targeted training audience or its trainers. Independent observers of participants' performance for the VTP found noticeable improvements in the training participants' ability to complete VTP exercises (Shlechter, Nesselroade, Bessemer & Anthony, 1995). In addition, training participants and trainers indicated that the BBSE helped the participating staff to become more proficient. The reviewed R&D efforts thus produced SST programs that could meet some of the Army's most pressing training needs, such as optimizing its use of simulation-based training materials.

> Lesson Learned(1)[8]: The potential value of the SST approach in meeting Army training needs must be communicated to senior Army policy makers.

Evolutionary Trends

Another prominent theme has been the evolutionary aspects to the development of ARI's SST instructional materials. Each successive program within a set of R&D efforts has augmented the previously developed training program or exercise. For example, the BBSE involved developing a walk/run exercise to complement the previously developed BSE.

Correspondingly then, the SST's evolution affected the development of the TSPs. Excluding the VTP's set of TSPs, each training program's TSP(s) was shaped, partially at least, by the lessons learned in developing the TSPs for the preceding R&D effort(s). As noted by Campbell et al. (1998).

> Every one of the lessons learned that was listed in the COBRAS I report holds true for COBRAS II experience. In many cases, we have been able to incorporate lessons in a next generation of training design or TSP. (p. 62)

Evolutionary trends were also found across the different sets of R&D efforts. For example, lessons learned from the SIMUTA set of programs on writing the TSPs helped the COBRAS I R&D team. Hence, the later R&D efforts benefited from their personnel's paying close attention to the TSPs and lessons learned in the earlier project(s).

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[8] Number in parentheses refers to the chronological order of the cited lessons learned. For example, (1) means that this was the first lesson discussed in this section.

Lesson Learned(2): SST training and support materials should be based on a programmatic R&D set of efforts.

One reason for this evolutionary trend was that many of the key R&D personnel for earlier R&D efforts were involved with subsequent R&D efforts. Finley and Shlechter (in preparation) found that 13 people worked on two or more R&D efforts. These personnel were thus familiar with the structured training concept. They were also familiar with the TSPs and lessons learned from their previous efforts, which helped them with their current developmental efforts.

Lesson Learned(3): Future SST efforts would benefit by having the same key personnel work on as many R&D efforts as possible.

Another reason for this evolutionary trend involved the R&D teams' accessibility to developed TSPs. R&D teams were able to obtain access to the developed TSPs and documented lessons learned from the preceding SST efforts. Hence, those members of an R&D team who were new to the SST process would become familiar with the TSPs and lessons learned from the previous SST efforts.

Lesson Learned(4): R&D teams should have access to previously developed TSP(s) and documented lessons learned.

The evolutionary trend was also a function of having the same two CORs throughout. One COR was responsible for most of the SIMUTA and STRUCCTT R&D efforts, while another was responsible for the SGT and COBRAS R&D efforts. These CORs could then write new SOWs for follow-on efforts (e.g., STRUCTT-2) vis-a-vis the lessons that they have learned from the previous effort(e.g., STRUCCTT).

Lesson Learned(5): A COR should, if possible, be responsible for an entire set of R&D efforts.

The SST R&D Process and Software Development. While software development is the focus of this segment, the reader should realize that issues discussed in this segment can also surface for hardware development.

Problems occurred with developing the SIMUTA and STRUCCTT programs when the selected training system was either emerging or being upgraded ((Hoffman et al., 1995; Graves & Myers, 1997; Hoffman, 1997; Koger et al., 1996; Flynn et al., 1998; Deatz et al., 1998). As stated by Koger et al.

During SIMBART…the upgrades to the software program were, for the most part, counterproductive (to the training program's development; p.33)

Flynn et al. noted that simultaneous instructional and software development could render an already completed portion of the instructional program obsolete. These issues can become a major concern to instructional developers as the system's developers (re-)write software codes.(Dr. Billy L. Burnside, personal communication December, 1999.)

> Lesson Learned(6): Developers of future SST program must be wary of developing the training materials while the training system's software is either emerging or being upgraded.

The reviewed reports have also provided strategies for integrating the efforts of the training developers with those of the software developers (e.g., Deatz et al., 1998; Flynn et al., 1998; Koger et al., 1996). Koger et al. have asserted that the training and software developers must plan their activities so that software development occurs before the training development work commences. Koger et al. have thus suggested that the training development and software development teams establish formal channels of communication to assure adequate planning and coordination.

> Lesson Learned(7): The training development and software development teams should establish formal channels of communication when a major software installation is scheduled.

Flynn et al. (1998) have also voiced a need for the training development team to establish formal channels of communication with the software development team. Such channels would allow the software developers to inform the training developers about a major change to the training system before it happens. The training developers could then plan their developmental activities, accordingly. Or, the training development and software development teams could identify mutually acceptable alternative modifications, which would be less disruptive to the instructional development effort. The instructional development team should then document the impact of these major changes upon the training development process.

> Lesson Learned(8): A training development team should document the impact that major software changes to the training system has upon developing the SST materials.

Flynn et al. (1998) have claimed that even minor software modifications warrant coordination between representatives of the training development and the software development teams. To avoid unnecessary delays in the training development or software development process, this coordination should be done through informal channels. As commented by Flynn et al.

> The informal arrangements with these agencies (proponents of and CORs for both the training and software developers)

were necessary to keep the flow of information open and quickly meet any small requirements that arose. (p. 45)

Lesson Learned(9): Informal coordination between the training development and software development teams should take place even for a minor software change.

Key Instructional Characteristics

As indicated by lesson learned 1, viable SST programs were developed. An important question is then: What are the defining instructional characteristics of a viable SST program?

The different SST programs have contained a common core of instructional characteristics. This core is composed of such instructional components as standardized exercise controls to cue performance and a progressive crawl-walk-run instructional sequence. It would seem to follow that this core set of instructional components is an integral component of a viable SST program. (See Section 2 for a description of the SST's core instructional components.)

Lesson Learned(10): Developers of future SST materials should incorporate each of the cited SST instructional components into their developed program.

The reviewed training programs have, as expected for non-experimental efforts, provided little empirical information about the relative training value of the different SST instructional components. Hoffman, (1997), however, does suggest that the strength of structured training involves providing the standardized exercise controls to cue performance. As he states:

The lesson (in the SIMUTA battalion expansion effort) is that the strength of structured training is not necessarily in the pre-packaged battalion order. Rather, the strength is provided in the surrounding events (e.g., brigade order, threat timelines) that ensure the unit will have to practice predetermined tasks. (p.22)

Lesson Learned(11): Developers of future SST materials need to realize the importance of developing a viable set of standardized instructional cues.

The SST design framework: Generic Issues

The next two segments focus on delineating the lessons learned concerning the SST's developmental framework. This particular segment contains a discussion of those issues that cut across the different developmental phases of the SST framework, such as this framework's utility.

Utility of the SST Framework

A salient finding about the SST framework concerns its utility. The R&D teams developed a viable set of materials for a diverse set of U.S. training requirements. These requirements have ranged from helping platoons develop the collective procedural skills necessary for war fighting to helping brigade staffs develop the team processing skills needed for managing the fight. These requirements have also involved developing training programs that deal with particular mission segments and (e.g., execution activities) those that deal with all mission segments. This framework thus has a wide-range of applicability with regards to developing SST programs.

> Lesson Learned(12): The SST design framework could be utilized in the development of Army SST programs, regardless of their training requirements.

Modifications to the SST Framework

Like any design methodology, R&D teams may have to modify the SST framework to meet their training requirements. One salient modification has involved variant forms of the SST framework.

Variant Forms of the SST framework. Several forms of the SST framework emerged during the course of the reviewed series of efforts. The SIMUTA and STRUCCTT R&D teams developmental procedures consisted of employing the initial SST framework (see Figure 1 in Section 2), while the COBRAS R&D team utilized variant forms of this framework (see Figures 3 and 4). The SIMUTA and STRUCCTT R&D teams determined the training objective prior to designing the scenario; in contrast, the COBRAS teams tended to design the scenario prior to determining the training/ performance objectives. In addition, the SIMUTA and STRUCCTT R&D team had a more linear progression through the different SST phases when developing the VTP than did the COBRAS R&D teams when developing the vignettes. Since the different R&D efforts produced viable instructional materials, the sequencing of the SST's developmental activities could vary.

> Lesson Learned(13): Developers of future SST program could progress through the SST framework in different ways. However, as shown in Figures 1, 3 and 4, they should start with the initial decision phase and conclude with developing the program's TSP(s).

There were several causes for the emergence of these variant forms of the SST framework. One cause involved contractual requirements. As discussed, SOW requirements stipulated that designing the BSE's scenario should be in concert with the development of the scenario for the SIMBART exercises. The COBRAS I R&D team had to proceed with designing

that scenario before designating the objectives, while the opposite occurred for SIMBART's developmental process.

Lesson Learned(14): An R&D team's progression through the SST framework will often reflect developmental constraints, rather than an adherence to a particular pedagogical philosophy.

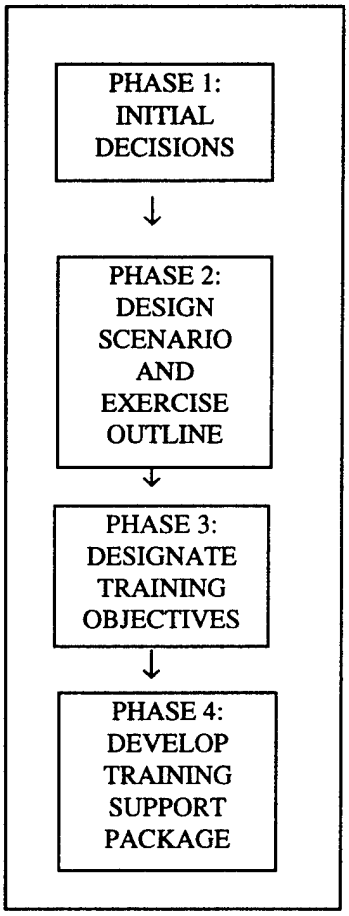

Figure 3. The SST design framework for the BSE and BBSE (Taken from Campbell et al., 1998).

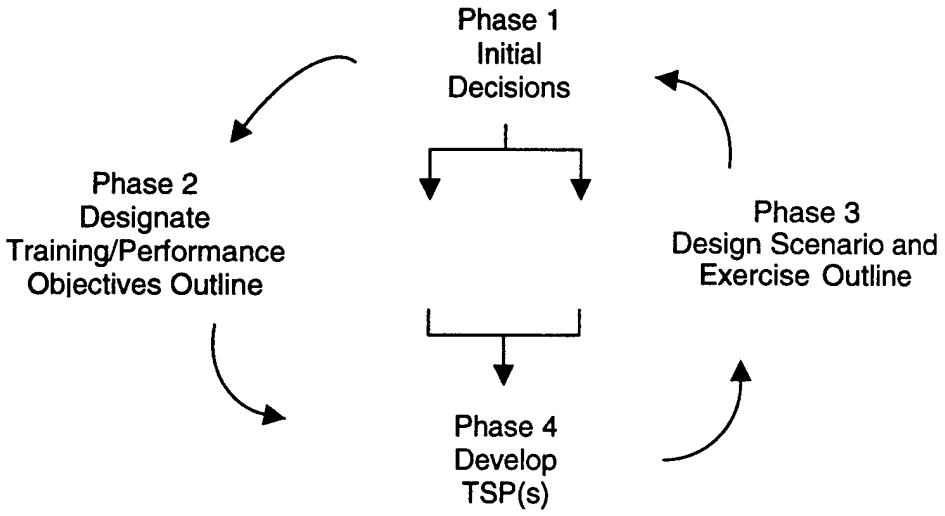

Figure 4. The SST design framework for the vignettes. (taken from Campbell et al., 1998).

The Evaluation Process

Formative evaluation played an integral role in each R&D effort. This role is summed up best by the following words from Campbell et al.,1998.

> The entire design and development process is supported by formative evaluation activities...Formative evaluation is considered to be a continuous product improvement process that extends throughout the life of the developmental effort. (p. C-2)

The SST's R&D efforts demonstrated the importance of integrating formative evaluation activities with other developmental activities.

> Lesson Learned(15): Developers of future SST materials should conduct a series of thorough formative evaluations, which integrates formative evaluation activities with other developmental activities.

Another evaluation issue involves the best procedures for conducting a trial implementation, which represents a formal evaluation of the TSP materials. Shlechter et al. (1995) have suggested that the use of multiple methods and sources would provide an evaluation team with a better understanding of a program's strengths and weaknesses than any single method and source could provide. Each method and source would yield insights into the training situation from complementary perspectives.

> Lesson Learned(16): Evaluators of future SST programs should employ a multimethod-multisource evaluation strategy, especially for the program's trial implementations.

A final evaluation issue concerned differences among the SIMUTA and COBRAS R&D efforts. The SIMUTA R&D team conducted two sets of developmental trials for the lower-echelon sets of VTP exercises. The COBRAS I and II R&D teams could only conduct a partial trial implementation of the BSE. This difference seemed to be a function of the resource-intensive nature of conducting and evaluating a full-scale exercise for higher-level echelons.

> Lesson Learned(17): Evaluators of future SST programs for Army training purposes must realize that assessing exercises for higher-level echelons is more resource intensive than it is for lower-level echelons.

The SST Design Framework: Phase-Specific Issues

Making Initial Decisions

Sources (e.g., the program's COR or proponent) external to the different R&D teams determined many of the key initial decisions in the development of the different SST programs. For instance, the SOW for the SIMUTA R&D effort required the R&D team to develop the training materials for the available training simulation systems at Fort Knox, KY. This decision was a determining factor in the VTP's developmental process.

The CORs and proponent agencies for the SST programs based their directives upon recognized Army needs. This aforementioned directive for the SIMUTA R&D effort came from a well-established Army need to more fully exploit its simulation-based training systems. The externally mandated decisions thus reflected the

needs of the intended users. Furthermore, an SST program's COR and proponent agency were ideally suited to mandate such decisions, because they represented the program's intended users.

> Lesson Learned(18): The requirements for future SST efforts should come from representatives of the users.

The R&D teams also made a number of initial decisions which shaped their program's developmental process. For example, the COBRAS II R&D team had to specify the new training members of the BSE's training audience. They had to make this designation because its SOW specified the new members/functions but not their positions within the brigade organization. Most of the initial decisions made by the different R&D teams were the result of similar, non-specific, guidance from their SOWs.

> Lesson Learned(19): R&D teams for future SST programs must make the critical initial decisions, in conjunction with the COR and proponent, when provided with non-specific requirements.

Nearly all of the R&D decisions involved conducting a stringent FEA. The COBRAS II R&D team's decision-making process, for example, involved conducting a stringent job analysis of brigade staff members' functions. Based on this analysis, the new training audience for the BSE included five members of a brigade staff who most closely fitted the SOW's criteria. This review has thus further demonstrated the value of an R&D team conducting an FEA.

> Lesson Learned(20): The R&D teams for future SST efforts should conduct an FEA when making the initial decisions about the developmental process.

As indicated above, the initial decision phase had a significant impact upon the remaining developmental activities. Concerning this point, Graves et al.,1997 have observed:

> The initial decisions and constraints must be identified as completely as possible, and all stakeholders should review them and concur. (p. 123)

> Lesson Learned(21): All stakeholders in future SST efforts should concur with the project's set of initial decisions.

Designating the Objectives

A prominent finding for this phase involved the "building-block" nature of the SST programs. For example, the STRUCCTT R&D team's procedures for designating objectives commenced with the acquisition of task lists from the SIMUTA and SIMUTA-B R&D efforts. This occurred because the CCTT and VTP addressed many

overlapping tasks, such as those dealing with fundamental platoon-level tactics.

> Lesson Learned(22): R&D teams for future SST efforts should consider ARI's SST R&D efforts as an important initial source of objectives.

Another prominent finding was that the procedures involved for designating the objectives for the COBRAS R&D efforts were more elaborate than were those for the other R&D efforts. As discussed, the designation of the training objectives for the COBRAS R&D I effort included, among other methodologies, the SPA/ModSPA. The SPA's primary function involved detecting undocumented brigade staff tasks by having SMEs enact a tactical scenario. In contrast, the designation of the objectives for the VTP involved a less cumbersome methodology (i.e., a modified version of Burnside's [1990] task selection procedures for the SIMNET system).

> Lesson Learned(23): As has been the case for the development of more traditional courseware, the FEA procedures for future SST efforts must be tailored to the effort's training requirements.

The noted difference concerning the selection of objectives also reflected differences in the training participants, and consequently, training tasks for the BSE and the VTP. The SOWs for the COBRAS I/II R&D efforts determined that the BSE, as discussed, would provide brigade staffs with needed practice opportunities concerning such higher-order cognitive tasks as planning and decision making. This directive was based upon a long-standing Army understanding of how brigade staffs function. Higher-order cognitive tasks are by nature hard to observe, and therefore, difficult to document. Conversely, the VTP, primarily, dealt with platoon-level and company-level tactical maneuvers, which involved procedural tasks. Such tasks are, relatively, easy to observe and document. A SPA-like methodology was, thus, needed to determine the objectives for the BSE's set of higher-order cognitive tasks, but not for the VTP's set of procedural tasks.

> Lesson Learned(24): Higher order cognitive brigade staff tasks require more cumbersome task-analytical procedures than do procedural platoon-level and company-level tasks.

The present report also discerned a relationship between the R&D team's designation of training objectives and its selected training system. For example, the SIMUTA R&D team found that basic platoon-level execution tasks (e.g., executing a wedge formation in daylight) represented doable objectives. However, a more complicated task (e.g., executing a wedge formation under conditions of poor visibility) did not represent a doable objective for the VTP, because SIMNET did not simulate less than perfect visibility conditions. The latter task was,

therefore, not a part of the VTP's list of tasks. Analyzing the selected training system's capabilities is a must.

> Lesson Learned(25): R&D teams for future SST efforts must analyze the suitability of the selected set of potential tasks for the selected training system.

Designing the Exercise/Scenario

An unmistakable fact about designing the SST exercises comes from Graves et al. (1997): "The scenario-based structure must be tailored to the program's objectives." (p. 129)

For example, as described, the VTP was designed to provide units with the opportunity to practice executing different tactical procedures. Hence, this program's scenarios mostly dealt with a mission's execution segment.

> Lesson Learned (26): Developing the scenario of a future SST program must be based on the program's objectives.

Another important finding concerning the procedures for designing an exercise/scenario comes from Hoffman (1997). He has observed that: "(T)asks included in a scenario-based exercise must tell a logical story." (p.19) Telling a logical story means incorporating the program's objectives into a scenario that reflects a realistic battle situation. A realistic battle situation for the VTP consisted of a maneuver unit's beginning and ending a mission from specified battlefield locations, encountering elements of METT-T during the course of the mission, and having an OPORD for the mission. The SMEs from each R&D team were responsible for specifying these battlefield elements. An R&D team's instructional designers and SMEs working closely together thus built the SST exercises/scenarios.

> Lesson Learned(27): The instructional designers and SMEs for future SST efforts must work closely together to develop logical and meaningful exercises/scenarios.

Ideally, the selected training system should support all elements of an exercise/scenario. However, this ideal situation might not always occur. The SIMUTA R&D efforts, for example, had to utilize training systems, such as SIMNET, with limited capabilities for battalion and brigade-level training purposes. There was a need to augment the battalion scenario for the VTP with non-computer-based techniques (e.g., role players representing higher and adjacent units). Such a situation might become increasingly likely as training resources become increasingly tighter.

> Lesson Learned(28): R&D teams for future SST efforts will, most likely, have to augment the simulation's capabilities with non-computer-based techniques.

Another noteworthy insight into the developmental activity of designing the scenario came, indirectly, from the CITT project. This project was initiated because unit personnel would soon be responsible for developing and modifying their units' SST exercises. Unit commanders and other training personnel had to understand the basic concepts of structured training; otherwise, the developed materials might not constitute a structured training exercise.

> Lesson Learned(29): A unit's training personnel must understand the SST concepts, because they may soon be responsible for developing or modifying SST exercises for the unit.

Developing the TSP(s)

This review produced the following obvious, yet important, finding concerning the TSP developmental process: Changes in the TSPs across the SST program tended to reflect different instructional requirements among the programs. One conspicuous difference in the instructional requirements among the programs involved the training support personnel. The SIMUTA sets of R&D had a dedicated O/C team; whereas, the STRUCCTT, SGT and COBRAS programs did not.

> Lesson Learned(30): TSP materials for future SST efforts must reflect the program's instructional requirements.

Another set of important findings concerned the issue of a TSP's accessibility to its users. Participants should be sent distribution sets of TSP materials prior to their training rotation. However, the participating unit in the STRUCCTT-2 R&D effort did not have complete access to the TSP materials. In response to such problems, the CITT R&D effort then developed a prototype distribution set of electronic TSP files. These files would, eventually, provide users with more direct access to the TSP materials than would its antecedent distribution mode.

> Lesson Learned(31): TSP materials for future SST efforts must be accessible to the user.

> Lesson Learned(32): Developers of future SST efforts should consider developing an electronic version of the distribution set of TSP materials. (This lesson is an offshot of Lesson 31.)

Training participants and support personnel also experienced problems with accessing TSPs that were overly complex. To overcome this problem with TSPs for VTP, the SIMBART and SIMUTA-B R&D teams rewrote them by utilizing the structured writing approach. The structured writing approach resulted in producing TSPs that were clearer and more concise than they were originally.

Lesson Learned(33): Developers of future SST efforts should utilize the structured writing approach.

A final set of issues concerning the TSP developmental process involved the observational and feedback materials. As reported, one notable issue involved the cognitive complexity in observing a battalion-level or brigade-level exercise (Graves & Myers, 1997). Because of this issue, the STRUCCTT-2 R&D team had to redesign the original STRUCCTT observational forms for the battalion observers. The enhanced forms helped the observers to focus their attention upon the relevant aspects of the battalion's performance vis-a-vis specific tasks.

Lesson Learned(34): R&D teams for future SST efforts need to create structured data collection forms that help observers focus their attention on the relevant information.

Implementation Strategies

The ultimate focus of the reviewed R&D efforts is to integrate these programs into the training strategy of field units. Even though the reviewed reports concentrated on these programs' developmental phases, they do contain important information about their implementation strategies.

The Users' Acceptance

A program's acceptance by users is a determining factor of its ultimate use. Army training programs are no different. Army training personnel will either not use or not optimally exploit those programs that are not acceptable to them.

Army expectations are a key determinant in the Army's acceptance of any training program (Hoffman et al., 1995). Platoons and companies have favorably received the VTP, because the VTP's "turn-key" approach is in accord with their belief systems about training. However, battalion and brigade commanders expect to have the freedom to "write their own orders," which runs contrary to a structured, "turn-key" approach. Participating battalions have had more problems than have participating platoons and companies with accepting the VTP.

Lessons Learned(35): Developers of future SST programs need to understand the expectations of the program's intended users; otherwise the intended users might not use or fully exploit the developed program.

However, the SIMUTA-B and COBRAS set of R&D efforts showed that, under the right training conditions, battalion and higher echelons could accept the SST concept. The SIMUTA-B R&D team did this by providing the participating battalion's training personnel with information about the SST concept and

corresponding training benefits to their unit. Consequently, a strategy for facilitating a battalion's acceptance of an SST program involved providing the training personnel with an advanced description of the SST concept.

> Lesson Learned(36): Developers of future SST programs should provide all participants, especially first-time users, with information concerning the SST concept.

Campbell et al. (1999) presented another strategy for facilitating acceptance of an SST program by battalion and higher echelons. They reported that the BBSE was welcomed and used with few modifications by the participating brigade. That was because this program was designed vis-a-vis their commander's stated training priorities.

> Lesson Learned(37): Developers of SST programs need to realize the relationship between program implementation and the training needs of its users.

The Training Support Personnel

As discussed in Section 2, training support personnel are responsible for program implementation. A program's training developers and training support personnel must be attuned to each other's intentions and expectations. Otherwise, the fielded program might not contain the desirable degree of structure.

The R&D team for the SIMBART effort (Koger et al., 1996) provided a salient illustration of such fielding problems. The O/Cs for the SIMBART portion of the VTP resisted implementing the R&D team's innovative approach for conducting an AAR, because the designed approach differed from current Army practices. Structured AARs thus did not always occur during the VTP's developmental trials.

> Lesson Learned(38): Implementation strategies for future SST programs must take into account the training support personnel's cultural expectations and previous experiences.

The R&D teams for the SIMUTA set of R&D efforts also noted that O/Cs varied considerably in the amount of "coaching" they provided to the training participants. As a consequence, the developers' intended crawl-walk-run progression of training tables did not occur during the VTP's developmental trials. The SIMUTA set of R&D efforts did address this issue with fielding the VTP. As noted, the TSPs' format and content were continually being enhanced during the course of these R&D efforts. These enhanced TSPs provided the O/Cs with detailed guidelines on when and how to coach their training participants.

> Lesson Learned(39): TSP materials for future SST programs must "clue" the training support personnel into the program's intended structure.

Another important issue concerning an SST's training support personnel involved their training. The R&D team for the SIMBART effort argued that the Janus interactors' experience and abilities had a major effect upon the participating brigade staff's performance (Koger et al., 1996). The participating battalion staff encountered problems, for example, when the interactors failed to report needed Janus information to them. Hence, a viable implementation strategy consists of ensuring that the training support staff has the ability to perform its duties.

This last sentence presents a special concern to developers of future SST programs. Emerging generations of Army training systems will probably not have a dedicated O/C team. Training support personnel must then come from the unit or a subordinate unit, and will probably have little if any experience operating the training system's equipment. For this reason, the TSPs for future SST programs must contain detailed train-the-trainer materials. Developers of such programs should base their train-the-trainer materials on the STRUCCTT TSPs, which contain a model set of such materials.

> Lesson Learned(40): A detailed and comprehensive "train-the-trainer" program must be included in future SST programs.

Miscellaneous Implementation Issues

The brigade participating in the trial implementation for COBRAS II R&D effort had to modify the prescribed fielding. This accommodation was made with the training program's structured composition remaining intact. The COBRAS II R&D team (Campbell et al., 1998)thus considered this particular trial implementation to be a valid test of the developed TSP(s).

> Lesson Learned(41): Implementation strategies for future R&D efforts must contain a degree of flexibility. Such flexibility is especially important for field units, who have their own particular training challenges.

> Lesson Learned(42): Any "locally-made" modifications must retain those features (e.g., having qualified role players) that are an essential element to the program's SST design framework (Campbell et. al., 1998). (This lesson is a an offshot of Lesson 41.)

Flynn et al.(1998) have presented a disturbing finding about the current state of the SST's implementation process. As stated by them:

> Currently, there is no system in place to attend to the long-term care and management of structured training associated with the CCTT training system. (p. 49)

Flynn et al.'s position also holds for the SGT and COBRAS sets of programs. A quality management system for each of the different SST programs must then be developed and installed at the different SST sites (Bessemer & Myers, 1998, as cited by Flynn et al.; 1998). If not, then ARI's SST programs might have a short life cycle.

> Lesson Learned(43): Developers of future SST efforts should develop a quality management system, which can be installed at different training sites.

Reflections

This section has delineated 43 lessons learned concerning the reviewed sets of R&D efforts. These lessons concerned the SST programs' (a) R&D process, (b) instructional design methodology, (c) key instructional characteristics, and (d) implementation strategies. These lessons provide developers of future SST efforts with guidance concerning the dos and don'ts associated with developing and implementing SST materials.

Section 8: Conclusions

As stated in Section 1 of this report, this investigation's goals consist of:

- Serving as a focal point of information for military policy-makers and training personnel concerning the history of ARI's efforts in the area of SST.
- Serving as a building block for future SST efforts.
- Providing needed information to instructional designers concerning the key instructional design attributes of the SST programs.

The reminder of this section highlights this investigation's accomplishments in relation to these goals.

Focal Point of Information on the SST Projects

This report provided a detailed history of ARI's R&D on SST. As such, the present report documented a five-year period of intensive R&D by a consortium of instructional designers, military SMEs, research psychologists, and military and civilian training support personnel. Developing the cited training products resulted in the publications of 28 ARI reports and research products (14 for the VTP, 4 for the SGT, and 10 for COBRAS set of programs); 14 conference papers (10 for the VTP and 4 for the COBRAS set of programs), and over 200 TSPs.

More notably, the reviewed R&D efforts produced the following sets of training products: the VTP, STRUCCTT, SGT, BSE, BBSE, and vignettes (see Table 1). Also produced was a

prototype software tool, the CITT, for helping unit commanders and other unit trainers to select, modify, and develop structured exercises/tables for use in the CCTT. These training products were developed in relation to the following training requirements:

- To more fully exploit the available simulation-based training systems for armor units and mechanized infantry units, including battalions and brigades that are composed of armor units, mechanized infantry units, and slice elements.

- To develop standardized collective training opportunities for combat forces, which have involved the development of TSPs.

- To maintain a battle-ready force in an era of dwindling economic resources, which is the ultimate bottom line for the U.S. Army.

The present report also contains an account of the evaluation data for the different developmental efforts. These evaluation data were mostly positive concerning the developed programs' viability. For example, Shlechter and his colleagues, who obtained data from a variety of sources, found the VTP to be an effective and efficient training program (Shlechter et al., 1995; Bessemer et al., 1995). The SST R&D efforts thus seemed to have produced suitable training products for the aforementioned training requirements

Building Blocks for Future SST Efforts

Developers of future SST programs should heed the delineated lessons learned from the reviewed R&D efforts. One notable lesson learned was the benefits of a programmatic approach to R&D, which was not the original intention of these R&D efforts. Developers of latter SST efforts were able to build upon the lessons learned and TSPs developed in earlier programs.

Another notable lesson was that developers of SST programs need to realize the relationship between program implementation and the training needs of its users. As stated by Campbell et al; 1999: "Design a program for which there is an identified need, and it will be used." (p. 32)

One such need involves the collective training of armor and mechanized infantry units to use digital systems. Soon armor platoons and companies will be composed of M1A2 tanks or equivalent types of tanks (e.g., upgraded M1A1 tanks), which contain digital equipment. Also, in the near future, brigade and battalion staffs will be operating in a digitized "Army Tactical Command and Control System" (Campbell et al., 1999). The next generation of SST programs should thus train armor and mechanized infantry units to function in a digital battlefield.

Key Instructional and Design Features of an SST Program

Key instructional features. This report has demonstrated the value of standardized exercise controls and instructional supports as key instructional features of SST programs. Standardized exercise controls prompt the training participants to practice predetermined tasks. For example, armor platoons in a STRUCCTT table must face such exercise controls as encountering an enemy in open terrain during a nighttime operation. Based upon Army doctrine, the platoon should respond to that situation by completing a prescribed set of tasks.

The instructional supports have come in the form of carefully developed TSP(s). An exercise's TSP provides the training support personnel with the necessary guidance and materials for overseeing a unit's training rotation. The TSP for the BBSE, for example, includes a job-aid for helping observers to properly coach their charges (Campbell et al., 1999). In addition, each program's or exercise's TSP(s) contain(s) all mission-essential materials for the training participants, such as overlays and OPORDs.

Key design variables. The preceding two paragraphs illustrate the importance of incorporating standardized exercise cues and instructional supports into an SST program. Salas et al. (1999) have also noted the instructional value of structuring simulation-based scenarios for training with enabling or performance cues. Standardized exercise cues thus seem to be a key instructional feature of simulation-based training materials. Table 1.

The present report has also shown that standardized exercise cues must be developed in relation to task demands. The VTP tables, which involved procedural-level tasks, consisted of METT-T elements embedded in each task and comments from the training support personnel. In contrast, the cues for the BBSE exercise, which was comprised of higher-order cognitive tasks, consisted of strategically placed time-marks. Procedural-level tasks thus might require more structure than higher-order cognitive tasks. Further research is needed to examine this proposed relationship between task demands and exercise controls.

Table 3. Summary of the SST Developmental Efforts.

Sets of Research and Developmental Efforts						
Sets of R&D* Efforts	Instructional Products	Training Systems	Training Audience	Mission Activities (Primary Focus)	Types of Tasks (Primary Focus)	Levels of Exercise
SIMUTA	(Training Support Packages for the:) VTP	SIMNET, Janus	Platoons, Companies, Brigade Staff (slice elements)**	Execution	Tactical Maneuvers	Crawl- Walk/Run
STRUCCTT	STRUCCTT	CCTT	Platoons, Companies, Battalion Staffs	Execution	Tactical Maneuvers	Crawl- Walk/Run
SGT	SGT	Computerized Network	(Inexperienced) Battalion & Brigade Staff Members	Execution	Team Processing	Crawl
COBRAS	BSE	BBS	(Experienced) Brigade Combat Team Staff & Slice Elements	Planning Preparation Execution (CS and CSS activities)***	Staff Processing Tactical Decision Making	Crawl/Walk
	BBSE	BBS	(Experienced) Brigade/Battle Combat Team Staff & Slice Elements	Preparation Planning Execution (CS and CSS activities)***	Staff Processing Tactical Decision Making	Walk/Run
	Vignettes	Office- settings (mostly) Janus BBS	Brigade Combat Team /Battalion Staff Members & Slice Elements	Planning Preparation Execution (CS and CSS activities)***	Problem-Solving	(not defined)

*Acronyms can be found in Appendix A.
**Slice elements have rarely been included in any VTP rotation.
***For these exercises, CS and CSS activities occur, mostly, after a unit has achieved the commander's intent.

- ♦ Instructional designers have been provided with needed insights into salient issues concerning the development of simlulation-based courseware.(See Section 1 for a overview of these issues.) One such insight is that exercise controls seem to be key instructional features of any simulation-based training program.

This report has thus demonstrated the importance of the SST programs to the Army's current and future training agenda. It has also advanced the process of developing simulation-based training materials.

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Appendix A

List of Acronyms

AAR	After-Action Review
AFT3	Assessment of Force XXI Training Tools and Techniques
ARI	Army Research Institute
ARTEP	Army Training and Evaluation Program
BBS	Brigade/Battalion Battle Simulation
BBSE	Brigade and Battalion Staff Exercise
BSE	Battle Staff Exercise
C2	Command and Control
C3	Command, Control, and Communication
CCTT	Close Combat Tactical Trainer
CITT	Commanders' Integrated Training Tool
COBRAS	Combined Arms Operations at Brigade Level, Realistically Achieved Through Simulation
COR	Contracting Officer's Representative
CP	Command Post
CS	Combat Support
CSS	Combat Service Support
EC	Exercise Controller
FASTTRAIN	Force XXI Training Methods and Strategies
FEA	Front End Analysis
IPISD	Interservice Procedures for Instructional Systems Development
IVIS	Intervehicular information system
JSIMS	Joint Simulation System
LUT	Limited Users Test
METT-T	Mission, Enemy, Time, Troops, and Terrain
ModSAF	Modified Semi-automated Forces
ModSPA	Modified Staff Performance Analysis
MTP	Mission Training Plan
NCO	Non-Commissioned Officer
NTC	National Training Center
O/C	Observer/Controller
OCIC	Observer/Controller in Charge
OPFOR	Opposing Force
OPORD	Operation Order
PM CATT	Project Manager Combined Arms Tactical Trainer
QAX	Quality Assurance Exercise

R&D	Research and Development
S1	Personnel and Administration Officer
S2	Intelligence Officer
S3	Training and Operations Officer
S3 NCO	Operations Non-Commissioned Officer
S4	Supply Officer
SAF	Semi-automated forces
SIMBART	Simulation-Based Mounted Brigade Training Program
SIMNET	Simulation Networking
SIMUTA	Simulation-based Multiechelon Training Program for Armor Units
SIMUTA-B	SIMUTA-Battalion
SIMUTA-D	SIMUTA-Digital
SGT	Staff Group Trainer
SME	Subject Matter Expert
SOCT	Senior Observer Controller Team
SOW	Statement of Work
SPA	Staff Performance Analysis
SST	Structured Simulation-Based Training
STRONGARM	Strategies for Training and Assessing Armor Commanders' Performance with Devices and Simulations
STRUCCTT	Structured Training for Units in the Close Combat Tactical Trainer
TEXCOM	The Test and Experimentation Command
THP	Take-Home Package
TRADOC	U.S. Army Training and Doctrine Command
TSP	Training Support Package
VTP	Virtual Training Program
XO	Executive Officer

Appendix B

Bibliography of the Structured-Based Simulation Training Programs' Reports, and Conference Papers

All materials are listed in chronological order.

I. The Simulation-based Multiechelon Training Program for Armor Units (SIMUTA).

A. Reports on the Research and Development (R&D) Process.

1. Hoffman, R.G., Graves, C.R., Koger, M.E., Flynn, M.R., & Sever, R.S. (1995). Developing the Reserve Component Virtual Training Program: History and Lessons Learned.(ARI Research Report 1675). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

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B. Orientation Guides.

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12. Shlechter, T.M., Shadrick, S.B., Bessemer, D.W., & Anthony, J. (1997). An Examination of Training Issues Associated with the Virtual Training Program (ARI Technical Report 1072). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

D. Miscellaneous Reports.

13. Campbell, C.H., Campbell, R.C., Sanders, J.J. Flynn, M.R., & Myers, W.E. (1995). Methodology for the Development of Structured Simulation-Based Training. ARI Research Product 95-08). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

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Appendix C

Training Systems Utilized in the Structured Simulation-Based Training Programs

The structured simulation-based training (SST) sets of programs involved utilizing the currently fielded virtual and constructive simulation systems at Fort Knox, KY, Fort Hood, TX, Fort Riley, KS, and Fort Lewis, WA.

The Virtual Simulation Systems

Virtual systems immerse the training audience in tactical situations that approximate actual battlefield conditions. Simulation Networking (SIMNET) and the Close Combat Tactical Trainer (CCTT) are the selected virtual training systems for the SST programs.

The SIMNET system. The SIMNET system was chosen because, among other reason, it has been shown to be an effective instructional system for the collective training of mounted vehicle units (Bessemer, 1991; Shlechter et al., 1991). The SIMNET is a real-time interactive network system of combat vehicle simulators (e.g., M1 Tanks and Bradley vehicles). The SIMNET also consists of Opposing Force (OPFOR) vehicles and support elements, which are controlled by the Observer/ Controllers (O/Cs), at their workstations. The SIMNET environment at Fort Knox contains 12 O/C workstations. These stations include a plan view display (two-dimensional electronic map), tactical radios, stealth vehicle display (three-dimensional view of the virtual battlefield), and audiovisual recording and replay equipment. The stealth vehicle, for example, provides the O/Cs or Exercise Controllers with a direct view of the battlefield from an invisible vehicle moving on or above the virtual terrain.

In order to create a realistic battlefield environment, the M1 and Bradley simulators were programmed to function under constraints similar to those for actual vehicles. In addition, the simulators operate on a computerized terrain that approximates that of an actual geographic area. For example, the computerized terrain for the VTP consists of sections of the National Training Center for mounted vehicles. Since the NTC is located in a desert locale, this terrain database contains realistic graphic representations of such terrain features as dirt paths, rocky hills, and cacti.

The CCTT. The CCTT represents a second generation SIMNET system. As such, the CCTT retains many of SIMNET's functional components. The CCTT includes a networked set of mounted vehicle simulators that can interact in real-time. It also includes O/C workstations with "stealth" vehicle capabilities. However, this system does NOT have a dedicated O/C team (Flynn et al., 1998).

The CCTT contains a number of enhanced functional features from those features incorporated into the SIMNET system. These new features include the capability to: (a) vary weather conditions and time of day, (b) operate the vehicle in an open-hatch mode; and (c) operate such add-ons to the M1 tank as the Intervehicular Information System, commonly known as IVIS. The CCTT facility also includes an operation center workstation for the following elements: (a) tactical unit's combat support (CS), such as the unit's signal corps and chemical division; (b) combat support service (CSS) elements (e.g., transportation and quartermaster companies); and (c) opposing forces. In addition, the O/Cs' workstations include a "state-of-the-art" multimedia presentation system, with an animation component (Flynn et al., 1998). (For more information concerning the CCTT see Deatz et al., 1998; Flynn et al., 1998).

The Constructive Simulation Systems

Constructive simulations consist of providing training participants with tactical scenarios based upon complex computer-driven models of the battlefield. These computer-driven models also serve to determine the training participant's performance (Turecek et al., 1995). A final characteristic of constructive systems is that system interactor encodes the information provided by the participating units into the computer system. There is a designated interactor per brigade or battalion element (Koger et. al., 1996). Janus, the Brigade/Battalion, Battle Simulation (BBS) are the constructive training systems for the SST sets of programs.

Janus. The Janus facility consists of a mock-up Command Post (CP) and combat trains CP settings, which are co-located in the Janus environment; though, they do remain physically and operationally removed from each other. A brigade commander and his executive, operations, and fire support officers are located in the CP. The logistic support officers operate out of the combat trains CP. Hence, the participating battalion staff operates from the CP/combat trains CP complex.

The CP/combat trains CP complex contains tactical apparatus found in a typical battalion's home headquarters. Both facilities feature, for example, realistic tactical radio systems. Through these systems, staff members in the CP and combat trains CP can communicate with each other. Also through these tactical radio systems the battalion's staff obtain information about the "battle" from their subordinate and controlling units, who are located by the different Janus' workstations.

As is the case in an actual battle, the participating battalion's staff is thus isolated from its subordinate units. This isolation should be maintained by insuring that both the CP/combat trains CP and the Janus workstation complexes are "off limit" to non-authorized personnel. The battalion's staff can

then neither view the different Janus computer consoles nor directly interact with the Janus' exercise observers and controllers. (Information about the Janus system came from Hoffman et al., 1995; Koger et al., 1996.)

The BBS. The BBS facility consists of 10 to 14 workstations, including workstations for the OPFOR and different elements within the brigade (e.g., engineer battalion Troop Workstation). The workstations for the brigade's elements consist of an exercise role-player, controller and interactor. The role-players are the military personnel from the brigade's subordinate (e.g., battalion-level) or supporting units (e.g., engineer battalion). Each workstation includes a combat terminal, a CS terminal, and a CSS terminal. The BBS' interactors operate these terminals, and provide their military counterparts (i.e., the role-player) with information provided by the computer concerning the mission's progress.

The BBS facility also consists of brigade staff work areas. This area includes a brigade's: (a) main CP; (b) tactical CP, which is the operation's center for the mission; and (c) rear CP, which is the mission's logistic center. As discussed for the Janus system, these different CPs remain physically and operationally removed from each other and from the BBS workstations. These CPs also communicate with each other and their respective workstations through a tactical radio system, which approximates the system used by the brigade during a live exercise or war. (Information concerning the BBS came from Campbell et al., 1998.)

Shortcomings with the constructive systems. There are several potential shortcomings with utilizing the cited constructive systems for the SST set of programs. First of all, their internal mathematical models provide information that relates primarily to battle outcomes rather than staff functioning. Moreover, these outcomes may reflect such extraneous factors to the intended training objectives as luck or good gamesmanship on the part of the simulation players (Graves & Myers, 1997). Making the important connections between the system's outcomes and intended training objectives requires personnel who observe a designated element of the battalion's or brigade's staff. A sizable number of personnel, including both interactors and observers, are thus required to provide the instructional support needed for a training exercise associated with a constructive system.

Appendix D

Constructivism and Behaviorist as Instructional Design Paradigms

A review of the instructional design literature has shown that the constructivism and IPISD/behaviorist instructional design paradigms contain the following elements.

Sources for Behaviorism: (a) Andrews and Goodson (1980); Branson, Rayner, Cox, Furman, King, and Harnum, 1975 (c) Branson & Grow (1987); (d) Dick and Carey (1978, 1985, 1990); and (e) Logan (1979).

Sources for Constructivism (a) Duffy and Jonassen's (1992) edited book, (b) the work of The Cognition and Technology Group at Vanderbilt (1992), and (c) Willis' (1995) article.

Table D-1. Listing of Salient Elements of the Constructivism and Behaviorist Instructional Design Paradigms

	INSTRUCTIONAL THEORY ELEMENTS	
	CONSTRUCTIVISM	BEHAVIORISM
1	Training objectives determined by the training participants.	Training objectives determined by the instructional design team.
2	Training objective also emerge as training participants interact with the training materials.	Training objectives determined as an initial part of the design process.
3	Task(s) immerse(s) participants in realistic battlefield conditions for their echelon.	Task(s) does not/do not need to immerse training participants in realistic battlefield conditions for their echelon.
4	Course materials focused on developing a unit's higher order cognitive skills (e.g., its tactical decision-making).	Course materials focused on developing the unit's procedural-level tactical skills (e.g., executing tactical formations).
5	Course materials focused on helping participants' develop the skills necessary to fight in new and different battlefield conditions.	Course materials focused on helping participants' develop the skills necessary to fight in battlefield conditions which resemble the scenario.
6	Instructional program need not contain a standardized set of instructional materials.	Instructional program must contain a standardized set of instructional materials.
7	Instructional program does not contain a particular instructional sequence (e.g., "crawl-walk-run").	Instructional program contains a particular instructional sequence (e.g., "crawl-walk-run").

Table D-1 Continued

	CONSTRUCTIVISISM	BEHAVIORISM
8	Instructional materials developed for the more experienced or advanced training participants.	Instructional materials developed for the less experienced or novice-level participants.
9	Experiential learning is more important than mastery learning.	Mastery learning is more important than experiential learning.
10	Instructional personnel should refrain from providing performance feedback to the participants as they are executing a table.	Instructional personnel should, if needed, provide performance feedback to the participants as they are executing a table.
11	Student-led After -Action Reviews (AARs).	Instructor-led AARs.
12	Feedback geared more to the unit processes (e.g., communication among tanks) associated with any particular action (e.g., getting to the Starting Point on time) than to the action itself.	Feedback geared more to the unit's actions (e.g., getting to the Starting Point on time) than to the processes (e.g., communication among tanks) associated with its action(s).
13	A non-linear or spiral progression used in the instructional design process.	A linear or spiral progression used in the instructional design process.

Appendix E

List of the Sample Set of Training Tables for the Virtual Training Program

I. Armor Platoons

Fundamental Training Tables

PAA1	Basic Movement Skills
PAA2	Tactical Movement; Actions on Contact
PAA3	Basic Defensive Techniques

Offensive Training Tables

PAB1	Tactical Road March
PAB2	Movement into Battle; First Contact
PAB3	Continued Movement; Platoon Reacts to Contact

II. Mechanizedanized Platoons

Fundamental Training Tables

PMA1	Basic Movement Skills: Command & Control
PMA2	Tactical Movements; Actions on Contact
PMA3	Basic Defensive Techniques

Offensive Training Tables

PMB1	Tactical Road March
PMB2	Tactical Movement; Initial Contact
PMB3	Continued Movement; Platoon Reacts to Contact

III. Armor Company/Team

Fundamental Training Tables

CAA1/CTA1	Tactical Road March; Command and Control
CAA2/CTA2	Basic Tactical Movement Skills; Actions on Contact

Offensive Training Tables

CAB1/CTB1	Tactical Road March
CAB2/CTB2	Tactical Movement; Initial Contact
CAB3/CTB3	Continued Movement; Company Reacts to Contact
CAC1/CTC1	Mission Changed; Increased Contact

Defensive Training Tables

CAF1/CTASK FORCE1	Defense
CAF2/CTASK FORCE2	High Risk Defense

Appendix F

Members of the Training Audience for the Staff Group Trainer Program

Members of the training audience for the battalion missions by Command Post (CP) and sections within a CP are as follows: (In the parentheses are examples of the corresponding staff members.)

- Tactical Operations Center
  Executive Officer and Battle Captain

- Main CP:
  Intelligence Section (Intelligence Non-Commissioned Officer [NCO])
  Fire Support Element (Fire Support Officer)
  Engineer Section (Engineer Specialist)
  Logistic Section (Logistics Officer/Supply NCO)

- Combat Trains CP:
  Personnel Section (Personnel Officer)
  BN Maintenance Section (Maintenance Officer)
  Medical Platoon (Medical Officer)

Members of the training audience for the brigade missions by CP and sections within a CP are as follows: (In the parentheses are examples of the corresponding staff members.)

- Tactical CP:
  Operations Section (S3)
  Intelligence Section (Senior Intelligence NCO)
  Fire Support (Fires Support Specialist)

- Main CP:
  Operations Section (Assistant S3)
  Intelligence Section (Intelligence NCO)
  Fire Support Element (Fire Support Officer)
  Engineer Section (Engineer Officer)
  Logistic Section (Senior Supply NCO)

- Rear CP:
  Personnel Section (Medical NCO)
  Support Operations Section (Forward Support Battalion Operations Officer)

Appendix G

Vignettes for the Combined Arms Operations at Brigade Level, Realistically Achieved through Simulation Training Program

Vignette		Training System
1	Plan for Dislocated Civilians	Small Group (live simulation)
2	Plan Refuel on the Move	Small Group
3	Develop a Concept of Service Support	Small Group
4	Develop a Reconnaissance and Surveillance Plan	Small Group
5	Conduct Target Development	Small Group
6	Develop Air Defense Concepts	Small Group
7	Develop Contingency Plan	Small Group
8	Conduct Mission Analysis	Small Group
9	Develop Courses of Action	Small Group
10	Conduct Course of Action Analysis	Small Group
11	Conduct Special Staff Rehearsal	Small Group
12	Develop a Reconnaissance Order	Small Group
13	Develop a Course of Action Branch	Small Group
14	Plan a Nuclear, Biological, and Chemical Defense Operations	Small Group
15	Plan Deliberate Smoke Operations	Small Group
16	Plan Brigade Rear Battle	Small Group
17	Plan Combat Service Support Rehearsal	Small Group
18	Identify and Resolve Airspace Conflicts	Small Group
19	Conduct a Brigade Rehearsal	Small Group
20	Conduct Accelerated Decision-Making Process	Small Group
21	Coordinate Mission Operations	Janus
22	Coordinate a Mission Transition – Offense to Defense	Battalion Brigade/Battalion Battle Simulation (BBS)
23	Conduct Parallel Planning	BBS
24	Plan and Execute a Fragmentary Order	Janus

(Taken from Campbell et al., 1999)