Theater Battle Management Core Systems (TBMCS)
Lessons Learned/Best Practices
Training and Testing for Acquisition

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ABSTRACT

This paper is divided into three sections. The first section is an in-depth analysis to assist future Command and Control (C2) decision makers in determining the conditions necessary for effective distributed learning for future C2 systems. The findings presented were gathered from a study conducted during the fielding and training of an Air Force C2 system entitled Theater Battle Management Core System (TBMCS). Data are presented in terms of (a) a summative evaluation that identifies strengths, weaknesses, lessons learned; (b) best practices of the TBMCS training program; and (c) a holistic view of the TBMCS distributed training program that shows the impact of training, not only on the individual but on the United States Air Force (USAF) as well. The second section reflects upon the TBMCS support to Homeland Defense in response to the September 11, 2001 events. The third section provides an overview of the paradigm changes needed in the Air Force acquisition process to support the warfighters' needs.

1.0—TRAINING ASSESSMENT

1.1 BACKGROUND

To meet the learning requirements of the future force, the Secretary of Defense stated:

"DoD personnel will have access to the highest quality training that can be tailored to their needs and delivered cost effectively, anytime and anywhere. Furthermore to achieve this vision anytime, anywhere learning must be distributed, just-in-time and on-demand and enabled with resources, development and exploitation of learning technologies".

The Department of Defense (DoD) Strategic Plan for Advanced Distributed Learning (ADL) dated April 30,1999 identified an ADL initiative intended to implement the Secretary of Defense's training vision.

1.2 ELECTRONIC SYSTEMS CENTER (ESC) COMBAT AIR FORCE COMMAND AND CONTROL (CAFC2) ADL INITIATIVE

DoDI 5000.2, The Defense Acquisition System states that the System Program Director (SPD) shall ensure that the design and acquisition of systems will be cost effectively supported and shall ensure that these systems are provided to the user with the necessary support infrastructure for achieving the user's peacetime and wartime readiness requirements. Support resources include operator and maintenance manuals, tools, equipment, and training. Furthermore, the SPD shall consider the use of embedded training and maintenance techniques to enhance user capability and reduce life cycle costs. Air Force Instruction (AFI) 63-123, Evolutionary Acquisition for Combat and Control Systems, states that prior to system fielding, the SPD shall ensure sufficient training is complete to fulfill approved operational concepts of employment and sufficient support in place to fix failures and sustain the system.

In accordance with (IAW) the policies stated above, the SPD for TBMCS ESC, CAFC2 is responsible for managing, preparing, and conducting training for the TBMCS system as it is fielded. How does the SPD ensure the adequacy of TBMCS training? What criteria is TBMCS training evaluated against? What data should be collected? AFI 36-2211 identifies the Instructional Systems Development (ISD) process as a systematic approach to developing and conducting training. The ISD process includes five phases—analysis, design, development, implementation, and evaluation. ESC utilized this process in the development of TBMCS training materials. Worthen, Sanders, and Fitzpatrick (1997) stated that SPDs face the following kinds of education and training evaluation considerations:

- *Context evaluations* that serve as planning decisions to determine what needs are to be addressed
- *Input evaluations* to serve structuring decisions in determining what resources are available and what training strategies should be considered

- *Process evaluations* to serve as implementing decisions such as how well the plan is being implemented and what barriers threaten its success
- *Product evaluations* to serve future product decisions

The goals of this section are to provide:

- A summative evaluation that identifies strengths, weaknesses, lessons learned, and best practices of the TBMCS training program
- An in-depth analysis in assisting future C2 decision makers in determining under what conditions distributed learning is likely to be effective for future C2 systems
- A holistic view (context, input, process, product evaluation) of TBMCS training that shows the impact of training, not only on the individual but on the USAF as well.

ESC was proactive in meeting the learning and technology needs identified in the ADL initiatives and DoD Strategic Plan when developing TBMCS training material. A great deal of progress was made in shifting from a paper-based, instructor-led training program established in 1995, to a distributed, web based training program led by facilitation upon fielding in 2001. Meeting the requirements of anywhere, anytime, and anyplace learning requires solutions to many technical, security, and financial barriers. As users from locations worldwide attempted to access TBMCS materials located on distributed servers, three problems emerged. The first problem was accessing materials from remote locations; the second was NIPRNET bandwidth; and the third was local computer security initiatives hindering the use of web servers at user locations.

1.3 TBMCS TRAINING CONCEPT, DESIGN AND DEVELOPMENT

Kemp, Morrison, Ross (1998) suggested before starting an instructional devebpment project, management should ask themselves “Why do we need instruction?” For TBMCS, it was evident that users needed to learn how to use the software application when it arrived at their desktop. Specific job training has precise, immediate requirements with identifiable and often measurable outcomes. The training material development must stress the teaching of knowledge and skills for the performance of assigned tasks. Kemp, Morrison, & Ross (1998), US Air Force Instruction 36-22 (1997), and Clark (2000) all identify a common ISD process consisting of the following:

- **Analysis** ¾ identifying tasks and skills requiring training
- **Design**¾ identifying the objectives, test questions, and sequencing of instruction
- **Development**¾ creating the courseware and activities
- **Implementation**¾ conducting the training
- **Evaluation**¾ reviewing the training design, development, and implementation of the course

Since the ISD process provides a structured, systematic means of providing training, the TBMCS training development contractor was required to follow the process to complete the distributed training effort. The following best practices and lessons learned are identified from each phase of the ISD process.

1.3.1 Requirements Identification - The Analysis Phase

Due to cost constraints at ESC, the developing contractor was not requested to conduct a Task and Skill Assessment (TASA) to determine the precise tasks and skills required for training on TBMCS. Instead, the key tasks identified as training requirements from the legacy TASAs were deemed adequate to transfer to the TBMCS training development contract. Jonassen, Hannum, and Tessmer (1989) stated that the TASA is probably the most important component of the ISD process. All future instructional strategies and decisions are based upon the results of the TASA. Thus, the quality of the task analysis determines the quality of instruction. Wolfe et al. (1991) stated that once job tasks are identified they must be prioritized to focus on key tasks that are most critical, difficult, and frequently used. Without an original TBMCS TASA, the developing contractor was required to provide training materials supporting all 2,140 tasks identified from the legacy TASAs. This decision is critical in understanding the direction of the training contract from its conception. This proved to be a poor decision that resulted in additional costs to the training contract.

1.3.2 The Cost of Paper - The Design Phase

DoD I 5000.2 states that training for major weapon system components shall not be procured before the weapon system hardware and software design stabilizes. However, the software acquisition life cycle identified in AFI 63-123 requires prototypes, tests, and low-rate, initial production of C2 applications during a 6-18 month spiral development schedule. Each TBMCS spiral test requires hundreds of testers to be trained. As a result, training materials must be developed simultaneously with software development. This poses a significant problem for the training developer. Each time the software is modified there is an equal and parallel effort required in updating and distributing the training materials. Paper-based training materials for a large C2 system are costly. During the time of contract award in 1995 the estimated number of users (operators, system and network administrators) was approximately 2700. It was assumed at this time that all students would receive copies of all training materials (student materials, programs of instruction, and lesson plans). Figure 1.3-1 depicts the cost to produce one hard copy of the full set of TBMCS training materials

Cost of Paper based Training Materials		
Paper-based Training Materials for Operators, System Administrators and Network Administrators	107 modules x 500 pages x.07 per page for reproduction * 2700 students	$10,111,500.00
Paper-based Program of Instructions (POIs) for Operators, System Administrators and Network Administrators	5 POIs x 60 pages x.07 per page for reproduction * 2700 students	$5,670,000.00
Paper Based Lesson Plans (LPs) for Operators, System Administrators and Network Administrators	5 LP x 60 pages x.07 per page for reproduction * 2700 students	$1,890,000.00
Total Paper-based Training Efforts		**$17,671,500.00**

Figure 1.3-1. The Cost of Paper

When training requirements are identified early in a program life cycle, development costs can be budgeted in incremental amounts over the life of the contract. The original cost estimate of TBMCS training material development and implementation was expected to be no greater than 10% of the overall software development effort. TBMCS training development costs upon contract conception in 1995 were anticipated to be $40 million dollars that were to be divided into progressive increments over the five-year contract. With an estimated $17 million in reproduction costs alone by 1997, ESC quickly realized that a major change in software functionality requiring updates and dissemination of training materials would seriously affect the TBMCS training development budget. Campbell and Bourne (1997) stated that at some point educators and trainers will use the web to reduce costs, increase quality and increase the rate of new knowledge and innovation about how to support learning—or disappear themselves. With the high cost of reproduction, it appeared the web—a technology that enables students to access materials in a timely manner without distribution costs—was the delivery mechanism of choice for TBMCS. By mid 1999, the TBMCS material conversion from MS Word to HTML was completed. Customers of this distributed training were anticipated to be 5,000 multi-service operators and system administrators who use TBMCS in their wartime duties. The goal was justifiable—users had immediate access to training material anytime, anywhere, and anyplace as required by Joint Vision 2010 and the DoD strategic plan/ADL initiative.

1.3.3 The Technology Chase - The Development Phase

In theory, web-based training provides immediate access to training materials as the acquisition life cycle progresses, and the software is updated. Although the materials were completed and accessible to multi-service personnel anytime, anywhere, and anyplace, there were still unresolved problems. In developing TBMCS training materials, the "knee jerk" reaction of converting to HTML as a media selection without a technology assessment of supporting architecture was a serious problem, which ultimately led to the cancellation of the web site. Ely (2000) stated that the rush to jump onto the distance education bandwagon is understandable in light of several factors: (1) everyone is doing it, (2) the promise of income and/or savings, (3) the ubiquitous presence of computers and networks available for users, and (4) the number of users who are not being reached by conventional education. Conversely, McNabb (2000) stated that historically implementing technology for technology's sake without regard for how the use of the technology will be integrated with the curriculum has failed. She further stated that a lesson learned from past technology implementation efforts is that a technology needs assessment is as critical as a TASA.

Somewhere in the quest for technology and the desire to "hop on the web bandwagon", the TBMCS technology/infrastructure plan was forgotten. As users from worldwide locations attempted to access the materials, three problems became apparent. The first was accessing materials from remote locations, the second problem was "bandwidth" (the real end-to-end communications speed for users), and the third was local computer security initiatives hindering the use of the web server at user locations. These issues significantly affected the success of the distributed learning initiative. The number of server hops required by users in locations such as Korea, Hawaii, and Germany to access the Colorado server were so numerous that most attempts were timed out, students became frustrated and often quit before completing the training. To resolve the problem three additional servers were placed at worldwide locations to lessen the geographic distance between the clients and servers. This effort was completed in August 2000. The cost of this effort is shown in Figure 1.3-2.

Training Infrastructure for Servers			
HW For Servers			
Distributed Servers	22,835.11	9	$205,516.00
Duplex Ultra 2 Chasis Upgrade			$427.00
Hot Plug Power Supply			$943.00
Prolieant 6000 Internal Drive Gage, SCSI-3			$298.00
Ram up-grades			$3,591.00
Redundant Fan Kit			$309.00
Smart Array 3200 Controller			$1,737.00
Laptops for MTTs	3,541.05	20	$70,821.00
Total HW for Severs			**$283,642.00**
SW For Servers			
Microsoft Windows NT 4.0 server doc kit, server license, service pack CD			$15,577.00
McAfee Anti-Virus v4.03			no cost
Netscape Navigator v4.07			no cost
Netscape security certificates		8	$2,000.00
Oracle Enterprise Edition v8i	12,444.00	9	$111,996.00
Plateau Enterprise v3.1		9	$172,750.00
WebTrends Professional Suite v4.0		8	$7,664.00
Misc Server SW			$1,023.00
Total SW for Servers			**$309,987.00**
Total HW/SW for Servers			**$821,368.00**

Figure 1.3-2. Infrastructure Costs

Bandwidth (response times for end users over the available communications path) was a great concern on the military bases containing the newly placed distributed servers. During an independent assessment conducted January through March 2001 by MITRE Corporation, with users initiating access via private internet service providers, access times to the training server at Hurlburt AFB in Florida were more than three times as slow as access times to the contractor's server in CO. In another specific test, simple "ping" commands were transmitted between the Colorado Springs, CO facility's training server and the corresponding server at Hurlburt AFB FL to assess the round trip communication time over the NIPRNET network. Round trip times were repeatedly documented as taking 10 seconds. Conversely, when simple "pings" were transmitted between civilian locations (MITRE's Bedford, MA facility through numerous routers, over a dedicated T3 communications line, to a server at the MITRE Washington, DC office) round trip times were 10 milliseconds. Plateau required Oracle replication of the student databases between locations. However, with the military facility NIPRNET infrastructure taking 1,000 times as long to accept and return simple ping transmissions, the feasibility of expanding database synchronization to a worldwide set of servers was judged to be very doubtful.

Student database transmission also requires ports in the firewalls to be accessible to exchange data. Local military base firewall policies hindered successful operation of the distributed servers. Security managers at certain locations would not allow Oracle database exchanges to occur through their firewall. Without an approved certification and accreditation package, distributed servers could not be used for training.

1.3.4 Summative Review of The Implementation - The Evaluation Phase

The TBMCS C2 software system and associated web-based training was fielded October 2000 through June 2001 based upon System of Record (SOR) decision by the Joint Configuration Control Board (JCCB). Mobile Training Teams (MTTs) traveled to force-level locations to facilitate the distributed training for the various system administrators, operators, and Perimeter Security System (PSS) network administrators. A preliminary evaluation was conducted October-December 2000 at the first four fielded locations. As users began to access the training materials, student feedback was negative due to scrolling text pages and lack of interactivity. This design defied many aspects of learning theory and web design. Nielson (1997) identified long scrolling pages as the sixth most common mistake in web design. He stated only 10% of users scroll beyond the information that is visible on the screen when a page comes up. All critical content and navigation options should be on the top part of the page. Moore (1989) defined interactivity in distance learning as: a) between the learner and the content; b) between the learner and the instructor; and c) between the learner and peers. TBMCS distributed training lacked all levels of interactivity. Results of the student End of Course (EOC) critiques, student achievement tests and focus groups are shown in Figure 1.3-3.

Location	Legacy Experience	TBMCS Experience	Satisfaction Means	Average Pre-test Scores Before Training	Average Post-test Scores After Training	Focus Group Comments
Shaw	50%	60%	74% overall 63% materials	61%	86%	Training lacked interactivity. Facilitators lacked operational knowledge of the system.
Osan	-	-	-	75%	89%	Training lacked interactivity. Facilitators lacked operational knowledge of the system.
Miramar	0%	23%	80% overall 75% material	52%	88%	Training lacked interactivity. Facilitators lacked operational knowledge of the system.
Elmendorf	38%	0%	72% overall 65% material	58%	89%	Training lacked interactivity. Facilitators lacked operational knowledge of the system.

Figure 1.3-3. Preliminary Feedback Distributed Learning

Although the data was preliminary, the EOC critiques suggest that the students were not "satisfied" with the concept of self-paced distributed learning with little human interaction; however, pre-/post-test scores revealed that students understood facts and concepts, which suggests that knowledge "achievement" resulted from the training. To better understand why the user satisfaction was low, ESC focus groups were conducted with the students at the training events. The largest single improvement the users wanted to see was facilitator-led interactivity with the "TBMCS system" versus the "TBMCS training materials". Students believed training would be greatly enhanced if they had facilitator-led, hands-on exercises versus facilitating web-based training. User perception weighs heavily on ESC training acquisition strategy. Although distributed learning environments are dictated by DoD policy, user preferences are for MTTs.

This requirement was identified to the Training Planning Team (TPT) for validation. ESC was requested to a) enhance the web-based training by adding interactivity, and b) shift from a distributed learning environment back to a traditional instructor-led, "hands-on" approach to training. The type of interaction chosen was between the "learner and the content". Roblyer and Ekhaml (2000) defined this type of interaction as "reciprocal events requiring two objects and two actions". They identified an instructional goal of interaction as encouraging reflection and/or discussion on course topics and concepts by utilizing instructional design to increase the participation and feedback. The tool of choice to implement interactivity for the TBMCS training materials was Macromedia's Dreamweaver. Vora (1998) stated What You See is What You Get (WYSIWYG) editor function like word-processing or desktop publishing programs, allowing authors to lay out pages as they want, and the WYSIWYG editors write the necessary HTML code in the background. The updated training materials were posted on the web server in June 2000. Technology insertion/conversion efforts include new hardware, software and training. Cost for the Hardware/Software (HW/SW) material updates are shown in Figure 1.3-4.

Development & Integration	Cost Per Unit	Number of Units	Total
HW For 46 training developers	**2,065.00**	**46**	**$94,990.00**
SW For training developers			
Web Trends	499.00	46	$22,954.00
Astra Site Manager	499.00	46	$22,954.00
Dreamweaver HTML Editor & Course Builder	722.00	46	$33,212.00
Replacement SW from Unix to PC			$25,168.00
Paint Shop	46.00	46	$2,116.00
Total SW For Servers			**$106,404.00**
Total Development & Integration costs for infrastructure			**$201,394.00**

Figure 1.3-4. Cost to Upgrade HW/SW and Skill Training

Facilitator-led Practical Exercises (PEs) were added to the course curriculum to fulfill the requirement for instructor-led, hands on. Instructors who participated in the earlier fielding gained valuable insight into the user requirements. An important discovery was that not all operators (operations, plans, intelligence) required training on all products. PEs were designed to focus on duty positions and job tasks within the Air Operations Center (AOC). This allowed a clearer division to be made between the training provided within the AOC cells. The tasks and skills that were used most frequently were identified as candidates for facilitator led PEs.

1.3.5 TBMCS 1.0.1 - Fielding And Training Process

The primary objective of TBMCS training is to attain and maintain the capability to operate and administer the system. A secondary objective is to develop advanced skills that facilitate increased effectiveness of the system. These objectives are met through type-1 training. AFI 36-2201 identifies type-1 training as "contract training" or "factory training" that Air Education Training Command (AETC) arranges for Air Force and other DoD personnel and contractors to conduct at either the contractor's location or a DoD facility. Due to large numbers of geographically dispersed personnel requiring TBMCS training, surge training of 100 percent of the TBMCS user population was not economically or physically possible. Thus, a train-the-trainer philosophy was chosen and approved by the Joint Air Operations (JAO) Training Planning Team (JAOTPT). Initial train-the-trainer training for TBMCS 1.0.1 was provided for personnel with previous legacy system experience. In theory, this approach provides training to a core cadre of personnel from all locations, which then relied on those students to train remaining unit personnel through On-the-Job-Training (OJT).

Limited initial cadre training was provided to operators and system administrators via MTTs at selected regional sites worldwide based on the train-the-trainer concept. Training was targeted for experienced legacy operators and system administrators. The degree of training was constrained to differences between the SOR of the legacy systems and TBMCS 1.0.1. A fielding decision + 300 days was anticipated for the services to complete installation, training, system accreditation, OJT, and system cutover. Type-1 training for system administrators and operators began at selected locations 30 days after the SOR decision. System administrators were trained on TBMCS installation processes by means of loading and configuring a training suite. Upon successful build of the training suite, operators were then provided hands-on training on the training suite. Type-1 training also included PSS installation and training for network administrators, and exercise support for operators.

1.4 DATA COLLECTION TECHNIQUES

Due to the numerous training baseline changes conducted during the overall software development evolution, inconsistencies of data collection, and lack of raw data, this study did not lend itself to a hypothesis testing approach. Instead, an exploratory research methodology was chosen to support Systems Program Director (SPD) concerns. Seven research questions presented in this report were identified by the SPD as the basis for determining the effectiveness of the TBMCS distributed training program. Kirkpatrick's theory of evaluation [satisfaction, learning, transfer, and Return on Investment (ROI)] was used to categorize the data collected. Overall data was gathered using four collection methods: surveys, focus groups, pre-/post-tests, and a student self-assessment.

1.4.1 <u>Research Questions</u>

- *Research Question 1*: Were the majority of students satisfied at the completion of training?
- *Research Question 2:* Will there be a difference in the students test scores after completing the training?
- *Research Question 3:* Will users be confident in their ability to perform key tasks upon completion of the training?
- *Research Question 4:* Is there a correlation between user experience and EOC satisfaction?
- *Research Question 5:* Will the students perceive the facilitator as knowledgeable about the course content?
- *Research Question 6:* Will students perceive that the course covered the key TBMCS skills specific to their work center?
- *Research Question 7:* Will students perceive that their units provided a workspace that supported a successful training environment?

1.4.2 Student Population

Upon system fielding, the total TBMCS user population is anticipated to be 5,000 multi-service system administrators, operators and network administrators. The train-the-trainer methodology trained a limited cadre of approximately 800 with MTTs at 21 locations. The trainees are geographically dispersed throughout multiple locations in the Continental United States (CONUS), and Pacific and European countries. AFI 13-1AOC, Volume 3, identifies the duty positions associated with the force-level operation of an air operations system. TBMCS operators, system administrators, and network administrators include contractors, military enlisted personnel, and officers. Students are both female and male, and range in age from 20-45 years with various educational backgrounds and experience levels. Training was conducted at the students' home station. A force-level operator course, a system administrator course and a PSS course were taught at 21 locations. The total Trained Personnel Requirement (TPR) is better understood based upon focus group discussions and System Program Office (SPO) observation during fielding. TPR for total joint operators is approximately 1350, joint system administrators is 300, and joint network administrators is 100.

1.4.3 Data Collection Model

The reason for evaluation is to determine the effectiveness of a training program. When the evaluation is done, we can hope that the results are positive and gratifying, both for those responsible for the program and for upper-level managers who will make timely decisions based on evaluation results. To demonstrate the effectiveness and value of the TBMCS distributed training program, Kirkpatrick's theory of evaluation was used. The following theories were evaluated prior to selecting a model:

- Kirkpatrick's Theory of Evaluation
- Stufflebeam CIPP model
- Stakes Countenance Model
- Sanders and Nifziger Checklist
- Gowin and Millman QUEMAC model
- Worthen and Sanders - Scriven's MEC (meta-evaluation checklist)

Kirkpatrick's model was designed for practitioners in the training field who plan, implement, and evaluate training programs. It was primarily chosen over the other models due to high usage rates, and validity for use by industry and Government. Figure 1.4-1 shows the Kirkpatrick IV Levels of Evaluation.

Level	Evaluation	Explanation	TBMCS Data Gathering
I	Reaction	Assesses participants' initial reactions to a course. This in-turn, offers insights into participants satisfaction with a course, a perception of value.	A questionnaire was used to gather quantitative data. A focus group was conducted to gather qualitative data
II	Learning	Assesses the amount of information that participants learned.	A knowledge-based pre- and post-test was used to assess the amount of information learned.
III	Transfer	Assesses the amount of material that participants actually use in everyday work after taking the course.	Students were asked to rate their ability to perform key tasks after training
IV	Business Results	Assesses the financial impact of the training course on the bottom line of the organization six months to two years after course completion.	Collecting data to identify experience levels, turnover rates, changing experience levels during test, and operational readiness inspection results is a longitudinal study not included in this report.

Figure 1.4-1. Kirkpatrick IV Levels of Evaluation

1.4.4 Instrumentation

Overall data was gathered using four collection methods:

- Surveys
- Focus Groups
- Pre-/Post-tests
- Student Self Assessment

1.4.4.1 Survey

The specific objectives of the survey were to obtain:

- valuable feedback to help evaluate the program
- comments and suggestions for improving the program
- quantitative information that can be used to establish standards of performance for future programs as explained in Kirkpatrick's Level I Evaluation-Reaction
- quantitative feedback to be used with the survey to validate user satisfaction as explained in Kirkpatrick's Level I Evaluation-Reaction

1.4.4.2 Focus Group

Focus groups are moderated group discussions designed to encourage free-flowing disclosures between students. TBMCS focus groups included ESC training representatives and students. Focus groups collect qualitative data and offer rich insights into the subject matter. Group dynamics and shared ideas provide results not obtainable from other research methods.

Specific objectives of this focus group were to:

- Obtain qualitative feedback to be used with the Survey to validate user satisfaction as explained in Kirkpatrick's Level I Evaluation-Reaction
- Identify a) user expectations, b) the satisfaction level, c) problems occurred, and d) areas for improvement.

1.4.4.3 Pre-test

Standardized tests are designed to fairly measure student achievement in different academic subjects. TBMCS test questions supporting training objectives were originally identified in the design phase as the TBMCS training material was developed.

The specific objectives of the pre-test were to:

- obtain initial data to compare with the post-test to validate the transfer of knowledge as explained in Kirkpatrick's Level II Evaluation–Learning
- Help instructors determine the strengths and needs of students in order to work with them to improve their individual academic skills
- Provide information to instructional designers to help determine how well training assisted users in learning

1.4.4.4 Post-test

At the completion of training, the pre-test, administered prior to the training, was re-administered as a post-test to all students to determine if the students' knowledge had improved.

The specific objectives of the survey were to:

- Correlate pre- and post-test scores to validate if a learning transfer took place as explained in Kirkpatrick's Level III–Learning

1.4.4.5 Self-Assessment

The self-assessment allows the instructors to gain an awareness of the confidence a student has in their ability to complete key tasks. It is not necessarily an accurate evaluation of an individual's ability, but does indicate how confident the training has left them. It is an indirect indication of satisfaction with the training and how well they learned what was taught. A likert scale of 1-5 was utilized. 1=Can't perform; 2=Perform with over-the-shoulder assistance; 3=Perform with only on-line help; 4=Perform without assistance; 5=Did not attempt task. Questions identified in the self-assessment are shown as appendix 2. Specific objectives of the self-assessment were to:

- determine the extent to which a change in behavior occurred because of the training as explained in Kirkpatrick's Level III Evaluation-Behavior
- determine students perceived ability to complete tasks after training
- help instructors determine the strengths and needs of students

- assist students in improving their individual academic skills
- assist in predicting if a change in behavior will occur during the first opportunity to utilize the skill set

1.5 FINDINGS

A major goal of this study is to determine the impact of training. For purposes of this study impact is viewed as "measurable learning" and "student perception" of learning. Perception drives motivation and emotion. Emotion drives attention and, in turn, memory. Abell (2000) stated emotion is often a more powerful influence on behavior than logic. Thus, it is an important indicator of course satisfaction. The research questions below have been supported with quantitative data from the end of course critique, pre-/post-test scores, focus groups and observable behavior by the program office.

Research Question 1: Were the majority of students satisfied at the completion of training?

Data indicated that 53.57% operators, 69.76 of system administrators, and 65.7% of PSS network administrators agreed that their expectations were met. Although the data reflect the majority of students being satisfied, the range is low, which means that training can continue to improve. Qualitative information from focus groups and observations conducted by the SPO reflected that many students had preconceived and/or negative attitudes in regard to the training. A common misconception was that the "TBMCS system" was unstable and difficult to use. Common observable negative attitudes appeared when students were required to learn via web-based training instead of instructor led. Students were often hostile, had short attention spans, and showed resistance to learn without the instructor. Additionally, when the instructor-led approach was used many students had "anti-contractor" preconceptions, which interfered with learning. Observable behaviors such as increased persistence and voluntary engagement in the task was seldom noticed by the Program Office.

Research Question 2: Will there be a difference in the students test scores after completing the training?

Cumulative average gain for operators and system administrators was 37.5%. Student test questions are identified as learning objectives as the course is designed. With all students shifting from below average score (<75%) to above average (>75%) it can be presumed that learning objectives were met as a result of the instruction.

Research Question 3: Will users be confident in their ability to perform key tasks upon completion of the training?

The student self-assessment instrument was used to determine the confidence level of the users in performing key tasks. Response rate of the student self-assessment was 45%. Of the 45% who responded, 1.4% stated they could not accomplish the key tasks, 91.4% stated they could complete the key tasks with over-the-shoulder help, on-line help, or without help, leaving 7.3% who did not attempt the task after training. Students' perception of their ability to perform key tasks is high. The key to maintaining this perception is to refresh these skills with OJT and continuous exercises.

Research Question 4: Is there a correlation between user experience and EOC satisfaction?

Data indicated 64.35 % of force-level operators possessed less than the required 12 months legacy experience compared to 12.54% of operators who did possess the course prerequisite of 12 months legacy experience. Data in indicated that 53.57% operators stated the course met their expectations. Data indicated an average of 48.96% of system administrator students possessed less than 12 months of required legacy experience compared to 31.43% of system administrators who did possess the 12-month legacy experience prerequisite. Data indicated that 69.76% of system administrators stated the course met their expectations. Although the majority of operators and system administrators did not meet the required course prerequisites of 12 months of legacy experience, there appears to be a correlation between higher experience and higher course satisfaction as indicated by the system administrators.

Research Question 5: Will the students perceive the facilitator as knowledgeable about the course content?

A cumulative total of 72.55% of operator, system administrator and PSS students strongly agreed or agreed that the instructor was knowledgeable about the subject matter versus a cumulative total of 3.15% of students who strongly disagreed or disagreed that the instructor was knowledgeable about the overall course. This information reveals that the majority of students perceived the course instructors to be highly knowledgeable of the course content. Observations and focus groups indicated that students were frustrated with facilitator lack of knowledge when method of instruction was 100% web based; however, instructor credibility increased when method of instruction changed to instructor-led practical exercises.

Research Question 6: Will students perceive that the course covered the key TBMCS skills specific to their work center?

Data indicated that a cumulative total of 61.73% of students strongly agreed or agreed that the training provided was specific to their duty center versus a cumulative total of 13.92% of students who strongly disagreed or disagreed that the training provided was specific to their duty center. This information reveals that most students perceived the training provided was specific to their duty center. Observations and focus groups indicate a correlation between user experience and user perception of the training being specific to their work center. Those students who did not meet the 12-month legacy experience prerequisite exhibited a lack of understanding of the TBMCS system, data flows between cells, and how their duty position related to the tasks and skills supported by TBMCS.

Research Question 7: Will students perceive that their units provided a workspace that supported a successful training environment?

Cumulative perceptions about the course environment (equipment, network connection, temperature, noise level, workspace) revealed an average of 57.93% of the students agreed that the course environment was acceptable. An average of 11.31% of the students agreed that the course environment needed improvement. Focus groups and observations revealed that students were often unhappy about the physical work environment due to lack of air conditioning, close proximity of other students, and high noise.

1.6 BARRIERS AND LIMITATIONS

Seven barriers are identified as impediments to a successful implementation of the TBMCS distributed learning program. They are: inconsistent funding, change of training requirements, lack of established evaluation criteria, inconsistent On-the-Job-Training (OJT) programs after fielding, lack of technology planning, unknown factors for determining ROI, lack of local distance learning policy and management enforcement, and lack of awareness and understanding of changing roles and responsibilities for students and instructors in distance learning environments. These can be overcome if known in advance by the SPD and emphasis is placed on establishing processes to overcome these barriers. It is recommended that C2 program managers understand the respective impacts and consequences of these limitations as part of their decision making progress when allocating training budgets, identifying resources, and establishing processes.

1.7 CONCLUSION

The goals of this paper were to provide: a) a summative evaluation that identifies strengths, weaknesses, lessons learned, and best practices of the TBMCS training program, b) an in-depth analysis in assisting future C2 decision makers in determining what conditions distributed learning is likely to be effective in for future C2 systems, and c) a holistic view (context, input, process and product evaluation) of TBMCS training that shows the impact of training, not only on the individual but on the USAF as well.

1.7.1 Summative Evaluation

A summative evaluation that identifies strengths, weaknesses, lessons learned, and best practices is best summarized as follows. Strengths are identified as having a flexible contract and training development contractor. The TBMCS procurement strategy was a cost plus contract with a best effort clause. Although this acquisition strategy resulted in considerably more risk on the government, it allowed for changes in scope as more COTS technology became available. A fundamental weakness was managing the contract due to the high attrition of military personnel from Permanent Change of Station (PCS) rotations and in-house transfers. The Air Force does not maintain a training Air Force Specialty Code (AFSC) for officer personnel. As a result, most Air Force personnel lacked skills in applying the ISD process and evaluating the various products. A significant lesson learned was in the evaluation of the course. To avoid controversy and scrutiny from the services, neither the developing contractor nor the office responsible for managing the contract should be in the position to administer and assess survey results. It would be advantageous to all services if an independent party conducted the evaluation of a multi-service training program. Best practices are identified as utilizing the ISD process as the basis to obtain requirements and to design/develop the most cost effective and efficient training to meet users' needs. It allows for user validation of requirements, multiple reviews of templates, prototypes, demos, and end products, and opportunities for stakeholder decisions when technical and cost trade offs are required.

1.7.2 DL Environment

Determining the best condition for a distributed learning environment is challenging. A C2 SPD can have adequate funding, the best training materials, and deliver a quality product on time to all users in a traditional training environment. However, there are a myriad of obstacles that can contribute to the failure of the same training in a distributed learning environment. Prior to establishing a distributed learning environment decision makers must do their homework. The following questions are guides in determining if a supportive environment exists. Negative responses can quickly change a supportive environment into a hostile learning environment.

- Do distributed learning policies exist at national and local levels?
- Does my senior leadership embrace a vision that supports distributed learning?
- Do I have adequate and experienced personnel to administer and execute a training program in a distributed learning environment?
- Does my training contractor have experience in developing training and administering distance learning programs?
- Do I have control over the training budget?
- What is my commitment to a distributed learning initiative if my budget is cut?
- Does my network infrastructure support anytime, anywhere, anyplace learning?
- What are the network bandwidth, security constraints, and latency rates at the distributed locations?
- Does the military culture support distributed learning environments?
- Do the training managers at the distance locations have a process in place to support a distributed learning environment?
- What organizations can I collaborate with, share lessons learned and best practices of distributed learning?

1.7.3 Holistic View of Training

A model for a holistic view of training is best described by Deming (2000). He identified a systems theory as “a network of interdependent components working together to achieve a common aim.” Figure 1.7-1 tailors the systems theory to the training process. Input is defined as the requirements and regulations that feed the system. The ISD and MTT process is defined as the key processes to training during fielding. Process owners are defined as: AC2ISRC to ensure personnel receive Initial Qualification Test (IQT) prior to arriving at their duty station, ESC training contractor to design, develop and implement type-1 training, and the Major Commands (MAJCOMs) to ensure processes are in place for OJT and continuation training after type-1 training. Output is defined as a qualified C2 warfighter. Feedback is defined as qualitative and quantitative data provided by students after a course that is used to enhance future courses. The key to the systems theory is accountability. All process owners must complete their respective portion of the process in order to support the overall aim of the system. The aim of the system is defined as “a qualified C2 warrior”. When process owners are not accountable, the system becomes dysfunctional and training objectives are not met. Without a proper training infrastructure the system as a whole cannot survive.

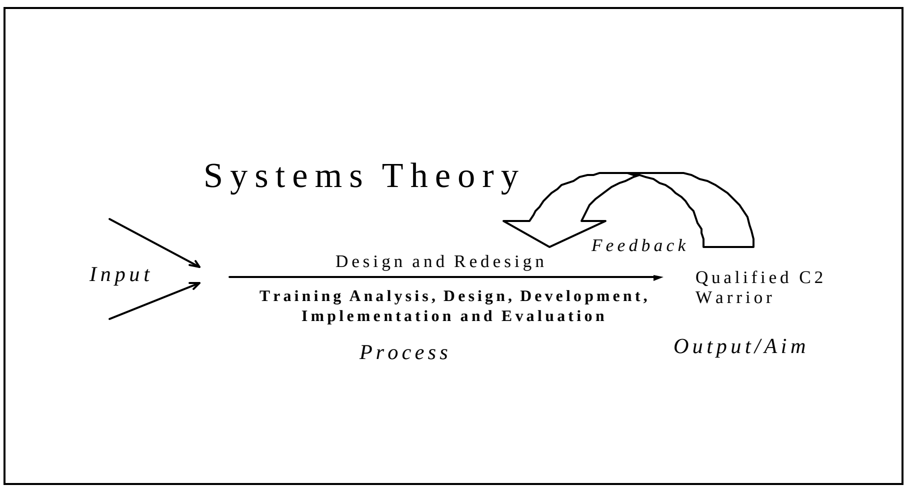

Figure 1.7-1. Deming System Theory as it Applies to Training

2.0—IN RESPONSE TO THE WARFIGHTER

TBMCS BACKGROUND

The mission of TBMCS program is to develop, integrate, field, and maintain an evolving sequence of increasing capabilities for joint and combined forces. This computer-supported management of theater airborne assets is used in peacetime, exercise, and wartime environments at the force, ASOC and unit levels. "Force level" refers to the headquarters elements of an Air Force, Navy, or Marine operating command, or of a numbered air force, unified command, sub-unified command, joint task force, or combined (multi-national) command, whereas "unit-level" refers to the wings and squadrons, which take direction from the force level organization. ASOC refers to Air Support Operations Center that normally provides direct support to the senior Army ground force organization.

TBMCS provides automated command and control (C2) and decision support tools to improve the planning, preparation, and execution of joint air combat capabilities. The tools also provide C2 support for operations other than war, e.g., humanitarian, United Nations peacekeeping, etc. The system provides full support to force-level and unit-level warfighters throughout all phases of military operations: Readiness, Deployment, Employment, Sustainment, and Reconstitution.

TBMCS is the C2 system for the senior theater air commander, the Joint Force Air Component Commander (JFACC). It links the various organizational levels of air command, control and execution. TBMCS facilitates air battle planning, intelligence operations, and execution functions for all theater air operations. The system provides functional connectivity horizontally to other services and allies, and vertically among standard or air expeditionary wings, deployed units, and higher headquarters. TBMCS provides tasking for all air assets in the Area of Responsibility (AOR) and produces the joint Air Tasking Order (ATO). TBMCS is a modular system designed to build up or scale down capabilities accommodating variations in information sources, operating units, weapon availability, participating services and allies, dispersal requirements, and intensity of operations.

TBMCS provides the JFACC with the means to plan, direct, and control all theater air operations in support of command objectives and to coordinate with ground and maritime elements engaged in the same operation. The system fully supports peacetime training and daily operations as well as timely reaction to contingencies. TBMCS implements interoperability with other Command, Control, Communications, Computer and Intelligence (C4I) systems. TBMCS replaced legacy Air Force C4I systems supporting theater air operations: Contingency Theater Automated Planning System (CTAPS), Wing Command and Control System (WCCS), Combat Intelligence System (CIS), and ASOC Modernization program.

TBMCS Version 1.0.1 established the TBMCS Common Core, which was the basis of future integration. This core foundation included the operating system and its utilities, network functionality, security features, common support functional capabilities, databases, and services necessary for system operation. Building on the core foundation, mission application products are integrated each year into a cohesive C2 system through an evolutionary acquisition program.

TBMCS also provides evolutionary automation features such as web enabled application environments coexisting with the Unix operating system environment. Another significant feature is the implementation of a common database design throughout TBMCS. This design allows common application access to common data and provides for improved information availability at all TBMCS sites through the use of data distribution. This is a significant paradigm shift away from reliance on formatted messages for information exchange.

2.1 TBMCS AND SEPTEMBER 11TH

On September 11th terrorists attacked New York and Washington, DC, murdering thousands of innocent people -- Americans and people from dozens of countries and all races and religions—in cold blood. On October 7th, less than a month later, we had positioned coalition forces in the region, and we began military operations against Taliban and al-Qaeda targets throughout Afghanistan. Since that time coalition forces have flown over 2,000 sorties, broadcast 300-plus hours of radio transmissions, delivered an amazing 1,030,000 humanitarian rations to starving Afghan people…We are now fighting a new kind of war. It is unlike any America has ever fought before. Many things about this war are different from wars past-but, as I have said, one of those differences is not the possibility of instant victory…The attacks of September 11 were not days or weeks but years in the making. The terrorists were painstaking and deliberate, and it appears they may have spent years planning their activities. There is no doubt in my mind but that the American people know that it's going to take more than 24 days. Our task is much broader than simply defeating the Taliban or al-Qaeda—it is to root out global terrorist networks, not just in Afghanistan, but wherever they are, to ensure that they cannot threaten the American people or our way of life. This is a task that will take time to accomplish. Victory will require that every element of American influence and power be engaged.

Nov 1 Defense Donald H. Rumsfeld

2.1.1 Operation Enduring Freedom

The military phase of the War Against Terrorism began October 7, 2001 under the name "Operation Enduring Freedom." Since then, coalition forces have liberated the Afghan people from the repressive and violent Taliban regime. As President Bush and Secretary of Defense Donald Rumsfeld have said…"this is a different kind of war against a different kind of enemy. The enemy is not a nation—the enemy is terrorist networks that threaten the way of life of all peaceful people" (http://www.whitehouse.gov/homeland/).

TBMCS supported the Air Operations Center (AOC) at Prince Sultan Air Base, Saudi Arabia throughout all phases of the command and control cycle during Operation Enduring Freedom. TBMCS provided automation support in strategic planning, target analysis, defensive planning, airspace planning, and strategy to task analysis. The outputs of which provided the foundation for AOC personnel to conduct air battle planning, weaponry, developing precise airspace control measures, and a detailed air battle plan. TBMCS was also used by the AOC to provide tasking for the joint air battle forces, unit scheduling and mission preparation activities. TBMCS execution management applications provided timely execution of the air battle plan and allowed AOC personnel to react quickly to changing battlefield situations. TBMCS applications also supported mission analysis and reporting activities that fed back into the joint command and control process.

2.1.2 Operation Noble Eagle

The mission of the Homeland Security Department is to protect the American people against terrorist attack. Operation Noble Eagle was the official name given to the homeland defense and civil support services in response to September 11th. The North American Aerospace Defense (NORAD) Command is a binational, United States and Canada, organization charged with the missions of aerospace warning and aerospace control for North America. TBMCS was installed in the CONUS NORAD Region (CONR) and Alaskan NORAD Region (ANR) to facilitate air sovereignty and air defense of the airspace of Canada and the United States. TBMCS was utilized by AOC operators at CONR and ANR in a defensive mode for airspace control, coordination, and management.

2.2 ESC/AC SUPPORT TO THE WARFIGHTER

TBMCS v.1.0.1 installation was completed just days prior to the September 11th tragedy. Navy, Air Force, and Marine warfighters in various AOCs and Tactical Air Component Centers throughout the world have been trained to use TBMCS to assess the intelligence threat, create air control orders, air tasking orders, air battle plans, schedule missions, and request close air support. Locations supporting Operation Enduring Freedom, and Noble Eagle contacted ESC/AC to request additional training to escalate the learning curve for their units. ESC/AC and the developing contractor quickly responded to the users request. ESC provided the necessary HW to operate TBMCS, and numerous Subject Matter Experts (SME) were immediately deployed to assist the warfighter. TBMCS users thrived with the just-in-time training environment, and over-the-shoulder help provided by ESC/AC and contractor SMEs. The web-based training materials previously developed were copied onto CD-ROMs and distributed to various sites to be used for refresher and on-the-job training for military personnel activated for duty. ESC/AC's response in the cry for freedom and security of the United States was benevolent, flawless, and valuable.

3.0—EVOLUTIONARY ACQUISITION

3.1 ACQUISITION POLICY

Air Force Instruction (AFI) 63-123 identified evolutionary acquisition as a nontraditional, overarching acquisition strategy that a program can use to develop and field a core capability meeting a valid requirement with the intent to develop and field additional capabilities in successive increments. An increment is defined as a distinct set of planned activities supporting the goal of delivering an operational capability to the user. The suggested schedule delivery of each increment is 18 months or less, with possible simultaneous increments. The result of an EA strategy is a continual evolution of a system toward fulfilling its overarching operational requirements with the ability to incrementally refine requirements and exploit opportunities as they arise. The use of a spiral development process is intended to be the primary development methodology for two types of modernization activities: 1) Evolutionary Acquisition Programs, and 2) C2 related technology demonstrations/experiments. The result is operational requirements that will evolve in parallel with system capabilities through an iterative process of idea generation rapid prototyping, technology insertion, and operational testing.

3.2 OPERATIONAL TEST AND EVALUATION POLICY

DoD Instruction 5000.2-R states that the test and engineering strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulation, evaluate technical performance and system maturity, and determine whether systems are Operationally Suitable, Survivable and Effective (OSS&E), against the threat detailed in the system threat assessment.

AF Manuals 99-111 and AFI 99-101, and AFI 99-102 provide specific information about how the Air Force Test and Evaluation (T&E) process applies to test and evaluation of C4I systems. The purpose of Operational Test and Evaluation (OT&E) is to ensure the Air Force acquires and maintains OSS&E systems that meet user requirements. The OT&E process is based on the principle of predict—test—and compare. The Air Force acquisition and test community develops a hypothesis as a prediction of performance, the test is executed, and the data analyzed and compared to the original hypotheses or prediction. If the identified risk is acceptable, the test is complete. If the risk is not acceptable, refinements are made and the test is then repeated.

3.3 OT&E ADVANTAGES FOR TBMCS TESTING

When the OT&E process is followed, OT&E is an unbiased systematic event that provides valuable information. Throughout the life cycle of a system, T& E facilitates delivery of high quality products to the user. OT&E contributes and fulfills four primary objectives:

- identifies, assesses, and reduces the risk that costly hidden flaws remain in the system
- demonstrates the system is functioning as expected and will meet the needs of the users

- ensures OSS&E of the system
- contributes timely, accurate, and affordable information to support life cycle acquisition and logistic decisions

3.4 OT&E DISADVANTAGES FOR TBMCS TESTING

Programs using spiral development require some form of combined and/or joint testing. Testers must collaborate as much as possible through the test planning working group and teaming arrangements. A barrier to successful testing in TBMCS was reaching mutual agreement on test procedures within the joint community. DoD 5000.2-R identifies a life cycle management framework that states policies and principles for all DoD acquisition programs. This acquisition process is structured in logical phases separated by major decision points called milestones. AFI 63-123 is an Air Force acquisition unique instruction that recommends acquisition strategies that quickly adapt to evolving requirements and shortening technology lifecycles. Traditional DoD acquisition processes developed during the cold-war era were oriented toward larger systems designed for unique military requirements and are not often suitable for today's rapid technology changes and continuous requirement refinements. Although the goals for C2 systems are easily understood, they are Air Force centric. Thus, implementing the evolutionary acquisition strategy required substantial tailoring of the traditional acquisition milestones and phases in DoD 5000.2-R in order to accomplish Air Force specific C2 system goals.

3.5 FUTURE CHALLENGES

Evolutionary acquisition and spiral development are methods that will allow us to reduce our cycle time and speed the delivery of advanced capability to our warfighters. These approaches are designed to develop and field demonstrated technologies for both hardware and software in manageable pieces. Evolutionary acquisition and spiral development will also allow insertion of new technologies and capabilities over time. There are two basic approaches to evolutionary acquisition. In one approach the ultimate functionality can be defined at the beginning of the program, with the content of each deployable increment determined by the maturation of key technologies. In the second approach, the ultimate functionality cannot be defined at the beginning of the program, and each increment of capability is defined by the maturation of the technologies matched with the evolving needs of the user. Regardless of the approach the Air Force will always face three challenges; doing more with less, changing the way we do business, and mentoring others on the new processes. Continuous mission support requests resulting from the September 11th tragedy has left the Air Force with a limited manpower pool to obtain support for system testing and training. The acquisition community can expect to provide the same level of support with fewer personnel. Shifting from old practices and incorporating new processes requires a major paradigm transformation for acquisition professionals. Change agents are needed and mentors are encouraged to revolutionize day-to-day acquisition performance.

4.0—GLOSSARY AND REFERENCES

4.1 GLOSSARY

ADL	Advanced Distributed Learning
AETC	Air Education Training Command
AF	Air Force Instruction
AFSC	Air Force Specialty Code
ANR	Alaska NORAD Region
AOC	Air Operations Center
AOR	Area of Responsibility
ASOC	Air Support Operations Center
ATO	Air Tasking Order
C2	Command and Control
C4I	Command, Control , Communications, Computers and Intelligence
CAFC2	Combat Air Force Command and Control
CIS	Combat Intelligence System
CONR	CONUS NORAD Region
CONUS	Continental United States
COTS	Commercial-Off-the-Shelf
CTAPS	Contingency Theater Air Planning System
DL	Distance Learning
DoD	Department of Defense
EOC	End of Course
ESC	Electronic Systems Center
IAW	In Accordance With
HTML	Hypertext Markup Language
HW	Hardware
IMI	Interactive Multimedia Instruction
IQT	Initial Qualification Test
ISD	Instructional Systems Development
JAO	Joint Air Operations Center
JAOTPT	Joint Air Operations Training Planning Team
JCCB	Joint Configuration Control Board
JFACC	Joint Force Air Component Commander

MAJCOM	Major Command
MTT	Mobile Training Team
NORAD	North American Aerospace Defense
OJT	On the Job Training
OSS&E	Operationally Suitable, Survivable and Effective
OT&E	Operational Test and Evaluation
PC	Personal Computer
PCS	Permanent Change of Station
PE	Practical Exercise
POI	Program of Instruction
PSS	Perimeter Security System
ROI	Return On Investment
SME	Subject Matter Expert
SOR	System of Record
SPD	Systems Program Director
SPO	System Program Office
SW	Software
TASA	Task and Skill Assessment
TBMCS	Theater Battle Management Core System
TPR	Trained Personnel Requirement
TPT	Training Planning Team
USAF	United States Air Force
WCCS	Wing Command and Control System
WYSIWYG	What You See Is What You Get

4.2 REFERENCES

1. Abell, M. (2001). *Soldiers as Distance Learners: What Army Trainers Need to Know.* US Army Headquarters Training and Doctrine Command.
2. Campbell, J. & Bourne, J. (1997). Designing distributed learning systems. *ALN Magazine,* 1(2)
3. Clark, D. (2000*). Introduction to Instructional System Design*. [On-line]. http://www.nwlink.com/~donclark/hrd/sat1.html. Accessed October 6, 2000.
4. Ely, D. (2000). Looking before we leap. Prior questions for distance education planners. *Syllabus*, 13(10), 26-28.
5. Jonassen, D., Hannum, W. and Tessmer, M. (1989). Handbook of Task Analysis Procedures. Praeger. New Work.
6. Kemp, J. Morrison, G. & Ross, S. (1998). *Designing Effective Instruction*. (2nd ed.). New Jersey. Merrill Prentice Hall.
7. McNabb, M. (2000). *Conducting a needs assessment.* North Central Regional Educational Library. [On-line] http://www.ncrel.org/tandl/plan2.htm. Accessed October 6, 2000.
8. Moore, M. (1989). Three types of interaction. *The American Journal of Distance Education,* 3 (2), 1-6.
9. Nielson, J. (1997). *Top 10 mistakes in web design*. [On-line] http://www.useit.com/alertbox/9605.html. Accessed October 6, 2000.
10. Report to the 106th congress. Department of Defense Strategic Plan for Advanced Distributed Learning. 1999.
11. Roblyer, M. & Ekhaml, L. (2000). How interactive are your distance courses? A rubric for assessing interaction in distance learning. Proceedings from Distance Learning Association 2000, Callaway, GA. [On line] http://www.westga.edu/~distance/roblyer32.html. Accessed October 6, 2000.
12. Secretary of the Air Force (1997). Air Force Instruction 36-2201. *Developing, managing and conducting training.* [On line] http://afpubs.hq.af.mil/pubfiles/af/36/afi36-2201/afi36-2201.pdf. Accessed October 6, 2000.

12\. Secretary of the Air Force. Air Force Instruction 63-123 Evolutionary Acquisition for C2 Systems, 2000.

13. Tyler, J., and Harper, L, MarineNet moves out: Marine Corps Deploys online training. Training and Learning: The Edge Newsletter. Mitre Corporation.
14. Vora, P. (May 1998). Design methods and tools. *Interactions*.
15. Webb, W. (November 1999). Show me the return. *Technology Training.*
16. Wolfe, P., Wezel, M., Harris, G., Mazour, T., Riplinger, J. (1991). *Job Task Analysis Guide to Good Practice.* Educational Technology Publications, New Jersey.

17. Worthen, R., Sanders R., Fitzpatrick, J. (1997). Program Evaluation: Alternative approaches and practical guidelines. Addison Wesley Longman, Inc.