GUIDELINES FOR ASSESSING EXERCISE DESIGN: IMPLICATIONS FOR SCENARIO-BASED TRAINING

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ABSTRACT

Scenario-based training (SBT) exercises are being increasingly used in a variety of military and non-military environments. While frameworks exist to facilitate the exercise design process (e.g., Instructional Systems Development, Systems Approach to Training, Joint Training System, Event-Based Approach for Training), the extent that a resulting exercise design actually incorporates a given framework is rarely assessed. Without this assessment, there is no way to determine whether the exercise facilitates learning. One potential reason for the lack of assessment is that most frameworks describe the phases of an SBT exercise (i.e., planning, preparation, implementation, and analysis) as separate components. By looking at each component separately, a comprehensive assessment of the overall exercise is difficult. Effective assessment requires a framework which views the exercise phases as a system of inter-dependent components.

A systems-oriented approach to training design structures training opportunities by tightly linking critical tasks, learning objectives, exercise design, performance measurement, and feedback. While existing guidelines identify what characteristics should be present within a given component of a training system, few guidelines document the linkages that must be present across the components. Based on a review of team training literature and observations of training exercises, fourteen systems-oriented guidelines for exercise preparation, conduct, and debrief were generated. The guidelines, which are based on instructionally-sound principles for learning, were used to assess the utility of five SBT exercises designed by three organizations.

This paper will describe the use of the guidelines for assessing exercise designs. Specifically, the paper will: (a) provide an overview of SBT, (b) present the guidelines, (c) describe the application of the guidelines to assess five SBT exercises, (d) briefly discuss the findings and lessons learned from the assessments, and (e) outline implications for future research, development, and implementation.

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INTRODUCTION

Scenario-based training (SBT) exercises are being increasingly used in military and non-military environments. In schoolhouse training, a set of lessons makes up the curriculum. In SBT, in contrast, the exercise is the curriculum. The primary goal of SBT is to provide opportunities for a training audience to practice and demonstrate competencies associated with tasks which must be performed on the job.

Increasingly, technology is being used to support SBT. Advancements are being made in modeling, simulation, and networking to create virtual shared problem spaces that imitate naturalistic environments (Bell, 1995). These technologies are expected to provide enhanced training capabilities that will result in a reduction of the resources necessary to conduct training. While these advancements hold considerable promise for effective SBT, technology alone does not ensure that effective learning will result (Cannon-Bowers & Salas, 1997). Technology to support SBT must enable the employment of systematic, deliberate approaches to support (a) all phases of the training development process (e.g., planning, preparation, execution, analysis), (b) performance measurement, and (c) feedback.

The overall design of SBT exercises is often supported by an organizing framework (e.g., Instructional Systems Development - NAVEDTRA 110A, 1981; Systematic Approach to Training - Wong & Raulerson, 1974; Joint Training System - CJCSI 3500.02A, 1995). Each of these frameworks identifies a number of assessments that should be performed during the design, development, and implementation of training. These assessments generally focus on individual components of the training (e.g., task lists, training objectives, media selection, performance measurement, feedback). By

looking at each component separately, the extent to which a resulting exercise actually incorporates an overall systems approach is difficult. Without a systems-oriented approach to assessment, there is no way to determine whether the exercise facilitates learning.

One potential reason that a systems oriented approach for assessing SBT exercises is generally not performed may be due to the lack of a framework to conduct such an analysis. While existing guidelines identify what should be present within a given component of the training system, few guidelines document the linkages that must be present across the components.

This paper will present systems-oriented guidelines to support the assessment of SBT exercises. These guidelines are based on training literature and from observations of operational training exercises. Specifically, the paper will: (a) present the guidelines, (b) describe the application of the guidelines to assess five SBT exercises, (c) briefly discuss the findings and lessons learned from the assessments, and (d) outline implications for future research, development, and implementation.

EXERCISE DESIGN GUIDELINES

In an effort to provide a foundation for the assessment of SBT exercises, fourteen guidelines related to exercise design, development, and implementation were identified based on a review of the team training and performance literature and on-going team training research and development (R&D) in both military and non-military settings. The guidelines were written in a generic manner in order to be subject matter content free. This enabled the guidelines to be applied to any training and/or mission rehearsal setting that involves teams.

A number of important themes can be found throughout the guidelines. These themes are critical for establishing and conducting effective training. The themes are: (1) practice alone does not guarantee effective training; training involves feedback, knowledge of results, performance measurement, and meaningful opportunities to practice, (2) allowing 'free-play' during an exercise does not ensure effective training; participants need to be exposed to events that create opportunities to perform and receive feedback (i.e., a requirement for systematic design of exercises), (3) simply exposing teams to a task is not a sufficient condition for learning to occur; performance measurement and feedback tools are needed to enhance learning in these situations, (4) a simulation system is only a tool that may have utility for training, it is not training in and of itself, and (5) training requirements and objectives must drive the design and development of simulation tools not vice versa.

The guidelines complement existing systems oriented approaches for training design (e.g., Instructional System Design, Systems Approach to Training, Joint Training System, Event-Based Approach to Training). These approaches to training tightly link critical tasks, learning objectives, exercise design, performance measurement, and feedback (See Figure 1). In the case of the Event-Based Approach to Training (EBAT), exercises have been designed for a variety of training environments which have resulted in improved performance (e.g., Hall-Johnston, Smith-Jentsch, & Cannon-Bowers, 1997; Fowlkes, Lane, Salas, Franz, & Oser, 1994; Dwyer, Oser, & Fowlkes, 1995).

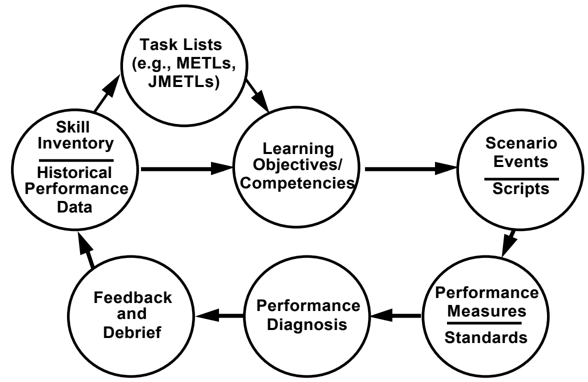

Figure 1. Systems Approach to Exercise Design

The following guidelines form the basis for the exercise evaluation process. Each guideline is followed by: (a) representative references from which the guidelines were derived and (b) a brief elaboration of the nature of the guideline.

GUIDELINE 1: Determine and document the overall purpose of the exercise (Cannon-Bowers & Salas, 1997; Hall, Dwyer, Cannon-Bowers, Salas, & Volpe, 1993). (e.g., to check off an annual requirement, to conduct mission rehearsal, to exercise the participating team and subteams, to test a contingency plan, to conduct training).

GUIDELINE 2: Establish and document the focus of the exercise (Federal Aviation Administration, 1990; Hall et al., 1993). (e.g., interactions within a team, interactions between teams, both intra- and inter-team interactions).

GUIDELINE 3: Develop and document clear objectives for the exercise (Federal Aviation Administration, 1990; Fowlkes, Lane, Salas, Franz, & Oser, 1994; Hall-Johnston, Smith-Jentsch, & Cannon-Bowers, 1997). The objectives should (a) specify the conditions in the exercise that are to trigger or elicit the behavioral responses, (b) specify the behavior of the desired responses (or category and range of responses required), and (c) specify some standard (speed, accuracy, completeness of response) by which feedback to the participants may be given.

<u>GUIDELINE 4:</u> Develop exercises that contain realistic circumstances that reflect real-world conditions and workload (Cannon-Bowers & Salas, 1997; Hall-Johnston et al., 1997; Prince, Oser, Salas, & Woodruff, 1993; Swezey & Salas, 1992). (e.g., situations with more than one right answer; situations where information may be conflicting, ambiguous, or incomplete; situations where multiple organizations must coordinate for effective performance).

<u>GUIDELINE 5:</u> Design and embed events into the exercise that require the trainees to demonstrate performance related to the exercise objectives (Federal Aviation Administration, 1990; Dwyer et al., 1997; Fowlkes et al., 1994; Hall et al., 1993; Prince et al., 1993). Events should be: (a) challenging yet reasonable given the exercise objectives, (b) identified prior to the exercise, (c) included for a specific purpose, (d) representative of realistic routine and non-routine circumstances that are characteristic of the task, (e) tied to performance measures and exercise objectives, and (f) adaptable to variations in the flow of the exercise and the performance of the participants.

<u>GUIDELINE 6:</u> Review of exercises by subject matter experts and pre-test the exercises with several individuals of the same type for whom the exercise is designed prior to implementation (Fowlkes et al, 1994; Hall-Johnston et al., 1997). Provide subject matter experts with opportunities to review the exercise to ensure that the content is relevant, realistic, and meaningful prior to implementation of the exercise. Perform "pilot-testing" of the exercises to identify and correct any aspects of the exercise that could not be established during the design process.

<u>GUIDELINE 7:</u> Develop an exercise management plan to facilitate the effective implementation and control of the exercise (Hall et al., 1993; Hall-Johnston et al., 1997). Identify the requirements for and roles of senior exercise personnel for overall exercise management (e.g., senior controller, senior role player, senior observer). The exercise management plan should include: (a) clear procedures for beginning and ending the exercise, (b) contingency plans to follow in case of unexpected events (e.g., communication problems, simulation problems), (c) the flow of the exercise, and (d) clear procedures for control of the exercise.

<u>GUIDELINE 8:</u> Develop performance measurement tools around the exercise events that provide a clear link between exercise objectives and participant performance (Federal Aviation Administration, 1990; Dwyer et al., 1997; Fowlkes et al., 1994; Hall et al., 1993; Prince et al., 1993). The relationship between events, objectives, and performance should be documented. Collecting the right data is necessary for exercise reconstruction and objective evaluation and feedback. The performance measurement tools should be: (a) tied to the exercise objectives, (b) organized around specific behaviors and skills that are identified to be critical for effective performance, (c) focused on specific behaviors and skills that can be observed during the exercise, (d) developed to facilitate the feedback process, (e) tied to specific events embedded in the exercise, (f) developed with subject matter expert input, (g) usable by observers and controllers with little training.

<u>GUIDELINE 9:</u> Design, develop, and implement computer-based simulation to support control of the exercise (Moses, in preparation; Sanders & McCormick, 1993; Wickens, 1992). The computer-based simulation should (a) reduce the workload of the controllers during the exercise, (b) assist the controllers in maintaining ground truth of the exercise, (c) possess simulation models that provide accurate accounts of resource status and environmental conditions, (d) maintain and display accurate accounts of resource status, (e) provide displays that are easily understood by all personnel with little or no training, (f) aid in the collection of data for feedback purposes, (g) allow rapid input and manipulation of data, and (h) have the capability to replay selected exercise segments.

<u>GUIDELINE 10:</u> Prepare and conduct pre-exercise briefing and hand out material to provide an orientation for the exercise participants (Cannon-Bowers & Salas, 1997; Hall-Johnston et al., 1997). The materials should include information related to: (a) an overview of the exercise purpose, focus, objectives; (b) an overview of the exercise schedule; (c) rules of the exercise; and (d) any simulation-specific limitations that may have an impact on performance.

GUIDELINE 11: **Prepare and conduct pre-exercise briefing and hand out material for exercise controllers, role players, and observers** (Hall et al., 1993; Hall-Johnston et al., 1997). The materials should include detailed information related to: an overview of the exercise purpose, focus, and objectives; a detailed description of the exercise flow; an overview of the exercise schedule; a description of each controller, role player, and observer responsibilities; the rules of the exercise; and any simulation-specific limitations that may have an impact on performance.

GUIDELINE 12: **Train controllers and role players to ensure the effective execution of the exercise** (Federal Aviation Administration, 1990; Hall-Johnston et al., 1997; Prince et al., 1993). Training should include information and practice related to: (a) observing key behaviors, (b) using performance measures, (c) inserting exercise events, (d) monitoring exercise progress relative to the exercise plan, (e) adapting to unexpected situations during the exercise, (f) controlling the exercise such that controller functions are transparent to participants, and (g) using exercise control equipment.

GUIDELINE 13: **Conduct the exercise according to the exercise management plan** (Federal Aviation Administration, 1990; Hall-Johnston et al., 1997). Ensure that: (a) exercise progress is monitored relative to the planned exercise; (b) controllers adapt, correct, and control the exercise so as to remain as close to the design objectives as possible; (c) the exercise is generally conducted in real-time; (d) the beginning and ending of the exercise is clearly communicated to all personnel; (e) resources are allocated in a realistic manner; (f) exercise rules are enforced; (g) significant deviations from the exercise plan are documented; (h) computer-based simulations are monitored for accuracy; and (i) the exercise is controlled in such a manner that controller functions are transparent to participants.

GUIDELINE 14: **Conduct post-exercise briefings (feedback) based on the objectives of the exercise** (Cannon-Bowers & Salas, 1997; Dwyer et al., 1997; Hall et al., 1993; Prince et al., 1993). Organize the feedback using observations made on the measures of performance. Support the feedback with meaningful demonstrations and illustrations of performance (e.g., replay of team communications or playback of displays showing resource location, resource status, and team communications) during key exercise events. In addition, solicit input from the participants regarding the exercise.

AN APPLICATION OF THE GUIDELINES

AN OVERVIEW OF THE DOMAIN

The following sections will describe the application of the guidelines to assess five SBT exercises developed for the U.S. Coast Guard. The scope of the exercises was to provide opportunities for oil spill management teams to practice "organization, communication, and decision-making in managing a spill response" (U.S. Department of Transportation, 1994). The exercises were designed as part of a larger effort to provide an enhanced capability for conducting simulation-based training for marine oil spill management teams.

Each of the exercises was conducted in different geographical locations. Although each training evolution lasted two or three days, the exercise portion of the training occurred in a single day over approximately eight-hours. Prior to discussing the specific application of the guidelines, a brief overview of oil spill management team tasks, team composition, and team training environment will be described.

OIL SPILL MANAGEMENT TEAM TASKS

The primary responsibility of a marine oil spill management team is to provide the necessary command and control functions in response to the discharge of oil in marine environments. These tasks involve decision making, resource management, and situation assessment. The oil spill management team must be capable of accessing and integrating a large amount of information from a variety of sources that may be ambiguous, incomplete, contradictory, or inaccurate.

Using information from a variety of sources, the team must develop strategies and plans to meet operational objectives over a specific period of time. The goal of the strategies and plans is to ensure that the right resources are at the proper location at the required time. Poor strategies and plans have the potential to result in ineffective management and resource allocation. Because, the strategies and plans may cover lengthy time periods (i.e., days, weeks, months), the effectiveness of a strategy or plan may not be known until a considerable amount of time has elapsed. This limits the ability of the team to receive immediate feedback for the purpose of changing the plans and strategies. Furthermore, although the team must focus on performance over extended periods of time, real-time changes in the operational environment must also be synthesized into new strategies and plans.

OIL SPILL MANAGEMENT TEAM CHARACTERISTICS

Oil spill management teams are often comprised of individuals from a variety of organizations representing different sectors (e.g., military, civilian, volunteers). While these teams can bring a considerable level of expertise and resources to task performance, it is possible that the diversity can complicate performance. Because members from one team may not possess a detailed understanding about the systems, procedures, terminology, goals, and tactics used by other teams, the establishment of the shared understanding may be difficult. The extent to which members of a team possess an appropriate degree of shared understanding can significantly impact team performance in positive and negative ways (Cannon-Bowers, Salas, & Converse, 1993).

Oil spill management teams are often organized around complex hierarchical structures. The membership of oil spill response teams can range from senior staff members responsible for the overall operation to junior personnel responsible for sub-elements of the operation. The information required by senior staff members is different than that required by junior staff members. While members of oil spill response teams are generally organized in a hierarchical manner, the teams must be capable of adapting their structures in response to changing situations. These characteristics can impact the requirement for and ability to exchange information (Urban, Bowers, Monday, & Morgan, 1995).

Many oil spill response teams perform in distributed environments. The separation limits the team members' ability to coordinate using traditional cues and as a result they must communicate via technologically mediated means. While advances in networking technologies have greatly improved the capability to send and receive information, research has suggested that technologically mediated communications are different than those that occur in non-mediated settings (Hollingshead & McGrath, 1995). Thus the nature of a physically distributed team can impact performance (Dwyer, Fowlkes, Oser, Salas, & Lane, 1997).

OIL SPILL MANAGEMENT TEAM TRAINING ENVIRONMENT

Opportunities for spill management teams to participate in training may be infrequent. Because of the multi-organizational composition of the teams, chances for these organizations to train in full complements do not frequently occur. For example, oil spill management teams may train in this configuration less than one time per year. The limited number of training trials has implications for the retention of skills. When these teams do have an opportunity to train, the training may involve a number of focal areas (e.g., academics, planning, execution). Also, an exercise in a given phase may last several days. These factors have implications for the retention of the knowledge and expertise. For example, knowledge acquired during one phase of training may not be retained for a following phase because of other activities that have taken place. These factors suggest that each training opportunity needs to be effectively designed and implemented to maximize the potential transfer to an actual marine oil spill situation.

ASSESSMENT APPROACH

ASSESSMENT OVERVIEW

The assessment was conducted by an analysis team composed of three to five individuals with considerable experience with SBT methodologies, strategies, and tools. Each of the team members had been involved in the design, development, and implementation of SBT exercises in a variety of team training environments. The analysis team made real-time observations associated with each of the guidelines prior to, during, and after the exercises.

It should be noted that although all of the guidelines are related to each other, the analysis group documented observations for each guideline independent from observations on other guidelines. This was performed to ensure that ineffective implementation of one guideline was not used as a basis for a poor assessment across all of the guidelines.

The observations took the form of handwritten notes. In many cases, the observations were supported with other pieces of relevant information (e.g., time, associated guideline, observation criticality, potential impact, criticality). In addition to observations, the analysis team also had some opportunities to conduct conversations and discussions with the exercise developers and exercise participants. These interactions supplemented the direct observations made by the analysis team and provided an important source of information. Specific approaches during pre-exercise, exercise execution, and post-exercise are discussed in the following sections.

PRE-EXERCISE

The members of the analysis team arrived at each exercise site 1-2 days before the exercise began. The analysis team used this period of time to review exercise support materials (to the extent that they were available upon arrival) and familiarize themselves with the physical layout of the exercise facility. The analysis team also attended pre-exercise briefings that may have been conducted for the participants, controllers, observers, and role-players.

EXERCISE CONDUCT

During the actual exercise, the analysis team made observations from a variety of physical locations. One member of the analysis team was stationed in the exercise control room throughout the entire exercise to monitor the activities of the exercise providers. Other members of the analysis team moved between different areas of the exercise facility make observations of the training audience's activities. The approach provided the capability to match observations made in the training audience areas with those obtained in the exercise control areas. This approach was particularly important for assessing the extent to which actions taken by the exercise provider influenced the training audience or vice versa. For those exercises that were designed around an exercise management plan or master exercise event list, specific observations were made using the framework established in these materials.

POST-EXERCISE

At the end of the exercise, observations were conducted during the after-action review and feedback sessions. The goal of these observations was to determine the extent to which feedback was provided to the training audience based on the training objectives, exercise events, and performance measures. In some cases, the exercise developers produced lessons learned reports that summarized the overall exercise. When available, these reports were also reviewed to determine the extent to which the exercise developer documented the exercise and provided meaningful assessment from which the training audience could implement in future exercises.

At the completion of the exercise, the analysis team convened to discuss the exercise in terms of each guideline. Using specific incidents observed during the exercise, the analysis team met and discussed their findings by going through each guideline, discussing each member's observations, and agreeing upon the content for the assessment report, guideline-by-guideline. Reports were then prepared by the analysis team and delivered to the project sponsor.

FINDINGS AND LESSONS LEARNED

APPLICATION OF THE GUIDELINES

Across the exercises, some guidelines--although implemented to varying degrees--could have been implemented more thoroughly. For many of the guidelines, the quality of the exercises generally increased from a given provider's first exercise to their second. Even though improvement occurred, there was opportunity for further improvement. For other guidelines however, there appeared to be no change from the first exercise to the second for a given provider.

Similarly, there appeared to be a sequential improvement across all exercises. This improvement was likely attributable to the fact that each provider had access to all previous assessment reports, consequently later exercises in the sequence had the potential to benefit more than earlier exercises. This suggests that improvements can be made in the design and implementation of exercises if a concerted effort is made to perform and communicate the results of SBT exercise analyses.

A major limitation observed across all of the exercises related to the manner in which performance of the training participants was measured. Recommendations were made to all exercise developers to focus on developing performance measurement systems that focus on assessing the processes used by team members. The measures need to focus on team processes within and between teams. Relatedly, a recommendation was made to all exercise developers to use these types of performance measurement data to support exercise debriefs.

ASSESSMENT METHODOLOGY AND APPROACH

The methodology and guidelines to observe SBT exercises was found to be effective. The guidelines appeared to capture the major systems-oriented characteristics of the exercises in that all observations could be clustered around one or more guidelines and that none of the exercise developers questioned the importance of the guidelines.

Using the guidelines, the analysis team was able to collect observations in real-time despite being distributed in different locations of the training facility. Furthermore, the observations could be easily aggregated to provide a meaningful analysis of the exercise's design. While this facilitated the rapid generation of an evaluation report at the completion of each exercise, the methodology could also be useful for identifying the requirement to make changes to an ongoing exercise.

Although the guidelines were used to assess the output of the exercise design process, the guidelines should be used to guide the design process. While an analysis after the completion of the exercise design process to verify the end product is important, effective use of the guidelines throughout the development process would enhance the potential for the exercise to be designed correctly the first time.

While utilization of the guidelines can enhance the design of exercises, resource constraints may preclude the complete or full implementation of all guideline components. As a result, exercise developers may have to focus on improvements in exercise design for a sub-set of guidelines. Exercise developers should identify those areas that are likely to result in the greatest enhancement to the overall training process. While an iterative approach is not optimal, careful allocation of resources to critical areas should lead to improved exercise design.

Finally, and perhaps most importantly, the training audience and developers of SBT exercises must be committed to improving their overall training process. An assessment of current SBT practices requires a willingness to identify existing weaknesses and to allocate resources to correct deficiencies. Without such a commitment, the findings of SBT analyses are likely to not be implemented.

CONCLUSIONS

The use of SBT in simulated and non-simulated training environments is likely to become more pronounced in the future. In many training environments, it will be the training environment of choice. While continued engineering is important, technological developments will not be enough. Additional work in the development of SBT strategies, methods, and tools--such as those offered through the guidelines must be pursued and applied if we expect to maximize training resources.

Other improvements could be achieved through effective design of the models, simulations, and networks used for performing exercises. These technologies need to be designed to provide software architectures and tools to support the development of SBT based on pedagogically derived principles. Efforts in this area will be an important step in the development of effective learning environments.

While the guidelines were applied to assess exercise-based training exercises developed for emergency oil spill response teams, the guidelines have considerable application for other team training environments (i.e., commercial and tactical aviation, ship-board command and control teams, multi/joint service military teams). The content-free manner in which the guidelines were documented supports their use in different team training domains.

In summary, while SBT has the potential to result in enhanced performance, the existence of an exercise by itself does not ensure effective training. Effective SBT requires that exercises are designed and implemented using a deliberate and systematic approach based upon instructionally-sound learning strategies, methods, and tools.

REFERENCES

Bell, H. H. (1996). “The Engineering of a Training Network” in “The Proceedings of the seventh annual International Training Equipment Conference”, Arlington, VA, pp 365-370.

Cannon-Bowers, J. A & Salas, E. (1997). A framework for developing team performance measures in training. In M. T. Brannick, E. Salas, & C. Prince (Eds.), Team performance assessment and measurement: Theory, methods, and applications. Hillsdale, NJ: Lawrence Erlbaum.

Cannon-Bowers, J. A., Salas, E., & Converse, S. A. (1993). Shared mental models in expert decision making teams. In N. J. Castellan, Jr. (Ed.), Current issues in individual and group decision making. Hillsdale, NJ: Lawrence Erlbaum.

CJCSI 3500.02A (1995). Joint training master plan for the armed forces of the United States. Chairman of the Joint Chiefs of Staff.

Dwyer, D.J., Fowlkes, J.E., Oser, R.L., Salas, E., & Lane, N.E. (1997). Team performance measurement in distributed environments: The TARGETs methodology. In M.T. Brannick, E. Salas, & C. Prince (Eds.), Assessment and measurement of team performance: Theory, research and applications. Mahwah, NJ: Erlbaum.

Dwyer, D.J., Oser, R.L., & Fowlkes, J.E. (1995). A case study of distributed training and training performance. Proceedings of the Human Factors and Ergonomics Society 39th Annual Meeting (pp. 1316-1320). Santa Monica, CA: The Human Factors and Ergonomic Society.

Federal Aviation Administration (1990, September). Line operational simulation: Line-oriented flight training, special purpose operational training, line operational evaluation (Advisory Circular No. 120-53B). Washington, DC: Department of Transportation.

Fowlkes, J. E., Lane, N. E., Salas, E., Franz, T., & Oser, R. L. (1994). Improving the measurement of team performance: The TARGETs methodology. *Military Psychology*, 6, 47-61.

Hall, J. K., Dwyer, D. J., Cannon-Bowers, J. A., Salas, E., & Volpe, C. E. (1993). Toward assessing team tactical decision making under stress: The development of a methodology for structuring team training exercises. *Proceedings of the 15th Annual Interservice/Industry Training Systems and Education Conference* (pp. 89-98). Washington, DC: National Security Industrial Association.

Hall-Johnston, J., Smith-Jentsch, K. A., & Cannon-Bowers, J. A. (1997). Performance measurement tools for enhancing team decision-making. In M. T. Brannick, E. Salas, & C. Prince (Eds.), *Team performance assessment and measurement: Theory, methods, and applications*. Hillsdale, NJ: Lawrence Erlbaum.

Hollingshead, A. B. & McGrath, J E.. (1995). Computer-assisted groups: A critical review of the empirical research. In R. A. Guzzo & E. Salas (Eds.), *Team effectiveness and decision making in organizations.* San Francisco: Jossey-Bass.

Moses, F. L. (Ed.), (in prep). Guidelines for using virtual simulation and Distributed Interactive Simulation (DIS) to train multi-service tactical operations. TAPSTEM: Washington DC.

NAVEDTRA 110A (1981). *Procedures for instructional system development.* Report 0502-LP-00000-5510. Department of the Navy, Chief of Naval Education and Training. Pensacola, FL.

Prince, C., Oser, R. L., Salas, E., & Woodruff, W. (1993). Increasing hits and reducing misses in CRM/LOS Scenarios: Guidelines for simulator exercise development. *The International Journal of Aviation Psychology*, 3(1), 69-82.

Sanders, M. S. & McCormick, E. J. (1993). *Human factors in engineering and design* (7th Ed.). New York: McGraw-Hill, Inc.

Swezey, R. W. & Salas, E. (1992). Guidelines for use in team-training development. In R. W. Swezey & E. Salas (Eds.), *Teams: Their training and performance* (pp. 219-245). Norwood, NJ: Ablex Publishing Corporation.

Urban, J. M., Bowers, C. A., Monday, S. D., & Morgan, B. B. (1995). Workload, team structure, and communication in team performance. *Military Psychology, 7(2)*, pp. 123-139.

U.S. Department of Transportation (1994). *National preparedness for response exercise program (PREP) guidelines.* Washington, DC. U.S. Department of Transportation

Wickens, C. D. (1992). *Engineering psychology and human performance* (2nd Ed.). New York: Harper Collins.

Wong, M. R. & Raulerson, J. D. (1974). *A guide to systematic instructional design.* Englewood Cliffs, NJ: Educational Technology Publications.