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ADVANCED ON-THE-JOB TRAINING SYSTEM:
SYSTEM LEVEL TESTING AND EVALUATION -
LESSONS LEARNED

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**ADVANCED ON-THE-JOB TRAINING SYSTEM: SYSTEMS LEVEL TESTING
AND EVALUATION - LESSONS LEARNED**

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This publication is primarily a working paper. It is published solely to document work performed.

SUMMARY

The Advanced On-the-job Training System (AOTS) was an Air Staff directed, Air Force Human Resources Laboratory (AFHRL) developed, prototype system which designed, developed and tested a proof-of-concept prototype AOTS within the operational environment of selected work centers at Bergstrom AFB, Texas, and Ellington ANGB, Texas, from August 1985 through 31 July 1989. The System Level Testing and Evaluation-Lessons Learned paper discusses the need to closely examine the constructs used to measure the Testing and Evaluation (T&E) objectives, use a flexible and comprehensive Master Test Plan (MTP) and collect background data to assess its influence on the deployment of the system. Standardized and practical training of the deployed technology will facilitate acceptance and use of the system. It was also found that the optimal compatibility with the AOTS was with participants who were computer literate, used the system on a regular basis, and were involved in On-the-Job Training (OJT). An additional implication of the T&E is to keep the evaluation and analysis practical and simple.



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PREFACE

The purpose of this paper is to share the conceptual insight gained from the formulations and revisions of the Master Test Plan (MTP) during the year-long Testing and Evaluation (T&E) of the Advanced On-the-job Training System (AOTS). The lessons to be learned from this field-based research effort will center on the major measurement objectives - the Critical Issues (i.e., Compliance, Acceptance, Suitability, and Performance). Assumptions underlying the Critical Issues are discussed, along with their usefulness during the T&E, and impact on the MTP. In addition, this paper will address human factors which proved to be compatible with the acceptance and use of the system. Finally, this paper will conclude with implications for future field-based research on technology deployed in the operational setting. The Air Force Human Resources Laboratory (AFHRL) work unit number for the project is 2557-00-02. The primary office of responsibility for management of the work unit is the Training Systems Division of AFHRL. The Air Force AOTS manager is Major Jack L. Blackhurst.

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ADVANCED ON-THE-JOB TRAINING SYSTEM: SYSTEM LEVEL TESTING AND EVALUATION - LESSONS LEARNED

I. INTRODUCTION

For over 10 years the Air Force has recognized deficiencies in the existing enlisted On-the-Job Training (OJT) system. The Air Force Human Resources Laboratory (AFHRL) conducted a study of the OJT system in 1975, and the Air Force Inspector General (IG) performed a functional management inspection (FMI) of OJT in 1977. Both efforts produced similar results: the OJT system was seriously deficient in training definition, delivery, evaluation, administration and personnel utilization. As part of a series of Air Staff-directed initiatives designed to correct these deficiencies, a follow-on study outlined the functional and automation requirements for Air Force OJT, developed a system specification, and picked a site for the design, development, test, and evaluation of an Advanced On-the-job Training System (AOTS).

Beginning in 1985, the team of AFHRL, Douglas Aircraft Company (DAC), and Ball Systems Engineering Division (BSED) began designing the prototype AOTS at Bergstrom AFB, Texas. A System Level Test and Evaluation (SLT&E) followed the successful completion of the development work in August 1988. Over 600 Active, Reserve, and Air National Guard personnel in five different specialties (452X0, 454X0, 732X0, 751X1, and 811XX) participated in the 12-month test; thirty-four work centers on Bergstrom AFB, Texas, and Ellington ANGB, Texas, were equipped with AOTS computers.

A field-based program evaluation approach was used to determine if AOTS satisfied four Critical Issues of the Master Test Plan (MTP) Compliance, Acceptance, Suitability, and Performance. While the first issue (Compliance) addressed the design and specification requirements, the remaining issues focused on the participants' use of the system. More specifically, the participants determined whether they liked AOTS and thought it was easy to use (Acceptance); the system solved the identified deficiency needs of the existing OJT (Suitability); and, whether AOTS improved the performance of individual trainees and exhibited the potential to improve the whole OJT system over time (Performance).

Overall, the results of the Critical Issues were favorable. All of the system specification requirements were met and users responded favorably toward AOTS and felt the automated features improved the efficiency of managing and conducting training. In addition, the system demonstrated the potential to improve task knowledge and task performance. Additional Testing and Evaluation (T&E) results are beyond the scope of this paper; more specific information can be found in the Final System Level Testing and Evaluation Results Report (Alba, Gosc, Blackhurst, Hays, & Marrero, 1990).

This paper will focus on the conceptual insight gained from the formulations and revisions of the MTP during the year-long T&E effort. Although there is a wealth of information to be shared, this paper will limit its focus on the basic tenants of the T&E--the Critical Issues. Assumptions underlying the Critical Issues and usefulness of these issues during the T&E will be discussed, followed by their affect on the overall MTP. In addition, specific information on human factor variables that were identified during the deployment of the AOTS will also be addressed. Finally, a list of implications for further field-based research will evolve from the concepts reviewed.

Measurement Assumptions of the Critical Issues

Measurement of the Critical Issues in the operational setting proved to be a major challenge. For the most part, these issues were measured by obtaining the participants' responses on an opinion survey. Respondents compared AOTS with conventional OJT and evaluated the impact

of the system on their OJT responsibilities. Comparative judgments were made on the utility, efficacy, efficiency, and relative merit of the AOTS. To make these judgments, the users needed to satisfy one of two basic assumptions: familiarity with either the AOTS or conventional OJT.

This assumption is based on the understanding that to judge the merit or relative worth of the prototype AOTS, one of two conditions must be satisfied. It was assumed that users would have a basic understanding of Air Force Regulation (AFR) 50-23 and, once AOTS was deployed, it would be used on a regular basis to conduct OJT. Neither of these two assumptions were realized to the level expected. Users conducted OJT in an unstructured manner with limited awareness of their OJT responsibilities, and the system was underutilized.

AOTS was designed to be in strict compliance with the Air Force OJT standards and AFR 50-23. When users were asked to judge AOTS, part of their judgments should have been based on how well AOTS met AFR 50-23. Because the average user of the system was minimally aware of this regulation (beyond completing the training records-- 623 forms), there was an incongruity in judging the system with this absolute standard. As you will note in the subsequent sections, this incongruity affected the judgment of some critical issues more than others.

Given the limitation of this standard to evaluate the AOTS, there are several questions that will be addressed. Namely, How useful were the Critical Issues (Compliance, Acceptance, Suitability, Performance) in evaluating AOTS? What revisions were made in the MTP to better evaluate AOTS in the operational setting? What human factors influenced the users' judgment of the efficacy, utility, efficiency, and relative value of the AOTS.

How Useful Were the Critical Issues in Evaluating the AOTS?

As the core structure of the SLT&E, the Critical Issues were essential. These issues served as constructs--concepts formulated for the specific purpose of observation and measurement (Kerlinger, 1973). These constructs are operationally defined to assign meaning and describe how a variable (e.g., Critical Issue) will be measured. Although operational definitions are indispensable, they are limited; they cannot express all of the meanings related to the variable or Critical Issue. Some of the Critical Issues were more subjective and difficult to operationally define than others.

The Critical Issues could be viewed as a hierarchy of least to most difficult to measure, beginning with Compliance and followed by Acceptance, Suitability, and Performance. Compliance is relatively easy to measure because it involves the objective measurement of the reliability and stability of the software. Software error rate and response time, for example, were objectively measured and rated. However, the remaining Critical Issues are more subjective and, consequently, more difficult to operationally define.

The Acceptance Issue is next on the hierarchy because it involves the basic judgment of whether the users liked the system and felt it was easy to use. According to our SLT&E results, participants who used the system on a regular basis liked it. Their acceptance was directly related to the regular use of the system. The other remaining issues, however, require a greater amount of differentiation.

A more complex issue is Suitability; it requires two levels of understanding. Participants needed to know Air Force OJT and learn the AOTS to judge whether the system meets identified OJT deficiencies. In some cases there were no OJT responsibilities that could be directly compared to an AOTS feature. For example, due to time constraints, performance evaluations are typically not administered, yet, participants were asked whether these evaluations were better for assessing task proficiency. As previously mentioned, these standards of judgment were not always comparable or at the level expected.

The final issue, Performance, ranks as the most difficult concept to measure. This difficulty is due to several factors: limited amount of time to determine performance differences, level of expertise required on the system, and involvement with OJT. Essentially, opinion survey responses related to this issue involved judgments on whether AOTS improved the quality and efficiency of OJT. In order to respond to these questions, the participant had to compare conventional OJT methods with the automated features of AOTS and infer the differential impact on training. Given the above mentioned constraints, such questions as determining whether AOTS provided trainees with the ability to perform tasks better than conventional OJT, or improved overall mission effectiveness was, in hindsight, an overly ambitious effort.

As constructs, the Critical Issues served their purpose; they provided the SLT&E with meaningful and measurable objectives. However, a closer look at these constructs reveal inherent difficulties with the underlying assumptions of some of the issues. Consequently, some issues were more difficult to measure than others. While the issues of Compliance and Acceptance were easier to measure, Suitability and Performance (in that order) presented more of a problem to evaluate.

What Revisions Were Made in the MTP to Better Evaluate AOTS in the Operational Setting?

The Master Test Plan (MTP) evolved to respond to the limitations of the last three Critical Issues--Acceptance, Suitability, Performance. Borich (1981) makes two useful distinctions in understanding the evolution of the MTP. Initially, the MTP had a "value oriented emphasis." This emphasis involved collecting and evaluating data on the basis of previously established criteria for the program (e.g., Critical Issues). As the MTP evolved, however, it became more flexible and comprehensive. Multifaceted data sources and supplementary evaluation efforts (e.g., Performance Study, individual interviews) resulted in a more global assessment of the OJT setting of which AOTS was a part. It evolved into a "systems oriented" approach, evaluating AOTS as a part of the ecological constraints and expectations that influence the OJT environment. This approach evaluated the extent to which field activities and organizational factors affected the outcome of the prototype and vice versa.

The more flexible MTP assessment approach included the collection of process and background data (see MTP for more specific descriptions). This flexibility resulted in the use of subsamples representing varying levels of usage of the AOTS. For example, a subsample of higher frequency users was identified and interviewed to obtain more valid feedback on the prototype. Process data consisted of standardized observations conducted on a regular basis at the work center level, documentation of information/assistance calls ("help hotline"), and computer records of system use by individual user identification number. In addition, a log of various activities during the deployment period was maintained. These supplemental measures expanded the MTP to include information on the reciprocal influences of the prototype-user-environment. The final MTP provided a more comprehensive, flexible and multifaceted assessment of automated technology in the Air Force OJT operational setting.

Human Factors Related to Outcome of SLT&E

An overall pattern of the SLT&E results revealed that the motivational aspects of learning and using the system can be described by the "Goodness of Fit" model. Although this model does not encompass all the possible factors that influenced the use of the system, it provides a heuristic model for understanding the SLT&E results. According to this model, the acceptance, utilization, and overall compatibility with the system was contingent on several user characteristics. These characteristics--computer literacy, regular use of the system, and involvement in training--were identified during the T&E and will be addressed individually.

The participants' familiarity with computers provided a greater likelihood of system acceptance and use. Based on work center observations, it was noted that some of the participants had

limited experience with computers and, consequently, were hesitant to use the system. These individuals were described as "computer phobic." Despite the one-to-one training and the user-friendliness of the system, some of the participants were afraid to make mistakes for fear of damaging the training records. In contrast, those individuals who were computer literate or not intimidated by computers were more willing to learn and use the system.

Once an individual received training on the system, it was important to maintain a level of regular use of the system. Regular use would allow a greater level of familiarity and ease in applying the various automated functions to complete OJT responsibilities. Participants who used AOTS on a regular basis became proficient on the system. Their motivation to learn the AOTS was linked to their involvement and need for the automated functions.

During the SLT&E, background training characteristics of participants who responded both favorably or unfavorably to the AOTS on the opinion surveys were analyzed. A major distinction among those who responded favorably was their involvement with training. They had an average of four to five trainees during the deployment period as opposed to one or no trainees among the less favorable respondents. In addition, Air Force Reserves supervisors, responsible for maintaining weekend personnel training records, were equally positive of the automated AOTS functions. Needless to say, the greater the need the higher the motivation to learn the system.

All of these characteristics provided a goodness-of-fit between the user and the AOTS. If the participant was not computer phobic or had some computer experience, spent time learning the system, and was involved in OJT, he or she was likely to be favorable toward AOTS. Although these characteristics are not meant to be all inclusive of those responding favorably toward AOTS, the optimal user-system compatibility was with participants that exhibited all of these characteristics.

Implications for Future Field-Based Research

The SLT&E of the AOTS provided an opportunity to conduct research in the operational OJT setting. Given the minimal research on Air Force OJT this field-based research effort provided the unique opportunity to understand Air Force OJT and the impact of the technology offered by the AOTS. Throughout the project, the major emphasis was to measure the impact of this system without being too intrusive and interfering with mission priorities. Overall, the challenge of evaluating this technology among the constraints and background characteristics of the operational setting was an informative and educational experience. The following is a list of implications of this effort that may be useful in future field-based research.

1. The development of the MTP should be preceded by a comprehensive evaluation of the operational setting. This evaluation should not be limited to identifying deficiencies but include the assessment of various factors that contribute to these deficiencies. Environmental events and constraints that influence the operational setting and unique training differences among the various specialties should be evaluated. This information would contribute to planning decisions in developing the prototype system. It would also provide a realistic awareness of the assumptions underlying the program evaluation objectives.

2. The SLT&E should include an MTP that is both flexible and multifaceted. Evaluation efforts should be implemented prior to and during the deployment of the technology. This approach would allow comparative baseline data and information that may result in modifications of the T&E efforts as needed. In addition, information collected during the deployment can be useful in understanding and interpreting the outcome data.

3. A structured training program is necessary to facilitate the learning of the system. Standardization of the training, use of visual aids, individual or small group training (no more than three people), and follow-up training are important. Emphasizing the most pertinent functions

specific to the individuals' OJT responsibilities would provide a level of practicality to the learning process. In addition, certification on the system based on demonstrated competency should be documented as part of the individual's training record. This recognition would highlight the training and enhance the motivation to learn the system. Moreover, it would help identify individuals who have learned the system and could provide valid feedback during the SLT&E.

4. Include an ecological or systems approach as part of the SLT&E. This approach allows the ongoing collection of background factors and events that have an impact on the deployment of a system and vice versa. It is just as important to be knowledgeable of how the ecological constraints and background factors affect the deployment of a prototype system as it is to know the impact the system has in the work setting.

5. The KISS principle ("keep it sufficiently simple") is important. Everything from the methodology, statistical analysis, and communication of results should be screened for practicality, accuracy, clarity, and brevity. There should be justification for all the data collection and every effort should be made to collect data in an unobtrusive manner. Given the experimental constraints of field-based research, the use of inferential statistics should be second to descriptive data. In most cases, results are best communicated and understood using basic descriptive statistics such as percentages, averages, and range of scores. The use of graphs to depict the T&E results is an art; it is a powerful tool in conveying results in a clear and succinct manner.

In summary, it could be argued that these implications are applicable to assessing the deployment of technology in other field-based research. Programmatic efforts to initiate change in the operational setting should be sensitive to the influence of contextual constraints and background factors. A systems oriented approach emphasizes the need to measure the impact and reciprocal influences of these environmental factors prior to and during the deployment of technology in the operational setting. Standardized training is recommended to assure a level of competency and acceptance. Given the rapid growth and availability of technology, it is likely that there will be demands for field-based program evaluation efforts similar to that used with the AOTS.

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