AFHRL-TP-90-23

AD-A225 886

AIR FORCE

HUMAN RESOURCES

ADVANCED ON-THE-JOB TRAINING SYSTEM (AOTS): SYSTEM LEVEL TEST AND EVALUATION RESULTS

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August 1990
Interim Technical Paper for Period August 1985 - February 1990

Approved for public release; distribution is unlimited.

LABORATORY

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NOTICE

This report has been reviewed and is approved for publication.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1. AGENCY USE ONLY (*Leave blank*)

2. REPORT DATE
August 1990

3. REPORT TYPE AND DATES COVERED
Interim - August 1985 to February 1990

4. TITLE AND SUBTITLE
Advanced On-the-job Training System (AOTS):
System Level Test and Evaluation Results

5. FUNDING NUMBERS
C - F33615-84-C-0059
PE - 63227F
PR - 2557
TA - 00
WU - 02

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Training Systems Division
Air Force Human Resources Laboratory
Brooks Air Force Base, Texas 78235-5601

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AFHRL-TP-90-23

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

This document summarizes a 4-year, three-phase effort to design, develop, and implement within operational work centers the prototype Advanced On-the-job Training System (AOTS). In addition to being one of the first major systems other than a weapon system to use Ada as the primary programming language, the prototype AOTS represents the most ambitious and comprehensive Instructional Systems Development (ISD) effort attempted to date within the Air Force on-the-job training (OJT) environment.

This paper outlines the procedures applied to evaluate the AOTS, and reports the results of a multifaceted field evaluation conducted while the AOTS was implemented in the work centers.

14. SUBJECT TERMS
AOTS, computer-aided training, on-the-job training, training, computer-based training, Instructional Systems Development (ISD), computer-managed instruction

15. NUMBER OF PAGES
53

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev 2-89)
Prescribed by ANSI Std Z39-18
298-102

AFHRL Technical Paper 90-23 August 1990

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

ADVANCED ON-THE-JOB TRAINING SYSTEM (AOTS)
SYSTEM LEVEL TEST & EVALUATION EXECUTIVE SUMMARY

Problems with the Air Force On-the-Job Training (OJT) system began surfacing in the late 1960s. In an effort to define specific deficiencies, the Air Staff directed studies be conducted by the Air Force Human Resources Laboratory (Stephenson, R. W., and Burkett, J. R., December 1975) and the Air Force Inspector General (PN 76-269, April 1977). Independent studies by these two agencies resulted in nearly identical findings:

a. Methodologies for identifying specific performance and training requirements were inadequate;

b. Valid evaluations of task knowledge and performance were infrequent and, when accomplished, lacked standardization;

c. Management focus was on Air Force Specialty Code (AFSC) skill level upgrade training and the ability of individuals to perform duty position tasks was being not addressed;

d. Reports submitted as a result of training program assessments focused on maintenance of training records rather than training effectiveness;

e. Methodologies for determining capacities of operational units to conduct training were lacking; and

f. Personnel assigned to the training specialty were being utilized to administer rather than to develop, maintain and manage training.

The Air Staff developed and implemented several initiatives aimed at correcting the deficiencies identified during the studies. The most dynamic initiative was the design, development, and test of a proof-of-concept, prototype computer-based Advanced On-the-job Training System (AOTS) that included all functions required for an effective training system. The purpose for the prototype AOTS was two-fold: 1) to determine whether modern computer and training technologies could be applied to provide solutions for the deficiencies identified in the two studies; and 2) to determine if the system would be suitable for implementation across the Air Force operational environment.

The Air Staff mandated that the prototype AOTS be designed, developed, and tested in an operational environment. The purpose was to ensure all functional requirements were included in the design and subjected to the conditions under which the system would operate if approved for Air Force-wide implementation. Bergstrom AFB, Austin, Texas was selected as the site at which the development of design and the system would occur. Bergstrom and Ellington ANGB, Houston, Texas were selected as the sites at which the System Level Test & Evaluation (SLT&E) of the prototype AOTS would occur. All Air Force components (Active, Guard and Reserves) and five Air Force Specialties were selected to participate in the SLT&E. The selected AFSs were:

a. Aircraft Maintenance, AFSC 452X4D/M;

b. Aerospace Propulsion, AFSC 454X0A;

c. Personnel, AFSC 732X0;

d. Security Police - Security, AFSC 811X0; and

e. Security Police - Law Enforcement, AFSC 811X2.

The prototype AOTS was one of the first major systems other than a weapon related system designated to use Ada(R) as the primary programming language. In addition, the prototype AOTS undertaking represented the most comprehensive single Instructional Systems Development (ISD) effort attempted to date in the Air Force OJT environment. Four years were allocated for the AOTS project. The effort was divided into three phases: Phase 1 for the preliminary design of the system and subsystems; Phase 2 for the detailed design of the subsystems and components and for the development of software required to implement the system; and Phase 3 for the SLT&E.

The prototype AOTS was comprised of five subsystems: Management, Evaluation, Training Development and Delivery, Computer Support, and Personnel and Support. The Management subsystem provided capabilities to identify training and evaluation requirements, identify resources required for training and evaluation, schedule training and evaluation events, manage trainee progress, maintain trainee progress data, and generate standard and ad hoc training reports. The Evaluation subsystem provided capabilities to develop and maintain behavioral objectives, develop and maintain test items, construct tests, deliver and score tests, collect and analyze test data, and assess the quality of training programs. The Training Development and Delivery subsystem provided capabilities to develop and deliver computer-assisted instruction. The Computer Support subsystem implemented system requirements and provided the necessary equipment. The Personnel and Support subsystem supported the determination of logistics support, maintainability, reliability and human factors requirements.

A Digital(TM) VAX 8650 computer located at Brooks AFB, TX hosted the system. During the periods of development and SLT&E, dedicated high-speed digital communication lines were used to transmit data between the host computer and work stations at the bases. Infotron(TM) Multiplexers were used to control and distribute communications at the bases. A typical work station at a base included a Zenith(TM) 248 personal computer, a Scantron(R) optical mark sense reader and an Alps(TM) P2000G dot matrix printer.

AFHRL and contractor personnel worked closely together to ensure the system design met all contractual and functional requirements. Following AFHRL approval of the prototype AOTS design, the project progressed to the development phase. Software required to implement the design, and evaluation and instructional materials required for use during task training of personnel participating in the prototype AOTS SLT&E were developed during this phase.

Prior to the scheduled SLT&E start date, the equipment necessary to establish prototype AOTS work stations was installed in the work centers designated to participate in the SLT&E. AOTS implementation was accomplished in phases with no major problems. Immediately following implementation within a work center, the personnel assigned to that work center were trained to operate the system and the conventional method of OJT was replaced by the prototype AOTS method.

A multifacted Master Test Plan (MTP) was developed to outline procedures for determining compliance, performance, acceptance and suitability of the prototype AOTS. Data were gathered through administering surveys, conducting structured interviews, reviewing Air Force reports, reviewing training records, reviewing results of knowledge and performance tests, and reviewing reports generated by the AOTS. Baseline data for experimental groups were collected during the year preceding the SLT&E. Data were collected for experimental groups and control groups during the period of the SLT&E. Baseline data and data for control groups were compared with data for experimental groups.

The results of prototype AOTS SLT&E revealed the following concerning compliance, performance, acceptance and suitability of the AOTS:

1. Compliance. The prototype AOTS met all specified functional requirements and established system performance goals. Terminal and data search response times were within the specified time limits. External interfaces were established. Hardware reliability exceeded established goals. Maintenance goals were met or exceeded, with minor exceptions occurring only when users failed to report problems in a timely manner. The availability of hardware components exceeded the established goal.

2. Performance. Indications were that the prototype AOTS performed better than the conventional OJT system. Training managers reported that less time was required for performing training management functions under the AOTS than under the conventional OJT system. Airmen trained under the AOTS scored higher on task related tests than did airmen trained under the conventional system. Managerial personnel indicated that airmen trained under AOTS performed tasks better and became position qualified sooner than airman trained under the conventional system. These same individuals also indicated their belief that the system improved unit effectiveness and would improve combat readiness if implemented throughout all workcenters.

3. Acceptance. Commanders of participating units, users and Major Command (MAJCOM) observers of the prototype AOTS gave the system high acceptance ratings. Users favored the methods for managing and recording training provided by the AOTS over conventional methods. Users indicated that the system should be implemented throughout the Air Force operational environment.

4. Suitability. Indications were that the prototype AOTS could overcome deficiencies identified in the conventional OJT system. Users believed the system was needed to enhance training within their specialties. Unit commanders believed the system satisfied their unit training requirements, would significantly improve the combat capabilities of their units, and was suitable for Air Force-wide implementation. Goals to reduce the amount of time required for performing training administrative duties and providing more time for the conduct of training were met.

Representatives from MAJCOMS performed an assessment of the prototype AOTS. These representatives received a thorough demonstration of the system, were provided opportunities to interface with the system, and observed system operations in the participating work centers. Following the orientation, the majority of these representatives indicated a desire to implement the system across the Air Force.

The Air Force considered the AOTS project to be a success. The system was designed, developed, and tested on schedule and within budget. The AOTS demonstrated that modern computer and training technologies could be successfully applied in the operational environment. The results from testing the system were positive. It is recommended that the Air Force proceed with efforts to implement automated OJT capabilities across the operational environment.

PREFACE

This report was developed by Douglas Aircraft Company, the development contractor, under Government Contract F33615-C-84-0059. *The AFHRL Work Unit number for the project is* 2557-00-02. The primary office of responsibility for management of the contract is the Air Force Human Resources Laboratory, Training Systems Division, and the Air Force AOTS manager is Major Jack Blackhurst.

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1 INTRODUCTION

This document provides a summary of a four year, three phase effort to design, develop and implement into operational work centers, the prototype Advanced On-the-Job Training System (AOTS). Besides being one of the first major systems other than a weapon system to use Ada® as the primary programming language, the prototype AOTS represented the most ambitious and comprehensive Instructional Systems Development (ISD) effort attempted to date within the Air Force OJT environment.

This report outlines the procedures applied to evaluate the AOTS and reports the results of a multifaceted field evaluation conducted while the AOTS was implemented in selected Air Force work centers.

For a detailed description of the AOTS design and development effort, see the Technical Report for the Advanced On-the-Job Training System (AOTS) dated 31 October 1989. For a description of the intended AOTS SLT&E data collection and analysis procedures, see the Master Test Plan (MTP) for the Advanced On-the-Job Training System dated 10 October 1988. For an explanation of how the AOTS functioned in operational work centers, see the Operational Guide to the Prototype Advanced On-the-Job Training System dated 10 June 1988.

2 AOTS BACKGROUND

For more than a decade, the increasing complexity of weapon systems and equipment, the loss of qualified middle management personnel through forced manpower reductions, and increasing mission demands have made On-the-Job Training (OJT) increasingly more difficult to conduct. To identify specific OJT problems and viable solutions to those problems, the Air Staff requested that the Air Force Human Resources Laboratory (AFHRL) conduct a study of the Air Force OJT system (Stephenson and Burkett, 1975) and that the Air Force Inspector General (IG) conduct a Functional Management Inspection (FMI) of the OJT system (PN 76-269, April 1977). Based on the findings during both the AFHRL study and the Air Force IG FMI the following recommendations were made:

a. Develop better methods for identifying and updating specific performance and training requirements;

b. Perform frequent, valid and reliable evaluations of job task performance;

c. Emphasize the quality of training programs;

d. Emphasize the relevance of training to mission accomplishments;

e. Deemphasize training administration;

f. Determine the cost of training on the job;

g. Determine the capacity of operational units to conduct training on the job; and

h. Utilize training personnel as training developers, as opposed to training administrators

Following the AFHRL study and the Air Force IG FMI, the Air Staff requested that the AFHRL manage an initiative to design, develop and test a prototype computer-based system for Air Force OJT. The Air Staff specified that the prototype system be developed, tested, and evaluated within an operational environment that represented typical Air Force work centers. Thus, the idea of an OJT system designed to include all functions of an effective training system was conceived and named the Advanced On-the-Job Training System (AOTS).

The primary objective of the prototype AOTS project was to demonstrate that, through the application of modern computer and training technologies, deficiencies found to exist in conventional on-the-job training (OJT) could be corrected. To meet the mission objective, AOTS was to focus on job task proficiency by specifying and defining the tasks required in a given duty position and by defining the training required to become fully position qualified. The prototype AOTS was to:

a. Provide workable and cost effective methods for evaluating task performance in an operational setting;

b. Ease the inherent difficulties of using operational equipment for OJT;

c. Address the problem of the limited availability of technically qualified personnel who could act as trainers and the limited training skills of those personnel;

d. Ease the paperwork burden associated with scheduling both expected and unique OJT opportunities, tracking trainee training progress, evaluating associated task knowledge and task performance, managing the flow of OJT data; and

e. Ultimately increase individual and unit productivity and readiness.

The preliminary design of the training system and subsystems was established in Phase 1. The detailed designs of the subsystems and components and the software required to implement the system were developed in Phase 2. A system level test and evaluation (SLT&E) occurred in Phase 3 during the implementation of the AOTS in an operational environment. Figure 2.1 displays an overview of the AOTS schedule. The remainder of this section provides a brief description of the procedures followed during the three phases of the AOTS design, development and implementation.

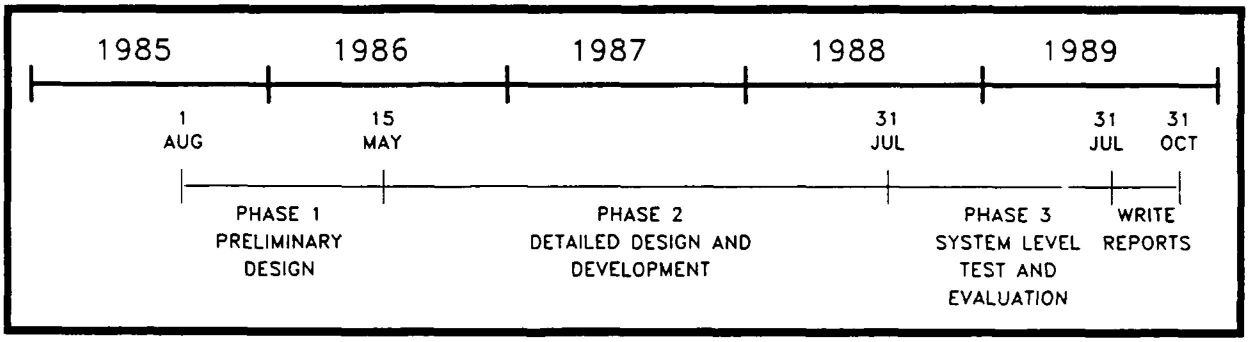

Figure 2.1. The AOTS Master Schedule

2.1 Phase 1 - Preliminary Design

The Air Force specified that the prototype AOTS provide state-of-the-art capabilities. Existing technologies were considered at the start of the preliminary design. Throughout the design, emerging technologies were scrutinized to determine whether they could be employed to enhance the prototype AOTS.

The methodology chosen to accomplish the Preliminary Design was top-down structured analysis and design. Hierarchy diagrams and Data Flow Diagrams (DFDs) were used as tools to describe the design. The hierarchy diagrams were developed to depict the structure of the prototype AOTS from system level through subsystem, components, and functions. These diagrams also established the vehicle for system naming and numbering (identification) conventions. DFDs were developed to show processes that would occur with the system, the internal and external interface requirements, the data flowing into and from processes and external entities, and data being stored. Each of these DFD entities were described in data dictionaries. A Computer-Aided Software Engineering (CASE) tool, DFDDraw(c), was used as an aid in constructing DFDs.

Design efforts started with the development of system level, subsystem, and component diagrams. Design walkthroughs were conducted and attended by personnel assigned to the project. Each diagram was discussed in detail to ensure not only that contractual and functional requirements were met, but also that the design would satisfy training requirements for all AFSs selected to participate in the effort and the corresponding operational environments. All required changes were accomplished, followed by further walkthroughs. These procedures were followed until all personnel concerned were satisfied that requirements were properly addressed in the design. Preliminary Design Reviews (PDRs) were conducted for all subsystems and components, to obtain Air Force approval prior to proceeding to Phase 2.

2.2 Phase 2 - AOTS Detail Design and Development

The contract for the design, development, test and evaluation of the prototype AOTS specified that all AOTS software would be delivered to AFHRL at the end of Phase 2. However, automated capabilities were needed early in Phase 2 to support training development requirements. A two part development effort was undertaken to provide the needed training development capabilities earlier in the phase.

The first part of the effort was performed using a traditional waterfall approach. The design was completed for a portion of the system and presented for Air Force approval at a Critical Design Review (CDR). The coding and informal testing started after this approval, followed by formal testing after all development was completed.

During the second part of the development effort an incremental or evolutionary approach was used. Logically related portions of the code were designed, approved via walkthroughs, coded, tested, and released. Air Force personnel participated in the walkthroughs and in the formal testing. This methodology provided an ever increasing capability to AFHRL with earlier user feedback into the development process improving the quality of later released increments. The increments were developed to provide the most critical capabilities first.

The actual design methodology was the same in both parts of the design effort. This involved a top-down structured design with a heavy object oriented influence when the design was translated into an Ada(R) package structure. The design was presented using an Ada(R) based programming design language that facilitated the direct transition to code. The Ada(R) compiler was used to validate the design by producing executable shells to check interfaces from both a data and flow of control point of view. The design was then expanded to include full executable code.

Ada(R) program language was used as both the design and primary implementation language. The Statistical Analysis System (SAS)(R) was used for generating standard and ad hoc reports from the prototype AOTS and to support analyses of System Level Test & Evaluation (SLT&E) data. Assembly language code was used to make the Zenith(TM)248 Personal Computers compatible with the Digital(TM) VAX 8650 computer.

To meet the functional requirements, the prototype AOTS was comprised of five subsystems; Management, Evaluation, Training Development and Delivery, Computer Support, and Personnel Support. Figure 2.2 provides a brief sketch of the subsystems. For a complete description of the AOTS subsystems, see each respective AOTS subsystem Prime Item Specification.

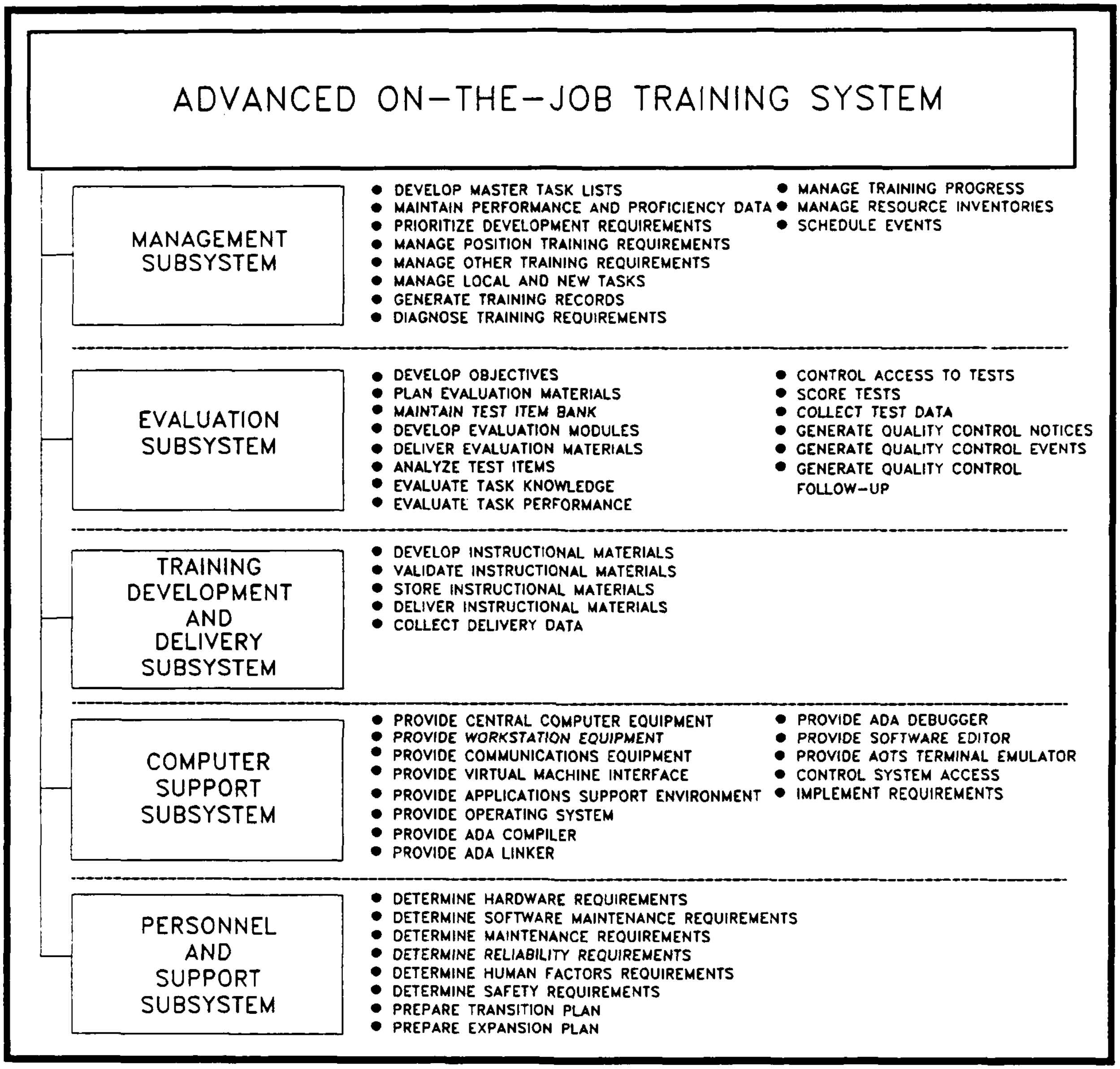

Figure 2.2. AOTS Subsystems

2.3 Phase 3 - AOTS Implementation

The Air Staff sponsor for the project, Headquarters United States Air Force/Director of Personnel Plans and Programs (HQ USAF/DPP) directed that the AOTS prototype be developed and evaluated within an operational environment to ensure that the system would be useful and acceptable to Air Force users. The criteria used to select the locations included:

a. a representative flying mission;

b. total force units (active Air Force, Air Force Reserve, and Air National Guard) in close proximity;

c. all units of the total force components flying the same weapon system; and

d. a stable weapon system.

HQ USAF/DPP selected Bergstrom AFB and Ellington ANGB, Texas as the installations on which to implement the AOTS. The main participants of the AOTS experiments were Active, Reserve, and Air National Guard individuals within each of the following Air Force Specialties:

a. Tactical Aircraft Maintenance, AFSC 452X4D/M, (previously AFSC 431X1/C);

b. Aerospace Propulsion, AFSC 454X0A (previously AFSC 426X2);

c. Personnel, AFSC 732X0; and

d. Security Police, AFSCs 811X0/811X2.

The five selected specialties represented approximately 20 percent of the total enlisted US Air Force and a wide range of job types requiring moderately different OJT methodologies. The Active, Air Force Reserve, and Air National Guard units assigned to the AOTS treatment group and corresponding control group are listed in Table 2.1.

AFHRL implemented the prototype AOTS in phases. The rationale for implementing the system in phases included: 1) initial implementation problems could be resolved before all work centers were affected, 2) if problems occurred, training would be minimally impacted since the majority of work centers would still be operating using conventional methods, 3) personnel at Ellington ANGB were having difficulty with the timely installation of communication lines, and 4) concern that the work centers would not be provided the full service required with initial implementation, given the limited number of personnel resources assigned to the project.

TABLE 2.1
EXPERIMENTAL AND CONTROL* UNITS BY COMPONENT

COMPONENT	EXPERIMENTAL GROUP
Active	67th Aircraft Generation Squadron, 12th Aircraft Maintenance Unit Flightline Section
Active	67th Component Repair Squadron, Jet Engine Intermediate Maintenance Section
Active	67th Equipment Maintenance Squadron, 12th & 62nd Aircraft Maintenance Unit Inspection Section
Active	67th Mission Support Squadron, Consolidated Base Personnel Office Base On-the-Job Training Management & Quality Force Sections
Active	67th Security Police Squadron, All Sections
Active	67th Tactical Reconnaissance Wing, Maintenance Training Management
AF Reserves	924th Consolidated Aircraft Maintenance Squadron, Training Management, Aircraft Propulsion and Aircraft Maintenance Sections
AF Reserves	924th Tactical Fighter Group Consolidated Base Personnel Office Base On-the-Job Training Management & Quality Force Sections
AF Reserves	924th Weapons System Security Flight, All Sections
Air National Guard	147th Consolidated Aircraft Maintenance Squadron, Training Management, Unit Administration, Aircraft Propulsion and Aircraft Maintenance Sections
Air National Guard	147th Fighter Interceptor Group, Base On-the-Job Training Management & Quality Force Sections
Air National Guard	147th Security Police Flight, All Sections

* Control groups identified in 91st and 45th AMU

The implementation schedule was as follows:

1 August 1988	Active Duty 67th Component Repair Squadron, Jet Engine Intermediate Maintenance Work center
15 August 1988	All remaining Active Duty work centers
1 September 1988	All Reserve and Air National Guard work centers.

As work centers were implemented, instruction for users of the prototype AOTS was provided by AFHRL and contractor personnel. To ensure priority was given to the primary users of the prototype AOTS, supervisors and training managers were trained first, followed by trainers, evaluators, trainees, test control officers (TCO) and quality control administrators. A ratio of one instructor to one user was applied during training to ensure users learned to operate the system at their own best pace. The initial intent was to instruct supervisors and training managers on operating the system, and in turn, have the supervisors and training managers provide instruction to other work center personnel. However, other work center personnel were not receiving adequate and timely instruction. Therefore, responsibility for all remaining instruction was assumed by AFHRL and contractor personnel. Copies of the Operational Guide for the Prototype AOTS were made available to users to enhance their understanding of system capabilities and how the system was intended to be used. In addition, User Handbooks for the Prototype AOTS were developed, published and distributed to explain how training functions were performed using the prototype AOTS.

Five hundred eighty-five individuals were identified to participate in the AOTS experiment. The participants included training/evaluation developers, supervisors, trainers, evaluators, trainees, training managers, quality control monitors, system administrators, and commanders as described here:

a. Training Developers - responsible for analyzing and documenting performance requirements, and developing behavioral objectives, tests and instructions;

b. Supervisors - responsible for ensuring training programs were properly planned and executed, that training requirements were defined for each trainee and that progress and training history records were maintained for each trainee;

c. Trainers - responsible for interacting with trainees to teach knowledge, skills and procedures associated with speciality tasks;

d. Evaluators - responsible for interacting with trainees to either administer knowledge test or to observe and rate performance on specialty tasks;

e. *Trainees - recipient of job-site-training;*

f. Training Managers - responsible for overall management of training for organizations and assisting supervisors with the development of work center training programs;

g. Quality Control Administrators - responsible for scheduling periodic performance evaluations to determine training program effectiveness and advise commanders of results; and

h. Commanders - responsible for ensuring effective training programs were established within all applicable work centers.

To ensure the AOTS participants' views on training were representative of a larger Air Force sample, a training views survey which had been previously administered in 1987 at 22 AF bases across four Major Commands (MAJCOMs) was administered to the majority of AOTS participants during June and July 1988. The number of individuals included in the 1987 sample and the AOTS sample are reported in Table 2.2 by training level.

TABLE 2.2
NUMBER OF SUBJECTS RESPONDING TO TRAINING VIEWS SURVEY

	1987 Sample N	AOTS Sample N
Commander	35	11
Training Manager	154	12
Supervisor, Evaluator, Trainer	639	232
Trainee	1200	419

The responses from the AOTS sample were similar to the larger group responding in 1987. Thus, the AOTS sample was considered representative of the general AF OJT population. Both groups described AF training as follows:

a. involves one-on-one training;

b. limited training materials available;

c. viewed as labor intensive;

d. lack of standardized evaluation; and

e. important to mission requirements.

3 AOTS EVALUATION FRAMEWORK

A major objective of the prototype AOTS project was to present data required for the Air Force to determine whether the system provided capabilities to overcome deficiencies identified in the conventional OJT system, and if the system should be implemented across the operational environment. To facilitate the presentation of required data, strategies were developed for testing and evaluating the system and for reporting results. These strategies were documented in a Master Test Plan (MTP). The MTP is discussed later in this section.

Strategies were developed for both formative and summative evaluations. Formative evaluation occurred during development of the system. The purpose was to determine whether specifications had been met, and to provide feedback to designers and implementers which enabled them to make necessary changes and adjustments. Summative evaluation took place after the system had been implemented in the operational environment. The purpose was to determine if the system functioned correctly, what impacts it had on training programs, and how it was perceived by users and observers. AFHRL identified four critical issues to be focused upon during the evaluation of the prototype AOTS. These critical issues were 1) Compliance, 2) Performance, 3) Acceptance and 4) Suitability. The development of evaluation strategies included developing objectives for the critical issues and establishing procedures for collecting, analyzing and reporting data.

During the design and implementation of the prototype AOTS, capabilities were provided for generating data required for system assessment. However, data required for assessing the conventional OJT system were not available. When it was deemed necessary to compare the prototype AOTS to the conventional OJT system, elements for data relevant to the conventional system had to be defined and procedures for collecting data and reporting results had to be developed. Further, when evaluation strategies included surveying and/or interviewing users and observers of the prototype AOTS, appropriate instruments and procedures for administration were developed.

A classic, widely used, three dimensional model from the program evaluation literature was tailored to provide the framework for the evaluation of the prototype AOTS. This was the Criteria Acquisition Model (CAM)[1] illustrated in Figure 3.1.

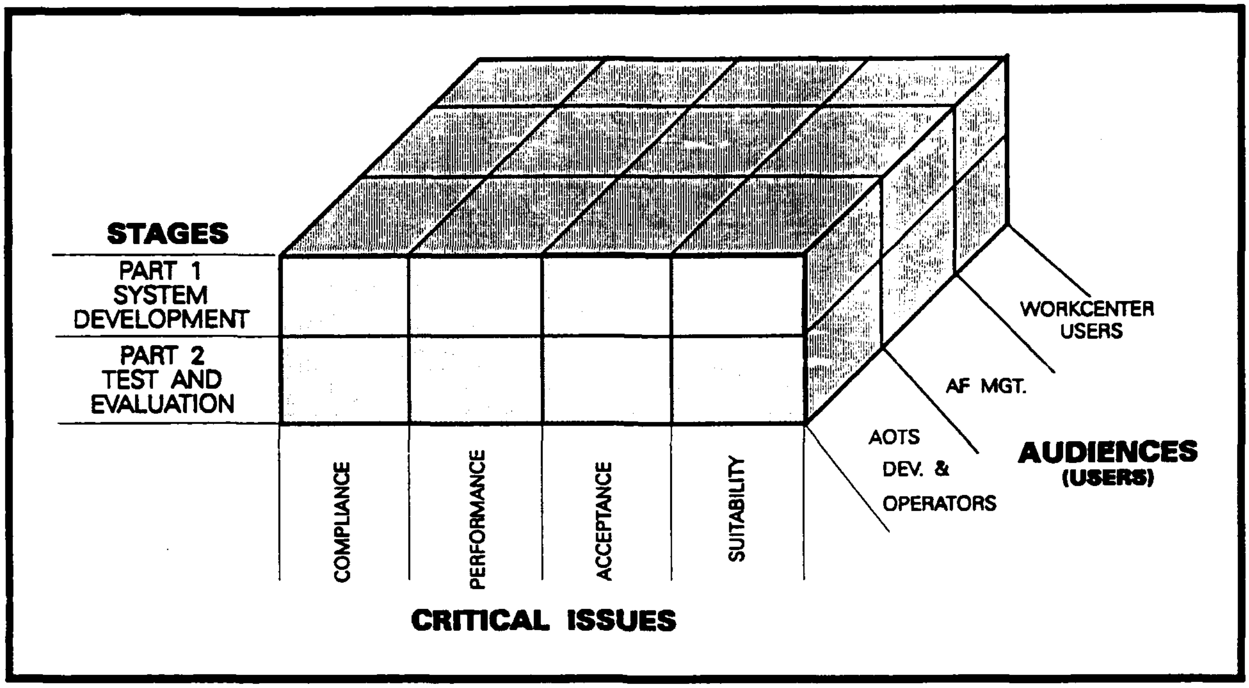

Figure 3.1. AOTS Tailored Criteria Acquisition Model

A primary consideration in selecting this model was that it supports systematic, comprehensive evaluation of a large scale system, such as the prototype AOTS. Additionally, factors to be considered during the evaluation of the AOTS could be easily correlated to the dimensions of the model. The two stages in the model referred to Parts 1 and 2 of the MTP. The audiences referred to the developers and managers of AOTS data; Air Force managers such as MAJCOM observers, commanders and training managers; and end users of AOTS products such as supervisors, trainees, trainers, and evaluators. The critical issues referred to the four critical issues identified to assess the success of AOTS. Definitions of the four critical evaluation issues were as follows:

a.	Compliance	Did the prototype AOTS meet the design and functional requirements of the system, subsystem, and component specifications?
b.	Performance	Did AOTS meet the system performance standards? How did performance of the prototype AOTS compare with the performance of conventional OJT systems?
c.	Acceptance	Was the AOTS accepted by the various system users as user friendly, i.e., easy to use?
d.	Suitability	Did the prototype AOTS overcome currently defined deficiencies in the Air Force's OJT system? Could AOTS be used for OJT throughout the Air Force?

[1] Wright, W.J., & Hess, R.J. (1974), A criteria acquisition model for education evaluation. In G. D. Borich (Ed.), Evaluation Education Programs and Products. Englewood Cliffs, NJ: Education Technology Publications.

A multifaceted evaluation scheme was developed to evaluate the AOTS. A two part MTP, monitored by a quarterly working group, was designed to evaluate the AOTS during system development (i.e., Phase 2) and during AOTS implementation in the operational work centers (i.e., Phase 3). Procedures outlined in Part 1 and Part 2 of the MTP are summarized below.

3.1 Master Test Plan Part 1 - Functional Testing

Part 1 of the MTP outlined procedures for verifying the attainment of design objectives for functions, components, subsystems, interfaces, and technical performance specifications before the AOTS was implemented into operational work centers. Test Plans were developed for alpha, beta, and readiness testing.

Alpha testing was accomplished by contractor personnel other than software engineers who had developed the software. The purpose for alpha testing was to determine whether the software functioned properly on the hardware selected to host the prototype AOTS, and whether the software and hardware together performed the functions required by the system, subsystem and component specifications. Alpha testing encompassed unit, integration and system level testing. During alpha testing, a go/no go approach was employed. This meant that either a computer program performed correctly or it was not released for operational use. Repairs were made until such time as the software functioned properly.

Beta testing was accomplished by AFHRL personnel, after each software release. The purpose for beta testing was to determine whether software programs functioned properly when operated by personnel familiar with the environment in which the system would reside, and whether products generated for off-line use were correctly formatted and contained appropriate data. Testing was accomplished through operating on-line capabilities for specified periods of time. Discrepancies were noted and revisions to software were prioritized and made in order of importance to the users.

Readiness testing was accomplished after beta testing by Air Force and contractor personnel who had not directly participated in the actual design and development of the prototype AOTS. The purpose for readiness testing was to ensure that all software and hardware functioned properly and was suitable for implementation in the operational work centers. The results of the readiness test confirmed that the prototype AOTS was ready to be phased into the previously identified work centers.

3.2 Master Test Plan Part 2 - System Level Test and Evaluation

Part 2 of the MTP outlined procedures for the system level test and evaluation (SLT&E) of the prototype AOTS in the operational work centers. Procedures were developed to collect baseline and control data for comparison with the AOTS data as illustrated in Figure 3.2.

	BASELINE DATA	AOTS DATA
TREATMENT GROUP	X	X
CONTROL GROUP		X

Figure 3.2. Prototype AOTS Experimental Design

Part 2 of the MTP called for data to be collected:

a. on and from individuals assigned to or associated with the treatment group work centers;

b. on individuals assigned to control groups;

c. from base-level reports;

d. from developers of training and evaluation materials; and

e. from observers of the prototype AOTS.

As the project progressed, it became apparent that revisions to the MTP were required to provide a more complete framework for conducting the SLT&E. The initial MTP lacked the dimensional perspective and flexibility required for conducting research in a "live" environment. Originally, the MTP was oriented toward outcome data with minimal evaluation of who used the system, when and how the system was used, and what background factors influenced the utilization of the system. The initial focus of the MTP was to evaluate the prototype AOTS functions and not the reciprocal interactions between the AOTS and the environment.

There were two basic assumptions during the MTP development: users had a basic understanding of Air Force OJT policies and procedures as prescribed by Air Force Regulation 50-23 and, once AOTS was deployed, it would be used on a regular basis to conduct OJT. Neither assumption was realized to the level expected. Users conducted OJT in an unstructured manner with limited awareness of their OJT responsibilities, and the system was underutilized. Because of these violated assumptions and the need to assess the interaction between the AOTS and users, the MTP evolved into a more responsive and multifaceted program evaluation approach.

A more flexible MTP assessment approach was developed which included the collection of process and contextual data (see the MTP for 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 provided information on who, when and how the prototype system was being implemented. It 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. Contextual data consisted of a log of various field activities during the deployment period. These supplemental measures expanded the MTP to include information on the reciprocal influences of the operational environment. The final MTP provided a more comprehensive, flexible and multifaceted assessment of automated technology in the Air Force operational setting.

4 SLT&E DATA COLLECTION METHODOLOGY

The methods used to collect the AOTS assessment data included: 1) administering checklists, surveys, and interviews; 2) conducting system performance tests; 3) extracting data from maintenance reports, training records, quality assurance reports, crime statistics and utilization reports; (4) reporting the percentage of time spent by commanders, supervisors, training managers and trainers/evaluators on training related tasks; (5) capturing process data; and (6) conducting an independent study to compare knowledge and performance scores obtained by subjects in treatment and control group maintenance work centers. Figure 4.1 provides a visual overview of the AOTS evaluation data sources.

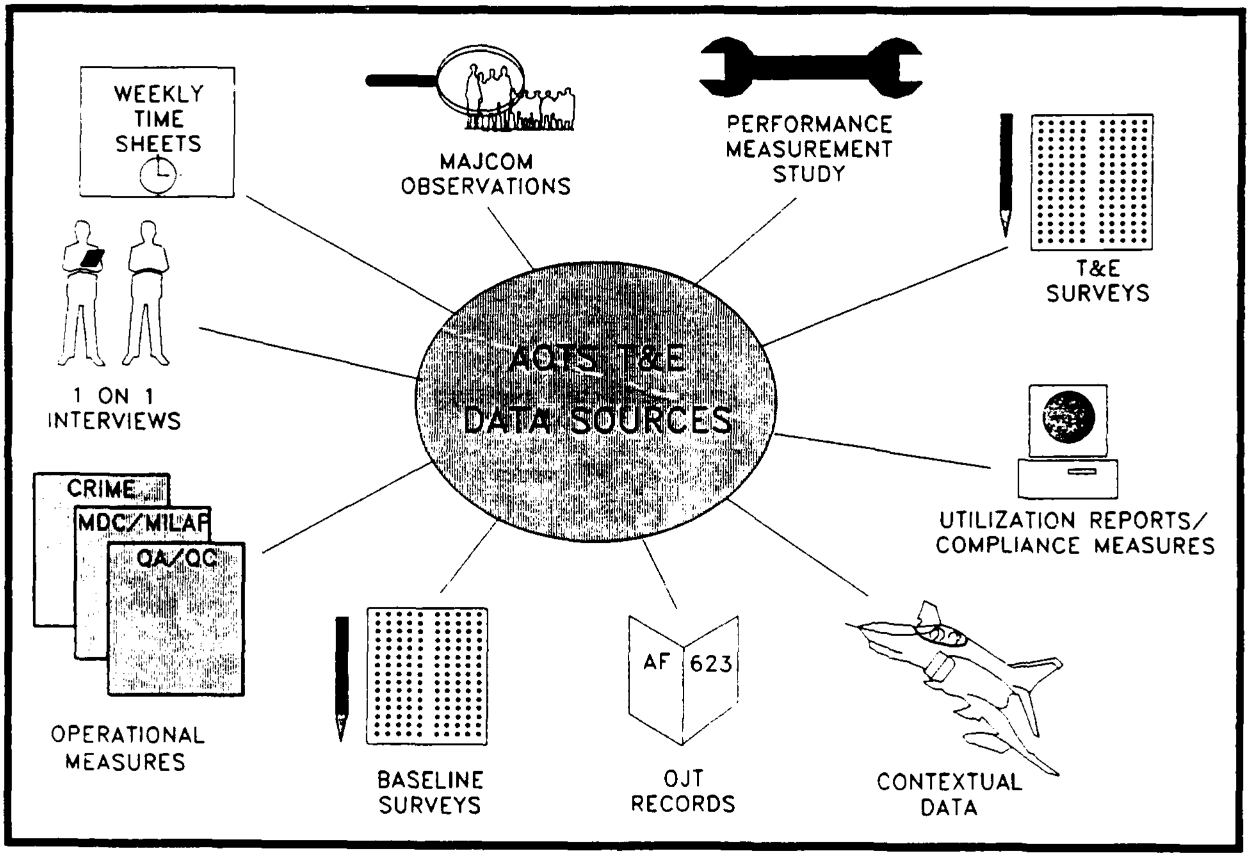

Figure 4.1. AOTS Test and Evaluation Data Sources

4.1 Compliance Data Collection Instruments

To determine whether the AOTS met the design and functional requirements of the system specifications, computer response times were observed, an interface checklist was reviewed and hardware reliability, maintainability, and availability were computed. Each methodology is explained here.

a. COMPUTER RESPONSE TIME. Computer terminal response times and search response times were observed under normal AOTS operating conditions three months after the start of the AOTS SLT&E to ensure the specified response times were met. Terminal response time was the amount of time required from the moment a keyboard key was pressed until the desired display appeared on the screen. Search time was the amount of time required from the moment a search request was entered until the information was displayed on the screen. Five trials were executed for each response time procedure. The results of the five trials and an average were recorded on a Performance Response Time Form.

b. EXTERNAL INTERFACE CHECKLIST. During Phase 2, interfaces between AOTS and 14 external entities (e.g., the United States Air Force Occupational Measurement Center, the Publication Management System, and the Air Force Military Personnel Center) were identified as desirable. A list of the external entities was displayed in a matrix. The matrix was used as a checklist to report whether one or more of the following interface types had been established between AOTS and each respective external entity:

1) Manual - An interface totally off line

2) Automated - An interface performed with the system using a keyboard, touch pad, and/or an optical mark reader

3) Automatic - An interface performed entirely by the computer without additional data input by the user.

The checklist was reviewed by three contractor and three Air Force representatives eight months after the start of the AOTS SLT&E. The reviewers collectively recorded "YES" if the interface was believed to have been established, and "NO" if the interface was believed to have remained unestablished.

c. EQUIPMENT RELIABILITY, MAINTAINABILITY AND AVAILABILITY. Goals were established and recorded on a table before the start of AOTS SLT&E. Representative operational data were gathered during normal operational use of the equipment between 1 October 1986 and 1 February 1989. The actual reliability, maintainability, and availability values were calculated and compared to the goals set before the start of SLT&E. The typical work center work station included a Zenith(TM)-248 Personal Computer, Scantron(R) model 5200 optical mark reader, Alps(TM) P2000G printer; and in some work centers, a Sony LDP2000/4 interactive disc player, an Electrohome 1300 color monitor with touch screen, and sound. Dedicated high-speed digital communication lines were leased for transmission between the Digital(TM) VAX 8650 host computer at Brooks Air Force Base and terminals at Bergstrom AFB and Ellington Air National Guard Base. Infotron Systems(TM) 992NP multiplexers were used to control and distribute communications at the bases.

1) HARDWARE RELIABILITY. Reliability was expressed as the Mean Time Between Failures (MTBF), in hours, that a component or system operated without a failure during normal operational use of the equipment. Data to determine the reliability of work center equipment (i.e., personal computer, monitor, printer and optical mark reader) were extracted from the prototype AOTS Maintenance Action Report Log and the prototype AOTS Procedure: Maintenance Log.

2) HARDWARE MAINTAINABILITY. Maintainability was expressed as the Mean Time To Repair (MTTR) a component or system to full operational condition. The data were extracted quarterly from the prototype AOTS Maintenance Action Reports, the Communication Problem Log and the VAX Down Time Log.

3) SYSTEM AVAILABILITY. Availability was the percentage of time the prototype AOTS equipment was available for use as opposed to down time. The percentage was obtained by dividing the total time the system was up and operational by the total time the system was required to be up and operational.

4.2 Performance Data Collection Instruments

Unit assessment data and individual airman training program data were used to compare performance under AOTS with performance under conventional OJT. The purpose was to determine whether the prototype AOTS had an impact on unit performance and trainee progress toward duty position qualification.

4.2.1 Unit Assessment Instruments Designed To Address Performance.

Maintenance quality assurance results and the number of repeat maintenance actions were extracted from two base level maintenance reports. Security police quality control average scores and crime statistics were extracted from two security police base-level quarterly reports. The frequency of extraction and the instruments used to collect the respective data are identified here. Data to determine personnel work center performance were unavailable.

a. MAINTENANCE QUALITY ASSURANCE DATA. Aircraft Maintenance Unit (AMU), Propulsion, and Maintenance Branch Quality Assurance (QA) Data were collected quarterly before and during the AOTS SLT&E. The Quality Assurance Program Monthly Summary Data Recording Forms were used to report technical inspection and personnel evaluation results extracted from the Air Force active duty 67 TRW Quality Assurance Quarterly Summary, the Air Force Reserve 924 TFG Quality Assurance Quarterly Summary, and Air National Guard AF Form 2419. Reserve and Air National Guard data were extracted for the Aircraft Maintenance and Propulsion branches. Active duty data were extracted for the AMU, Propulsion, and Inspection branches.

b. REPEAT MAINTENANCE ACTIONS DATA. Aircraft Maintenance Data extracted monthly before and during SLT&E from Maintenance Data Collection (MDC) and Maintenance Information Logically Analyzed and Presented (MILAP) 480 reports generated by the 67th TRW DCM/MASA office were reported on the MDC/MILAP Data Collection Form. The data extracted from the MDC documents reported the number of repeat maintenance actions performed at five work centers. The data extracted from the MILAP 480 reports represented the number of repeat actions at the aircraft level as reported by pilots flying the respective aircraft.

c. SECURITY POLICE QUALITY CONTROL DATA. The Security Police Quality Control Trend Data Recording Form was used to report average scores extracted from the Security Police Quality Control Analysis report. The data were collected quarterly before and during the prototype AOTS SLT&E.

d. BASE CRIME DATA. Base Crime Statistics were collected and reported quarterly before and during the SLT&E. Data were extracted from the Base Crime Analysis Report and recorded on the Security Police Crime Analysis Data Collection form.

4.2.2 Airman Training Progress Data To Measure Performance

Four methods were used to collect data relevant to individual airman training programs. Task training record data were extracted from AF Forms 623 during the baseline interval and from AOTS Airman Training Records during SLT&E. Time available and time spent on training related tasks were recorded on Weekly Inventory of Time Spent (WITS) forms before and during SLT&E. Knowledge and performance test results were captured towards the end of the prototype AOTS SLT&E. Survey and interview responses were captured during and at the end of SLT&E. All four methods are described below.

a. ON-THE-JOB TRAINING DATA. OJT Data Recording Forms were used to report individual trainee baseline data extracted from AF Forms 623. Data obtained from the forms were recorded at the beginning, midway, and at the end of the baseline data collection effort. The extracted data included:

1) the number of tasks circled (i.e. the number of tasks required for an individual to be duty position qualified)

2) the number of tasks opened each month during the reporting period (i.e. the number of tasks being trained)

3) the number of tasks closed/completed each month during the reporting period (i.e. the number of tasks certified)

4) the date the trainee was position qualified (i.e. the date the last task was completed indicating that all circled tasks were certified).

Individual Airman Training data were automatically collected by the system during the AOTS SLT&E. The data included the number of tasks required for an individual to be duty position qualified, as well as the number and percentage of the duty position required tasks that the airman was certified to perform. The data were captured monthly from October 1988 through June 1989.

b. WEEKLY INVENTORY OF TIME SPENT (WITS). Treatment and control group subjects recorded the number of hours available and the number of hours spent performing training related activities before and during AOTS SLT&E. The data were collected for a seven-day period every other week from the Active duty personnel. The Reserve and Air National Guard personnel documented their hours during Unit Training Assembly (UTA) weekends and while on annual tour.

c. TEST AND EVALUATION SURVEY AND INTERVIEW RESPONSES. Test and Evaluation survey data relevant to AOTS performance were collected from training managers, supervisors, trainers, and evaluators via questionnaires and interviews midway and at the end of SLT&E. The instruments were intended to provide information as to whether the AOTS was better, worse, or no different than conventional on-the-job training.

d. PERFORMANCE MEASUREMENT STUDY. Maintenance knowledge and performance tests were administered to tactical aircraft maintenance and aerospace propulsion airmen who were previously certified on tasks performed by members of their respective specialty. The purpose of the evaluations was to determine whether maintenance personnel, who viewed Computer Based Training (CBT) modules, demonstrated having more task related knowledge and performed tasks better than personnel who did not view the CBT modules.

4.3 Acceptance and Suitability Data

Opinion surveys and interviews were administered to address the perceived acceptance and suitability of the prototype AOTS. The surveys were intended to provide information as to whether AOTS participants believed the AOTS was easy to use and suitable for use in the operational environment

The survey response scale ranged from low (a=1) to high (g=7). For the purpose of conveying SLT&E findings via bar charts, the scale was clustered into three major categories: 1-3, unfavorable; 4, neutral; 5-7, favorable. Developers responded to their survey one time, three months after the start of SLT&E. Surveys were administered to supervisors, training managers, trainers, evaluators, and trainees midway through and at the end of AOTS SLT&E. Commanders responded to an AOTS opinion survey one time approximately eight months into the evaluation. Third Party MAJCOM Observers were administered opinion surveys one time between January and April 1989 after a two day orientation of the AOTS.

Table 4.1 indicates the category of individuals responding to the test and evaluation surveys, the number of items included on each respective survey, the frequency of administration, and the number of individuals returning usable survey response sheets at each administration.

TABLE 4.1
TEST AND EVALUATION SURVEY CHARACTERISTICS

RESPONDENT CATEGORY	NUMBER OF ITEMS	ADMIN FREQUENCY	NUMBER OF RESPONDING RESPONDENTS	
			TIME 1	TIME 2
SUPERVISOR	116	2	114	59
TRAINING MANAGER	87	2	16	16
TRAINEE	39	2	82	46
COMMANDER	54	1	11	N/A
DEVELOPER	20	1	8	N/A
MAJCOM OBSERVER	37	1	82	N/A

4.4 Process Data

Process data were collected to help the researchers understand the results of the captured SLT&E data. Process data were obtained by identifying and monitoring AOTS-user-environment information concerning the utilization of the system in the operational setting and by documenting the occurrence of base activities during the SLT&E interval. Process data consisted of the following:

a. **Context Information-** field activities occurring during the SLT&E period of 1 August 1988 to 31 July 1989 (e.g., base exercises, ORI, major base activities),

b. **Observations-** 380 work center observations documented on a standardized form by Instructional Systems Team (IST) personnel,

c. **Hotline calls-** 225 telephone calls by work center personnel, asking for assistance in using the prototype AOTS, and

d. **Log-on records-** user requested computer generated records of AOTS use sorted by individual access code number.

Figure 4.2 summarizes the MTP development and data collection schedule.

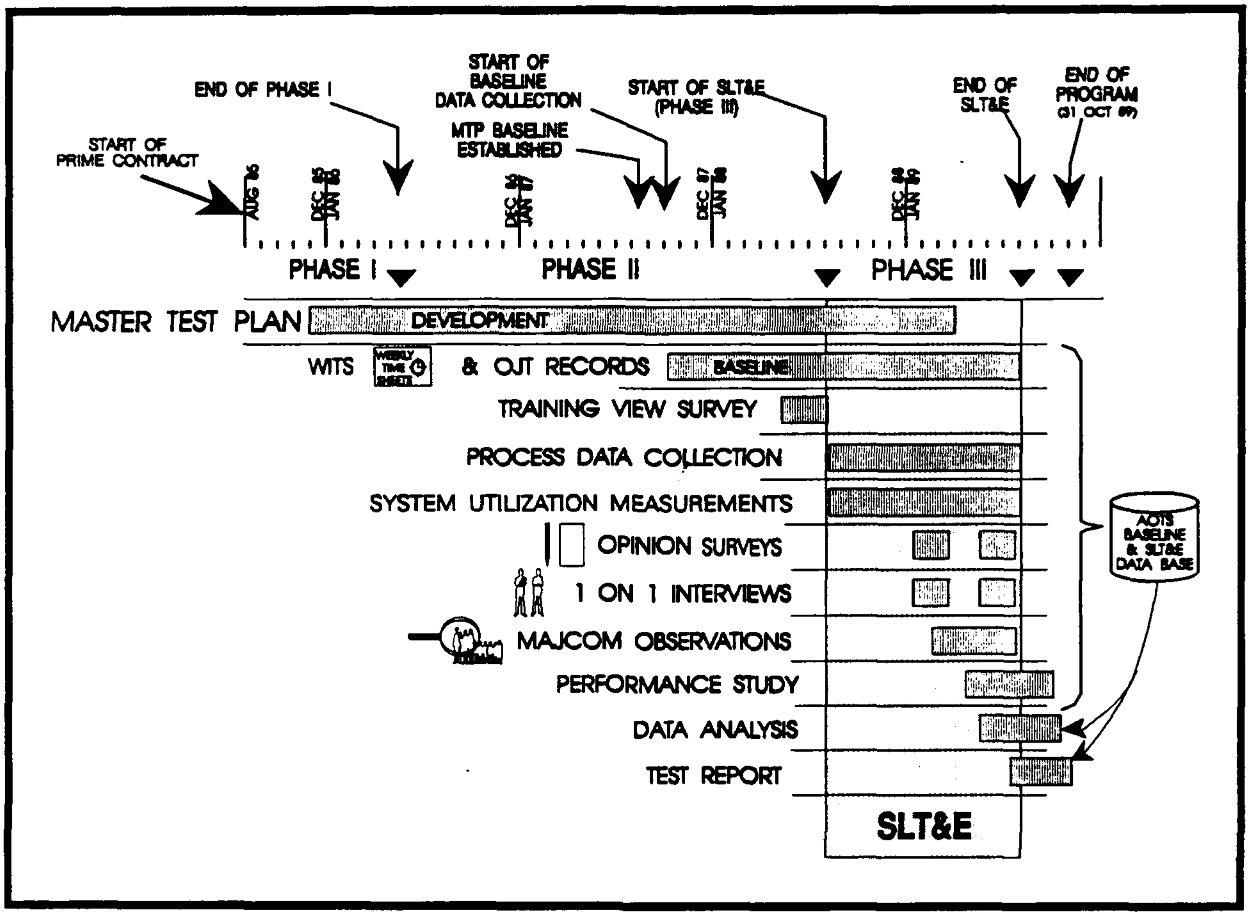

Figure 4.2. AOTS MTP Development and Data Collection Schedule

As noted on Figure 4.2, the Master Test Plan covered all phases of the AOTS project. Baseline and training view data were collected to provide a benchmark against which the impact of the AOTS on the existing AF OJT could be measured. Phase III Process Data provided information on the implementation of the system. These data as well as outcome measures were used to address the critical issues of interest to this study.

5 RESULTS

This section provides discussions of the results from analyzing data collected before and during the SLT&E period. Discussions are presented by critical issue.

5.1 Compliance Results

The AOTS met the system specification while operating in an operational environment: 1) performance response times were met and exceeded; 2) appropriate external interfaces were established; and 3) all equipment goals were met and exceeded as reported here.

5.1.1 Computer Response Times

The average terminal response and Master Task List (MTL) search times observed under normal AOTS operating conditions were 2 and 56 seconds respectively. As shown in Table 5.1, both average times were within the specified acceptable levels.

Table 5.1
AOTS AVERAGE TERMINAL AND MTL SEARCH TIMES IN SECONDS

OPERATION	ACCEPTABLE AVERAGE TIME	ACTUAL AVERAGE TIME
TERMINAL RESPONSE	02.50 Seconds	02.00 Seconds
MTL SEARCH	60.00 Seconds	56.00 Seconds

5.1.2 External Interfaces

Interfaces were established between the AOTS and eight external entities. Table 5.2 reports the type (i.e., manual, automated, or automatic) and descriptions of the established interfaces, and indicates the reasons for deleting the interface requirements between the AOTS and six external entities.

Table 5.2
EXTERNAL INTERFACE CHECKLIST

EXTERNAL INTERFACE ENTITY	INTERFACE YES/NO	METHOD OF INTERFACE	COMMENTS
UNITED STATES AIR FORCE OCCUPATIONAL MEASUREMENT CENTER	YES	1 MANUAL/ 2 AUTOMATIC	SURVEY DATA ARE ELECTRONICALLY PASSED FROM SPERRY TO VAX; AOTS AUTOMATICALLY PULLS DATE SUCH AS TASK STATEMENT AND TASK FACTORS ANALYSIS; AOTS MANUALLY PROVIDES USAFOMC WITH INFORMATION TO VALIDATE TASK LIST
PUBLICATION MANAGEMENT SYSTEM	YES	MANUAL/ 3 AUTOMATED	AOTS REPRESENTATIVES MANUALLY OBTAIN PUBLICATIONS; AOTS ALLOWS FOR AUTOMATED LOADING OF ID FOR PUBS GOVERNING AOTS TASKS AND REVISED PUBS THAT MIGHT EFFECT TASK TRAINING
AUTOMATED TECHNICAL ORDER SYSTEM (ATOS)	NO		ATOS CURRENTLY NOT IMPLEMENTED AT THIS AFB, INTERFACE IS NOT POSSIBLE
PERSONNEL DATA SYSTEM (PDS) PERSONNEL CONCEPT III (PC3)	YES	MANUAL/ AUTOMATIC (MAGNETIC TAPE) AUTOMATED	AOTS MANUALLY RECEIVES MAGNETIC TAPES FROM PDS; AOTS SOFTWARE READS MAGNETIC TAPE AND AUTOMATICALLY PULLS DATA SUCH AS DUTY POSITION AND CONTROL AFSC INTO AOTS; DATA ALLOWS FOR AUTOMATED LOADING OF MANPOWER DATA SUCH AS POSITION NUMBERS
SECURITY POLICE AUTOMATED SYSTEM (SPAS)	NO		AOTS ALLOWS FOR AUTOMATED LOADING OF TASK AND OTHER TRAINING REQUIREMENTS DATA ONCE THE DATA ARE INCLUDED IN SPAS AND THE DATA ARE MANUALLY DELIVERED TO AOTS (TASK AND OTHER TRAINING REQUIREMENTS DATA ARE NOT YET INCLUDED IN SPAS)
CORE AUTOMATED MAINTENANCE SYSTEM (CAM)	YES	MANUAL/ AUTOMATED	AOTS MANUALLY RECEIVES AND ALLOWS FOR AUTOMATED LOADING OF TASK QUALIFICATION/TRAINING REQUIREMENTS IDENTIFIED IN CAMS; AOTS MANUALLY PROVIDES CAMS WITH UPDATED DATA
OPERATIONAL UNITS	YES	AUTOMATED/ AUTOMATIC	AOTS ALLOWS FOR AUTOMATED TRAINING MANAGEMENT AND DATA UPDATES; AOTS AUTOMATICALLY GENERATES EVENT NOTICES, TRAINING AND EVALUATION RESULTS, AND REPORTS

............................INTERFACE PROCESS KEY............................

1 MANUAL — PROCESS PERFORMED EITHER PARTIALLY OR TOTALLY OFF LINE

2 AUTOMATIC — PROCESS PERFORMED ENTIRELY BY THE COMPUTER ONCE THE COMMANDS HAVE BEEN ENTERED

3 AUTOMATED — PROCESS PERFORMED BY USER INTERACTION WITH THE SYSTEM USING A KEYBOARD, TOUCH PAD, OR RUNNING A FORM THROUGH AN OPTICAL MARK READER

Table 5.2 Cont.
EXTERNAL INTERFACE CHECKLIST

EXTERNAL INTERFACE ENTITY	INTERFACE YES/NO	METHOD OF INTERFACE	COMMENTS
AIR FORCE MILITARY PERSONNEL CENTER (AFMPC)	YES	MANUAL	AFMPC PROVIDES POLICY CHANGES AND AFS CONVERSION DATA SO USERS CAN PREPARE FOR CHANGES BEFORE THE CHANGES OCCUR
EXTENSION COURSE INSTITUTE (ECI)	YES	MANUAL/ AUTOMATED/ AUTOMATIC	ECI MANUALLY TELLS AOTS WHEN COURSES ARE AVAILABLE/CHANGING; AOTS ALLOWS FOR AUTOMATED LOADING OF COURSES; AOTS AUTOMATICALLY GENERATES NOTICES OF ELIGIBILITY
COMPUTER ASSISTED TRAINING SYSTEM (CATS)	NO		AOTS ALLOWS FOR AUTOMATED LOADING OF CAI LESSONS IDs (THE LESSONS ARE NOT AVAILABLE IN AOTS)
OFF-LINE TRAINING ACTIVITIES	YES	MANUAL/ AUTOMATED	AOTS MANUALLY RECEIVES COURSE DATA; AOTS ALLOWS FOR AUTOMATED LOADING OF COURSE DATA AND GENERATION OF SCHEDULES FOR ANCILLARY, CONTINGENCY AND FORMAL TRAINING COURSES
TRAINING DECISIONS SYSTEM (TDS)	NO		TDS CURRENTLY NOT OPERATIONAL; HOWEVER, AOTS PROVIDES CAPABILITY FOR AUTOMATED LOADING OF TASK TRAINING MODULE INFORMATION IN THE MTL TASK RECORDS
ADVANCED TRAINING SYSTEM (ATS)	NO		ATS CURRENTLY NOT DEVELOPED
BASE SUPPLY	NO		REQUIREMENT DELETED

5.1.3 Hardware Reliability

All reliability goals were met. As shown in Table 5.3, the actual Mean Time Between Failures (MTBF) was more than double the established goal of 250 hours. The actual Mean Time Between Downing Events (MTBDE) was two thirds higher than the specified goal of 400 hours, and Mission Reliability exceeded the established goal by more than two percent. The reliability coefficient calculated to predict the probability that the four work center components (computer, monitor, printer, and optical mark reader) would operate successfully in the operational environment during an eight hour shift was .8915 at a .9 confidence factor.

TABLE 5.3
SYSTEM RELIABILITY GOALS AND ACTUAL VALUES

PARAMETER	SPECIFIED GOAL	ACTUAL
Mean Time Between Failures (MTBF)	250 Hours	562 Hours
Mean Time Between Downing Events (MTBDE)	400 Hours	673 Hours
Mission Reliability	96.5%	98.93%

5.1.4 Hardware Maintainability

Table 5.4 displays the maintainability goals established before the start of SLT&E and the actual maintainability values obtained during the deployment of the prototype AOTS. All maintainability goals except Mean Administrative Delay Time (A_{dt}) and Mean Maintenance Down Time (M_{dt}) were met. Mean Maintenance Down Time incorporated Mean Administrative Delay Time. Thus, the Mean Administrative Delay Time resulted in an actual Mean Maintenance Down Time that exceeded the previously established Mean Maintenance Down Time goal. While Mean Administrative Delay Time does not effect other maintenance parameters, Mean Administrative Delay Time may affect the availability of a component or system. *To ensure availability, users should make every effort to* keep Mean Administrative Delay Time at a minimum by reporting nonoperating equipment immediately following the discovery of the equipment's nonfunctioning condition.

TABLE 5.4
EQUIPMENT MAINTAINABILITY GOALS AND ACTUAL VALUES

PARAMETER	GOAL	ACTUAL
Mean Time To Repair (MTTR) On The System 90% Upper Limit To Repair	1.5 ManHours 2.5 ManHours	0.98 Ma· Hours 1.66 ManHours
Mean Time To Restore (MTR) 90% Upper Limit to Restore	0.5 ManHours 1.0 ManHours	N/A N/A (no data)
Mean Time To Remove & Replace 90% Upper Limit To Remove & Replace	0.4 ManHours 1.25 ManHours	0.25 ManHours 0.66 ManHours
Direct Maintenance Manhours Per Equipment Operating Hour	0.05 Hours	0.01 Hours
Response Time To Site Of Failure	4.0 Hours	0.85 Hours
Principal Period of Maintenance	16 Hour/Day 7 Day/Week	24 Hour/day 7 Day/Week
Off Line Maintenance Average MTTR 90% Upper Limit To Repair	1.5 ManHours 6.0 ManHours	N/A N/A (no data)
Mean Preventive Maintenance Time	3.0 Hours	1.18 Hours
Mean Maintenance Time (M)	3.4 Hours	1.99 Hours
Logistic Delay Time (L_{dt})	4.0 Hours	0.0 Hours
Maximum Corrective Maintenance Time	8.0 Hours	2.0 Hours
Administrative Delay Time (A_{dt})	2.0 Hours	16.83 Hours
Mean Maintenance Downtime (M_{dt})	7.4 Hours	9.21 Hours
Maintenance Manhours Per Month	6.0 Hours/Mo	2.0 Hours/Mo
Frequency of Preventive Maintenance	1 Time/Mo per Work center	1 Time/Mo per Work center

5.1.5 System Availability

Table 5.5 displays Operational Availability (A_O) goals and actual values for the entire system and three components of the system: the Zenith(TM)248 personal computer, the Z-248 monitor, and the ALPS(TM) printer. In all four instances, the actual operational availability value met and exceeded the previously established goal. Actual operational availability values of eight components for which goal values were unspecified were also calculated. The actual operational availability of all eight components was 99.64 percent or higher.

TABLE 5.5
OPERATIONAL AVAILABILITY (A_o) GOALS AND ACTUAL VALUES

PARAMETER	SPECIFIED	ACTUAL
System Wide	95.0 %	99.90 %
8600 Digital Central Processing Unit	UNSPECIFIED	99.90 %
56 KBPS Communication Lines	UNSPECIFIED	99.77 %
992NP Multiplexer	UNSPECIFIED	99.83 %
632 Multiplexer	UNSPECIFIED	99.64 %
CSU Modem	UNSPECIFIED	99.96 %
Infotron Line Driver	UNSPECIFIED	100.00 %
ZWX-248-52 Z-248 Personal Computer	96.5 %	99.94 %
ZVM-1380 Z-248 Monitor	98.0 %	99.97 %
AFP-45 ALPS Printer 2000	98.0 %	99.95 %
Scantron Optical Mark Reader	UNSPECIFIED	99.96 %
Summagraphics 11x11 Bit Pad	UNSPECIFIED	99.99 %

COMPLIANCE SUMMARY

The prototype AOTS met all design and functional requirements specified for the system, subsystem and components.

a. Appropriate external interfaces were established.

b. Terminal and search response times were conducted within the specified time limits.

c. Hardware reliability was at 98.3 percent, which exceeded the established goal of 96.5.

d. All maintenance goals were met or exceeded except Mean Administrative Delay Time (A_{dt}) and Mean Maintenance Down Time (M_{dt}). The goals for A_{dt} and M_{dt} were not met due to failure by users to notify maintenance activities in a timely manner.

e. All hardware components were available for use at least 99.4 percent of the total SLT&E period.

5.2 Overall Results of Performance, Acceptance and Suitability Issues

The majority of data used in drawing conclusions about the remaining critical issues was collected via surveys of all AOTS participants and interviews of those personnel found to be high frequency users of the AOTS. Data relevant to time spent performing training responsibilities before and after the implementation of the prototype AOTS were also collected from WITS sheets, as discussed in Section 4.2.2. However, valid comparisons of time spent performing training responsibilities before and after the AOTS was implemented could not be made due to the environmental impacts. Factors such as changing mission requirements, trained personnel requirements, training opportunities, and base exercises and inspections dictate the time available for training. Additionally, these factors differed significantly during the two collection periods.

The survey and interview instruments were administered twice, once at the mid-point of the SLT&E period, and once at the end of the period. High frequency was defined as using AOTS two or more times per week. Figure 5.1 shows the cumulative survey and interview results, by critical issue, for the final issuance.

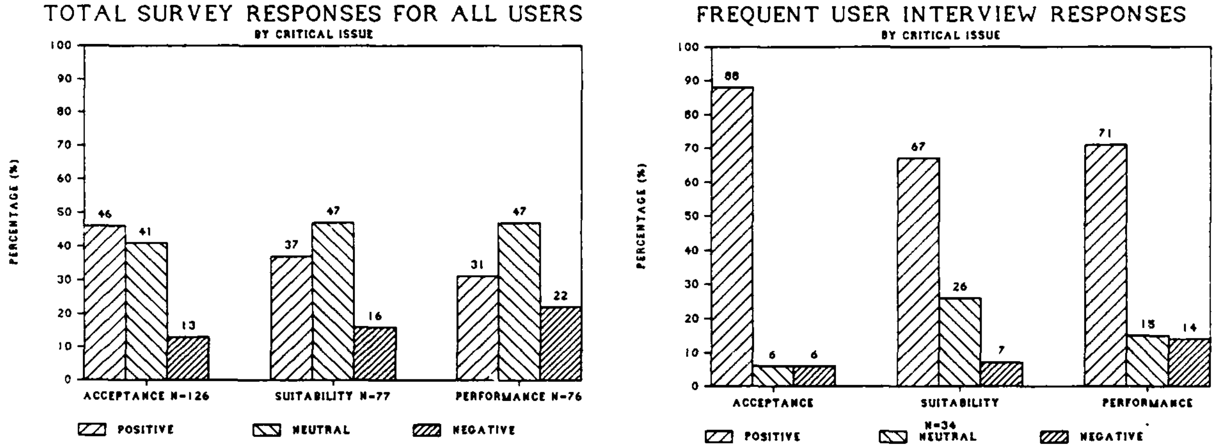

Figure 5.1. Cumulative Survey and Interview Results

These graphs show the total survey and interview results for the remaining critical issues Performance, Acceptance and Suitability. Responses to the surveys and structured interviews were collapsed into three categories: positive, neutral and negative. The bars represent the percentage of responses that fell into the three categories by critical issue.

As noted on both graphs, the overall response to AOTS was positive. The high number of neutrals was expected given the brevity of the deployment period, limited use of all of the AOTS functions, and the specificity of the questions. However, a consistent test and evaluation finding was that the more time individuals spent learning the system, the more positive were their views towards the AOTS. In addition, higher frequency users were able to provide more valid positive and negative feedback on the system. The subsequent sections of this report will address the test and evaluation findings of each critical issue in greater detail.

5.2.1 Performance Results

Unit level performance and airman progress under AOTS were compared with performance and progress under conventional OJT. Commanders, third party MAJCOM observers and a majority of the AOTS participants believed the prototype AOTS was an improvement over conventional OJT. This section reports the individual results obtained when analyzing data captured with each respective performance data collection methodology. The results of the unit level data collection instruments are reported first, followed by the results obtained with airman level data collection instruments.

5.2.1.1 Unit Level Performance

Four types of data were collected to measure unit level performance: 1) maintenance quality assurance technical inspections and personnel evaluations; 2) number of repeat maintenance actions; 3) security police evaluation scores; and 4) number of crime incidents. These existing operational measures were used to determine the impact of AOTS on conventional OJT. However, the measures were found not to be an accurate reflection of the OJT process. The limited availability (i.e., quarterly reports) and recording bias added to the limitations of these measures.

5.2.1.2 Airman Data To Measure Performance

Four types of data were collected to measure airmen level performance: 1) airman training progress; 2) proportion of time spent on training management, training, and administration; 3) opinions; and 4) the effect of administering computer based training modules. The following section reports the airman level findings by data type.

5.2.1.2.1 Airman Training Progress Data

Individual Airman Training Record data varied from month to month, suggesting that either airmen changed duty positions or supervisors modified the number of tasks required to be position qualified. Few airmen moved from entry-into-a-position to full position qualification during the nine month interval. Most airmen were fully or partially position qualified when the AOTS program began. Security police airmen were required to become fully position qualified within one month of entry, regardless of whether trained under AOTS or conventional OJT. Because of the reactionary nature of OJT documentation to external demands (e.g., ORI) it was difficult to obtain valid rate of training progress information. In addition, some supervisors continued to change the tasks required for duty positions throughout the SLT&E, making it impossible to obtain any meaningful results. Thus, data collected from individual airmen training records became part of the data that were excluded from analysis.

5.2.1.2.2 Time Spent on Training and Training Related Tasks

Weekly Inventory of Time Spent (WITS) worksheets were completed by supervisors, training managers and trainees before and during the AOTS SLT&E. The worksheets were used to track the number of duty hours available, the number of hours spent performing training management and administrative functions, and the number of hours spent actually conducting or participating in training. The intended purpose for collecting these data was to determine whether the proportion of time spent was greater or less under the AOTS than under the conventional OJT system. Comparisons of data collected before the SLT&E with data collected during the SLT&E revealed that: 1) supervisors spent less than one percent (.88%) more time under AOTS performing training management and administrative functions; 2) supervisors and trainees spent less than eight percent (7.5%) more time under AOTS conducting and participating in training; and 3) training managers spent almost six percent (5.8%) less time under AOTS performing training management functions. As previously discussed in Section 5.2, comparisons were considered invalid because factors within the operational environment determined the amount of time spent performing training related functions, and the impacts of those factors varied greatly between the two data collection periods. Therefore, graphs displaying comparisons of percentages of time spent performing task related functions under the conventional system with time spent under AOTS were excluded in this report.

5.2.1.3 Performance Survey Data

Performance survey items were administered twice to supervisors and training managers. Figure 5.2 displays the time 2 data by component and AFS.

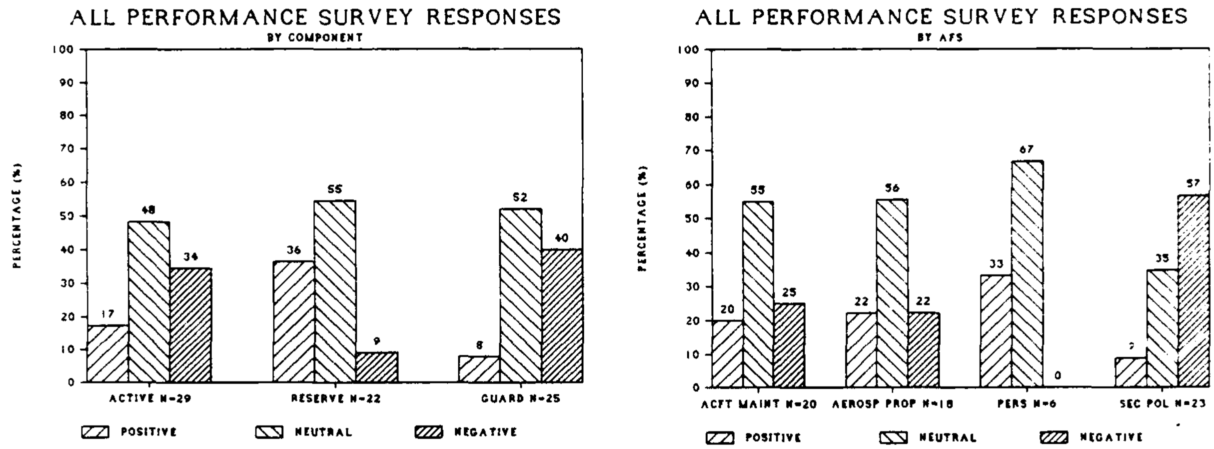

Figure 5.2. Performance Response Range by Component and AFS

Only 30 supervisors and eight training managers responded twice to the performance survey items. A dependent t test comparing eleven time 1 and time 2 ratings from the guard component revealed a significant difference. The guard respondents gave a more favorable rating at time 1 than at time 2. A dependent t test comparing ten time 1 and time 2 ratings from the security police revealed a significant difference. The security police respondents gave a more favorable rating at time 1 than at time 2. The significant differences between the ratings may have been attributed to the AOTS being off line in the ANG security police work center for approximately 30 days between the time 1 and time 2 administrations before system availability problems were reported to the system administrator. There were additional factors that may have contributed to these outcomes. The prototype AOTS was designed to satisfy requirements for the majority of specialties participating in the SLT&E of the system. Security Police policies established processes for training, certification and evaluation requirements that differ from most other functional areas. Consequently, Security Police units conducted much of their training outside the control of AOTS. Also, due to the nature of their jobs, Security Police members spent most of their duty time outside of the work centers, where the AOTS work stations were located during the SLT&E period.

Figure 5.3 displays the percentage of user responses falling in the positive, negative and neutral ranges. The left bar graph displays the percentage of responses falling in each category for all users surveyed, regardless of the amount of time the user spent on the system. The right graph displays the percentage of 34 AOTS frequent user interview responses by component.

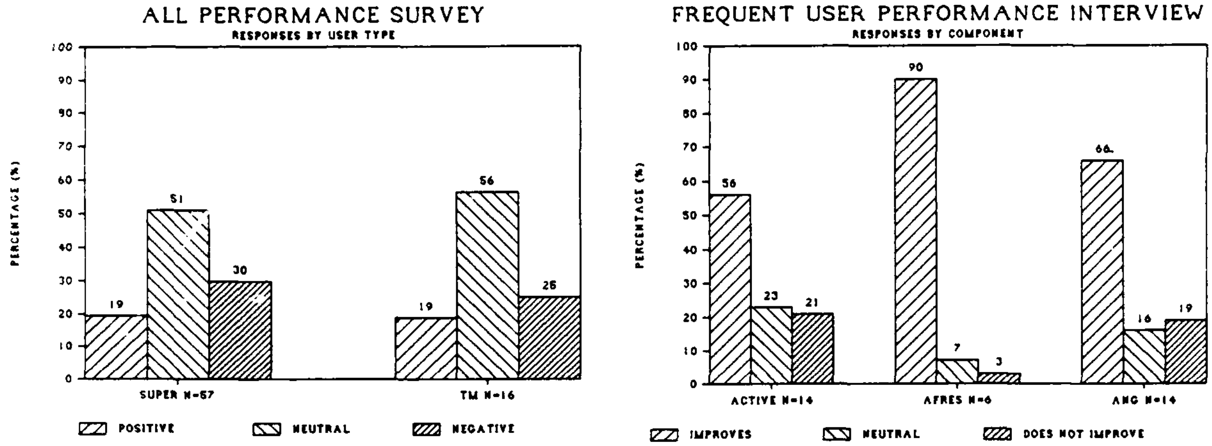

Figure 5.3. Performance Response Range by User Type and Component

Many users reported that they believed individuals trained under the AOTS possessed more task related knowledge and were better able to perform tasks than airmen trained under others methods of OJT. For the reasons discussed in Section 5.2.1.2.1 and the short SLT&E period, it was difficult for some users to determine whether airman trained under the prototype AOTS performed better than airman trained under conventional OJT.

5.2.1.4 Performance Measurement Study

In an effort to take a closer look at performance data, an AOTS job performance study was conducted to investigate knowledge and performance differences attributed to the use of Computer-Based Training (CBT). Airmen who received task training via CBT modules believed that the training modules were beneficial and easy to use. Twelve aircraft maintenance personnel and nine aerospace propulsion personnel selected for treatment groups viewed CBT modules developed for their respective specialty. An equal number of control group counterparts did not view the CBT. Task knowledge tests and over-the-shoulder performance evaluations were administered to all forty-two airmen. The results are depicted in Figure 5.4. Airmen who viewed the CBT obtained significantly higher knowledge test scores than the companion control group airmen who did not review the training material. In addition, the treatment group personnel scored as well on the performance evaluations as the control group airmen who had more experience performing the respective tasks.

AIRCRAFT MAINTENANCE

KNOWLEDGE TESTS (MEAN PERCENTAGE SCORE)

TASK TESTED*	A	B	C	D
CBT	91%	85%	60%	92%
NO CBT	82%	70%	60%	79%

PERFORMANCE TESTS (MEAN PERCENTAGE SCORE)

TASK TESTED*	A	B	C	D
CBT	100%	86%	98%	100%
NO CBT	100%	86%	98%	88%

* A – INSTALL DRAG CHUTE
B – SERVICE MAIN LANDING GEAR STRUT
C – REMOVE WHEEL AND TIRE ASSEMBLY
D – INSTALL WHEEL AND TIRE ASSEMBLY

AEROSPACE PROPULSION

KNOWLEDGE TESTS (MEAN PERCENTAGE SCORE)

TASK TESTED*	A	B	C
CBT	83%	95%	83%
NO CBT	66%	68%	66%

PERFORMANCE TESTS (MEAN PERCENTAGE SCORE)

TASK TESTED*	A	B	C
CBT	84%	79%	100%
NO CBT	89%	91%	86%

* A – INSTALL CSD GENERATOR ASSEMBLY
B – INSTALL CSD DOME ASSEMBLY
C – CLOSE CSD DOORS

Figure 5.4. Performance Measurement Results

PERFORMANCE SUMMARY

The analysis of those data which were useful in determining the performance of the AOTS yielded very positive results. Airmen trained using the CBT developed under the purview of the AOTS demonstrated a higher level of task knowledge than airmen trained under the conventional system, and were equally qualified to perform tasks, although they had considerably less experience. Many personnel responding to surveys and interviews indicated they believed the AOTS produced better qualified airmen and qualified airmen sooner than the conventional system, and that unit effectiveness increased under the AOTS.

Analysis of data collected to assess unit level performance and airman training progress revealed that comparisons could not be made. The baseline and AOTS data were in some instances inconsistent or too similar to determine which training system performed better; AOTS or conventional OJT.

5.2.2 Acceptance Results

Overall, respondents were positive about the AOTS. Individuals familiar with the AOTS and conventional OJT methodologies preferred the Advanced On-the-Job Training System to the conventional methods. More than three fourths (77%) of commanders had a positive reaction to the AOTS. Eighty-five percent of commanders felt the AOTS satisfied their unit OJT requirements. Three out of four (75%) commanders believed the AOTS would significantly improve combat readiness if implemented throughout the operational environment. Figure 5.5 displays the percentage of acceptance responses falling in the positive, negative and neutral ranges by component and AFS.

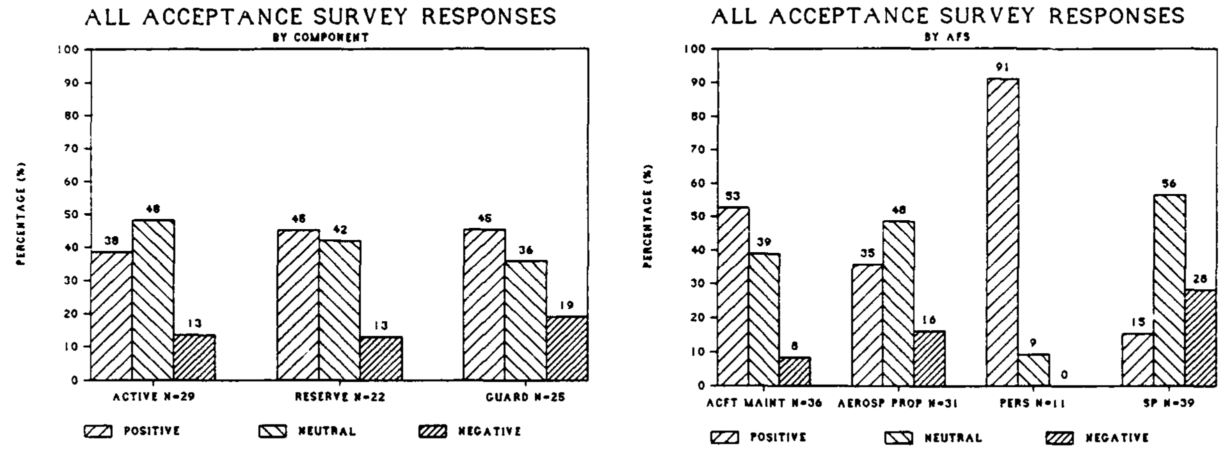

Figure 5.5. Acceptance Responses by Component and AFS

Little difference was noted across components. Individuals in Maintenance and Personnel were more favorable than raters from the other specialties. Security Police were least favorable. As the largest specialties, maintenance personnel liked the automated functions for accessing and annotating training records. Personnel had a small number of individuals assigned to the specialty and most were trained by the IST or contractor trainers. Airmen assigned to Personnel had more experience with computers and appeared less computer phobic than their counterparts in the other specialties. The probable causes for the lower ratings by the Security Police were discussed in the Performance Summary.

Figure 5.6 displays the percentage of user responses falling in the positive, negative and neutral ranges. The left bar graph displays the percentage of responses falling in each category for all users surveyed, regardless of the amount of time the user spent on the system. The right graph displays the percentage of 34 AOTS frequent users' interview responses falling in each response range by component. A comparison of the two graphs suggests that acceptance of the AOTS increased as use of the system increased.

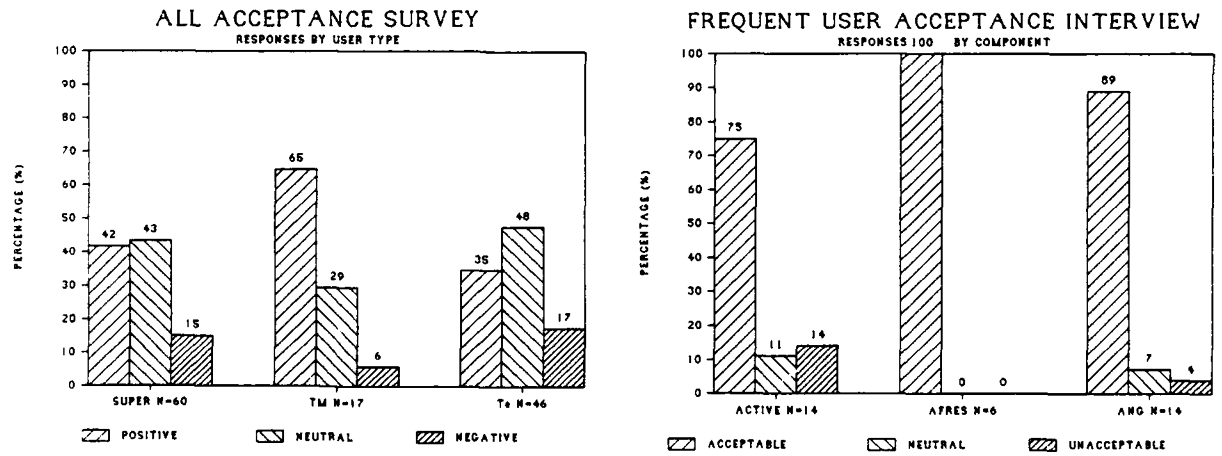

Figure 5.6. Acceptance Responses by User type and Component

More than one-third of all individuals responded in the neutral acceptance range. Not all personnel were able to distinguish between training and task performance because much of conventional on-the-job training was conducted during the performance of operational tasks. Some individuals had an insufficient understanding of Air Force OJT and required an orientation on generic OJT practices before attempting to learn the AOTS functions. One hundred percent of all AOTS participants' acceptance mean ratings fell in the positive or neutral categories indicating overall user acceptance with the AOTS.

Evaluation of the AOTS by eighty-two third party MAJCOM observers after a two day orientation supplemented the evaluation efforts. These individuals evaluated AOTS from a perspective of conceptually using the system at both the command and AF-wide level. While the observers were familiar with the deficiencies in AF OJT, they were not bound by the constraints of the operational setting in evaluating the system. Figure 5.7 shows the percentage of positive, negative and neutral responses by observer. Sixty-four percent of the observers liked the AOTS and believed the system was easy to use.

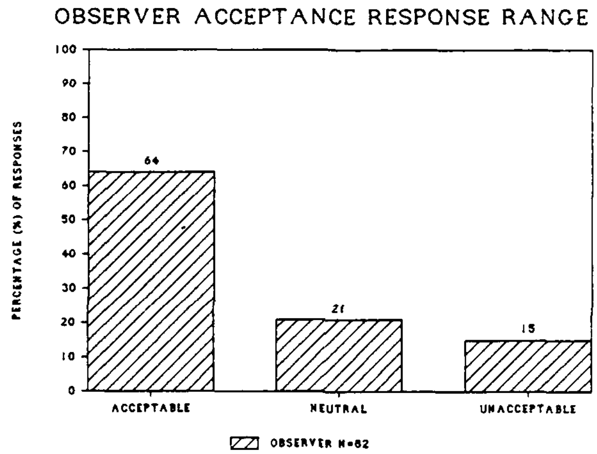

Figure 5.7. Percentage of Observer Responses in Each Acceptance Range

ACCEPTANCE SUMMARY

The overall results for the Acceptance critical issue revealed that the respondents liked the prototype AOTS and felt it was easy to use. This finding was consistent across all components, and with the exception of the Security Police, across all AFSs. There were communication line problems and unique training process differences among the Security Police that may have contributed to this finding. MAJCOM observers and higher frequency users of the system reported the most positive view of the system.

5.2.3 Suitability Results

According to the majority of the respondents, the AOTS was viewed as overcoming identified OJT deficiencies and should be implemented. For example, seventy-three percent of all AOTS participants responding to the opinion survey believed a system similar to the AOTS is needed in their career fields. Fifty-seven percent favored the AOTS Airman Training Record over AF Form 623 for documenting OJT data. Fifty-two percent believed the AOTS should be implemented in the operational environment AF wide. Almost all commanders (92%) believed the AOTS was suitable and should be implemented across the Air Force. Figure 5.8 shows the percentage of supervisor, training manager and trainer/evaluator responses falling in the positive, negative and neutral ranges by component and AFS.

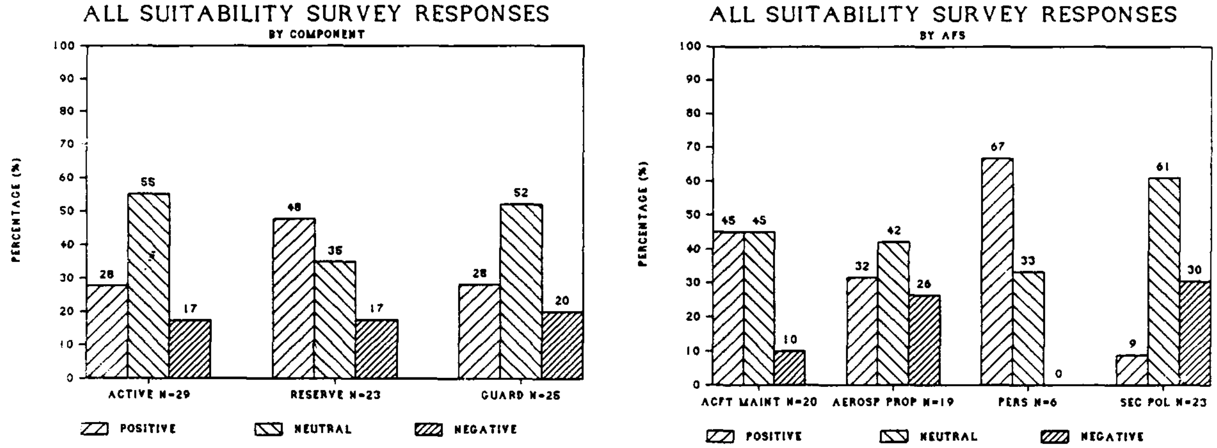

Figure 5.8. Suitability Responses by Component and AFS

The guard respondents gave a higher suitability rating at time 1 than at time 2. A dependent t test comparing 10 time 1 and time 2 ratings from the security police also revealed significantly higher suitability ratings at time 1 than at time 2. As with the Security Police acceptance ratings, the lower Security Police suitability ratings at time 2 may have been due to equipment and communication line problems and unique training differences.

Figure 5.9 displays the percentage of user responses falling in the positive, negative and neutral ranges. The left bar graph displays the percentage of responses falling in each category for all users surveyed, regardless of the amount of time the user spent on the system. The right graph displays the percentage of 34 AOTS frequent users' interview responses falling in each category by component. Other suitability questions revealed that sixty-five percent of the supervisors believed that their career field needed an on-the-job training system similar to the AOTS. Sixty-one percent indicated liking one or more of the AOTS features. Twenty-two percent liked using the entire AOTS system. Forty-seven percent of the supervisors believed that AOTS should be implemented in the Air Force.

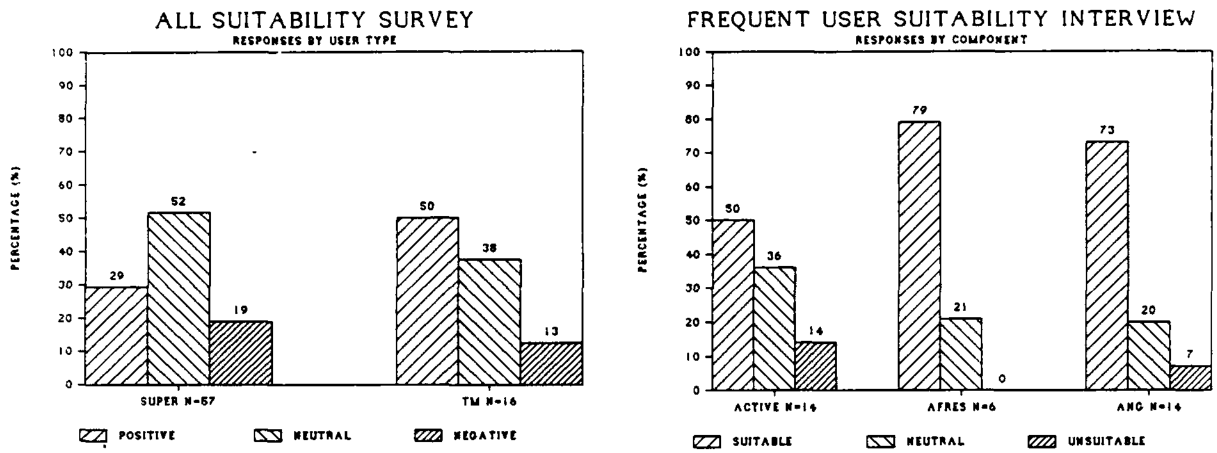

Figure 5.9. Suitability Response Range by User Type and Component

The majority of training managers (77%) preferred the prototype AOTS to the conventional OJT system. More than half (53%) indicated they favored the AOTS automated methodologies for recording training requirements and history over maintaining manual AF Forms 623. Three out of four (75%) of the training managers believed that their career field would benefit greatly through implementation of an on-the-job training system similar to the AOTS. Fifty percent of the training managers believed AOTS would significantly increase combat capabilities. A significant number (63%) believed that the application of training technologies demonstrated via the AOTS would enable trainees to complete training requirements more efficiently. An even greater number (65%) of the training managers believed that AOTS should be implemented throughout the Air Force.

After completing a two-day orientation, the majority (77%) of MAJCOM observers believed they had received sufficient information to adequately assess the potential of AOTS. Almost nine out of ten (87%) indicated their belief that the conventional OJT system has severe deficiencies and needs to be improved. Analysis of responses to a survey having questions specifically related to the suitability issue revealed that seventy-one percent of the MAJCOM observers believed the prototype AOTS met or exceeded Air Force OJT policies, as documented in AFR 50-23. Nearly 3 out of 4 (74%) of the MAJCOM observers believed their functional area or MAJCOM had a need for an OJT system similar to AOTS, and more than half (54%) believed AOTS could improve the combat readiness status of MAJCOMs. More than three fourths of the observers (78%) believed all OJT systems operating in their functional areas required management, training development and delivery, and evaluation development and delivery functions. Figure 5.10 displays the percentage of MAJCOM observer responses falling in the positive, negative and neutral response ranges. The majority (74%) of the third party observers' responses were in the positive range.

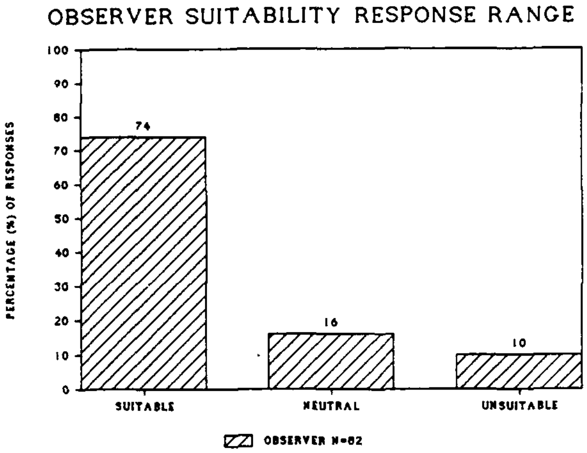

Figure 5.10. Percentage of Observer Responses in Each Suitability Range

SUITABILITY SUMMARY

Overall results for the Suitability critical issue revealed that the prototype AOTS solved existing OJT deficiencies and that the system functioned well within the operational environment. This finding was consistent across all components and AFSs. The only exception was Security Police. Respondents who were most familiar with Air Force OJT policies and procedures and with the AOTS responded more favorably. These respondents also believed the AOTS is needed in the operational environment and should be implemented Air Force wide.

5.3 Process Data Results

AOTS training was delivered independently to each user to allow the level and pace of the training to be tailored for each individual. Contractors and members of the Air Force Instructional Systems Team (IST) trained supervisors, training managers, and quality control monitors to use AOTS. The responsibility of training trainers, evaluators and trainees fell on the trained supervisors and, in some instances, training managers. After the initial training, many individuals became more proficient on the system. However, some management personnel reported feeling overwhelmed by the initial instruction on the system and avoided seeking further training. Lack of motivation by the supervisors to learn AOTS and instruct their subordinates required the subordinate personnel to learn AOTS on their own or to request training from an IST member. Supplemental training was available to anyone seeking additional training. Many of the trainers and trainees who received inadequate training remained infrequent users of the AOTS and indicated on their opinion surveys that they disliked or were neutral toward the prototype AOTS.

A "hot-line" for reporting problems and requesting additional training was available for all users 24 hours a day. Novice users reported simple problems (e.g., logging onto the system). Frequent users reported more complicated problems and required assistance with complex functions such as scheduling training for one or more trainees.

AOTS log-on records and observation reports revealed that users who learned to use the system liked the AOTS automated functions, and used the functions to complete their OJT responsibilities. Usage patterns were examined by components (i.e., Active, Air National Guard and Air Force Reserves), specialties (i.e., Aircraft Maintenance, Aerospace Propulsion, Security Police and Personnel) and preferred/least preferred AOTS function (e.g., Individual Airman Training Record, Quality Control, On-line/Off-line evaluations).

After the initial two months of training on the AOTS, there was a gradual increase in usage among the Air Force Active Duty personnel and a noticeable drop in usage by Air National Guard and Air Force Reserve personnel. Air Force Active Duty personnel continued to show an increase in usage until the months of January and February. In contrast, the Air National Guard and Air Force Reserve personnel maintained a low and stable pattern of usage during most of deployment period except for a peak usage period during January for the Air National Guard.

The differential usage pattern among components may have been a function of differences in mission requirements and field activities. For example, Air Force Active Duty personnel were able to utilize the system on a full time basis. With the limited exception of full-time personnel, Air National Guard and Air Force Reserve unit personnel used the system only one weekend per month, during Unit Training Assembly.

There was substantial use of the AOTS functions to review OJT records and update task certification and position qualification status during February. The peak period of use among the Air Force Active Duty personnel in January and February and the gradual decline after February may have been the results of several base exercises leading to an Operational Readiness Inspection (ORI) in February.

Among the Air Force Active Duty personnel, the Aircraft Maintenance personnel used the system most often. Aircraft Maintenance had the largest number of personnel; consequently, it is not surprising that they would have the highest usage on the system. However, Aircraft Maintenance use after February fell to a level below the usage rate of the Security Police specialty for the remaining months of the deployment period.

Within the Air Force Reserves, system utilization among the Aircraft Maintenance and Aerospace Propulsion specialties exceeded the usage by Personnel and Security Police specialties. This finding was expected given the disproportionately higher number of personnel in the two maintenance specialties. However, among the Air National Guard specialties, the Security Police exhibited the greatest amount of usage, except for the months of April and June, when the Aircraft Maintenance specialty used the system more.

The Airman Training Record (ATR) was the most frequently accessed data base. The capabilities in the management subsystem to access and update training records such as identifying training requirements, scheduling training events and certifying task qualifications were used more frequently than those in the evaluation or training development and delivery subsystems.

6 DISCUSSION

The primary objective of this project was to determine if deficiencies in the conventional Air Force enlisted OJT system could be resolved through applying modern computer and training technologies. Lower level objectives were established for testing and evaluating the system so that a determination could be made as to whether the primary objective was met. These lower level objectives were appropriately aligned with the critical issues Compliance, Performance, Acceptance and Suitability.

Two types of testing and evaluation occurred. First, testing of the system occurred during development to determine whether all functions specified were included, whether the functions performed as specified, and whether the system was ready to be installed in the participating operational work centers. The results of this testing were used to measure Compliance. Second, following development and installation, the system was tested and evaluated to determine the impacts it had on work center training programs and how it was perceived by users and MAJCOM observers. The results of this testing and evaluation were used to measure Performance, Acceptance and Suitability.

A twelve-month period was scheduled for the SLT&E of the prototype AOTS. However, this period was considered too brief to effectively compare the AOTS to the conventional OJT system. At least four factors served as indicators that more time should have been allotted for the SLT&E. These were 1) the time required for users to learn to operate the system, 2) the time required to teach work center personnel Air Force OJT policies and procedures, 3) the infrequent use of the system by many work center personnel, and 4) the need to terminate the collection of data two months prior to the end of the period to enable analyses to occur. Although the AOTS could not be effectively compared with the conventional system, results of assessments by users and MAJCOM observers clearly indicated whether established objectives were met. Discussions relevant to the results of analyzing data collected before and after the implementation of the prototype AOTS are presented below, by critical issue.

COMPLIANCE

The prototype AOTS met all requirements specified for the system, subsystems and components.

a. Appropriate external interfaces were established;

b. Terminal and search response times were conducted within specified time limits;

c. Hardware reliability exceeded the established goal;

d. All maintenance goals were met or exceeded except in instances where users failed to report problems;

e. All hardware component availability exceeded established goals; and

f. The system was available seven days a week, to all shifts and all participating work centers.

PERFORMANCE

The analysis of position qualification data collected to compare airmen trained under the AOTS with airmen trained under the conventional system revealed that valid comparisons could not be made. The majority of airmen were position qualified before data collection began. For those airmen who were actively participating in training, the number of tasks required for position qualification did not remain constant from month to month. Airmen were frequently reassigned to different duty positions. Also, few airmen trained under AOTS entered position qualification training and became position qualified during the SLT&E period.

Analysis of data collected via WITS sheets revealed that comparisons of time spent performing training responsibilities before the implementation of the prototype AOTS with time spent after implementation were difficult to make, due to environmental impacts.

Analysis of performance data revealed that maintenance personnel trained under the AOTS consistently scored higher on knowledge tests than did personnel trained under the conventional system. When given performance tests, personnel trained under the AOTS scored as well as personnel trained under the conventional system, even though these airmen had significantly less experience in performing the tasks.

The analysis of survey and interview data revealed that users of the prototype AOTS believed that airmen trained under the system achieved task qualification sooner, and were better qualified to perform tasks than were airmen trained under the conventional OJT system. Also, the majority of personnel surveyed and interviewed responded positively when asked if the prototype AOTS improved performance of the overall OJT system, saved time during the performance of training responsibilities, improved unit effectiveness, and would improve combat readiness if implemented throughout the operational environment.

The analyses of unit assessment data (Aircraft Maintenance quality assurance and repeat maintenance statistics, and Security Police quality control and base crime statistics) showed there were no significant differences between baseline and AOTS data.

ACCEPTANCE

The results from analyzing survey and interview data clearly indicated a high level of acceptance of the prototype AOTS by frequent users of the system. Users favored the methods for managing, scheduling and documenting training provided with the AOTS over conventional methods.

SUITABILITY

The analysis of survey and interview data showed that most users and MAJCOM observers believed the AOTS was needed to enhance training within their respective career fields. Further, these personnel believed the AOTS was suitable for deployment throughout the Air Force operational environment, and should be implemented. Unit commanders who were interviewed responded very positively about the prototype AOTS. These commanders believed the AOTS satisfied their unit OJT requirements, would significantly improve the combat capabilities of their units, was suitable for Air Force-wide use, and should be implemented.

7 CONCLUSION AND RECOMMENDATION

The execution of the prototype Advanced On-the-Job Training System at Bergstrom Air Force Base and Ellington Air National Guard Base was successful. The project was completed on schedule and within its budget. The experiment proved that a total training system as defined by AFHRL could be developed and implemented in the operational environment. The AOTS successfully provided AFHRL specified on-line capabilities and methodologies to:

a. Identify and define task performance and training requirements;

b. Develop and deliver training and evaluation materials;

c. Schedule training and evaluation events, and identify performance, training and evaluation resource requirements;

d. Track and record individual airman training accomplishments;

e. Evaluate individual airman task knowledge and performance;

f. Track, evaluate, and report the AOTS program effectiveness; and

g. Report airman training, evaluation status, and evaluation results to appropriate Air Force managers.

The AOTS met performance and hardware reliability, maintainability, and availability goals and provided the required interfaces with appropriate external entities. During the implementation of the AOTS, the system was available 99 percent of the time. The amount of time required for maintenance personnel to recover from an error and bring the AOTS or its components back to an operational mode was minimal. The probability of the AOTS operating successfully in the operational environment was significantly high. Individuals familiar with the AOTS capabilities and OJT methodologies expressed a desire to deploy the AOTS in the operational environment. After assessing the prototype AOTS, a committee of Air Staff and MAJCOM functional management representatives agreed that a system such as the prototype AOTS was needed to provide standardized training and evaluation procedures Air Force wide.

As recommended by the commanders, observers and frequent users of the AOTS, the system should be implemented in the operational environment Air Force wide to help increase the quality of training programs within the Air Force organizations.

8 ABBREVIATIONS AND ACRONYMS

A_{dt}	Administrative Delay Time
AFB	Air Force Base
AFS	Air Force Specialty
AFSC	Air Force Specialty Code
AMU	Aircraft Maintenance Unit
ANG	Air National Guard
ANGB	Air National Guard Base
ANOVA	Analysis of Variance
A_o	Operational Availability
AOTS	Advanced On-the-job Training System
ATC	Air Training Command
CAM	Criteria Acquisition Model
HQ USAF/DPP	Headquarters United States Air Force /Director of Personnel Programs
IST	Instructional System Team
JEIM	Jet Engine Intermediate Maintenance
L_{dt}	Logistic Delay Time
M	Mean Maintenance Time
MAC	Military Airlift Command
MAJCOM	Major Command
MDC	Mean Data Collection
MILAP	Maintenance Information Logically Analyzed and Presented
M_{dt}	Mean Maintenance Downtime
MTBF	Mean Time Between Failures
MTL	Master Task List
MTP	Master Test Plan
MTR	Mean Time To Restore
MTTR	Mean Time To Repair
NCO	Noncommissioned Officer
OJT	On-the-Job Training
ORI	Operational Readiness Inspection
QA	Quality Assurance
QC	Quality Control
SAC	Strategic Air Command

SLT&E	System Level Test & Evaluation
SME	Subject Matter Expert
SOA	Separate Operating Agency
SPOL	Security Police Operations-Law Enforcement
TAC	Tactical Air Command
UTA	Unit Training Assembly
WITS	Weekly Inventory of Time Spent

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