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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORAT--ETC(U)
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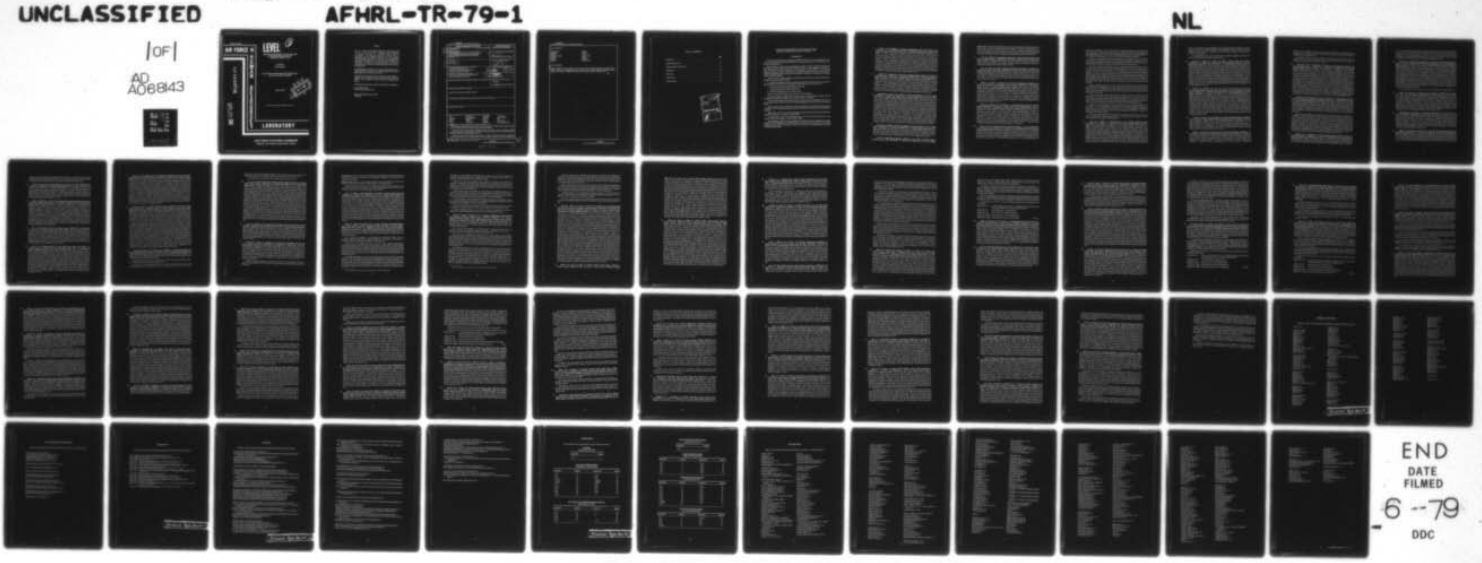

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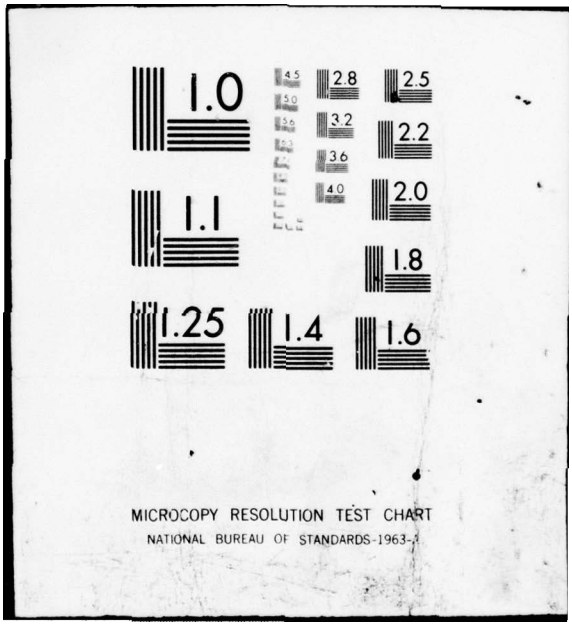
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AIR FORCE HUMAN RESOURCES LABORATORY

LEVEL 2

ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS – 1977

Compiled by

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Brooks Air Force Base, Texas 78235

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This bibliography was submitted by Technical Editing Working Group, under project 9991, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

This report has been reviewed by the Information Office (OI) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

LOU ELLIOTT, Chief
Technical Editing Working Group

RONALD W. TERRY, Colonel, USAF
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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: AFHRL-TR-79-1	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS – 1977	5. TYPE OF REPORT & PERIOD COVERED: Final rept.
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Esther M. Barlow	8. CONTRACT OR GRANT NUMBER(s): 52p.
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Technical Editing Working Group, HQ Air Force Human Resources Laboratory, Brooks Air Force Base, Texas 78235	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 62703F 9991 PROJ PR
11. CONTROLLING OFFICE NAME AND ADDRESS: HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235	12. REPORT DATE: Feb[illegible]79
	13. NUMBER OF PAGES: 56
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

AIS	bibliography	data analysis	human factors
aptitude	career development	drug abuse	human resources
assignment	classification	education	ISD
ASPT	CODAP	equipment	job inventories
attitude	cost analysis	evaluation	job performance aids

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This annotated bibliography presents a listing of technical reports (1977) dealing with personnel and training reseach conducted by the Air Force Human Resources Laboratory (AFHRL).

The research has been conducted by professional personnel representing a variety of disciplines, including psychologists, operations research specialists, mathematicians, computer analysts, economists, electronic engineers, aeronautical engineers, and technical support personnel.

AFHRL is charged with the planning and execution of USAF exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of

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Item 19 (*Continued*)

job satisfaction
management
manpower
occupational analysis
personnel
readability
retention
selection
simulation
surveys
systems design
training
utilization
weapon systems

Item 20 (*Continued*)

military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment.

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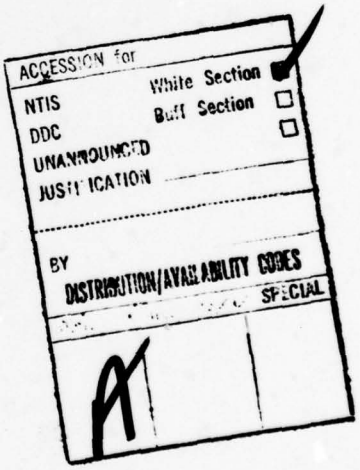

ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS – 1977

INTRODUCTION

The Air Force Human Resources Laboratory (AFHRL), Brooks AFB, Texas, was established in 1968 as an Air Force Systems Command (AFSC) laboratory. (During the early part of 1968 it was part of the Aerospace Medical Division.)

This Laboratory is charged with the planning and execution of USAF exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment.

At the end of 1977, AFHRL consisted of a headquarters and three divisions at Brooks AFB and three geographically dispersed divisions as follows:

1. Computational Sciences Division, Occupation and Manpower Research Division, and Personnel Research Division were transferred from Lackland to Brooks AFB, Texas, in the Spring of 1977.
2. Advanced Systems Division, Wright-Patterson AFB, Ohio.
3. Flying Training Division, Williams AFB, Arizona.
4. Technical Training Division, Lowry AFB, Colorado.

Abstract entries list the division name at the time of report publication.

The abstracts appear in technical report number sequence. Entries following the author and title heading give information identifying the report and indicate where it is available:

Project number: Research areas identified by these numbers are given in the PROJECT index. The Air Force contract number and the name of the contracting organization are entered for contract-produced reports.

DDC accessioned document (AD) number indicates availability to Government offices and registered contractors from the Defense Documentation Center; this number should be used when requesting reports from DDC.

NTIS appears only if the report has been deposited with the National Technical Information Service, Springfield, Virginia, 22151, for sale to the general public.

To obtain copies of reports without DDC accessioned document (AD) numbers, furnish the names of authors, titles, report numbers, and dates to DDC or NTIS.

This bibliography contains six indexes: PERSONAL AUTHOR, CIVILIAN CORPORATE AUTHOR, PROJECT, TITLE, DIVISION, and KEYWORD. Reports are identified in the indexes by the serial number appearing in the left margin of the abstract entries. This report does not contain classified or For Official Use Only technical reports.

1 **Curton, E.D., & Nataupsky, M. Senior noncommissioned officers' APR opinion survey. AFHRL-TR-77-1, AD-A039 900. Lackland AFB, TX: Personnel Research Division, February 1977. Project 7719. NTIS.** A questionnaire was mailed to 10,000 Air Force NCOs in the grades of E7, E8, and E9 in order to sample their opinions, expertise, and attitudes about various aspects of performance evaluation systems. The senior NCOs were asked about rating factors with which they should be evaluated, their opinions of the current APR system, and their attitudes toward proposed changes to the current APR system. In general, there was agreement across all senior NCO groups with respect to which rating factors should be included on a performance evaluation instrument. The overall level of satisfaction with the current APR system was fairly high. However, considering the population being surveyed was those who have been most successful with the system, the level of satisfaction was perhaps lower than might have been expected. With respect to possible changes to the APR system, the senior NCOs were about evenly divided on most major issues such as the possibility of an OER-type control system and career field specific APRs. (32 pp.)

2 **Kulhavy, R.W., Schmid, R.F., & Dean, R.S. Assessing instrument sensitivity for heading and attitude information. AFHRL-TR-77-2, AD-A046 065. Williams AFB, AZ: Flying Training Division, August 1977. Project 2313, Contract F41609-75-C-0028, Arizona State University. NTIS.** The three studies, described in this report, concerned the assessment of procedures which influence instrument sensitivity in military flight instruction. The ability to determine the relative location of an in-flight vehicle from a set of dial indicators was influenced more by students' expectations than by context. Sensitivity to heading and attitude information was increased when learners were supplied with overt attention control. The teaching of instrument sensitivity appears best facilitated by employing publically observable responses during training, and seems to be a function of the degree to which the learner can be directed to use a spacial processing mechanism during initial encoding. (14 pp.)

3 **Krahenbuhl, G.S., Marett, J.R., & King, N.W. Stress and performance in T-37 pilot training. AFHRL-TR-77-3, AD-A041 734. Williams AFB, AZ: Flying Training Division, May 1977. Project 2313, Contract F41609-75-C-0028, Arizona State University. NTIS.** Catecholamine excretion was determined for USAF student pilots (N = 8) during three basal and four T-37 training conditions. When viewed as the dependent variable, catecholamine excretion patterns support the conclusion that the Basic Cockpit Training Emergency Procedures unit was not stressful. The remaining lesson units, including Power-on Stall and Spin-recovery, First Solo, and Instrument Check lesson units, resulted in a pronounced stress response. When catecholamine excretion data were interpreted for psychological significance, it was concluded that the lesson unit which included Power-on Stalls and Spin-recoveries created the highest arousal, anxiety, and apprehension. Student pilot observations support this interpretation. The relative production of epinephrine and norepinephrine showed changes accompanying pilot training which may be interpreted as demonstrative of successful coping behavior. When compared with inferior students, pilot trainees rated as superior appeared to be under lower stress during nearly all phases of the T-37 Undergraduate Training Program. Interestingly, the increase in epinephrine excretion over basal levels during the three most stressful conditions was strongly related ($r = +.934$) to the neuroticism scale of the Eysenck Personality Inventory. (26 pp.)

4 **Cyrus, M.L., & Templeton, T.K. Buffet simulation for Advanced Simulator for Pilot Training (ASPT). AFHRL-TR-77-4, AD-A040 550. Williams AFB, AZ: Flying Training Division, March 1977. Project 1123. NTIS.** This paper presents a motion/control landing buffet simulation package as implemented on the Advanced Simulator for Pilot Training (ASPT) located at Williams AFB, Arizona. All primary buffet effects are included. The high level of pilot acceptance and subjective realism indicate a simplified approach to buffet simulation is sufficient for training purposes. (12 pp.)

5 **Cyrus, M.L. Engineering and geometric constraints of a six degree of freedom synergistic platform motion system. AFHRL-TR-77-5, AD-A043 194. Williams AFB, AZ: Flying Training**

Division, May 1977. Project 1123. NTIS. Recent controversy surrounding the training effectiveness of the six degree of freedom, synergistic platform motion system is centered on several issues, one of which is, surprisingly, just exactly what motion the platform is capable of producing. This paper presents the primary equations and constraints, as well as a number of derived constraints applicable to the Advanced Simulator for Pilot Training (ASPT), a representative motion system. (16 pp.)

6 **Cyrus, M.L. Method for compensating transport lags in computer image generation visual displays for flight simulation. AFHRL-TR-77-6, AD-A040 551. Williams AFB, AZ: Flying Training Division, March 1977. Project 1123. NTIS.** This paper examines an analytical technique for simultaneously compensating transport delays in Computer Image Generation (CIG) visual systems, while eliminating high frequency "flutter" effects. (12 pp.)

7 **Cyrus, M.L. Energy conservation through the optimization of hydraulic power supplies for the six degree of freedom motion system. AFHRL-TR-77-7, AD-A040 443. Williams AFB, AZ: Flying Training Division, March 1977. Project 1123. NTIS.** The objective of this project was to estimate the approximate hydraulic fluid flow requirements for the six degree of freedom motion system of the type specified in MIL-STD-1558 and determine means by which motion hydraulic supplies can be cut, combined, or made more efficient. This paper defines the approach, data collection, analysis, and results of that project. (18 pp.)

8 **Williams, A.R., Siegel, A.I., Burkett, J.R., & Groff, S.D. Development and validation of an equation for predicting the comprehensibility of textual material. AFHRL-TR-77-8, AD-A040 755. Lowry AFB, CO: Technical Training Division, February 1977. Project 2313, Contract F41609-75-C-0025, Applied Psychological Services, Inc. NTIS.** Norms for Air Force technical training materials were developed for seven previously developed Structure-of-Intellect and seven psycho-linguistically oriented variables which have been used to assess the readability/comprehensibility of textual materials. Separate norms are presented for Air Force study guides, manuals, career development course materials, and technical orders. An "overall" norm is also presented along with norms on the same variables for a small sample of general literature. A multiple linear regression equation, which relates the various comprehensibility measures to measured comprehensibility, was developed and cross-validated. (56 pp.)

9 **Bebeau, M.J., Sullivan, H.J., & Eubanks, J.L. Learning incentives preferred by university students. AFHRL-TR-77-9, AD-A041 733. Williams AFB, AZ: Flying Training Division, May 1977. Project 2313, Contract F41609-75-C-0028, Arizona State University. NTIS.** This study involved an extension of the data base from an earlier incentive survey describing student preferences for incentives commonly available for use by instructors to promote good achievement in course work. Three hundred and eighty-five College of Education students rated ten incentives on 45 paired-comparison items and on a seven-point rating scale. "Release from final examination" was most preferred, "no reward at all" was least preferred, and "assisting the instructor as proctor" ranked ninth among the ten incentives. Consistency of ratings was high within subjects on the paired-comparison items, between the paired-comparison and rating-scale methods ($r = .98$), and between education and introductory psychology student samples ($r = .99$). (14 pp.)

10 **Knoop, P.A. Man-computer symbiosis through interactive graphics: A survey and identification of critical research areas. AFHRL-TR-77-10, AD-A041 136. Wright-Patterson AFB, OH: Advanced Systems Division, April 1977. Project 6114. NTIS.** The purpose of this effort was to determine the research areas that appear most critical to achieving man-computer symbiosis. First, an operational definition of man-computer symbiosis was developed by: (a) reviewing and summarizing what others have said about it, and (b) attempting to distinguish it from other types of man-computer relationships. Most general views of it are typified by amplifications of the points originally raised by

Licklider upon introduction of the concept in 1960. An operational definition was derived by casting the various types of man-computer relationships into a systems framework, and determining the major distinguishing features of each. The major distinguishing feature of man-computer symbiosis is the capability of both man and computer to transceive relevant unrequested information.

Using the derived definition, basic key requirements of a symbiotic system were projected. These included: (a) transceivers and memories, (b) graphics techniques, (c) a language, and (d) an attention-getting capability. These basic requirements were used to outline and provide structure to a literature survey to determine the state of the art and identify critical research areas.

The survey revealed that raster scan cathode ray tubes hold the greatest promise for use in symbiotic systems, but that a critical problem accompanies their use in that scan conversion methods are required. Existing methods are either too time consuming or too memory consuming, and attempts to improve on one of these aspects have all resulted in tradeoffs on the other. A promising technique was found for reducing the number of vectors comprising a scene. This technique would find its greatest utility in random scan systems, where its use may provide flicker-free displays whose densities approach those possible with raster scan systems. In the area of input device technology, it was found that few distinct improvements have been made in over a decade of research, and that no single device exists which is optimal for all basic types of input that the man would expectedly need to employ.

Despite considerable evidence as to its need, little work has been performed in extending man's memory precision and recall capability. The only notable research found was provision of a simulated short-term memory for application in automotive design work. Efforts to extend computer memory capacity center around the development of improved data structures, but there is some evidence that these efforts are misdirected.

There are no methods with immediate utility for symbiotic systems for efficiently removing hidden lines and surfaces to effect a 3D display. Most methods are too slow, with attempts at improvement only resulting in speed/memory tradeoffs. The only real-time solution is unsuitable for use with environments where many objects move independently, and is accomplished only at the expense of enormous processing power dedicated exclusively to hidden line/surface removal.

Finally, it was determined that the most promising solution to the language problem lies in the development of hybrid communication techniques using a combination of graphic languages and small scale voice input methods. This could offset some of the disadvantages of using graphic languages alone as well as provide a highly efficient attention-getting capability and enhance the rapport man feels with the computer.

The critical research areas that were identified were summarized in table form. In the author's opinion, advancements in these areas would effect the most rapid closure on achieving the type of system required for man-computer symbiosis. (40 pp.)

11 **Alley, W.E., & Gibsons, T.A. Predicting success in the AFROTC scholarship program. AFHRL-TR-77-11, AD-A041 132. Lackland AFB, TX: Personnel Research Division, April 1977. Project 7719. NTIS.** Research was conducted to improve applicant selection procedures in the AFROTC scholarship program. The objectives were to document predictive relationships, if any, between student aptitude measures, academic major, institutional selectivity, and eventual completion of the scholarship program. The analysis included records of student performance for all Air Force Reserve Officers' Training Corps (AFROTC) participants during FY 71 through FY 75 (N = 23,000). Results indicated that success in the program could be forecast with prior knowledge of: (a) applicant scores on the Air Force Officer Qualifying Test (AFOQT)—OQ composite and (b) the intended academic major (science and engineering versus other). A significant degree of predictive accuracy was achieved for each of the 4-year, 3-year, and 2-year programs. The effects of additional information based on the AFOQT (Pilot and Navigator composites) and institutional selectivity was

found to be non-essential for predicting ROTC training outcomes although the usefulness of the rated training composites was again documented for undergraduate pilot and navigator training. Specifications were discussed to developing a dual selection system appropriate for both pre- and post-entry training programs.

The implementation of such a system could result in considerable savings given the high costs of attrition typically associated with these programs. (30 pp.)

12 **Kantor, J.E., Noble, B.E., & Reid, G.B. Project Constant Growth: Pilot attitudes. AFHRL-TR-77-12, AD-A040 753. Lackland AFB, TX: Personnel Research Division, April 1977. Project USAS. NTIS.** Recent cutbacks in military resource allocations have resulted in decreased unit equipment (UE) flying time. In order to counteract any resultant decrement in UE proficiency, it has been suggested that small, low cost aircraft (LCA) be used to augment simulator and UE time. Project Constant Growth was conducted to assess the feasibility of the LCA concept. Selected pilots supplemented their UE time with additional time in LCAs. Based on pilot attitudes, it would appear that when sufficient UE flight time is available, additional sorties flown in supplementary, or non-UE aircraft, do not necessarily represent a worthwhile training aid. Any positive aspects of such a program could possibly be negated by the detrimental effects perceived in UE operational procedures proficiency. However, where UE flight time has been substantially reduced, LCA sorties probably do represent a useful method of maintaining some pilot skills. If the maximum positive results are to be obtained, either the LCA or its mission capability should duplicate that of its UE counterpart to the greatest possible extent. (22 pp.)

13 **Irish, P.A., III, Grunzke, P.M., Gray, T.H., & Waters, B.K. The effects of system and environmental factors upon experienced pilot performance in the Advanced Simulator for Pilot Training. AFHRL-TR-77-13, AD-A043 195. Williams AFB, AZ: Flying Training Division, April 1977. Project 1123. NTIS.** The objectives of the study were: (a) to assess the relative contribution of platform motion, G-seat and visual factors to pilot performance in the Advanced Simulator for Pilot Training (ASPT); (b) to acquire information on the relationships between system output and pilot input measures as collected in the ASPT; and (c) to evaluate the utility of economical multifactor designs for Flying Training Division, Air Force Human Resources Laboratory (AFHRL/FT) research in flight simulation. Three experienced T-37 pilots flew five maneuvers in the ASPT under combinations of the independent variables: platform motion, G-seat, field of view, turbulence, wind and ceiling/visibility. Automated performance measures based on system parameters, pilot inputs and derived scores were collected and analyzed. Both main and interactive effects of the independent variables were found for a majority of the maneuvers. A discussion of the utility of the economical multifactor designs is included. Additionally, implications for determining the direction of future studies are discussed. (60 pp.)

14 **Cyrus, M.L., & Beck, J. Computer graphics: Two- and three-dimensional clipping. AFHRL-TR-77-14, AD-A043 017. Williams AFB, AZ: Flying Training Division, May 1977. Project 1123. NTIS.** A clipping algorithm is derived and both two- and three-dimensional implementations of it are discussed. The algorithm finds the proper intersection of a line with any convex planar, polygon or spacial polyhedron. By interpretation of the computed clipping coefficients, both interior and exterior clipping to a convex region can result. Finally, the implementation lends itself well to highly parallel execution which reduces execution time. (18 pp.)

15 **Earles, J.A., & Winn, W.R. Assessment centers: An annotated bibliography. AFHRL-TR-77-15, AD-A040 446. Lackland AFB, TX: Personnel Research Division, May 1977. Project 7719. NTIS.** This report contains a compilation of published reports dealing with assessment centers and assessment center research. The reports include general information articles, reports on the implementation of an assessment center, research studies to determine the best method of arriving at a single overall evaluation of managerial potential from assessment center data, and reports on validities of

assessment center evaluations. Not included are the many related studies on individual assessment techniques; such as in-basket exercises or leaderless group discussions since they have been used independently of assessment centers.

The general finding, in the reports described, is that assessment center evaluations are more predictive of future management success than the traditional evaluations based on supervisor's reports, paper-and-pencil tests, and interviews. (28 pp.)

16 **Vitola, B.M., Guinn, N., & Wilbourn, J.M. Impact of various enlistment standards on the procurement-training system. AFHRL-TR-77-16, AD-A040 752. Lackland AFB, TX: Personnel Research Division, April 1977. Project 7719. NTIS.** Data were collected on male and female personnel who graduated or were eliminated from basic military training (BMT) or technical training (TT) in CY 1972–1974. Information on the enlistees included aptitude scores, education, age, sex, and racial subgroup membership. Twenty-one enlistment requirement standards were generated and compared to the enlistment requirements of 1974 and 1975. Each standard was comprised of subsets of aptitude data, age, and educational qualifications. Criterion assessment included: (a) cost associated with amount of attrition from BMT and TT, (b) percentage of the population rejected by the standard, (c) effect of each standard on the quality of the accession population and, (d) impact of each standard on racial subgroup mix. Results of the investigation indicate that a flexible index of enlistment requirements can be provided personnel planners which takes into consideration, cost, quality, racial subgroup mix, and expansion or contraction of recruiter market. Data from this study lead to a recommendation that two standards be considered as replacement for the 1975 enlistment requirements: (a) a minimum aptitude composite of MAGE 165 and either high school graduation or less than high school with a score between 65–90 on the AFQT (165/HSC) and, (b) all the requisites of 165/HSC plus a minimum age requirement of 17 years and 6 months (165/AGE/HSC). (24 pp.)

17 **Steinkerchner, R.E., Deignan, G.M., Waters, B.K., & DeLeo, P.J. Computer assisted instruction in Air Force medical training: Preliminary findings. AFHRL-TR-77-17, AD-A043 650. Lowry AFB, CO: Technical Training Division, May 1977. Project 1121. NTIS.** The present report documents development procedures and findings from an initial exploratory application of computer interactive instructional terminals within Air Force medical training. An experimental problem-oriented medical curriculum (POMC) constituting less than 10 percent of the total instructional hours during the first year of training was developed and administered by means of PLATO IV computer terminals to School of Health Care Sciences students enrolled in the Physician Assistant (PA) course at Sheppard AFB, Texas.

To assist informed judgment by decision-makers, preliminary information on the suitability of the POMC was required to determine if subsequent in-depth study of the comparative effectiveness of computer-assisted instruction (CAI) as opposed to alternative conventional modes of instruction was warranted. The present report provides Phase I preliminary information on development procedures, implementation conditions, student reactions, lessons learned, and cost data analyzed by Air Force health care scientists. The second phase, currently in progress, emphasizes the systematic and objective comparison of CAI with alternative instructional modes on dimensions of: (a) instructional effectiveness, (b) student/instructor attitudes, (c) characteristics of learners whose performance-effectiveness was differentially facilitated or otherwise influenced by CAI and non-CAI instructional modes and (d) comparative cost data of alternative instructional treatments. (78 pp.)

18 **Valentine, L.D., Jr. Prediction of Air Force technical training success from ASVAB and educational background. AFHRL-TR-77-18, AD-A041 735. Lackland AFB, TX: Personnel Research Division, May 1977. Project 7719. NTIS.** Nonprior service Air Force accessions during September 1973 through October 1975 were used as the sample in a series of analyses to (a) determine utility of educational data in predicting technical training success, (b) validate ASVAB, Form 3, (c) determine

extent of overlap between education data based predictions and test based predictions, and (d) assess race and sex equity of predictions. Major findings are that (a) both test data and educational background data contribute uniquely to prediction, (b) test data makes the largest unique contribution, and (c) some limited consideration of race and sex could improve predictions. Finding (d) applies only to a limited subset of the 43 training groups analyzed. (32 pp.)

19 **Fruchter, D.A., & Ree, M.J. Development of the Armed Services Vocational Aptitude Battery: Forms 8, 9, and 10. AFHRL-TR-77-19, AD-A039 270. Lackland AFB, TX: Personnel Research Division, March 1977. Project 7719, Contract F41609-76-C-0027, Educational Development Corporation. NTIS.** The purpose of the reported research was to construct, edit, test on a national sample, and standardize three new versions of Armed Services Vocational Aptitude Battery (ASVAB), which would become ASVAB Forms 8, 9, and 10. Operational Form 7B was suggested as the example for item selection and the criterion for comparability with previous ASVAB forms. According to a specific geographic sampling plan, 16 experimental tryout booklets containing a total of 2,400 items were administered at the 64 Armed Forces examining and entrance stations (AFEES) to a sample of about 2,600 subjects. Three new forms of ASVAB were developed from a selection of these experimental items using ASVAB Form 7B as a model. These three new forms were administered at the 64 AFEESs to samples of 1,479, 1,387, and 1,442 for Forms 8, 9, and 10, respectively. These AFEES subjects were also administered ASVAB Form 7B. Descriptive statistics were computed for each subtest and composite of the new forms, and each new form was equated to identically named subtests and composites of ASVAB 7B.

The results indicate that the new Forms 8, 9, and 10 are equivalent to ASVAB 7B. (102 pp.)

20 **Smith, E.A. Acceptance test of high-speed cassette duplicator. AFHRL-TR-77-20, AD-B019 935L. Lowry AFB, CO: Technical Training Division, June 1977. Project 1121. DDC.** This report documents the inspection testing of a new high-speed cassette duplicator. It duplicates audio cassettes at 16 times live speed which is considerably faster than previous units. The device was found to meet the standards described in AFHRL-TR-75-37. It was judged to be excellent in terms of usability and in estimates of reliability and durability. However, it requires maintenance procedures and test equipment not previously required. It is recommended that if the unit is purchased, the initial delivery should be accompanied by calibration tapes, head height blocks, and harnesses. It is also recommended that the unit used to generate the master cassette be calibrated to precisely match the duplicator. The need for standard USAF calibration tapes is noted. (24 pp.)

21 **Spangenberg, R.W. Territoriality in carrel design. AFHRL-TR-77-21, AD-A043 196. Lowry AFB, CO: Technical Training Division, June 1977. Project 1121. NTIS.** Carrel design is not yet based upon tested principles. Three factors which may impact upon carrel design are cloistering, social interaction, and territory-related behaviors. Level and manner of seclusion are discussed and related literature findings are reviewed in this report. Social interaction, both student-to-student and instructor-to-student are surveyed and the group size factor is carefully reviewed. Shared space adaptation can involve territorial and dominance behaviors. The potential impact of these factors is discussed. Conclusions suggested the need for a variety of customized learning spaces and a program to determine their impact upon learning. (10 pp.)

22 **Mathews, J.J. Racial equity in selection in Air Force officer training school and undergraduate flying training. AFHRL-TR-77-22, AD-A043 019. Lackland AFB, TX: Personnel Research Division, May 1977. Project 7719. NTIS.** Air Force Officer Qualifying Test composite scores were obtained for 274 Airman Education and Commissioning Program (AECP) officer training school (OTS) students and 15,532 undergraduate flying training (UFT) students. College grade point average (GPA) were also obtained for the AECP group. The objective was to determine the extent of any racial bias

present in certain officer selection and classification procedures. For non-whites in the AECP group, OTS graduation rates and final grades were lower than would be expected from test scores or GPAs. UFT graduation rates for Blacks were also over-predicted by AFOQT composites. (26 pp.)

23 **Reid, G.B., & Cyrus, M.L. Formation flight trainer evaluation for T-37 UPT. AFHRL-TR-77-23, AD-A043 197. Williams AFB, AZ: Flying Training Division, June 1977. Project 1123. NTIS.** The present research was conducted to provide a preliminary look at the feasibility of using a general-purpose trainer rather than an aircraft-specific simulator, to provide formation practice for undergraduate pilot training (UPT) students. The results obtained appear to support a conclusion that trainer practice does have positive transfer to aircraft formation flying. A principal finding is that students in this study were influenced more by stage of training than were more advanced students in previous studies using the same equipment. (12 pp.)

24 **Guinn, N., Berberich, G., & Vitola, B.M. Reenlistee/non-reenlistee profiles and prediction of reenlistment potential. AFHRL-TR-77-24, AD-A043 198. Lackland AFB, TX: Personnel Research Division, June 1977. Project 7719. NTIS.** A total of 3,062 enlisted personnel were administered an attitude and opinion survey after 33 to 45 months of service. When the career decisions of the population sample were obtained, distributional analyses of the biographical, aptitudinal, and attitudinal variables were obtained to develop profiles of individuals with varying reenlistment outcomes. The survey response data were used to investigate the feasibility of developing a reenlistment potential index derived from the noncognitive and cognitive variables which could be used to predict an individual's career decision. The multiple correlation of the composite developed from these data was .55; upon cross-application, the multiple R was .51. Using the reenlistment potential equation, 81% of the sample population at time of enlistment could have been correctly identified as to their ultimate reenlistment status. Although 56% of the reenlistees would have been incorrectly identified as non-reenlistees, only 6% of those who actually left service would have been incorrectly identified as reenlistees. (20 pp.)

25 **Koym, K.G. Familiarity effects on task difficulty ratings. AFHRL-TR-77-25, AD-A043 079. Lackland AFB, TX: Occupation and Manpower Research Division, June 1977. Project 7734. NTIS.** This report examines interrater reliability estimates for task difficulty raters having differing levels of familiarity with rated tasks. Data were collected from 455 NCO supervisors who rated the difficulty and familiarity of 424 tasks in the Aircraft Electrical Repair career ladder task inventory. The results showed that the interrater reliability estimates (R_{kk}) decreased from .930 to .802 for six task difficulty rating scale conditions in which ratings were eliminated due to levels of familiarity. This finding suggests that little is to be gained from eliminating task difficulty ratings based upon an experienced judge's level of familiarity with tasks. (12 pp.)

26 **Koym, K.G. Predicting job difficulty in high aptitude career ladders with standard score regression equations. AFHRL-TR-77-26, AD-A043 080. Lackland AFB, TX: Occupation and Manpower Research Division, June 1977. Project 7734. NTIS.** This report was designed to validate a method for evaluating the difficulty levels of Air Force enlisted jobs. Multiple regression equations which captured the job difficulty evaluation policy of supervisors in two electronics and two general career ladders were produced. The equations yielded predicted difficulty values for 250 jobs from each career ladder. These values correlated above .81 with supervisory rankings of job difficulty validating the findings of previous job difficulty studies conducted in 12 Air Force career ladders. Various constant standard weight equations were developed and compared. Of these, an equation derived from all 16 career ladders offered valid predictions when it was applied in the electronics area. Although this 16-ladder equation showed no significant improvement over the 12-ladder equation, it has wider applicability than the 12-ladder equation currently in use. The 16-ladder equation is recommended as a replacement because it is based upon results from all four aptitude areas and because it has been successfully applied in career ladders with both high and low aptitude entrance requirements. (14 pp.)

27 **Kantor, J.E., Vitola, B.M., & Guinn, N. Development and validation of the Air Force technical training student survey. AFHRL-TR-77-27(I), AD-A042 967. Brooks AFB, TX: Personnel Research Division, June 1977. Project 7719. NTIS.** As part of a larger study to assess the impact of student attitudes on performance in Air Force technical training, a Technical Training Student Survey (TTSS) was developed and validated. The TTSS, composed of 121 items which are divided into 12 scales, was administered to 12,666 enlisted students attending one of 53 different Air Force technical training courses. Based upon performance in training, this sample was subdivided into "graduate" and "eliminee" groups. Normative test characteristics were evaluated and found satisfactory. Comparisons between the responses of the graduate and eliminee groups were accomplished, and it was found that 8 of the 12 scale means were significantly different between groups. These differences might be summarized as follows: the graduates thought the training experience more important, saw their instructors as being more competent and personable, felt less control and stress, and were more satisfied with their training and career choices. A regression analysis indicated that the TTSS added significant and unique information concerning student performance, and, based on these findings, it was concluded that the TTSS could provide reliable and valid assessment of student attitudes related to performance in Air Force technical training. (40 pp.)

28 **Kantor, J.E., Guinn, N., & Vitola, B.M. Development and validation of the Air Force technical training student survey: Attitudinal correlates of course attrition level and student gender. AFHRL-TR-77-27(II). Brooks AFB, TX: Personnel Research Division, April 1979. Project 7719. NTIS.** As part of a multiphase study on student attitudes towards Air Force technical training and the relationship between those attitudes and student performance, a data base was established consisting of attitudinal self-report data and course performance measures on 12,666 technical training students. The purpose of this study was to utilize that data base to compare the attitudes of two student subgroups. First, the attitudes of students from high attrition courses were compared to the attitudes of students from low attrition courses to identify those attitudes related to course attrition rate and to compare attitudes related to student performance at different levels of student attrition. A number of significant attitudinal differences were found relating to course attrition level. While some of these differences referred directly to academic issues, other differences appeared to reflect motivational factors. In comparing the attitudinal correlates of performance between students from high and low attrition courses, many similarities were found, but again, differences suggested the importance of motivational factors. Second, the attitudes of male and female students were compared to identify gender specific attitudes and those attitudes related to performance for men and women. Male and female attitudes towards the training experience were found to differ in several areas. While some differences referred to specific aspects of training, most appeared to be reflecting the differences in attitudes between a group with experience in a particular environment (men) versus those of a group entering a relatively new experience (women). The attitudes related to performance for men and women were found to be very similar with some indications that women were having greater difficulty with some aspects of the academic work. These findings and the application of this methodology to other subset of the existing data base are discussed. (30 pp.)

29 **Hunter, D.R., Maurelli, V.A., & Thompson, N.A. Validation of a psychomotor/perceptual test battery. AFHRL-TR-77-28, AD-A044 525. Lackland AFB, TX: Personnel Research Division, July 1977. Project 7719. NTIS.** A battery of seven psychomotor/perceptual tests was administered to two samples of Air Force personnel—Officer Trainees slated to attend undergraduate navigator training (UNT) and Airmen in 30 different career fields.

The objective of the project was to determine the validity of the tests comprising the battery for the prediction of success in technical training courses.

Analyses of the data indicated that several of the psychomotor/perceptual measures were individually predictive of training outcomes; however, the joint contribution of all the tests in the

battery was, in general, not statistically significant. The reasons for this result are discussed, and comparisons with the predictive validity of Air Force paper-and-pencil measures are made.

Recommendations for subsequent research and development are given. (22 pp.)

30 **Gray, T.H., & Fuller, R.R. Effects of simulator training and platform motion on air-to-surface weapons delivery training. AFHRL-TR-77-29, AD-A043 649. Williams AFB, AZ: Flying Training Division, July 1977. Project 1123. NTIS.** The objectives of this research were to determine: (a) the extent to which generalized, conventional, air-to-surface (A/S) weapons delivery training in the Advanced Simulator for Pilot Training (ASPT) transferred to a specific aircraft; (b) the contribution of six-degree-of-freedom platform motion to the transfer of training from simulator to aircraft; and (c) the differential effects, if any, of this simulator training on student pilots of differing ability levels. These objectives were accomplished by selecting 24 students in the lead-in A/S training course at Holloman AFB, NM, to serve as subjects. These subjects progressed through lead-in training, receiving all training except the A/S flights, and then proceeded to Williams AFB where they were assigned into matched experimental and control groups. At Williams AFB, AZ, all of the subjects received academic training in weapons delivery techniques and procedural training on F-5B operations. At this point, the students in the control groups flew two data collection sorties in the F-5B aircraft, performing 10°, 15°, and 30° bomb deliveries. The experimental groups received A/S weapons delivery training in ASPT on 10°, 15°, and 30° bomb deliveries with a fixed number of trials on each event. The experimental subjects then received two data collection flights in the F-5B identical to those received by the control group. Analysis of the results proved that simulator training significantly increased air-to-surface weapons delivery skills (e.g., approximately double the number of qualifying bombs, a one-fourth reduction in circular error) but that platform motion was not a contributing factor in this process. It was also found that novice student pilots of greater initial ability benefit most from such simulator training when a minimum fixed number of trials is used. (50 pp.)

31 **Gott, C.D., & Koplyay, J.B. Automatic interaction detector-version 4 (AID)-4 reference manual addendum 1. AFHRL-TR-77-30, AD-A042 968. Brooks AFB, TX: Computational Sciences Division, July 1977. Project 6323. NTIS.** This document serves as the addendum to the AID-4 Reference Manual (Koplyay, J.B., Gott, C.D., and Elton, J.H., *Automatic Interaction Detector-Version 4 (AID)-4 Reference Manual*, AFHRL-TR-73-17, Lackland Air Force Base, Texas, Personnel Research Division, Air Force Human Resources Laboratory, October 1973.) The addendum describes changes to the original reference manual, technical notes on certain aspects of the program not mentioned before, and supplemental information to assist in running the AID-4 package on the UNIVAC 1108 computer. (16 pp.)

32 **Johnson, R.C., Thomas, D.L., & Martin, D.J. User acceptance and usability of the C-141 job guide technical order system. AFHRL-TR-77-31, AD-A044 001. Wright-Patterson AFB, OH: Advanced Systems Division, June 1977. Project 1710. NTIS.** This report documents a study of the user acceptance and usability of the technical data developed under the C-141 Job Guide Technical Order (TO) Program. Step-by-step, illustrated technical orders, called job guides, were developed to replace the original TOs on the C-141 aircraft. Job guides are characterized by detailed, fully proceduralized task instruction which are keyed to illustrations which identify each component and its location. Other features include a small handbook size, standardized verb usage, simplified writing style, job preparation instructions, identification of tools and parts required, and little or no referencing to other TOs.

In this first large-scale application of the job guide concept, the following positive and negative factors affecting usability and user acceptance were identified using questionnaires, interviews and observation.

Positive Factors included: small size; ease of reading and understanding; good illustrations keyed to procedures; job preparation information; and information acceptable to both experienced and inexperienced technicians.

Negative Factors included: too many volumes required for some task sequences; errors in the data; inability to locate information quickly; storage problems; and torn and lost pages.

Although problems existed, the C-141 job guides are considered to be very usable and well-accepted. It is obvious that the development of the data and the implementation of the data are two very critical factors in the success of the job guide concept. (78 pp.)

33 **Reed, L.E. Effects of visual-proprioceptive cue conflicts on human tracking performance. AFHRL-TR-77-32, AD-A042 006. Wright-Patterson AFB, OH: Advanced Systems Division, June 1977. Project 1710. NTIS.** The purpose of this experiment was to investigate operator performance in an environment which was highly conducive to visual-proprioceptive conflict. The experimental task required that subjects maneuver a simulated remotely piloted vehicle from a simulated airborne control station (i.e., "mother ship"). The vehicle and/or the station were given gust-like disturbances on pitch and/or roll. In a between groups design the performance of pilots, navigators, and non-rated Air Force officers was compared under conditions of conflict (e.g., visual roll right and roll left motion), non-conflict, motion only, and no motion. To maintain adequate performance it was necessary for the subjects to disregard sensations of motion. The results revealed that the conditions of conflict engendered the highest proportion of reversal errors by all subjects. The past experience of pilots did not help them overcome the effects of conflict as measured by reversal errors, but it did help them reduce response latencies. The effects of practice were evidenced primarily by a reduction of reversal errors under conditions of conflict. Strong evidence was found to support the notion that motion plays an alerting function and also provides information on the direction of attitude changes. (226 pp.)

34 **Baron, P.C., Charles, E.R., Sprotbery, D.E., & Jorgensen, D.B. High resolution, high brightness color television projector: Analysis, investigations, design, performance of baseline projector. AFHRL-TR-77-33(I), AD-A049 279. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 6114, Contract F33615-76-C-0040, Hughes Aircraft Company. NTIS.** This study addressed the problem of establishing the feasibility of, and defining, a high performance color television projector to be used in optically mosaicked, computer image generator (CIG) driven wide-field-of-view simulators.

The 12-month study consisted of the following tasks: requirements analysis, survey of technology, component investigations, equipment definition, and generation of final report. In general, these tasks were initiated and completed in chronological order.

The first two tasks established the ground work for the study. Based on verbal briefing, reviewing documentation, and a visit to the Advanced Simulator for Pilot Training (ASPT) at Williams AFB, the RFP requirements were interpreted, refined and prioritized. The survey task reviewed the extant state-of-the-art in display technology for techniques which held promise of meeting the RFP requirements. Based on this task, it was concluded that only the liquid crystal light valve (LCLV) technology had a chance to do so; however, its performance needed to be upgraded significantly from the then current state.

A systematic investigation of all components contributing to projector operation was therefore undertaken. The lamp*, illumination system*, polarizing beamsplitter*, dichroics, LCLVs*, CRT*, deflection system, projection lens and screen were all subjected to a systematic test/analysis cycle, and improvements were made as required. Samples were obtained, tested and analyzed; breadboards were built and tested; and detailed studies were conducted. Subcontract studies were let, to investigate the dichroics and the projection lens. The latter was a major effort by Kollmorgen Corp.

*Much of this work was conducted on concurrent independent R&D (IR&D) funds.

The design of a high resolution, low distortion lens to project on a curved screen represented a significant technical challenge. These investigations resulted in significant improvements in some areas, and a clarification in others, of component performance.

Based on this data, system tradeoffs were conducted to determine what combination of component performances were required to meet RFP requirements. Tradeoffs were generated relating brightness to color purity/range, light falloff to pilot head motion, and resolution to CRT spot size and projection lens cost. Components were then selected (or specified) to result in an RFP-compliant system which yielded minimum overall risk.

Based on these decisions, the projector was then defined in detail. Hardware descriptions were generated for the electronics, the optics, and the mechanical hardware. Integration of the projector into a multiprojector system was considered, and resulted in the development of system alignment procedures, mosaicking specifications, and central hardware to assist with maintenance.

A detailed analysis of every RFP-specified performance parameter was performed. Projector and system level performance were described, and reliability/maintainability characteristics of both a single projector and a multiprojector system were described.

This study concluded that meeting the RFP requirements using state-of-the-art component technology was technically feasible, and could be implemented with practical, reliable hardware.

Portions containing proprietary and contractor evaluation information are contained in AFHRL-TR-77-33(II), with distribution limited to U.S. Government agencies. (142 pp.)

35 **Baron, P.C., Charles, E.R., Sprotbery, D.E., & Jorgensen, D.B. High resolution, high brightness color television projector: Technology survey, component investigations, LCLV operation. AFHRL-TR-77-33(II), AD-B024 236L. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 6114, Contract F33615-76-C-0040, Hughes Aircraft Company. DDC.** This study addressed the problem of establishing the feasibility of, and defining, a high performance color television projector to be used in optically mosaicked, computer image generator (CIG) driven wide-field-of-view simulators.

The 12-month study consisted of the following tasks: requirements analysis, survey of technology, component investigations, equipment definition, and generation of final report. In general, these tasks were initiated and completed in chronological order.

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The study concluded that meeting the RFP requirements using state-of-the-art component technology was technically feasible, and could be implemented with practical, reliable hardware. (26 pp.)

36 **Huff, K.H., Sticht, T.G., Joyner, J.N., Groff, S.D., & Burkett, J.R. A job-oriented reading program for the Air Force: Development and field evaluation. AFHRL-TR-77-34, AD-A047 203. Lowry AFB, CO: Technical Training Division, May 1977. Project 1121, Contract F-41609-76-C-0001, Human Resources Research Organization. NTIS.** This report describes a study undertaken to respond more fully to the current literacy problems in the Air Force. This involved the development, implementation, and evaluation of a prototype Job-Oriented Reading Program (JORP) which stressed the *acquisition and development of job-related reading skills* for Air Force personnel. The two major objectives were (a) to demonstrate the feasibility of using a job-related approach to reading instruction with airmen in the Air Force training system, and (b) to test the effectiveness of this approach in an operational setting by using job-related reading materials to improve airmen's performance. Design of the JORP included special requirements that the reading grade level (RGL) of JORP be set at 9.0; student input RGL was from 6.0 to 8.9; JORP training was to be integrated in the duty day of the permanent party personnel; and time available for training was 2-1/2 hours per day for five days a week for six weeks. Two Air Force job career clusters were chosen for this effort: Maintenance and Non-Maintenance. Two instructional strands were developed. In Strand I, the students utilized their existing literacy skills to practice locating, extracting, analyzing, and comprehending job-related information from source material excerpted directly from job and training manuals. Instructional techniques emphasized individual practice, self-pacing, and written responses which utilized worksheets and tests in the four instructional modules of Narrative, Procedural Directions, Schematics, and Forms. Strand II was designed to improve basic reading and thinking skills, in addition to basic job concepts and vocabulary. Strand II source material was comprised of a series of passages written specifically for the JORP. Each package dealt with a different job content area and was written at a lower level of difficulty than the typical job reading materials. The instructional procedures for Strand II emphasized direct teacher instruction, group activities, discussion, and oral and graphic responses from the students. Tests were developed for student mastery and feedback in the Strand I work. Since Strand II student responses were neither right nor wrong, they were judged by the individual student, his peers, and the instructor in terms of appropriateness to the task at hand. The JORP prototype program was field tested during 1976 at Travis AFB, California. Data generated by this study indicated that there was a significant improvement in job-specific JORP test scores. Overall, the study showed the JORP to be a valuable and feasible approach to job-specific reading training in the Air Force. (136 pp.)

37 **Hansen, D.N., Ross, S., & Harris, D.A. Flexilevel adaptive testing paradigm: Validation in technical training. AFHRL-TR-77-35(I), AD-A042 977. Lowry AFB, CO: Technical Training**

Division, July 1977. Project 1121, Contract F41609-75-C-0040, Memphis State University. NTIS. This study was designed to empirically assess a computerized adaptive testing model in an ongoing technical training system. The model was a modification of Lord's (1971) flexilevel paradigm and consisted of: (a) the sequencing of test items in a difficulty hierarchy, (b) adaptive entry of students into the test at a difficulty level appropriate to their predicted score, and (c) systematic movement of students up and down the hierarchy based upon their performance on preceding items. The subjects were 444 airmen enrolled in the Inventory Management/Materiel Facilities Course at Lowry Air Force Base, Colorado. They participated in the study as part of the normal achievement testing requirement for Block II of the course. Predictor variables for individualized entry were three reading tests administered to students prior to course enrollment. A within-subject design was employed in comparing the adaptive strategy to conventional testing on dependent variables or performance, test reliability, and test time. This involved first administering items according to the flexilevel algorithm and then, after the student exited from the test at either the top or bottom end of the hierarchy, presenting all remaining items. Consequently, both adaptive and conventional test scores were obtained for each subject. The results revealed a high positive part-whole correlation between flexilevel and total test scores. Internal consistency indices for the two forms were essentially equivalent. With regard to length and time, however, the flexilevel test required nine less items than the entire test, yielding a length reduction of 39.5 percent with a concomitant time savings of 18.4 percent. Results for individualized entry were more indecisive as only a very small time reduction was realized, without any noticeable change in performance, relative to a fixed entry control group. The interpretation of findings stresses the potential benefits of adaptive testing in terms of significant time reductions and the maintenance of high standards of test validity. (20 pp.)

38 **Hansen, D.N., Ross, S., & Harris, D.A. Flexilevel adaptive testing paradigm: Hierarchical concept structures. AFHRL-TR-77-35(II), AD-A042 966. Lowry AFB, CO: Technical Training Division, July 1977. Project 1121, Contract F41609-75-C-0040, Memphis State University. NTIS.** Recent research indicated the benefits of computerized adaptive testing for assessing achievement in technical training. In a prior study (Hansen, Harris, & Ross, 1976), results indicated that, relative to a conventional test, the adaptive strategy significantly reduced testing time while yielding equivalent parametric outcomes. The present study extended this research by examining the feasibility of a similar model applied over a hierarchically arranged series of subtests in a more sophisticated instructional context. As in the initial study, the adaptive model was a modification of Lord's flexilevel algorithm which allows students to move systematically among easier and harder items according to a response contingent rule; an individualized entry component, however, was not employed in this particular application. The course selected for evaluating the model was the Precision Measurement Equipment Specialist Course taught at Lowry Air Force Base, CO. A total of 133 students participated in the study in fulfillment of achievement testing requirements for Blocks II and IV of the course. The two Block achievement tests were each divided into five hierarchically related subtests so as to allow for the assessment of sequential performance contingencies. Data collection involved a within-subject design in which students were entered at the median of the initial subtest and administered items by the flexilevel procedure. Following completion of the adaptive test, all remaining items were administered. The same procedures were then followed for the remaining subtests in the hierarchy. Test validity analyses yielded part-whole correlations between adaptive test and total test scores (r's = .95). Descriptive test indices and test reliabilities were also essentially identical. Importantly, the time savings associated with adaptive testing approximated 30 percent for both blocks. Additional findings concerned the interrelations among subtest outcomes both within and between blocks. The results were interpreted as clearly supporting the generalizability of adaptive testing benefits to highly complex, hierarchically structured training. (24 pp.)

39 **Valentine, L.D., Jr. Navigator-observer selection research: Development of new Air Force Officer Qualifying Test navigator-technical composite. AFHRL-TR-77-36, AD-A042 689. Brooks AFB, TX: Personnel Research Division, May 1977. Project 7719. NTIS.** Toward the objective of improving selection of undergraduate navigator trainees, a large scale study was conducted to evaluate various experimental tests for possible use in a complete revision of the Air Force Officer Qualifying Test (AFOQT's) Navigator-Technical composite.

Forty-five noncognitive test scales and 17 experimental cognitive tests were administered to 507 students at the Officer Training School who subsequently entered undergraduate navigator training (UNT). Analyses of these data, along with AFOQT data, against training success indicated that, of the noncognitive materials, the only device with unique validity was the Personality Research Form; follow-up work with this is recommended. The experimental cognitive tests provided substantial improvements in prediction over that achieved with the present AFOQT. Content of a revised AFOQT Navigator-Technical composite is recommended. (16 pp.)

40 **Nataupsky, M., Curton, E.D., Waller, E., & Ratliff, F.R. Report on the 1975 officers' OER opinion survey. AFHRL-TR-77-37, AD-A049 705. Brooks AFB, TX: Personnel Research Division, November 1977. Project 7719. NTIS.** The primary objective of the 1975 Officers' OER Opinion Survey was to collect baseline attitude data relative to the following nine dimensions: (a) experience in writing OERs, (b) contact with people who write the respondent's OER, (c) knowledge, understanding, and satisfaction with both OER systems, (d) performance factors, (e) evaluation of potential, (f) the quota system, (g) possible biases in rendering OERs, (h) impact of the current OER on career plans, and (i) alternatives to the OER. The current OER was widely publicized before implementation. Only lieutenant colonels had reviewed completed OERs before responding to the survey, although the current OER was in the process of being rendered on personnel in other ranks. The survey was mailed individually to a stratified random sample of 25,000 Air Force Officers with prescribed over-sampling of females and non-Caucasians. There was a return rate of 63.3%. An analysis of response errors indicated that the median (average) rate of error per item was 0.05%. Second lieutenants and colonels reported the most favorable attitude towards the current OER, while lieutenant colonels expressed the strongest dissatisfaction with it. Whereas DOD and Hq USAF respondents liked the previous OER system better than officers assigned to commands, they disliked the current OER system more than officers assigned to commands. It was found that there is a positive relationship between knowledge and understanding of each OER system with satisfaction. (44 pp.)

41 **Guinn, N., Wilbourn, J.M., & Kantor, J.E. Preliminary development and validation of a screening technique for entry into the security police career field. AFHRL-TR-77-38, AD-A043 919. Brooks AFB, TX: Personnel Research Division, July 1977. Project 7719. NTIS.** A sample of 4,502 basic airmen, assigned to the security police career field, was administered an experimental battery consisting of biographical, attitudinal, and interest items. Aptitudinal scores and criterion data (in/out of service after completion of technical training) were retrieved from the airman record files. Multiple linear regression were accomplished to determine the utility of aptitudinal and inventory data in predicting adaptability to the security police career field. The multiple correlations of the final selector composites derived from this study were .46 and .47. Since the small number of eliminees in the sample precluded cross-application of regression weights, it was recommended that further validation be accomplished to determine the reliability and stability of the predictor composites. (12 pp.)

42 **Baran, H.A. USAF military personnel costing: Problems and approaches. AFHRL-TR-77-39, AD-A047 761. Wright-Patterson AFB, OH: Advanced Systems Division, August 1977. Project 1124. NTIS.** This report attempts to identify the most pressing Air Force military personnel costing problems and to specify the prerequisite needs of Air Force cost analysts in order to solve them. A

survey was made to identify costing approaches and techniques to satisfy the needs. These were then examined to assess their utility in developing standardized costing techniques and standard cost parameters for Air Force military personnel. The examination revealed ways in which planned application restricts the choice of methods, and the existence of widespread disagreements concerning basic definitions and objectives.

A requirement does exist for the development of additional tools and techniques to improve the accuracy and comparability of personnel cost estimates within the Air Force. However, the Air Force appears to possess the essentials of an effective capability to resolve most of its military personnel costing problems. What is most lacking is a set of universally recognized standards for the collection and analysis of cost data such that individual user requirements are served, while maintaining the integrity of a standard process.

The accounting approach, using the investment quantification method, seems best to meet the majority of USAF military personnel costing requirements. It is one of nine possible combinations of costing approach and technique cited which constitute the generic basis of most of those available for USAF implementation. Use of this approach would require a close examination of the possible ways to combine and structure cost elements in order to meet the dual objective of conforming to individual user requirements while achieving the benefits of standardization. The establishment of standard cost element structure tables for generic rather than specific applications should also be considered. These tables should be accompanied by standard definitions of cost elements and clear guidelines for the allocation of individual requirements into generic categories. Rigid guidelines should also be established which provide for the case wherein an individual user has a requirement to "fine tune" the cost estimate to achieve greater specificity.

USAF military personnel should be costed more in terms of the weapon systems they support. Rules should be developed to categorize them on the basis of whether they provide direct or indirect support, and personnel cost data defined which reflect personnel support requirements imposed by weapon system design and support plans. One possible approach is to develop functional relationships between personnel cost and the characteristics of weapon system design and support plans which drive personnel requirements.

USAF should avoid personnel costing methodology which balances investment against returns and be less hesitant to use relative as opposed to absolute cost estimates. Billet or job cost estimates may, in most instances, be substituted for the less easily obtained and more tenuous calculation of personnel life cycle cost. All personnel cost data packages should be accompanied by a means of quickly determining the consequences of their use in terms of comprehensiveness, accuracy, reliability, and underlying assumptions governing their applicability and the conduct of data collection pursuant to their development. (54 pp.)

43 **Brown, F.D., Griswold, D.E., Mahoney, R.J., Walker, G.A., Wilson, D.H., & Dieterly, D.L. C-130E Hercules aircraft: Review of published literature and structured interviews. AFHRL-TR-77-40, AD-B021 711L. Wright-Patterson AFB, OH: Advanced Systems Division, July 1977. Project 1959, Contract F33615-76-C-0062, Boeing Aerospace Company. DDC.** This report contains an explicit bibliographic compendium of C-130E and/or C-130 Hercules aircraft data systems and published documentation. The documents were screened and selected to provide all available information relative to historical resource utilization. The two major areas of concern were human and material resources used to maintain and support the C-130E aircraft over the past fifteen years. A total of 361 published documents, brochures, technical reports, microfiche and other C-130 data references, spanning 15 years (1962 through 1976) of historical data were isolated from many hundreds of documentation sources and acquired by the Boeing Aerospace Company, Experience Analysis Center. Documented C-130E Weapon System features denoting strong points, system weaknesses, and/or problem areas were manually extracted from applicable documentation and summarized

within the report text. The bibliographic summary within this report is a computerized printout sequenced by computer accession number. Other computerized sorts such as by author, title, document number and data sources are available in the project office.

In addition, a formal 42 question structured interview was prepared and administered to a sample of experienced military and civil service personnel. The purpose of the interview was to provide comparable information on resource utilization and problems to supplement to published information obtained. Interview results presented reflect system engineering trends/features whenever respondee inputs permitted.

The review of published documents and the structured interviews establishes a historical picture of human and material resource utilization. Admittedly the information is limited in scope and constrained in content. It represents the most comprehensive available from the sources considered.

This document is the first of a series of five Boeing Technical Reports emanating from this study, namely:

AFHRL-TR-77-40	C-130E Hercules Aircraft: Review of Published Literature and Structured Interviews (Available to U.S. Government Agencies only.)	
AFHRL-TR-77-48	Historical Analysis of C-130E Resources	
AFHRL-TR-77-46	Life Cycle Cost of C-130E Weapon System	
AFHRL-TR-77-64(I)	Historical Resource Utilization Methodology	
AFHRL-TR-77-64(II)	Historical Task Analysis of C-130E Personnel	(272 pp.)

44 **Knight, J.M., Stefancyk, P.R., & Looper, L.T. Technical description and user's guide for the enhanced Total Objective Plan for Officer Procurement (TOPOPS). AFHRL-TR-77-41, AD-A047 607. Brooks AFB, TX: Occupation and Manpower Research Division, September 1977. Project 2077. NTIS.** This Technical Report documents an enhancement of the previously developed Total Objective Plan for Officer Procurement (TOPOPS) model. The TOPOPS model simulates via the FMPS UNIVAC 1108 linear programming package, the optimal numbers and types of Air Force officers to procure within a 5-year horizon. It is designed to simulate officer accession and training and achieve optimal solutions in terms of either cost minimization or quality maximization. This enhanced technical description discusses the expansion of the supply pool and training agency parameters, the increase in the allowable number of valid constraints, and the procedures whereby the model may be utilized. It enhances documentation on the previous TOPOPS model by expanding user flexibility in defining and managing model parameters. Sample input forms, a sample problem, and associated computer output are included in Appendix A. (88 pp.)

45 **Klein, G.A. Phenomenological approach to training. AFHRL-TR-77-42, AD-A043 920. Wright-Patterson AFB, OH: Advanced Systems Division, August 1977. Project 1710. NTIS.** Current approaches to training attempt to break complex tasks into simple, discrete steps. This attempt while valuable for teaching procedural tasks, may not be optimal for teaching complex perceptual and motor tasks; it is valuable for initial stages of training, but may not be optimal for training to highly proficient levels of performance. The assumptions behind current approaches to training are questioned. A phenomenological approach is discussed as a means for supplementing the traditional methods, and for accomplishing high proficiency training of complex perceptual-motor tasks. A phenomenological approach would emphasize wholistic features of tasks, and shifts in perspective that develop with competence. Such an approach could provide a theoretical framework for the use of modelling, demonstrations, prediction displays, and other instructional methods. (16 pp.)

46 **Deem, R.N., Hicks, V., Faucheux, G.N., & Nichols, S.R. Predicting powered support equipment and associated maintenance manpower requirements. AFHRL-TR-77-43, AD-A048 876. Wright-Patterson AFB, OH: Advanced Systems Division, August 1977. Project 1124. NTIS.** There is a need for a more responsive method for predicting the ground support equipment (SE) requirements and the related SE maintenance manpower requirements associated with newly developing weapon systems. A study was conducted whose purpose was to develop such a method by first establishing the basic analytical rationale, and then by creating a users' guide for the method.

A computer program was developed from an existing maintenance data collection program. It processes maintenance data on operational SE in order to produce the information needed to conduct a Logistics Composite Model simulation of proposed SE work centers for newly developing aircraft. Primary inputs are the standard 6-month maintenance tapes kept at base level, and completed AF Forms 864 which provide records of SE utilization. The program is currently in operation on the Aeronautical Systems Division's CDC 6600 computer. (68 pp.)

47 **Goody, K. Matching job education requirements of a variety of officer specialties with the educational attainments of potential incumbents. AFHRL-TR-77-44, AD-A050 826. Brooks AFB, TX: Occupation and Manpower Research Division, August 1977. Project 7734. NTIS.** The traditional methods for documenting educational achievements have limited application for prescribing desirable and mandatory educational prerequisites for Air Force specialties. Because of lack of standardization, the college transcript is an ambiguous document for this purpose. Air Force Human Resources Laboratory developed an educational profile which can be used to condense the essential information contained in the college transcript into a simple, standardized, quantified format. To establish a methodology for determining educational requirements of Air Force line officer specialties, a representative sample of 120 such profiles was prepared. These were then rated by incumbent officers on educational suitability for service in their specific specialties. The entire Navigator/Observer Utilization Field and four other specialties were included in this survey. The four other specialties were: Air Traffic Control Operations Officer, Aircraft Maintenance Officer, Transportation Officer, and Air Intelligence Officer. Sufficient raters were used to analyse five individual specialties within the Navigator/Observer Utilization Field. On confirming that the inter-rater agreement within each of these groups was satisfactory, the vector of mean ratings was accepted as a measure of educational suitability for each group. It was then shown that this measure could be predicted mathematically from a limited set of the data in the profiles by regression models, a different model being developed for each group. These regression models describe the educational requirements for the corresponding specialty, and verbal descriptions of these requirements were deduced from the regression models. (50 pp.)

48 **Czuchry, A.J., Engel, H.E., Bristol, M.A., Glasier, J.M., Baran, H.A., & Dieterly, D.L. Digital Avionics Information System (DAIS): Mid-1980's maintenance task analysis. AFHRL-TR-77-45, AD-A047 886. Wright-Patterson AFB, OH: Advanced Systems Division, July 1977. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS.** The fundamental objective of the Digital Avionics Information System (DAIS) Life Cycle Cost (LCC) Study is to provide the Air Force with an enhanced in-house capability to incorporate LCC considerations during all stages of the system acquisition process. The purpose of this report is to describe the technical approach, results and conclusions obtained from a Maintenance Task Analysis (MTA) conducted on a mid-1980s DAIS conceptual design configuration to identify and quantify support maintenance task requirements. This conceptual design configuration is one of two developed as bases for determining the maintenance support requirements of DAIS systems. They are described in AFHRL-TR-76-59, *Mid-1980s Digital Avionics Information System Conceptual Design Configuration*. The first is representative of an application of the DAIS principles of avionics integration to current avionics equipment. The second represents an application of DAIS principles to equipment expected to be operational in the mid-1980s.

An MTA was conducted on the current DAIS conceptual design configuration, AFHRL-TR-76-71, *Digital Avionics Information System (DAIS): Current Maintenance Task Analysis*. Its results provided a baseline for conducting the MTA reported here. The approach taken was to identify major system design changes and innovative support system capabilities projected to be available in the mid-1980s timeframe, along with major mechanization differences between the two conceptual designs. These were quantified in terms of their impact on maintenance support task requirements on the basis of an analysis of their impact on system reliability and maintainability (R&M) parameters. The calculation of R&M values for each task associated with the maintenance of the subsystems and line replaceable units of the mid-1980s DAIS conceptual design configuration represents a major portion of the effort covered by this report.

Three areas having significant impact on maintenance requirements were studied in some detail. First the impact of the DAIS architecture in terms of system reliability was quantified in terms of the demand on the maintenance system. Then two major innovations in system support capability, projected to be available in the mid-1980s timeframe, were evaluated in terms of their impact on the maintainability of the DAIS avionics. The first of these was the implementation of a central integrated test system (CITS) for on-board testing, flight reconfiguration, and flightline trouble-shooting. The second was the use of consolidated support equipment (SE). Results indicate that the mid-1980s DAIS configuration with CITS and consolidated SE should yield a 47% reduction of total direct maintenance manhour requirements when compared with a conventional avionics suite.

The result of this mid-1980s DAIS MTA have been incorporated into a computerized mid-1980s DAIS data bank. It will be integrated into the overall LCC modeling system and associated data banks to be provided as a final product of the DAIS LCC Study. (78 pp.)

49 **Brown, F.D., Walker, G.A., Wilson, D.H., & Dieterly, D.L. Life cycle cost of C-130E weapon system. AFHRL-TR-77-46, AD-A044 046. Wright-Patterson AFB, OH: Advanced Systems Division, July 1977. Project 1959, Contract F33615-76-C-0062, Boeing Aerospace Company. NTIS.** Human and material resource data accumulated from all available Air Force sources is used to calculate the approximate life cycle cost (LCC) of the C-130E Hercules aircraft. The data was located, collected and reduced to computer files under another phase of the study. The Air Force Cost Analysis and Cost Estimating (CACE) model was modified and used to calculate the C-130E LCC. Based on fifteen years of Air Force data (1962–1976) a LCC estimate was calculated.

The methodology for determining the historical LCC may be applied to other systems. The primary difficulty in computing historical LCC estimates is the lack of required data files and the low quality control on many data variables. This research provides a methodology and a guide for accomplishing historical LCC on other weapon systems. The reason for determining historical LCC is to establish a baseline that can be applied to new weapon system development programs to identify possible areas for redesign to reduce future weapon system LCC.

This document is the third of a series of five Technical Reports emanating from this Project 1959 Phase I study, namely:

AFHRL-TR-77-40	C-130E Hercules Aircraft: Review of Published Literature and Structured Interviews (Available to U.S. Government Agencies Only)	
AFHRL-TR-77-48	Historical Analysis of C-130E Resources	
AFHRL-TR-77-46	Life Cycle Cost of C-130E Weapon System	
AFHRL-TR-77-64(I)	Historical Resource Utilization Methodology	
AFHRL-TR-77-64(II)	Historical Task Analysis of C-130E Personnel	(70 pp.)

50 **Ward, J.H., Jr. Creating mathematical models of judgment processes: From policy-capturing to policy-specifying. AFHRL-TR-77-47, AD-A048 983. Brooks AFB, TX: Occupation and Manpower Research Division, August 1977. Project 2077. NTIS.** Planning for a computer-based personnel job opportunities system for the Air Force led to a requirement for a procedure to generate a "payoff" or "value" of the assignment of each person to each possible job. This report discusses three methods of weighting different information to form a single indicator of "payoff" or "value," explicit weighting and two implicit weighting methods – policy-capturing and policy-specifying. The two implicit weighting methods are combined into a more comprehensive method referred to as policy-development.

The policy-capturing process presents a series of decision situations to one (or more) policy makers and the policy maker assigns to each situation a number which reflects the "value" or "payoff." Then a mathematical model is derived by obtaining the regression equation that best predicts the policy maker's judgments.

Policy-specifying, which is the main focus in this report, does not depend on a sample of actual judgments to determine the regression weights, but attempts to translate into mathematical form a policy maker's more global statements about the general properties that the model should have.

The mixing of policy-capturing and policy-specifying leads to a process called policy-development. (78 pp.)

51 **Brown, F.D., Griswold, D.E., Hindes, D.K., Walker, G.A., Wilson, D.H., & Dieterly D.L. Historical analysis of C-130E resources. AFHRL-TR-77-48, AD-A044 712. Wright-Patterson AFB, OH: Advanced Systems Division, July 1977. Project 1959, Contract F33615-76-C-0062, Boeing Aerospace Company. NTIS.** This report presents the results of the collection and analysis of 15 years of C-130E Historical Resource Utilization data. The purpose of this study was to determine the type, quality and availability of resource utilization data for a specific weapon system. The information collected covers both human and material resource requirements. This type of information provides the baseline for planning for new weapon systems. It also establishes those areas of high utilization which may be reduced in the new system by possibly modifying some design parameter.

A major problem encountered in this type of analysis is that the current Air Force management systems are not developed for historical evaluation. Frequently, the critical data are not available or in a form that makes it too costly to obtain. The resulting data bank was developed from existing Air Force data samples. Where only partial data was located, statistical methods were developed and applied to generate the missing data.

Analyses were accomplished against seven (7) basic data categories, namely: (a) operations, (b) maintenance, (c) reliability, (d) safety, (e) human resources, (f) material resources, and (g) cost data. All data categories addressed, whenever possible, the 15 year period or life cycle of the C-130E weapon system (1962 through 1976).

This document is the second of a series of five Boeing Technical Reports emanating from this study, namely:

AFHRL-TR-77-40	C-130E Hercules Aircraft: Review of Published Literature and Structured Interviews (Available to U.S. Government Agencies only.)	
AFHRL-TR-77-48	Historical Analysis of C-130E Resources	
AFHRL-TR-77-46	Life Cycle Cost of C-130E Weapon System	
AFHRL-TR-77-64(I)	Historical Analysis Methodology Resource Utilization	
AFHRL-TR-77-64(II)	Historical Task Analysis of C-130E Personnel	(250 pp.)

52 **Leisey, S.A., & Guinn, N. Development of a screening methodology for entry into medical technical training courses. AFHRL-TR-77-49, AD-A048 119. Brooks AFB, TX: Personnel Research Division, August 1977. Project AMDS. NTIS.** This research reports the evaluation of a current screening methodology and the feasibility of developing a refined selection methodology for entry into three medical technical training courses: Aeromedical Specialist (90130), Environment Health Specialist (90730), and Physiological Training Specialist (91130). A sample of 1,003 students who entered these courses during the 1973–1975 time period were administered three commercial tests by the USAF School of Aerospace Medicine (SAM). Aptitudinal and biographical data were retrieved from historical record files. Multiple linear regression analyses were accomplished to determine whether the commercial tests and/or aptitudinal and biographical data contributed to the prediction of training performance. It was found that the most effective predictor composite contained both the commercial tests and the aptitudinal and biographical data. Results indicated that such a predictor composite can help in identifying potential failures and/or personnel requiring remedial training in these courses. (30 pp.)

53 **Schwartz, N.F. Display and speech devices for simulator instructor/operator station applications. AFHRL-TR-77-50, AD-A049 247. Wright-Patterson AFB, OH: Advanced Systems Division, December 1977. Project 6114. NTIS.** The Air Force Human Resources Laboratory (AFHRL) has the responsibility for research and development of advanced simulation techniques, including more efficient and more effective Instructor Operator Stations (IOS) which would possibly use newly developed display devices and techniques and speech response/recognition devices.

This review was undertaken to become better acquainted with the state of the art of hardware devices which could be used for the IOSs of advanced aircraft training simulators and to provide some guidance in the devices to designers, specifiers and users of IOSs. Attention focused mainly on display devices and speech response/recognition devices.

A survey of technical literature concerning display devices, and speech synthesis and speech recognition devices was accomplished and contacts were established with a number of manufacturers and developers of these devices to determine the latest developments and potential applications. Also, literature was searched for R&D related to the application of such devices.

Some of the merits and shortcomings of a number of display devices (i.e., cathode ray tubes (CRT) and alternative but similar devices) are discussed and descriptions of their operation are included. Speech interaction with computers is also discussed in a similar manner.

It is concluded that new display devices will not significantly impact the general design or utilization of the IOS. Advancement of speech recognition could have a significant impact, but development beyond present capabilities does not appear imminent. (18 pp.)

54 **Harris, D.A., & Pennell, R.J. Simulated and empirical studies of flexilevel testing in Air Force technical training courses. AFHRL-TR-77-51, AD-A050 829. Lowry AFB, CO: Technical Training Division, September 1977. Project 1121. NTIS.** This study used a series of simulations to answer questions raised by empirical studies. The first study showed that for reasonable high entry points, parameters estimated from paper-and-pencil test protocols cross-validated remarkably well to groups actually tested at a computer terminal. This suggested that feasibility studies; i.e., running actual subjects, may not be called for. The second study showed that the proportion correct during flexilevel testing was a sensitive measure of student performance. It was also concluded that the modest time savings (12 to 15 percent) were due to the parameters used to implement flexilevel testing. Study III showed that a 50 percent savings in items, and, potentially, a large savings in test time could be realized through the implementation of alternate flexilevel strategies. In summary, the overall conclusion from the three studies was that flexilevel testing, with variable entry, offers an easily implemented testing procedure with potential for significant dollar savings at minimal risk. (22 pp.)

55 **Slenker, K., & Cream, B.W. Part-task trainer for the F-106A MA-1 radar/infrared fire control system: Design, specification, and operation. AFHRL-TR-77-52, AD-A048 810. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 1710, Contract F33615-76-C-5028, AAI Corporation. NTIS.** This exploratory development effort was directed towards two objectives. First, refinement of a behavioral data design technique for the identification and specification of training device requirements; and second, use of these techniques to specify and procure a prototype, low-cost, functional part-task trainer for the F-106A Radar/Infrared Fire Control System. The design technique uses ISD data as a baseline and adds further analysis and information from the prospective operational users to determine: (a) Which of the training tasks actually need to be taught in the proposed device; and (b) The cost/benefit relationship of various degrees of simulation for each task. A one-year evaluation of the actual training impact of the device currently is being conducted. The design techniques used resulted in an inexpensive, reliable trainer with considerable flexibility inherent in the design. (28 pp.)

56 **Mathews, J.J., & Jensen, H.E. Screening test battery for dental laboratory specialist course: Development and validation. AFHRL-TR-77-53, AD-A048 120. Brooks AFB, TX: Personnel Research Division, October 1977. Project 7719. NTIS.** The object of this study was to develop a valid replacement for the difficult to administer and costly Chalk Carving Test presently used in screening Dental Laboratory Specialist (DLS) candidates. An experimental battery of perceptual tests was given to 172 prospective DLS students. Dexterity tests were also given to a subsample. Experimental laboratory ratings and final course grades, if available, were obtained for the subjects. Tests were factor analyzed, and individual and multiple validity correlations were computed.

The Chalk Carving Test presently used in screening prospective DLS students did not demonstrate significant validity with laboratory ratings or final grades. This lack of relationship seems partly due to somewhat subjective scoring reflected by a low interrater reliability. Several of the experimentally administered perceptual tests and a finger dexterity test (Peg Turning) did correlate significantly with laboratory ratings. A few perceptual tests also were valid for predicting DLS final grades.

The General Aptitude Index was significantly related to final grades, but was not substantially related to laboratory ratings. A composite based on four perceptual tests appeared able to screen out about one-half of the 15% of students with the lowest performance in DLS course laboratory work. While the Peg Turning test appeared to make an independent contribution to prediction of laboratory ratings, this apparatus test presents cost and test administration problems which make it less attractive. In contrast, the use of the Perceptual Composite (in place of the Chalk Carving Test) would reduce test administration time about 15%, test scoring time at least 50%, and test material costs would also be reduced. In addition, this study indicates that DLS training attrition should be lowered somewhat through utilization of the Perceptual Composite. (14 pp.)

57 **Wissman, D.J. Audio-visual proficiency testing: Annotated bibliography. AFHRL-TR-77-54, AD-A048 122. Brooks AFB, TX: Personnel Research Division, October 1977. Project 2313. NTIS.** This report contains an annotation of published reports dealing with the use of audio-visual media for proficiency testing. Reports included discuss investigation of audio-visual administrations of standardized printed tests as well as motion picture filmed tests assessing job knowledge and skill. Reports dealing with the use of audio-visual media in teaching were not included, though references to several bibliographies dealing with the use of motion pictures in education are listed. The reviewed research covers a period from 1945 to 1976.

The majority of the investigations of motion picture filmed tests were done between 1945 and 1958. Most of the more recent research is limited to the audio-visual display of printed tests during test administration.

Although the published results of the reviewed reports vary from extremely positive to quite negative, the general finding of this review stresses the paucity of thorough investigations using the audio-visual medium in proficiency testing. (16 pp.)

58 **Watson, T.W., & Zumbro, P.A. Job enrichment: Evaluation with implications for Air Force job redesign. AFHRL-TR-77-56, AD-A050 827. Brooks AFB, TX: Occupation and Manpower Research Division, October 1977. Project 7734. NTIS.** The main text of this report consists of a review and evaluation of job enrichment as an approach to job redesign, with implications for Air Force research and application. In addition, two appendices are included: the first, a supplemental historical discussion; the second, an annotated bibliography. Specific objectives are to provide: (a) a general review and evaluation of job enrichment and its related motivational concepts, (b) an assessment of the utility of job enrichment to the Air Force in terms of implications for job-redesign research and application, and (c) a comprehensive annotated bibliography of job-enrichment and related literature. The report should prove useful to anyone, within or outside the Air Force, who is interested in evaluating job enrichment as an organizational-change technique. Job enrichment is discussed within the historical framework of changing managerial assumptions about the worker and work motivation and within the motivational framework of Maslow, McGregor, and Herzberg. The technique of job enrichment is reviewed, evaluated, and compared with other job-redesign interventions. Its limitations are discussed with special emphasis on individual and cultural differences and a more eclectic approach to job redesign is advocated. Recent advances in job-redesign theory and research, by Hackman, Oldham, and Umstot are presented and implications for Air Force research and applied programs are discussed. (72 pp.)

59 **Reed, L.E. Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles. AFHRL-TR-77-57, AD-A049 706. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 1710. NTIS.** The purpose of this experiment was to investigate operator performance in an environment which was conducive to visual-proprioceptive conflict. More specifically, the intent was to determine the relative ability of pilot, navigator, and nonrated Air Force officer groups to maneuver a simulated remotely piloted vehicle (RPV) from a simulated airborne control station (i.e., a mother ship). The vehicle and/or the station were given gust-like disturbances on pitch and/or roll. In a between-groups design, the performance of the three groups of subjects was compared under two conditions of conflict (e.g., visual roll right and roll left motion; visual roll right and pitch-up motion), nonconflict, motion only, and no motion. To maintain adequate performance, it was necessary for the subjects to disregard sensations of motion. The results revealed that the two conditions of conflict engendered the highest proportion of control errors (i.e., reversal, and axis errors) by all subjects, regardless of experience, but pilots tended to make more errors than nonpilots. The past experience of pilots did not help them overcome the effects of conflict as measured by control errors, but it did help them reduce response latencies. Motion cues appear to play not only an alerting role, but also provide information on the direction of attitude changes. This research indicated no advantage of training pilots, as opposed to nonpilots, to perform airborne control of RPVs as represented by the conditions of this experiment. Such training should be conducted in the presence of motion cues. (32 pp.)

60 **De Vany, A., Reynolds, M., Shughart, W., & Taylor, J.N. Stochastic analysis of Air Force manpower: A research prospectus. AFHRL-TR-77-58, AD-A048 121. Brooks AFB, TX: Occupation and Manpower Research Division, September 1977. Project 2077. NTIS.** This report describes an approach to analyzing the military/civilian manpower markets and their interface which explicitly includes stochastic elements and characterizes their impact on military manpower supply. (20 pp.)

61 **Dallman, B.E., DeLeo, P.J., Main, P.S., & Gillman, D.C. Evaluation of PLATO IV in vehicle maintenance training. AFHRL-TR-77-59, AD-A052 623. Lowry AFB, CO: Technical Training Division, November 1977. Project 1121. NTIS.** This study documented an Air Force service test of the PLATO IV Computer-based Educational System at Chanute Technical Training Center, Chanute AFB, Illinois. As a part of an instructional systems development effort for four Special Purpose Vehicle Repairman's courses, thirty-five computer-assisted instruction (CAI) lessons were prepared, covering approximately 20 hours of instruction. The evaluation addressed six major areas. In the first area, instructional effectiveness, the PLATO based version was the most efficient of the four versions compared (but the efficiency increase directly attributable to PLATO IV was not determinable).

A cost analysis demonstrated that the Chanute application of PLATO was not cost-effective, but the potential exists for enhanced benefits by selectively applying PLATO and increasing student usage of terminals. A study of instructional impact showed student and instructor attitudes to be, respectively, favorable and acceptable. No major adverse impacts relative to the conduct of training were experienced. The fourth area, instructional material development, found the development process with its reliance on a team approach to be effective, but the lessons did not exploit the full potential of PLATO. The study of the remaining two areas, management and human factors considerations, revealed that relatively minor adjustments were necessary to accommodate PLATO within the military technical training environment.

The authors concluded that PLATO IV could be a viable tool for military technical training once it is learned how to exploit the system's capability, and increase production efficiency of courseware and management applications. Recommendations were provided for this effort. (146 pp.)

62 **Summers, R.H., Pelletier, D.A., & Spangenberg, R.W. Front-end analysis of the instructor's job in self-paced instruction. AFHRL-TR-77-60, AD-A052 675. Lowry AFB, CO: Technical Training Division, December 1977. Project 1193. NTIS.** This report divulges the development and administration of instruments for the front-end analysis of the instructor's job in a self-paced instructional environment. A validated task list was developed, administered, and analyzed. The development process is carefully described. One thousand one hundred nineteen respondents rated one hundred ninety-one tasks in the job inventory. An opinion survey of various activities was also completed. Analyses of the data acquired are included. (52 pp.)

63 **Weyer, D.C., & Fuller, J.H. Evaluation of T-37 IFS syllabi in the ASPT. AFHRL-TR-77-61, AD-A052 624. Williams AFB, AZ: Flying Training Division, December 1977. Project 1123. NTIS.** Two syllabi were developed for potential use in the T-37 phase of undergraduate pilot training (UPT), when the Air Training Command's (ATC) Instrument Flight Simulator (IFS) become operational. These syllabi were designed to maximize the use of proven instructional strategies with state-of-the-art simulators; the goal was to demonstrate that such a program would permit using only one aircraft check ride for validation of instrument skill learning. Four UPT students from Class 77-03 were trained using the first syllabus; and four students from Class 77-05 were trained using the second syllabus. The remaining students in each of the respective classes, trained using the current ATC syllabus, were used as control groups. The Advanced Simulator for Pilot Training (ASPT), modified to simulate IFS capabilities as closely as possible, was used as the test vehicle.

Comparisons were made between average training times required by the experimental groups (progressed on a proficiency basis) and average training times required by the remainder of the UPT classes, using the conventional syllabus. Average check ride scores were compared for all groups. Training effectiveness ratios were computed by training category for each of the two syllabi tested.

Using these syllabi, which maximized the use of available devices (T-4 trainers and the ASPT as modified to approximate the IFS), it was demonstrated that most of the instrument training

currently accomplished using T-37 aircraft can be accomplished in the IFS with no degradation in pilot output quality; an average of 2.4 aircraft hours was required for experimental subjects, as compared with 15.8 aircraft hours currently used.

Since experience indicates that some number of students (estimated at 13%) will fail their first aircraft instrument check ride, a goal of one check ride per student is unattainable (except administratively); however, this study indicates ATC has a high probability of coming very close to their goal.

Student instructor and simulator operator interviews provided several suggestions which will be helpful in implementing the selected syllabus with the IFS. (34 pp.)

64 **Crosby, J.V. Cognitive pretraining: An aid in the transition from instrument to composite flying. AFHRL-TR-77-62, AD-A048 816. Williams AFB, AZ: Flying Training Division, October 1977. Project 2313, Contract F41609-75-C-0018, Arizona State University. NTIS.** This study was designed to investigate the role of cognitive pretraining relative to the early difficulties encountered by student pilots transitioning from ground-based instrument training to composite flying training. The cognitive pretraining consisted of: (a) an instrument reading review, (b) a vocabulary of relevant cockpit features, (c) the use of brief perceptual rules for pitch and bank attitudes, and (d) prototype representations of a variety of pitch and bank attitudes. Three groups of 12 pilots each participated in the study: student experimental, student control, and experienced instructor pilots (IP). The experimental group was exposed to cognitive pretraining and then compared to the student control and IP groups in a simulated composite flight laboratory task. Results of the laboratory task demonstrated superior discrimination performance of the student experimental group over both the student control and experienced pilot groups for the most difficult discrimination. As the discrimination difficulty decreased, the performance of the experimental and experienced pilot groups were equal and both were superior to the student control group. As a measure of the external validity of the laboratory task, both student groups were subjected to four discrete maneuvers in the Williams Air Force Base Human Resources Laboratory, Flying Training Division (AFHRL/FT) Advanced Simulator for Pilot Training (ASPT). Results of the ASPT task support the findings of the laboratory task. The laboratory and simulator results were discussed in the context of directed attention and schema theory. (46 pp.)

65 **Knight, J.M., Pope, W.H., & Polk, S.B. Integrated Simulation Evaluation Model (ISEM) of the Air Force manpower and personnel system: Requirements and concepts. AFHRL-TR-77-63, AD-A044 047. Brooks AFB, TX: Occupation and Manpower Research Division, August 1977. Project 2313. NTIS.** This report develops a need, concept, and methodology for modeling the Air Force manpower and personnel system as a single, unified, integrated system which translates human resources into mission capabilities. The report lays the conceptual foundations for development of a large scale simulation model, which will integrate subsystems across functional specialties and evaluate performance from a total systems perspective of effectiveness and efficiency; thus follows the name: Integrated Simulation Evaluation Model (ISEM). The report explores the persistent features of the Air Force manpower and personnel system and systematically develops these characteristics into systemic functions, and finally into the basis for an ISEM. Theoretical modeling issues, as well as more practical issues; such as requirements for implementation are addressed. (32 pp.)

66 **Brown, F.D., Walker, G.A., Wilson, D.H., & Dieterly, D.L. Historical weapon system resource utilization methodology. AFHRL-TR-77-64(I), AD-A047 885. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 1959, Contract F33615-76-C-0062, Boeing Aerospace Company. NTIS.** This report presents recommended methods and practices to be considered for implementation during future Historical Weapon Systems Analysis efforts. Recommended

methodology contained within this final report includes: (a) contract performance planning; (b) review of published literature; (c) documentation search and data acquisition techniques; (d) historical data analyses; (e) task analyses of selected Air Force Specialties personnel (maintenance and operations); and (f) life cycle costing. Recommendations contained within this final report are presented in functional/sequencial flow formats. They represent the results of "lessons learned" by investigators during their implementation of Phase I of Project 1959, viz: "C-130E Historical Weapon System Analysis," encompassing 15 years (1962–1976). All methodologies, portrayed in functional flow sequences, are general in nature and encompass three tiers of logic; i.e., zero indenture or top level, first indenture or second level, and second indenture or third level.

Highlights of problem areas to be expected in future HWSA efforts are also presented.

This document is the fourth technical report emanating from Phase I or Project 1959, namely:

AFHRL-TR-77-40	C-130E Hercules Aircraft: Review of Published Literature and Structured Interviews (Available to U.S. Government Agencies only.)	
AFHRL-TR-77-48	Historical Analysis of C-130E Resources	
AFHRL-TR-77-46	Life Cycle Cost of C-130E Weapon System	
AFHRL-TR-77-64(I)	Historical Weapon System Resource Utilization Methodology (This Issue)	
AFHRL-TR-77-64(II)	Historical Task Analysis of C-130E Maintenance Jobs	(78 pp.)

67 **Brown, F.D., Walker, G.A., Wilson, D.H., & Dieterly, D.L. Historical task analysis of C-130E maintenance jobs. AFHRL-TR-77-64(II), AD-A047 501. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 1959, Contract F33615-76-C-0062, Boeing Aerospace Company. NTIS.** This concluding HWSA report provides the results of data acquired at Little Rock Air Force Base, Arkansas, wherein 274 airmen personnel encompassing 11 Air Force Specialties completed task inventories against 6,294 C-130 maintenance tasks. Cumulative frequency polygons and histograms portraying duty/task results of each of the 11 AFSCs are also portrayed. (122 pp.)

68 **Boldt, R.F., Levin, M.K., Powers, D.E., Griffin, M., Troike, R.C., Wolfram, W., & Ratliff, F.R. Sociolinguistic and measurement considerations for construction of armed services selection batteries. AFHRL-TR-77-65, AD-A050 828. Brooks AFB, TX: Personnel Research Division, December 1977. Project 7719, Contracts DAHC 15-73-C-0364 and F41609-75-C-0034, Center for Applied Linguistics and Educational Testing Service. NTIS.** The objective of this study is to identify potential sources of linguistics bias in Armed Forces aptitude tests. General aspects of a sociolinguistic perspective are set forth as a basis for investigating the use of language in tests. Linguistic interference is investigated for three different aspects of language usage in tests: directions; word problems, as seen in tests for arithmetic reasoning and automotive information; and word knowledge. For each of the main areas of investigation procedures for verification and experimentation are suggested, and further questions are explored. The conclusion summarizes specific considerations that should be given to sociolinguistic aspects of aptitude tests and suggests ways in which this analysis may be followed up by test designers and test interpreters. (42 pp.)

69 **Bunker, W.M., & Ferris, N.E. Computer image generation imagery improvement: Circles, contours, and texture. AFHRL-TR-77-66, AD-A053 477. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977, Project 6114, Contract F33615-76-C-0038, General Electric Company. NTIS.** Computer Image Generation (CIG) visual simulation systems are now being procured for research and as pilot training simulators. Current systems generate scenes that do not provide sufficient velocity and altitude cues. Training effectiveness would be increased by improving this aspect of the visual scenes.

This report covers investigations into three approaches to improving visual scene cues. These are generation of contours (ridge-like and valley-like features), generation of circular features, and a ground-map technique for generating surface texture. In each of the three areas, the approach was to develop efficient algorithms, to produce scenes for evaluation of the algorithms and illustration of various methods of using the capability, and to estimate requirements for hardware implementation in real-time systems. A goal in all cases was to minimize the use of the edge-processing capacity of the CIG system. In several cases, scenes were prepared to evaluate the effect of applying different algorithms to achieve a desired result.

Two quite different algorithms were developed to produce circular features on the surface. One proved superior both in results and in reduced processing requirements. Very minor modification to the algorithm would allow simulation of nonsurface circles, ellipses and of spheres. This capability was added to the software scene generation facility. These features can be used to enhance scene realism by simulating lakes, settling tanks, curved roads, puffy clouds, etc. Scenes were produced to illustrate this capability. Further extension will allow ellipsoid simulation.

For reference and comparison with other techniques, contours were generated using standard CIG edges to form three-dimensional objects. It was determined that, within certain constraints, identical effects could be produced using delineators defined entirely on the surface. To achieve spatial consistency, it is necessary to redefine these delineators for each scene. This added computation is not justified by reduction in requirements elsewhere in the processing; further, the constraints would prevent contours produced in this manner from providing valid cues near the ground. Effort was then applied to evaluating a number of techniques for producing contours using edges.

The effort on the ground-map texture generation was not performed under this contract. It was an IR&D effort, and the results are included in this report by agreement with the Air Force. It involves defining a set of maps on the surface, with algorithms to determine the map contribution to each pixel during scene generation. Evaluation scenes indicate this may be very effective in providing texture cues.

In addition to the scenes included in this report, video tapes were made using the static scene generator with a time-lapse video disc recorder. These show the dynamic effect of the techniques developed. (136 pp.)

70 **Shaffer, L.W., & Waidelich, J.A. Wide-angle, multiviewer infinity display design. AFHRL-TR-77-67, AD-A051 158. Wright-Patterson AFB, OH: Advanced Systems Division, September 1977. Project 6114, Contract F33615-76-C-0064, General Electric Company. NTIS.** There has long been a need in aircraft simulation for a wide angle visual display that will accommodate the entire crew of a large aircraft type such as a bomber or tanker.

This study is concerned with the approach and design of a wide angle display for multiple crew members in large aircraft simulators. The study traces the development of a concept from existing simulation methods.

Throughout its 180° by 60° field of view which accommodates pilot, copilot, and instructor pilot the final design meets most of the requirements of the original specification. Because of its relatively large optical components the fabrication of the display will be of a developmental nature itself. (116 pp.)

71 **Headquarters Air Force Human Resources Laboratory. Fiscal Year 1979 – Air Force technical objective document. AFHRL-TR-77-68, AD-A046 476. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, September 1977. (Covers all AFHRL projects.) NTIS.** This document

provides the academic and industrial R&D community with a summary of the technical area objectives of Air Force research in the field of human resources. The areas covered are: (a) Personnel and Manpower Management, (b) Education and Training, (c) Personnel Selection and Retention, (d) Force Structure and Utilization, (e) Flying Training Technology, (f) Technical Training Technology, (g) Simulation Technology for Training, and (h) Personnel and Training Factors in Advanced Systems. (18 pp.)

72 **Berger, F.R., & Berger, R.M. Vocational Interest-Career Examination: Norming and standardization on a nationwide high school sample. AFHRL-TR-77-69, AD-A047 762. Brooks AFB, TX: Personnel Research Division, September 1977. Project 7719, Contract F41609-76-C-0019, Psychometrics Inc. NTIS.** The Vocational Interest-Career Examination (VOICE), a general purpose interest inventory developed by the Air Force for use in vocational and technical counseling, was standardized on a nationwide sample of high school students. This report describes the sample design, data collection and statistical analysis. Raw score norms are provided for subsamples identified by school grade, sex, ethnic background and geographic region. (40 pp.)

73 **Borah, J., Young, L.R., & Curry, R.E. Sensory mechanism modeling. AFHRL-TR-77-70, AD-A049 278. Wright-Patterson AFB, OH: Advanced Systems Division, October 1977. Project 6114, Contract F33615-76-C-0039, Gulf + Western Applied Science Laboratories. NTIS.** The purpose of this study was to model human motion and orientation sensing mechanisms so that simulator motion cueing systems can be designed to take full advantage of the characteristics of these sensory mechanisms. Individual models for vestibular, visual, tactile, and proprioceptive sensors have been either adapted from previous modeling work or formulated from available psychophysical and neurophysiological data. A computer aided literature search was conducted to help identify material in the area of mechanoreceptor systems, and the resulting bibliography is included in the report.

A composite model structure has been proposed, using a Kalman filter blending technique to integrate information from the different sensory modalities into a single estimate of state. The Kalman filter represents the presumed function of neural central processing. The model has been implemented in the form of a digital computer program, and promising preliminary results, in qualitative agreement with known human responses, have been obtained using only vestibular model components.

Ongoing work is directed at exercising the nonvestibular modalities, performing thorough validation and exercise of the entire model, and extending the model where possible. Modifications are expected as this work is pursued. (138 pp.)

74 **Rhinehart, R.M. Wide-angle, multiviewer infinity display design. AFHRL-TR-77-71, AD-A053 679. Wright-Patterson AFB, OH: Advanced Systems Division, December 1977. Project 6114, Contract F33615-76-C-0052, McDonnell Douglas Electronics Company. NTIS.** A research design study was undertaken to define an extended field of view (60° x 180°) infinity image display, suitable for multiviewer use on wide-bodied aircraft simulators. Mosaicking of single channel units, both reflective and refractive was investigated, along with extended field, off-axis reflective systems. Major emphasis was placed on the investigation of extended field of view, off-axis reflective systems. Various figured screen and mirror combinations, ranging from spherical to high order aspherics, were designed and evaluated. Two specific designs were selected, optimized and evaluated over an extended viewing volume. (78 pp.)

75 **Eddowes, E.E. Proceedings of the simulator effectiveness research planning meeting. AFHRL-TR-77-72, AD-A052 622. Williams AFB, AZ: Flying Training Division, December 1977. Project 1123. NTIS.** The proceedings of a Simulator Effectiveness Research Planning Meeting held at

the Flying Training Division, Air Force Human Resources Laboratory, Williams Air Force Base, Arizona on 21–22 April 1976 are reported. The objective of the meeting was to identify simulator training requirements and to determine the availability of research facilities and personnel to use in studies of the training effectiveness of simulator motion and visual systems. The meeting consisted of two sessions. During the first session attendees were divided into four groups which studied: (a) capabilities and characteristics of simulators, (b) simulator requirements for flying training, (c) measurement of simulator training effectiveness, and (d) management and utilization of simulators. During the second session the findings of the study groups were summarized and discussed in a general meeting of all attendees. (22 pp.)

76 **Hawley, J.K., Mullins, C.J., & Weeks, J. Jet engine mechanic–AFSC 426X2: Experimental job performance tests. AFHRL-TR-77-73, AD-A053 302. Brooks AFB, TX: Personnel Research Division, December 1977. Project 7719, Contract F33615-76-C-0057, Applied Science Associates, Inc. NTIS.** Historically, the Air Force has used technical school grades (TSGs) to validate aptitude tests. The purpose of the current study was to develop a job-related criterion metric against which to validate aptitude measures. Along this line, three Criterion Tests relevant to the 3, 5, and 7 skill level of PAFSC 426X2–jet engine mechanic–were developed. ANOVA results demonstrated that mean Criterion Test scores were significantly different across the relevant skill levels. Stepwise regression results indicated that Armed Services Vocational Aptitude Battery (ASVAB) information subscales were most predictive of Criterion Test performance for experienced mechanics. Considering only basic airmen, the ASVAB information measures and general knowledge subscales were most related to Criterion Test performance. When TSGs were regressed on ASVAB scores, general knowledge scales were most consistently predictive of technical school performance. The regression of TSGs on Criterion Test scores indicated that only Test 1 was generally related to technical school performance. (72 pp.)

77 **Mathews, J.J. Analysis aptitude test for selection of airmen for the radio communications analysis specialist course: Development and validation. AFHRL-TR-77-74, AD-A051 962. Brooks AFB, TX: Personnel Research Division, December 1977. Project AFSS. NTIS.** The objective of this study was to assess the increase in prediction of Radio Communication Analysis Specialist course performance when an Analysis Aptitude (AA) test is added to current selection instruments. Highly significant validities were obtained with AA for samples of 173 Air Force and 144 Army students. A multiple R of .7 in predicting final grades from AA and the three subtests of the Armed Forces Qualification Test (AFQT) was obtained for a subsample of 108 Army students. Minimum qualification scores of 71 percentile on AFQT and a raw score of 15 on AA were recommended for selection of students. (12 pp.)

78 **Wiley, L.N., & Hahn, C.P. Task level job performance criteria development. AFHRL-TR-77-75, AD-A055 694. Brooks AFB, TX: Occupation and Manpower Research Division, December 1977. Project 7734, Contract F41609-71-C-0010, American Institutes for Research. NTIS.** This study investigated the possibilities for improving the identification of the requirements for jobs by studying performance of job incumbents on separate tasks. Three specialties were selected for study: 291X0, Telecommunications Operations Specialist; 304X4, Ground Radio Communications Equipment Repairman; 431X1C, Aircraft Maintenance Specialist, single- and dual-engine jet. Incumbents, peers, and supervisors rated the performance of the incumbents on a selected set of tasks. In addition, job inventories and an experimental test battery were administered to the incumbents. The battery included 11 short experimental cognitive tests, a Biographical Inventory, the Vocational Interest-Career Examination (VOICE), and a 43-item Job Satisfaction Information blank. Data of record were also obtained from Air Force files to provide such items as incumbent grade, service time, sex,

education at enlistment, and Aptitude Index scores. Correlations were run between raters, correlating performance on separate tasks, and between raters, correlating performance on 6 overall dimensions of appraisal. Cross-rater reliabilities were low, but significant, on task assessments, and in the r = .40 range on overall ratings. Similarly low correlations were found for nontask predictors, such as grade, service time, and Aptitude Indexes. All types of obtained measures, except data on the origins of training and on task performance satisfaction, were put into regression problems to account for the 6 overall performance ratings made by peers and supervisors. The data suggest that different factors were important for different kinds of work, and for different dimensions of performance appraisal. Of all the many findings of the study, by far the most enlightening was that difficult tasks (in terms of learning time) were better measured on performance. This arose from less use of the top of the rating scale, and it produced lower performance appraisals from the group (AFSC 304X4) which had been selected by the Air Force for having the highest aptitude scores. Should subsequent analyses prove that this finding also applies to job ratings within AFSCs, the result would have implications for Air Force job performance appraisal. (54 pp.)

79 **Foley, J. P., Jr. Performance measurement of maintenance. AFHRL-TR-77-76, AD-A053 475. Wright-Patterson AFB, OH: Advanced Systems Division, December 1977. Project 1710. NTIS.** This paper discusses the status of performance measurement (PM) for maintenance. During and after World War II, both Navy and Air Force maintenance training programs made extensive use of formal job task performance tests. But for economy reasons, these tests were later abandoned in favor of paper-and-pencil theory and job knowledge tests. Considering the results of later research, these actions were most unfortunate. This research has indicated that such paper-and-pencil tests do not indicate how well individuals can perform the tasks of their jobs. Even though PM were used extensively during and after World War II, there have been few systematic research and development (R&D) efforts concerning the refinement of PM for maintenance. This paper briefly describes the AFHRL R&D efforts for PM which have given due consideration to the man-machine interface. The rather promising results of efforts to develop symbolic substitutes for PM are also presented. In addition, several problems concerning the research, development, and implementation of PM are discussed. The paper ends with proposals for future R&D efforts based on what has already been accomplished. (30 pp.)

80 **Foley, J.P., Jr. Overview of Advanced Systems Division criterion research (maintenance). AFHRL-TR-77-77, AD-A053 478. Wright-Patterson AFB, OH: Advanced Systems Division, December 1977. Project 1710. NTIS.** A prime but seldom considered cause of the current high maintenance cost of DoD hardware, and thus the high ownership cost of systems, is the current criteria used by personnel systems to select, train, assign, and promote maintenance personnel. The current criteria emphasize the ability to obtain high scores on paper-and-pencil theory and job knowledge tests. This paper summarizes the many studies which indicate that such tests have little demonstrated relationship to ability to perform job tasks. This current testing emphasis must be shifted to the demonstration of the ability to perform job tasks. Such a shift is also a necessary factor for the implementation of improved job instructions and job (task) oriented training technologies. Such technologies have great potential for reducing high maintenance costs.

The criterion research program of the Advanced Systems Division (AS), described in this paper, has included important aspects of the criterion problem as it applies to the measurement of such ability to perform maintenance tasks in training and on the job. The objective of AS in the solution of this problem is to get as close to the real job as possible. When "on-line" tasks occur often enough, their structured observation may be appropriate. *But* when such observations are not appropriate or when tasks occur infrequently, we propose to have the tasks performed "off-line" in a job-like environment. The Advanced Systems Division approach to the development of such measures was

started with an analysis of the structure of the man/hardware interface for maintenance. Based on the results of this analysis, a model test battery of job task performance tests (JTPT) was developed for electronic maintenance. Using this model as the criterion, batteries of graphic and video symbolic substitute tests were also developed. Several of the graphic symbolics have indicated respectable empirical validities but require more refinement and tryout. The attempts to develop video symbolics were unsuccessful.

A continuing research program based on what already has been accomplished is recommended. This includes the development of a model battery of JTPT together with symbolic substitutes for maintenance tasks generated by a typical mechanical hardware. The perennial problem of getting new technologies such as JTPT implemented is also briefly discussed. There is definitely a requirement for a structured mechanism which will guarantee the orderly institutionalization of such technologies as well as their integrity. (24 pp.)

81 **Cowan, D.K. Comparative occupational survey of USAF civilian and military members in three civil engineering specialties. AFHRL-TR-77-78, AD-A053 303. Brooks AFB, TX: Occupation and Manpower Research Division, December 1977. Project 7734. NTIS.** Military and civil service carpenters, masons, and plumbers were surveyed using a job inventory check list and relative time spent rating method along with background item responses. Job clustering and job typing of combined responses were performed and comparisons made between civilian and military groups as well as comparisons between the two groups on several background variables. Data reveal that civilian and military members in the respective specialties are performing approximately equally. Significant differences were found between the two groups in the number of tasks performed, job difficulty, months in job, job interest, and job utilization of training and talents. Overall job interest and job utilization of training and talents are relatively high for both civilian and military members. (28 pp.)

82 **Guinn, N., Kantor, J.E., Magness, P.J., & Leisey, S.A. Screening for entry into the security police career field. AFHRL-TR-77-79, AD-A053 304. Brooks AFB, TX: Personnel Research Division, December 1977. Project 7719. NTIS.** A sample of 4,502 airmen assigned to the security police career field were administered a test battery consisting of biographical, attitudinal, and interest measures. Using a criterion of in/out of service after a minimum period of 1 year on the job, regression analyses were accomplished to determine the effectiveness of the predictor composites. Efforts were made to decrease the magnitude of the selection composite by eliminating one or more of the experimental test measures or minimizing the overall number of test items. Three selection composites containing different numbers of test items were developed and evaluated for practical utility in identifying individuals most likely to separate from service. The multiple correlations ranged from .46 to .37. Cross-application analyses resulted in multiple correlations of .20 to .19. Recent changes and improvements in this career field were reviewed, and the advisability of implementing a new screening methodology discussed. (14 pp.)

83 **Cowan, D.K. Comparative occupational survey of civilian and military members in the pavements maintenance and construction equipment operator specialties. AFHRL-TR-77-81, AD-A055 534. Brooks AFB, TX: Occupation and Manpower Research Division, December 1977. Project 7734. NTIS.** Military and civil service pavements maintenance workers and construction equipment operators were surveyed using a job inventory checklist and relative time spent rating method along with background item responses. Job clustering and job typing of combined responses were performed and comparisons made between civilian and military groups as well as comparisons between the two groups on several background variables. No significant difference was found between civilian and military members in number of tasks performed for the total sample. However, at the specialty level some significant differences did occur. Average task difficulty and job difficulty means were higher for military members than for civil service members in some skill levels. Generally, the

civilian members indicated higher job interest and felt job utilization of training and talents than did the military members. Military data collected in 1969 were compared to current data. An increase in felt utilization of training and talents was found as well as increased equipment utilization for first-term airmen. (40 pp.)

84 **Taylor, J.N. Influence of the external labor market on the Air Force manpower and personnel system: A review of selected research. AFHRL-TR-77-82, AD-A053 479. Brooks AFB, TX: Occupation and Manpower Research Division, December 1977. Project 2077. NTIS.** This technical report documents a review of selected studies undertaken to determine if a theoretical framework has been developed which reveals how economic factors transmit their effects into the Air Force Manpower and Personnel System (AFM&PS). This report also, determines if a consistent rationale has been developed to serve as a basis for formulating Air Force policies which optimally respond to environmental fluctuations. Studies were examined that describe quantitative relationships between the external labor market (ELM) and the AFM&PS. Of particular interest were studies directed toward determining whether definite relationships could be established that link the ELM with (a) career and training preferences of present and potential members of the Air Force, (b) retention rates by job and/or skill categories of current Air Force members, and (c) structural characteristics and internal behavior of the AFM&PS. Results of this study, if applicable, will be used in developing an ELM module for the Integrated Simulation Evaluation Model of the AFM&PS. Contained in the appendix is an annotated bibliography of the technical reports reviewed for this study. (22 pp.)

85 **Smith, E.A. Four systems for controlling multiscreen or team training presentations. AFHRL-TR-77-83, AD-A055 093. Lowry AFB, CO: Technical Training Division, December 1977. Project 1121. NTIS.** Many training sequences require the simultaneous presentation of more than one visual image or images with more than one visual component. These may consist of pictorial images accompanied by verbal material, schematics accompanied by legends, comparative pictorials, or diagrams accompanied by pictorial or verbal material. In other situations, coordinated instruction is required for each member of a small team being trained. At present, developing and producing such images is so technically complex that it is not accomplished by the majority of USAF training installations. The objective of this investigation was to develop and describe procedures and techniques for generating and presenting such instructional material.

An informal survey of USAF training compatible with multiscreen presentations was conducted to determine types of control techniques that would be of benefit to the Air Force. It was determined that no one system would be appropriate in all situations. Most of these situations could be classified into two categories; first, those in which the student or group of students required more than one simultaneous visual and, second, those in which teams of students required synchronized but different instruction. The first category could be divided into one group that required complex presentations from the beginning and a second group that required less complexity initially, but the complexity could be expected to increase or vary.

This report describes (a) a system for controlling multiple images that can be assembled in modular fashion starting with existing equipment and systematically adding components as additional functions are required, (b) a more complex system for controlling multiscreen presentations that requires a considerable initial investment of money and personnel, (c) a team training configuration designed to provide orientation or theory to small teams, and (d) a configuration for providing performance oriented training to teams.

The discussions are limited to techniques for implementing the instructional strategy. There is no attempt to present data regarding the instructional effectiveness of the strategy. A summary of a classroom field test and evaluation of the usability of the modular configuration is included.

In order to provide usable guides and still keep the report down to a manageable size, the description of the first two systems are focused on hardware considerations. The description of the third is limited to a brief functional narrative. The discussion of the fourth focuses on courseware development. In any application, attention must be focused on all three aspects but there is enough similarity between the systems that it is felt unnecessary to discuss hardware, courseware, and function for all systems.

For the convenience of the reader, the detailed information on the specific systems has been placed in Appendices. Appendix A provides detail regarding the field trial and evaluation of the modular system described in Chapter 2. Appendix B provides a rather detailed Operations Manual for the complex multiscreen system described in Chapter 3. Appendix C provides a digest of the development of the specific courseware employed in the team teaching application.

This material was developed in response to a specific request and was written to provide some suggestions for agencies considering the initiation of multiscreen or team training media programs. As a result, it is intended as an applications guide and will probably be of rather limited interest to the general reader.

This report is intended to be used in conjunction with AFHRL-TR-75-37, *Quality Assurance of Media Devices and Courseware* and AFHRL-TR-75-68, *Techniques for Generating Instructional Slides*. (60 pp.)

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