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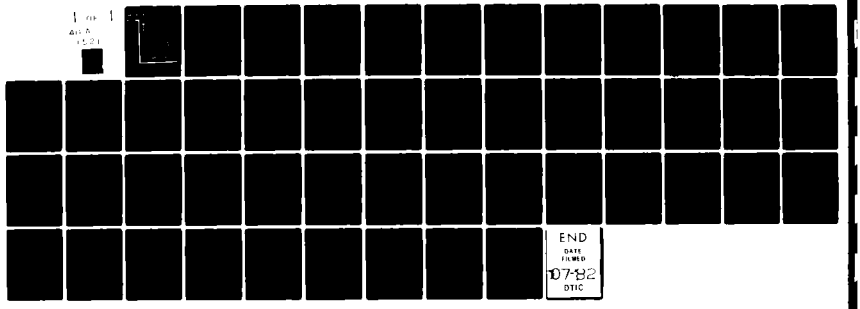

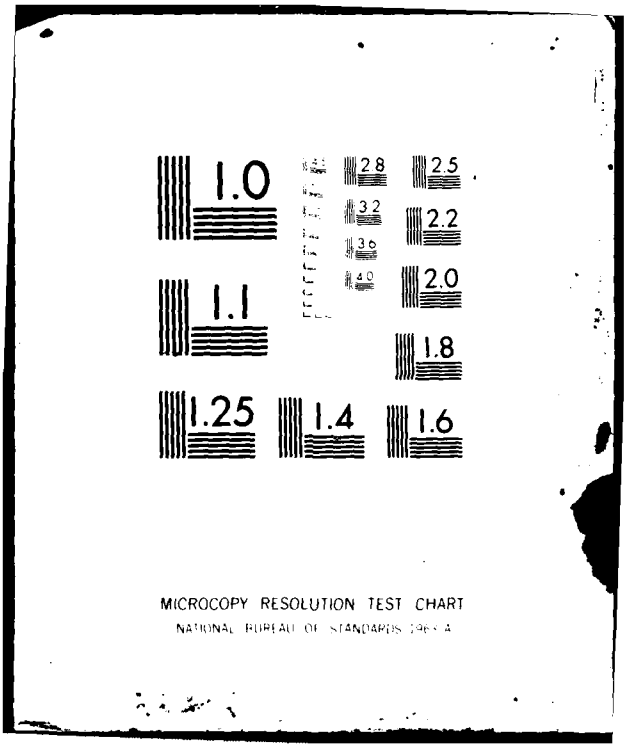
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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS — 1980

Esther M. Barlow

TECHNICAL SERVICES DIVISION
Brooks Air Force Base, Texas 78235

May 1982

Final Report

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

This annotated bibliography presents a listing of technical reports and technical papers (1980) dealing with personnel and training research conducted by the Air Force Human Resources Laboratory (AFHRL). The research has been conducted by professional personnel representing a variety of disciplines. These personnel include 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 Air Force exploratory and advanced development programs in training and personnel systems technology. This includes manpower and personnel programs in selection, classification, retention, force structure and force utilization; education and training programs in technical training, flying training, and crew and team

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training; simulation and training devices programs to develop flight simulators and maintenance training simulators; and logistics and human factors programs in weapon systems logistics and combat maintenance.

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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS — 1980

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 planning and executing the Air Force exploratory and advanced development programs in training and personnel systems technology. Included are manpower and personnel programs in selection, classification, retention, force structure and force utilization; education and training programs in technical training, flying training, and crew and team training; simulation and training devices programs to develop flight simulators and maintenance training simulators; and logistics and human factors programs in weapon systems logistics and combat maintenance.

At the end of 1980, AFHRL consisted of a headquarters and two divisions at Brooks AFB and two geographically dispersed divisions as follows:

1. Manpower and Personnel Division and Technical Services Division, Brooks AFB, Texas.

2. Logistics and Technical Training Division, Wright-Patterson AFB, Ohio.
   a. Logistics Research Branch, Wright-Patterson AFB, Ohio.
   b. Technical Training Branch, Lowry AFB, Colorado.

3. Operations Training Division, Williams AFB, Arizona.

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.

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

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

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

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 bibliography does not include For Official Use Only technical reports nor those having a security classification.

1 **Barlow, E.M. Annotated bibliography of the Air Force Human Resources Laboratory technical reports — 1978. AFHRL-TR-80-1, AD-A087 065. Brooks AFB, TX: Technical Services Division, June 1980. (Covers all AFHRL projects.) NTIS.** This annotated bibliography presents a listing of technical reports (1978) dealing with personnel and training research 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 Air Force 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. In addition, this Laboratory provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment. (70 pages)

2 **Eckstrand, G.A. Technology projection: Manpower and logistic factors in weapon system development. AFHRL-TR-80-2, AD-A088 314. Wright-Patterson AFB, OH: Logistics and Technical Training Division, August 1980. Project 1959. NTIS.** This report outlines the importance of and requirement for considering manpower and logistic factors in weapon system acquisition programs. The scope of the area is defined, and the relationships between the Integrated Logistics System program and the Human Factors Engineering program are discussed.

Developing weapon systems which can meet peacetime readiness and wartime employment objectives at the lowest possible life cycle cost (LCC) requires the ability to integrate manpower and related support considerations into the system acquisition process in a way that allows them to influence requirements and design. A number of human factors related technologies that contribute to the achievement of this goal are described in the report. The areas covered are: Maintenance Manpower Modeling; Training Plans and Requirements; Maintenance Technical Data; System Ownership Costing; Human Resources in Design Trade-offs; Supporting Data Bases. For each of these component technologies, a near-term (5 years) technology projection is presented. Although each of the component technologies independently can make an important contribution to weapon system acquisition, what is needed most is a method to integrate the application of these component technologies during weapon system development or modification. Work to provide such an integrated methodology is described and a near-term technology projection in this area is provided.

In addition, far-term (10 to 15 years) projections are provided for each of the component technologies and for the integrated application of these technologies.

Finally the report provides a discussion of key issues involved in transitioning this technology into use as an accepted part of the weapon system development and modification process. (20 pages)

3 **Goett, J.M., Post, T.J., & Miller, G.G. 6883 maintenance training simulator development utilizing imagery techniques. AFHRL-TR-80-3, AD-A088 315. Lowry AFB, CO: Technical Training Division, May 1980. Project 2361, Contract F33615-78-C-0047, BioTechnology, Incorporated. NTIS.** This exploratory study evaluated a low fidelity, imagery-based simulation technique to determine its effectiveness in training certain avionics maintenance tasks. The technique was compared experimentally with conventional (technical order) training materials in terms of its ability to produce learning of procedural tasks. On learning tests, groups using the imagery training materials (experimental) scored significantly better than groups using the conventional materials (control) on one out of four tasks. The control groups likewise significantly outscored the experimental groups on one out of four tasks. On a delayed retention test, the scores of the experimental groups declined more than did those of the control groups (who displayed no

significant loss of learning). Further tests are recommended to (a) determine optimum difficulty level for application of the technique, (b) isolate the technique's elements and evaluate them individually, and (c) investigate the individual effect on training of various components of the imagery training materials. (56 pages)

4 **Moore, M.H., Anderson, N.D., Adams, T.A., & Looper, L.T. Markov resource utilization decision aid for Air Force Recruiting Service. AFHRL-TR-80-4, AD-A083 194. Brooks AFB, TX: Manpower and Personnel Division, March 1980. Project 2077, Contract F33615-78-C-0043, ORINCON Corporation. NTIS.** This technical report presents a recruiting resource and goal allocation decision model developed for the Air Force Recruiting Service. The model uses a Markov probability process to determine the optimum use of recruiting effort and advertising funds to obtain desired recruit input levels. Probability statements are made concerning the likelihood of meeting objectives. The model has considerable variability in user input and output and non-optimum goals can be examined. (92 pages)

5 **Albert, W.G., & Whitehead, L.K. IAPG: An item analysis program for questionnaire—type test instruments. AFHRL-TR-80-5, AD-A089 814. Brooks AFB, TX: Manpower and Personnel Division, August 1980. Project 6323. NTIS.** IAPG (Item Analysis Program, General) is a versatile series of item analysis computer programs. The input consists of responses to items for which the correctness or incorrectness of a particular alternative is not the same for all respondents. The comprehensive statistical/mathematical methodology that comprises IAPG enables the user to optimize the composite validity of a test instrument subject to certain restrictions delineated in this report and perform complex item analysis procedures.

This report documents the input/output and mathematical/statistical methodology to be used in executing and interpreting the results of the IAPG group of programs. It contains the technical details that are necessary for the user to take complete advantage of the analytical capabilities of IAPG. This information includes computational formulas, control and data card descriptions, file layouts, printed output samples, diagnostic messages, and examples of run time. (68 pages)

6 **Albert, W.G. Computerized algorithms: Evaluation of capability to predict graduation from Air Force training. AFHRL-TR-80-6, AD-A091 105. Brooks AFB, TX: Manpower and Personnel Division, September 1980. Project 6323. NTIS.** This report contains the results of a study to compare the classification accuracy and computer resource requirements of the Motivational Attrition Prediction (MAP) computerized algorithm with the classification accuracy and computer resource requirements of other computerized statistical algorithms capable of predicting graduation from Technical Training, Basic Military Training, and Undergraduate Pilot Training. It includes descriptions of the sampled populations, sample selection from each population, independent and dependent variables, comparison of classification accuracies and required computer resources, and related research efforts. (126 pages)

7 **Skinner, M.J., & Alley, W.E. Performance of retrained airmen in Air Force technical schools. AFHRL-TR-80-7, AD-A090 535. Brooks AFB, TX: Manpower and Personnel Division, September 1980. Project 7734. NTIS.** Research was conducted to determine the effect of changing occupational specialties on the performance of Air Force retrained enlistees attending basic technical schools. The academic performance and attrition rates of approximately 20,000 retrainees and 230,000 non-prior-service enlistees (non-retrainees) attending 272 schools were compared. Schools were categorized by selector aptitude index requirements into 18 subgroups for analysis. Data were compiled from historical personnel records. Multiple linear regression analyses examined the relationship between school performance criteria and retraining status and aptitude as well as the amount of military service, career status, and background experience acquired prior to retraining for each subgroup.

Results indicated that the performance of retrainees was comparable or superior to non-retrainees with equivalent aptitudes. Further, among retrainees performance generally increased as more time was spent in military service before changing specialties. Retrainees who were career airmen with more than three years of service tended to do better than non-career airmen in training. Results also indicated that experience in a specialty with the same aptitude index (Mechanical, Administrative, General, or Electronics) as the retraining specialty typically facilitated performance. A characteristic increasing relationship between aptitude and success in technical training was found. Potential research applications to retrainee selection and assignment procedures were considered. (38 pages)

8 **King, G.F., & Askren, W.B. Human resources, logistics, and cost factors in weapon system development: Project summary. AFHRL-TR-80-8, AD-A089 708. Wright-Patterson AFB, OH: Logistics and Technical Training Division, September 1980. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** This report provides a summary of an Air Force advanced development effort, Integration and Application of Human Resource Technologies in Weapon System Design. The project resulted in the development and demonstration of a methodology, the coordinated human resource technology (CHRT), and its complementary consolidated data base (CDB). The methodology is applicable throughout weapon system acquisition and provides for (a) the early assessment of the system design and support plan impact on human resources, logistics, and costs, and (b) the development of a mutually supportive and coordinated training program and technical manual set.

Specifically, this report summarizes (a) the development of CHRT and the CDB, (b) the demonstration of the CHRT and the CDB on major systems of the Advanced Medium STOL[1] Transport, (c) CHRT and the CDB as they presently are defined, and (d) the guidelines for future application of CHRT and the CDB. (72 pages)

9 **Dean, J., Overton, R., Miller, R., Lankford, H., & Hughes, R.G. Specialized undergraduate pilot training: Tanker/Transport/Bomber (TTB) training requirements. AFHRL-TR-80-9, AD-A088 730. Williams AFB, AZ: Operation and Training Division, August 1980. Project 1123, Contract F33615-78-C-0059, Logicon, Incorporated. NTIS.** A one-year contract effort was performed in response to the USAF Air Training Command Request for Personnel Research No. 75-27, "Tanker/Transport/Bomber (TTB) Lead-In Training." The effort accomplished the following: (a) identification of training requirements for the TTB phase of a proposed dual-track UPT program. These requirements cover those tasks which are common to the B-52, KC-135, C-130, C-141, C-9, and C-5 aircraft, (b) development of ways of estimating the training benefits to be derived by MAC and SAC from pilot lead-in training on these common tasks, (c) development of a method for determining the generalizability of any subset of TTB lead-in training tasks to the entire domain of TTB training tasks, and (d) development of an approach to the measurement of aircrew performance in the TTB training environment. This study effort was prerequisite to the Air Training Command development of a syllabus for the TTB track of a Specialized Undergraduate Pilot Training System (SUPTS). (196 pages)

10 **Collyer, S.C., Ricard, G.L., Anderson, M., Westra, D.P., & Perry, R.A. Field of view requirements for carrier landing training. AFHRL-TR-80-10, AD-A087 012. Williams AFB, AZ: Operations Training Division, June 1980. Project 1123. NTIS.** A study was conducted to investigate simulator visual field-of-view (FOV) requirements in conjunction with two approaches to training daytime carrier circling approach and landing. The study found that evidence does not support a requirement for a wide-angle visual display for the training of circling approaches and carrier landings.

[1]Short takeoff and landing.

Three groups of Air Force T-38 instructor pilots were given simulator training in aircraft carrier landings. These pilots were taught to execute a landing on a simulated aircraft carrrier in the Advanced Simulator for Pilot Training (ASPT) at Williams Air Force Base. The visual image for the simulation was provided by a data base which created the aircraft carrier USS Forrestal (CVA-59) in the ASPT computer-image-generation system. The pilots in these three groups were trained under different conditions. Two groups flew a circling approach with one group using a wide (300° horizontal/150° vertical) visual FOV and the other group using a narrow FOV (48° horizontal/36° vertical). A third group flew a straight-in approach using the narrow FOV. A variety of performance measures were taken to characterize the carrier approach. These measures were categorized as (a) instantaneous measures, (b) continuous measures, (c) measures representing the success of the approach at touchdown, and (d) Landing Signal Officer (LSO) ratings. Various statistical routines were carried out with the results obtained from these measures.

Results indicate that, for carrier circling approaches and landings, there are no clear training advantages of a wide-angle visual display. Practice on straight-in approaches, using a narrow-angle visual display, appears to be the most cost-effective use of simulators for training this task. (54 pages)

11 **Massey, R.H., & Mathews, J.J. Reading grade levels of Air Force civilian personnel. AFHRL-TR-80-11, AD-A087 066. Brooks AFB, TX: Manpower and Personnel Division, July 1980. Project 7719. NTIS.** The objective of this study was to examine the reading levels of Air Force civilians according to occupational groupings and grade structure. Civilian grade structure was composed of classification types General Schedule (GS), Wage Supervisor (WS), and Wage Grade (WG) and grade levels (1, 2, 3, . . .). Approximately 1,050 Air Force civilian subjects were tested on the Nelson-Denny Reading Test (ND) or the California Reading Test (CR). The ND was administered to GS-7 and above and WS subjects. The CR was administered to GS-1 through GS-6 and to Wage Grade (WG) subjects because of the expected lower reading level of these groups. Subjects were selected from eight Air Force bases representing the major commands. The GS, WG, and WS samples were selected to be proportionate to the composition of the Air Force civilian population.

Reading grade levels were reported for Air Force civilians according to occupational groupings and grade structure. This study demonstrated that the RGL of subjects was associated with the grade of subjects; however, the meaning of this association is not clear. Difficulties associated with the application and interpretation of the RGL concept were discussed. It was concluded that other RGL questions or associated variables need to be investigated to determine where the utility of RGL knowledge lies—in selection, in classification, revision of certain materials, or in decisions about the extent of remedial training and to whom it should be administered. (18 pages)

12 **Saving, T.R., Battalio, R.C., De Vany, A.S., Dwyer, G.P., & Kagel, J.K. Air Force enlisted personnel retention-accession model. AFHRL-TR-80-12, AD-A085 658. Brooks AFB, TX: Manpower and Personnel Division, June 1980. Project ILIR, Contract F33615-78-C-0049, Resources Research Corporation. NTIS.** This report presents the methods of analysis and results of an effort designed to develop a methodology for explaining Air Force accessions and retentions. The analysis was conducted in three stages. First, the life-cycle model of the enlistment decision originally developed in a previous contract was extended and clarified. Second, a new data set was developed. These data are described extensively and plotted to reveal its relation to significant institutional changes that occurred over the 1957 to 1978 period. The data were then used to estimate accession supply equations for each sex, race, and AFQT category. Third, two new theoretical developments are presented. The first of these develops a model of the enlisted force by skill group. The second utilizes the theory of economic dynamics to simulate the adjustment of the enlisted force to changes in pertinent variables. (64 pages)

13 **deSpautz, J.F., Bender, M.B., & McNamara, V.M. Flight training simulator: Surface texturing via pseudo random noise codes. AFHRL-TR-80-13, AD-A093 734. Williams AFB, AZ: Operations Training Division, December 1980. Project 6114, Contract F33615-77-C-0068, Applied Digital Communications. NTIS.** Increased use of infrared and low light level television systems within the operational environment has presented increasingly difficult problems to the technology of simulation systems in the area of target identification, textural cues, and simulation fidelity. The principal effort reported here has been to develop a software simulation using cyclic codes for providing surface texture without the use of typical computer image generation (CIG) edge-type algorithms. The latter type algorithms, when used to provide valid and realistic surface detail, cause the edge processing load to exceed system capability.

Cyclic code techniques provide a compact texture data base definition that is versatile, has substantial tonal assignment capability, and is based on real-time simulation concepts.

The simulator system was delivered and made operational on the Sigma 5 facility using the ACTES facility for offline video data storage, retrieval and display. The software is user interactive from a remote terminal and includes capabilities for modeling the data base, display characteristics, aircraft positioning, and simulator control of printouts and default options. (64 pages)

14 **Walsh, M.J., Burgin, G.H., & Fogel, L.J. Tactical performance characterization applied to student pilots. AFHRL-TR-80-14, AD-A092 558. Williams AFB, AZ: Operations Training Division, October 1980. Project 6114, Contract F33615-78-C-0011, Decision Science, Incorporated. NTIS.** The purpose of this effort was to develop new methods for characterizing important features of pilot tactical performance for display at the instructor/operator stations of flight simulators. In particular, the work involved developing a technique for computing the weight (importance) a pilot assigns various performance criteria. Phase I involved developing the techniques and methods to be used. An AML pseudopilot with fixed weights was utilized as the pilot to be "modeled." A modified AML program using observations of the actions of the pseudopilot without access to the weights of the pseudopilot calculated the weights used by the pseudopilot. Phase II involved the application of the method to human pilot data collected on the Simulator for Air-to-Air Combat at Luke AFB.

The AML program determines its next action by evaluating several alternative next moves against the projected trajectory of the opponent. A set of importance weighted questions concerning performance criteria with responses involving yes or no answers are applied to possible alternative actions. Each alternative is given a score equal to the sum of the weights of those questions with affirmative answers. That alternative with the highest score is taken as the next maneuver. In observing the pseudopilot (AML program), since the chosen maneuver must have the highest score, the sum of the weights associated with it must equal or exceed the sum of the weights associated with other possible actions. This gives rise to a set of inequalities involving the weights which can be solved by Linear Programming techniques. Application of this technique in Phase I gave reasonably accurate results.

Analysis in Phase I indicated that for Phase II the performance criteria should be combat-maneuver specific. The selected maneuver was the high-speed yo-yo. Data from several high-speed yo-yo maneuvers flown by instructor pilots on the SAAC were obtained, and the best flights were used as reference high-speed yo-yo maneuvers. The reference yo-yo maneuvers were used for subsequent flights by student pilots in determining the truth values of the questions involving the performance criteria.

Critical problems with the technique were discovered when used to determine weights associated with human student pilot actions. For those instances with all nonzero weights, a unique solution

could not be found so that zero weights had to be allowed. This resulted in determined weights being either zero or five (maximum weight allowed) with no correlation between the weights and flight performance.

In summary, a method showing initial promise failed when used on human student pilot data; this because of the inherent inconsistency and lack of repeatability in human student pilot actions. (68 pages)

15 **Krahenbuhl, G.S., Darst, P.W., Marett, J.R., Reuther, L.C., Constable, S.H., & Reid, G.B. Undergraduate pilot training: Instructor pilot behavior and student stress and performance. AFHRL-TR-80-15, AD-A088 802. Williams AFB, AZ: Operations Training Division, July 1980. Project 2313, Contract F33615-78-C-0053, Arizona State University. NTIS.** Research has shown flying training to be a very stressful experience. Stress appears to be greater in less capable students. One of the most salient stress producing agents in pilot training is the instructor pilot. Studies have shown that instructor pilot behavior can be quantified and its stress-producing quality measured. The stress response of students can be assessed via measurement of catecholamines excreted into the urine. The present research examined the interaction between instructor and student during selected rides of the instrument phase of T-37 training. Two issues were addressed: Quantification of Instructor Pilot behavior and its relation to student stress and performance. Six instructor pilots and 12 students served as subjects. Instrument training sorties in the T-50 instrument flight simulator were tape recorded and analyzed to determine the frequency of 12 categories of instructor pilot behavior. Student stress levels were determined through analysis of urine samples collected immediately following each sortie. Four instructors were found to use a generally positive teaching style and two a negative style. Stress was greater in students of negative instructors. Negative correlations were obtained between student performance and several instructor pilot behaviors. (22 pages)

16 **Krahenbuhl, G.S., Marett, J.R., Reuther, L.C., Constable, S.H., & Reid, G.B. Pilot stress in A-10 surface-attack training. AFHRL-TR-80-16, AD-A088 803. Williams AFB, AZ: Operations Training Division, July 1980. Project 2313, Contract F33615-78-C-0053, Arizona State University. NTIS.** Research has shown that flying training is a highly stressful experience. The degree of stressfulness is greater in situations involving immediate threat. The present research addressed the stress involved in A-10 surface-attack training. Stress responses of A-10 student pilots in ground-attack training were assessed through measurement of catecholamine excreted into the urine. Stress responses were assessed over the course of 11 simulator and aircraft sorties. An investigation was also made of the effect of simulator platform motion on induced stress.

Fifteen USAF pilots in A-10 B-course training served as subjects. Urine collections were made following the first two conversion rides in the simulator. Collections were made following three subsequent aircraft conversion rides, three simulator surface-attack rides, and three aircraft surface-attack rides. Baseline urine samples were collected on three non-flying days. Conversion and surface attack sorties were found to create a pronounced stress response. Stress response diminished over time in the simulator but not in the aircraft. Stress response in the simulator was not significantly different from that in the aircraft. (22 pages)

17 **Kottenstette, J.P., Steffen, D.A., & Lamos, J.P. Microterminal/microfiche system for computer-based instruction: Hardware and software development. AFHRL-TR-80-17, AD-A090 974. Lowry AFB, CO: Logistics and Technical Training Division, October 1980. Project 1121, Contract F33615-78-C-0046, University of Denver. NTIS.** The development of the Air Force Human Resources Laboratory Microterminal/Microfiche System is an effort to combine microprocessor technology with microfiche medium to provide a low cost system for the delivery of technical training with a capability to function in the broader scope of computer-based instructional environments, including both computer-managed instruction and computer-assisted instruction.

The system is composed of four major components and associated interfaces. The major components are (a) microterminal, (b) microfiche reader, (c) memory module, and (d) hardware interface between the microterminal and the microfiche reader. The microterminal is the result of a previous effort and was developed to support stand-alone, off-line testing. The microfiche reader is an off-the-shelf unit and is adapted to allow sensing of the position of the platen containing the microfiche so that frame locations can be verified by the microterminal software. The memory module is portable and removable from the microterminal which provides an interface to a larger computer-based instruction system. The microterminal can support various levels of testing and has already been successfully demonstrated in a technical training environment. The interface between microterminal and microfiche consists of linear position transducers on the microfiche unit and control circuitry in the microterminal to provide platen position sensing and additional circuitry to allow software control of the projection lamp. A demonstration of the microterminal/microfiche system has been successfully performed supporting testing functions in technical training. The demonstration showed that the microterminal is a preferred technology for recording student responses during testing and that the microfiche presentation of test items is an effective medium. (78 pages)

18 **Kraft, C.L., & Anderson, C.D. Psychophysical criteria for visual simulation systems: Phase II — Experimental investigations of display joints and scene inserts. AFHRL-TR-80-18, AD-A088 316. Williams AFB, AZ: Operations Training Division, August 1980. Project 6114, Contract F33615-78-C-0012, Boeing Aerospace Company. NTIS.** This report describes the approach, procedures, and results of two psychophysical experiments to provide data useful in developing design criteria for visual simulation systems. The first dealt with the influence of the width of joints between display channels on the discrimination of vertical and rotational scene misalignment across the joint. The resulting information indicated that increasing amounts of rotation resulted in an increased percentage of correct detections. This anticipated result was not found for the displacement conditions. It was hypothesized that this unexpected result may have been caused by the counteracting effect of the Poggendorff visual illusion. The second psychophysical experiment dealt with the discrimination of rotational misalignment of scene inserts. Increasing insert size and increasing rotational misalignment produced increased detection performance. The 50% detection threshold occurred at 7 arc seconds of displacement between corresponding portions of the insert and surrounding scenes. Design tolerances based on these data are suggested. (82 pages)

19 **Harker, G.S., & Jones, P.D. Depth perception in visual simulation. AFHRL-TR-80-19, AD-A087 828. Williams AFB, AZ: Operations Training Division, August 1980. Project 6114, Contract F33615-78-C-0021, University of Louisville. NTIS.** The purpose of the study was to examine human depth perception as it relates to the requirements for visual simulation in Air Force flight simulators. Most, if not all, flying tasks require that depth judgments be made on the basis of extra-cockpit visual information. The bases on which such judgments are made by observers in the real world have been the subject of study for more than a century, and the majority of the cues have been identified. This effort examines the visual displays of a sample of Air Force and commercial flight simulators in order to assess the efficacy with which these cues are presented in visual simulation systems.

A review of the psychophysical and simulation literature was conducted in order to identify the possible cues to depth and their relative importance at various distances and under various conditions. Each of four flying tasks (approach and landing, formation flying, aerial refueling, and low level flight) was subjected to task analysis/cue requirements determination in order to determine what tasks required depth judgments, whether those judgments were relative or absolute, and to identify the depth cues required for the successful completion of those tasks.

Information gained through the task analysis/cue requirements determination was used to subjectively assess visual simulation systems for the quality of the depth cues presented and to evaluate the need for additional or improved depth cues. (98 pages)

20 **Gray, T.H., Chun, E.K., Warner, H.D., & Eubanks, J.L. Advanced flight simulator: Utilization in A-10 conversion and air-to-surface attack training. AFHRL-TR-80-20, AD-A094 608. Williams AFB, AZ: Operations Training Division, January 1981. Project 1123. NTIS.** The purposes of this research were to develop transition and surface attack simulator training programs for novice A-10 pilots and to determine simulator features and capabilities required for effective training in the air-to-surface (A/S) mission. These goals were refined to four specific objectives: development of a transition and surface attack syllabus; generation of objective performance measurement algorithms; determination of design requirements for instructor stations; and assessment of the utility of advanced instructional features.

These objectives were accomplished using A-10 Instructor Pilots and four classes of "B" course students who had recently completed Undergraduate Pilot Training and Fighter Lead-In School. Each class received two blocks of instruction on the Advanced Simulator for Pilot Training (ASPT). The first block consisted of 4 to 8 hours of conversion training with primary emphasis on traffic pattern work. The second block of training was composed of 4 to 7 hours of A/S weapons delivery (i.e., dive bombing and strafe).

The key findings of the study were:

1. For the initial phases of weapons delivery training, the transfer of training from the ASPT to the A-10 is nearly 100 percent, therefore, in the early phases of A/S training, one simulator mission can effectively replace one aircraft mission, thus allowing actual flying time to be transferred to other phases of training.

2. Objective assessments of piloting and weapons delivery skills are highly useful in A-10 training.

3. Improvements are needed in the display and controls at the A-10 instructor station.

4. Many advanced instructional features are not fully utilized by the IPs, implying either that they may not be required for achieving effective weapons delivery training or that the IPs need more training on the use of these features to enhance student learning. (202 pages)

21 **Mulligan, J.F., & Bird, J.B. Guidance for maintenance task identification and analysis: Organizational and intermediate maintenance. AFHRL-TR-80-21, AD-A089 918. Wright-Patterson AFB, OH: Logistics and Technical Training Division, September 1980. Project 1710, Contract F33615-78-C-0015, Management and Technical Services Company. NTIS.** This report was to develop guidance for Air Force, other DoD agencies, and industry in the use of specifications contained in AFHRL-TR-79-50 to fulfill the requirements for maintenance task identification and analysis (MTI&A). Several new types of technical data, such as job guide manuals (JGMs) and logic tree troubleshooting aids (LTTAs), have been adopted for use by the Air Force. The development of accurate and effective JGMs and LTTAs requires that a thorough MTI&A be accomplished to prepare the data base from which JGMs and LTTAs are developed. At present the only suitable data specification available to establish JGMs and LTTAs is AFHRL-TR-79-50. The guidance developed here is to assist in the application of that specification.

This report is to be used as a handbook. An overview of MTI&A processes is presented followed by a listing of fundamental requirements to be performed prior to the actual start of MTI&A. Once the analyst has become knowledgeable of the preliminary requirement of MTI&A the handbook provides the directions on how to perform MTI&A. It includes definitions, procedures, planning data, staffing criteria, checklists, suggested forms, and guidelines for review, evaluation, and quality audit of MTI&A products. Guidance is provided for conducting MTI&A for programs with Logistics Support Analysis data available and for programs which do not have this data. The guidance provided by the specification and its guide book are suitable for the procurement of MTI&A for both organizational and intermediate levels of maintenance. (150 pages)

22 **Cooper, M., Imhoff, D.L., & Myers, D.C. Introduction of women into work groups in traditionally male career fields: Annotated bibliography. AFHRL-TR-80-22, AD-A087 067. Brooks AFB, TX: Manpower and Personnel Division, June 1980. Project 7719, Contract F33615-79-C-0007, Advanced Research Resources Organization. NTIS.** The purpose of this annotated bibliography is to identify prior research relevant to the individual, group, and organizational factors involved in the introduction of women into work groups in traditionally male career fields. This search revealed that most of the literature has been concerned with the problems that women experience rather than those methods which give insights to alleviating the problems of women in non-traditional careers. (30 pages)

23 **Hritz, R.J., & Purifoy, G.R., Jr. Maintenance training simulator design and acquisition. AFHRL-TR-80-23, AD-A089 149. Lowry AFB, CO: Logistics and Technical Training Division, August 1980. Project 2361, Contract F33615-78-C-0019, Applied Science Associates, Incorporated. NTIS.** The project explored the problems of maintenance training simulator design and acquisition. The report (a) describes the research activities that were performed, (b) describes the products and reports produced, as well as the reactions of the intended audiences to these products, and (c) presents a list of problem areas, recommendations, and areas for future research. The report describes the procedures developed for designing and documenting maintenance trainers: i.e., the procedures for determining when to use a simulator, the procedures for determining the degree of fidelity of the trainer components, and the procedures for selecting and defining the instructional features of the maintenance trainer. In addition, the report describes the project-generated *ISD (Instructional System Development) Derived Training Equipment Design* model specification and the *Prime Development Specification for Maintenance Training Simulators*. Both are model or generic specifications. The ISD-derived model specification is used to communicate to the System Program Office (SPO) the results of the ISD analysis (with respect to training equipment requirements). The Prime Development Model Specification is used by the SPO to construct a procurement specification, which contains both training-oriented and engineering requirements. The report also discusses nine problem areas: e.g., the increasing emphasis for an accelerated acquisition schedule, the lack of continual communications between ISD analysts and SPO personnel, the reassignment of ISD analysts and the lack of documentation of corporate knowledge. For each problem, recommendations/alternative-solutions are offered. (220 pages)

24 **Cicchinelli, L.F., Harmon, K.R., Keller, R.A., & Kottenstette, J.P. Relative cost and training effectiveness of the 6883 three-dimensional simulator and actual equipment. AFHRL-TR-80-24, AD-A091 808. Lowry AFB, CO: Logistics and Technical Training Division, September 1980. Project 2361, Contract F33615-78-C-0018, University of Denver. NTIS.** The cost and training effectiveness of the 6883 3-D simulator, as compared to that of operational 6883 test station equipment, for training intermediate level F-111 avionics maintenance personnel was evaluated. The objective of this study was to isolate classroom and field performance differences as a function of the training equipment used and to compare the costs of using the two systems in the existing ATC training course. Students entering the Converter/Flight Control Systems instruction block were randomly assigned to one of four basic experimental groups.

A trouble-shooting performance test and a "Projected Job Proficiency" test were developed and administered to compare the training adequacy of the simulator and actual test station equipment. Student and supervisor followup questionnaires were administered in the field to provide additional feedback about training experiences. It was found that the simulator and the actual test station equipment were equally capable of training students. It is hypothesized that a number of environmental factors, which were noted, may have reduced the likelihood of observing significant performance differences among experimental groups. These factors included shifting training objectives and classroom formats, equipment reliability, changing job requirements, and lack of a clearly defined role for the simulator in training.

The life cycle cost model used to compare actual and simulated equipment indicated that using actual equipment was approximately twice the cost of using the 6883 simulator for training. Since the 6883 test station was found to be one of the more reliable stations, it was hypothesized that, from a total course systems standpoint, the cost savings might be significantly higher. Although this investigation was hampered by the lack of systems-related cost data, the cost of alternative strategies for integrating simulators in the training environment was explored using a scenario format. (122 pages)

25 **Thomas, E.L., Newhouse, D.A., & Hankins, R.J. Human resources data in weapon system design: An initial plan for development of a unified data base. AFHRL-TR-80-25, AD-A093 282. Wright-Patterson AFB, OH: Logistics and Technical Training Division, November 1980. Project 1124, Contract F33615-78-C-0010, Clemson University. NTIS.** The objective of this study is to establish an initial plan for development of a prototype unified data base (UDB) and of a data generating technology base (DGTB) of human resources information for use in weapon system design. The total study consisted of four tasks: (a) existing Air Force, Army, Navy, and other data systems which could support the UDB were reviewed, (b) the weapon system design and acquisition process was assessed in order to establish the concept of operation of a UDB, (c) user needs were identified in terms of the adequacy of the data systems investigated, and (d) an initial plan for the development of a prototype UDB was established based on the results of the first three tasks and on an industry survey. This report addresses the fourth task in which (a) a concept for the UDB was developed, (b) a concept for the operational use of the UDB was developed, and (c) an initial plan for the development of a prototype UDB/DGTB was established. This development plan addresses the initial structure, content, and process for a prototype UDB/DGTB which is evolving in a heuristic manner. (76 pages)

26 **Siegel, A.I., Federman, P.J., & Welsand, E.H. Perceptual/psychomotor requirements basic to performance in 35 Air Force specialties. AFHRL-TR-80-26, AD-A093 981. Brooks AFB, TX: Manpower and Personnel Division, December 1980. Project ILIR, Contract F33615-78-C-0032, Applied Psychological Services, Incorporated. NTIS.** A description of the perceptual/psychomotor ability requirements for performing the tasks of various Air Force career fields was sought. To this end, an analysis of the literature relating to taxonomies, measurement considerations, and job analyses was completed to establish appropriate methodologies. This yielded a taxonomy containing 13 perceptual/psychomotor classes along with techniques for collecting the required data. The methods were first tested in two career fields and then, after appropriate revision, were applied in a large scale data acquisition effort which included 35 Air Force career fields. This work included over 800 job incumbents at 10 Air Force bases. High and low perceptual/psychomotor ability requirements were determined for each of 35 Air Force career fields. Indices of profile similarity indicated that the perceptual/psychomotor requirements for most career fields are, in part, unique. A factor analysis of the data indicated that the perceptual/psychomotor ability taxonomy can be described by three factors: visual, auditory, and manual factors.

The conclusions of the study point to: (a) the adequacy of the taxonomy for describing the perceptual/psychomotor requirements of Air Force career fields, (b) the utility of the technique employed for future investigations of this sort, (c) the partially unique perceptual/psychomotor requirements for various Air Force career fields, and (d) the adequacy of the present effort as a basis for perceptual/psychomotor test development for use as an aid in career selection and classification. (252 pages)

27 **Imhoff, D.L., & Levine, J.M. Perceptual-motor and cognitive performance task battery for pilot selection. AFHRL-TR-80-27, AD-A094 317. Brooks AFB, TX: Manpower and Personnel Division, January 1981. Project 7719, Contract F33615-79-C-0004, Advanced Research Resources Organization. NTIS.** A review of the literature on pilot selection and training,

perceptual-motor processes, and cognitive processes was conducted. The objectives of this review were: (a) to identify perceptual-motor and cognitive tasks that demonstrated reliable individual differences in performance and (b) to identify perceptual-motor abilities and cognitive processes of demonstrated importance to successful piloting behavior. From this review, a set of tasks were identified that tapped the abilities and processes important to piloting and that showed evidence of producing reliable individual differences in performance. A conceptual framework makes explicit the link between the tasks selected and the requirements for successful pilot performance. This resulted in a large number of tasks which were candidates for inclusion in a pilot selection task battery. Psychometric and pragmatic criteria were applied to the tasks in the candidate pool, resulting in the identification of 15 tasks for inclusion in the final task battery. These tasks span the perceptual-motor and cognitive domains, with special emphasis on attentional and decision-making performance. The paradigms for the selected tasks are specified in detail to allow for the development and implementation of the tasks on a computer system, and a number of implications for validation of the battery are provided. The tasks included in the final battery are Perceptual Speed, Complex Coordination, Compensatory Tracking, Kinesthetic Sensitivity, Route Walking, Selective Attention, Time Sharing, Encoding Speed, Mental Rotation, Item Recognition, Immediate/Delayed Memory, Decision Making Speed, Probability Estimation, Risk Taking, and Embedded Figures. (160 pages)

28 **Borman, W.C., & Rosse, R.L. Peer ratings: Scoring strategy development and reliability demonstration on Air Force basic trainees. AFHRL-TR-80-28, AD-A090 325. Brooks AFB, TX: Manpower and Personnel Division, September 1980. Project 7719, Contract F33615-78-C-0041, Personnel Decisions Research Institute. NTIS.** Peer ratings were obtained from over 27,000 Basic Trainees. An effective method was developed for scoring them by algebraically summing the positive and negative ratings. A modification of the Spearman-Brown prophecy formula was used to determine interrater reliability coefficients which were adjusted to the mean number of trainees in the flights. The peer ratings yielded uniformly high interrater reliability coefficients which indicated substantial agreement among raters. It was concluded that the method developed for norming peer ratings from different size groups was valuable and could be applied to standardize future peer ratings. Peer ratings thus show promise for performance appraisal when normed using this method. (72 pages)

29 **King, G.F., & Askren, W.B. Human resources, logistics, and cost factors in weapon system development: Methodology and data requirements. AFHRL-TR-80-29, AD-A093 353. Wright-Patterson AFB, OH: Logistics and Technical Training Division, November 1980. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** This report describes a methodology which is useful for applying human resources, logistics, and cost factors in weapon system acquisition programs. The methodology, termed the coordinated human resources technology (CHRT), was developed from an integration of five individual human resources technologies: maintenance manpower modeling, instructional system development, job guide development, human resources in design tradeoffs, and system ownership costing. The CHRT methodology operates from a consolidated data base (CDB) which integrates data from these five technologies into a single data source. The CHRT methodology has two distinct capabilities: (a) it can assess the impact of baseline and alternative equipment designs and support plans on human resources, logistics, and ownership costs, and (b) it can provide an integrated maintenance personnel, training, and technical manual program for the system. The CHRT methodology is implemented by a number of computer operated models, manual operated models, and task analysis procedures. The CDB has both computer data files and hard copy data files. The description of the CHRT and the CDB is based upon a conceptual structure and the results of a preliminary tryout of the conceptual structure using data from the Advanced Medium STOL* Transport System acquisition program.

*STOL — short takeoff and landing.

30 **Wooldridge, L., Kelly, M.J., Vreuls, D., Cotton, J.C., Martin, E.L., & Norman, D.A. Adaptive performance testing system for surface attack tasks in the advanced simulator for pilot training. AFHRL-TR-80-30, AD-B053 504L. Williams AFB, AZ: Operations Training Division, December 1980. Project 1123, Contract F33615-79-C-0001, Canyon Research Group, Incorporated. DTIC.** Current techniques for assessing a pilot's progress through flight training are often inefficient and may introduce various forms of bias into the testing situation. These limitations could be overcome through the use of an automated adaptive performance testing system. This document details development of an automated performance testing system for A-10 pilots undergoing training on controlled range ground attack patterns on the Advanced Simulator for Pilot Training (ASPT). Included are descriptions of recommended test items arranged into a 20-step testing syllabus, a candidate performance measurement structure, and a preliminary adaptive testing model. Also included is a functional specification for implementation of this system on the ASPT. Finally, the report contains plans for the empirical development and refinement of the Adaptive Performance Testing System. (76 pages)

31 **Hazel, J.T., & Finstuen, K. Non-aircrew officer positions: Determination of grade requirements. AFHRL-TR-80-31, AD-A093 283. Brooks AFB, TX: Manpower and Personnel Division, November 1980. Project 7734. NTIS.** For over 20 years the Air Force has needed a systematic method to establish officer grade requirements based on job content and responsibility. The major objectives of this study were (a) development and large-scale field-testing of a reliable and systematic method by which Air Force Management Engineering Teams (METs) could determine the appropriate grade levels (Lieutenant to Colonel) of non-aircrew officer positions and (b) application of this Officer Grade Requirement (OGR) technology to a job sample of sufficient size to estimate requirements for the non-aircrew force and various officer utilization fields.

To test the technology and make projections of grade requirements, 950 raters from 122 Air Force-wide METs collected and evaluated over 11,000 officer job descriptions. In addition, ratings were obtained on a sample of jobs which had previously been evaluated by a HQ USAF Policy Board. A variety of analyses were conducted to determine the reliability and accuracy of the MET application and the stability of the data on the 11,000 jobs for making projections to the total non-aircrew force. An integral part of the analyses was the development of an integer-weighted eight-variable policy equation and a grade conversion table which represent the systematic method for METs to use in determining non-aircrew officer grade requirements.

Findings revealed that MET raters could accurately and consistently apply the technology, and there was considerable assurance of a stable base from which to make projections of grade requirements to the non-aircrew force. Comparison of these projected requirements with currently authorized grade levels revealed that the present non-aircrew force had fewer authorized field grade positions than was indicated by the OGR technology. This difference was particularly striking at the major grade level where a substantial increase was indicated. Comparison of authorized versus OGR stated requirements also indicated that implementation of the OGR technology would produce significant changes in stated grade requirements for many officer utilization fields. In some fields there would be a general downgrading of jobs, while in others, there would be an upgrading of jobs. Recommendations regarding usage of certain findings from the study were provided. (72 pages)

32 **Finstuen, K., Matthews, G.N., & Pope, W.H. Management engineering team application of officer grade requirements method. AFHRL-TR-80-32, AD-A093 508. Brooks AFB, TX: Manpower and Personnel Division, December 1980. Project 7734. NTIS.** This report presents detailed results of a large scale Management Engineering Team (MET) application of the Officer Grade Requirements (OGR) methodology. The OGR technology was applied to determine the appropriate grades for non-aircrew Air Force officer positions based on job content and responsibility. Based on data from over 11,000 position descriptions collected by METs and MET

ratings of a representative sample of descriptions from the original OCR project the following major steps were accomplished: (a) development of an efficient linear regression equation for grade determination, (b) construction of a stable grade conversion table, and (c) computation of validity and reliability information concerning MET rating behavior. These analyses indicated that METs apply the technology in a systematic and reliable manner, resulting in a defensible statement of the appropriate military grade for a given non-aircrew job. (70 pages)

33 **Lyon, D.R., Eubanks, J.L., Killion, T.H., Nullmeyer, R.T., & Eddowes, E.E. Pop-up weapon-delivery maneuver: Use of pilot self-assessment data in analysis of critical components. AFHRL-TR-80-33, AD-A091 229. Williams AFB, AZ: Operations Training Division, October 1980. Project 1123, Contract F33615-77-C-0054, University of Dayton Research Institute. NTIS.** Performance of the pop-up weapon-delivery maneuver by F-4 pilots and Weapons Systems Officers was analyzed by collecting detailed ratings and reported errors on segments of the maneuver. The major result of this analysis was that rated performance on the final few seconds of the maneuver, during which the crew is trying to execute a constant angle, high-speed dive, is clearly the best predictor of weapons delivery accuracy. Training implications and issues related to the use of self-assessment data are briefly discussed. (30 pages)

34 **Allbee, K.E., & Semple, C.A. Aircrew training devices: Life cycle cost and worth of ownership. AFHRL-TR-80-34, AD-A094 704. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, United Airlines Flight Training Center. NTIS.** This report presents a life cycle cost model that was developed to use Air Force accounting system data to determine the cost of aircrew training and to differentiate between simulator and flight training costs. A hierarchical cost model is presented that relates training costs to cost interests of various levels of Air Force management. Sources of cost information are specifically identified. Selected cost data are presented, as is a computational example of how to use the model. Recommendations are made for enhancing the accuracy of some cost data. Training device worth of ownership also is addressed. Worth is defined as benefit; a procedure for quantifying worth is described. (248 pages)

35 **Caro, P.W., Shelnutt, J.B., & Spears, W.D. Aircrew training devices: Utilization. AFHRL-TR-80-35, AD-A095 071. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Seville Research Corporation. NTIS.** This report, prepared for personnel responsible for effective and efficient use of aircrew training devices (ATDs), identifies factors which influence ATD utilization and provides guidance concerning ATD use. Information upon which the report is based was obtained from reviews of the professional/technical literature, observations of ATD management and utilization practices, interviews with personnel involved in those practices, and visits to manufacturers and R&D agencies. Principal topics of the report are (a) complexity of aircrew skills learning and adaptation of ATD usage to requirements for effective and efficient training; (b) structure of ATD training in relation to the skills being trained and ATD capabilities; (c) instructor selection and training, management of ATD instructors in ways consistent with effective instruction; (d) development and maintenance of attitudes among instructors and students conducive to a favorable training environment; (e) assessment of ATD training effectiveness and use of assessment data to improve ATD training; and (f) maintenance of training quality after ATD programs become operational. *This report is one of seven* prepared under the Simulator Training Requirements and Effectiveness Study (STRES). (162 pages)

36 **Semple, C.A., Hennessy, R.T., Sanders, M.S., Cross, B.K., Beith, B.H., & McCauley, M.E. Aircrew training devices: Fidelity features. AFHRL-TR-80-36, AD-A094 665. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Canyon Research Group, Incorporated. NTIS.** This report

presents relationships between aircrew training requirements and aircrew training device (ATD) fidelity features and degrees of fidelity. Research and operational experience information was used. Fidelity refers to the degree to which cue and response characteristics of ATDs allow for the learning and practice of specific training tasks. Visual system fidelity is addressed from the standpoints of visual system physical design and training effectiveness. Platform motion systems and their relationship to training effectiveness, efficiency and user acceptance are addressed. The design and use of force cueing devices (e.g. G-seats and arm loaders) and their relationship to platform motion and visual system cues are discussed. A conceptual training effectiveness framework is presented for use in assessing the training value of motion and force cueing. Flight characteristics fidelity, or the reproduction of aircraft control and response characteristics in an ATD, is examined to determine instructional values of having an ATD "feel" like its aircraft counterpart. A conceptual framework is presented to guide training decisions about the need for high flight characteristics fidelity. The interaction of visual and motion system cues is discussed in terms of effects on training and performance of delays between related cues. (206 pages)

37 **Prophet, W.W., Shelnutt, J.B., & Spears, W.D. Simulator Training Requirements and Effectiveness Study (STRES): Future research plans. AFHRL-TR-80-37, AD-A094 625. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Seville Research Corporation. NTIS.** This report, prepared for Air Force personnel responsible for the development and execution of future programs of research on the design, development, and use of aircrew training devices (ATDs), presents topics to be considered in the development of future ATD research programs. The topics were developed in the course of the Simulator Training Requirements and Effectiveness Study (STRES). One objective of STRES was to identify gaps in the technology base that underlies the development and use of ATDs. Research needs were identified on the basis of reviews of the simulation research literature; observations and interviews conducted at a wide variety of simulator training agencies; interviews and discussions with simulator research, procurement, management, and design personnel; and comparisons of suggested topics with plans of various ATD research agencies.

The report presents a basic listing of 111 potential research topics. Detailed research plans were developed for 21 of these topics of highest priority. Each plan includes: (a) problem statement; (b) research overview; (c) analytic requirements; (d) suggested experimental methodology; (e) subjects requirements; (f) data collection and analysis plans; (g) facilities requirements; and (h) projected schedule and manpower requirements. Less detailed plans are presented for nine additional topics. (178 pages)

38 **Spears, W.D., Sheppard, H.J., Roush, M.D., II, & Richetti, C.L. Simulator Training Requirements and Effectiveness Study (STRES): Abstract bibliography. AFHRL-TR-80-38 (Part I, AD-B054 784; Part II, AD-B054 825). Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Seville Research Corporation. NTIS.** This report presents comprehensive abstracts of 196 research and development reports and other documents related to aircrew training devices (ATDs). A broad range of topics is represented: design, operation, and evaluation of simulators and simulator systems, especially visual and motion/force cueing systems; automated performance measurement; instructional support features; analysis of ATD training program requirements; ATD training methods; evaluations of ATD training; management of ATD training; costs of ATDs and ATD training; and worth of ATD ownership. These abstracts supported the overall Simulator Training Requirements and Effectiveness Study (STRES) by providing members of the research team with detailed summaries and evaluations of relevant documents. This report is one of seven prepared during STRES. (740 pages)

39 **Foley, J.P., Jr. Occupational analysis technology: Expanded role in development of cost-effective maintenance systems. AFHRL-TR-80-39, AD-A092 557. Wright-Patterson AFB, OH: Logistics and Technical Training Division, November 1980. Project 1710. NTIS.** The objective of this study was to refine and coordinate occupational analysis, job performance aids (JPAs), and elements of the instructional systems development (ISD) process for task specific maintenance training. More specifically, the purpose was to interrelate techniques for Task Identification and Analysis (TI&A) (from the technologies for JPAs and task-specific ISD) and data gathering techniques for occupational analysis. Occupational analysis and TI&A can function as complementary technologies for major improvements in Air Force maintenance. However, a comparative analysis of TI&A and current occupational analysis technologies indicates substantial incompatibilities between them. The Task Identification Matrix (TIM) of the TI&A technology identifies *specific* tasks for each specific hardware to which it is applied. Such specific tasks are described in terms of maintenance functions (such as checkout, align, and troubleshoot) coupled with an appropriate portion of the hardware being considered. In contrast, although using similar maintenance functions, the occupational analysis technology identifies *sets* of heterogeneous maintenance tasks across an Air Force Specialty Code (AFSC) without regard to the specific hardware in the AFSC; this hardware is frequently of varying vintages of design. By neglecting the real differences among tasks within the same set, from hardware to hardware, current occupational analysis results in oversimplified and distorted portrayals of job content of many maintenance AFSCs. More sensitive occupational analysis procedures should be developed and used to gather, to analyze, and to display job data generated. Proposals are made for expanding the capability of the technology by gathering information on hardware-specific bases, which makes possible the reporting of results in terms of hardware-specific *sets* of tasks. This hardware-specific feature permits data to be gathered against important frames of references other than AFSCs, such as by a major weapon system, by groups of weapon systems, by major command, or by maintenance units. The use of hardware managers from the Air Force Systems Command or Air Force Logistics Command, as readily available sources of hardware-specific information, is proposed. Proposals are also made for gathering and displaying data concerning activities which normally are common elements of many maintenance tasks such as the use of test equipment and hand tools. Appropriate analyses of data gathered on these bases will identify important *patterns* of personnel/job/hardware relationships for reclustering of hardware for improved maintenance specialty codes as well as for cost-effective applications of task specific ISD and fully proceduralized (FP) JPA technologies. Once such clusters are identified, their specific task content can be ascertained and analyzed for task-specific ISD and FPJPA development using the TI&A technology. Such reclustering, coupled with the use of FPJPA and task specific ISD, would result in better personnel assignment practices, more cost-effective utilization of Air Force manpower and improved maintenance. These improvements would be further reflected in substantial reductions in the life cycle costs of ownership of hardware systems. (28 pages)

40 **Denson, R.W. Team training: Literature review and annotated bibliography. AFHRL-TR-80-40, AD-A099 994. Wright-Patterson AFB, OH: Logistics and Technical Training Division, May 1981. Project 1710. NTIS.** A review of the literature on team training is presented. The source material was derived from government documents, industry reports, journal articles, and books. The objective of this effort was to conduct a comprehensive review of the team training literature in order to establish a baseline of what is currently known and to identify unresolved technical issues relevant to Air Force team training. In addition, recommendations concerning the most important areas for Air Force team training R&D were to be made. An attempt was made to be as comprehensive as was considered practical. Documents dated prior to 1960 and the preponderance of research on small group behavior within a social psychological context were limited to a few representative review articles. Hundreds of source documents were investigated to obtain just over 100 relevant reports that focus on definitional issues; individual, task, and team characteristics of team training; the role of feedback; performance objectives; measurement and evaluation; and the

potential of instructional system development for effective team training. The appendix contains an annotated bibliography. The review is intended to serve as a basis and a resource for the improvement of the state-of-the-art in team training. (54 pages)

41 **Kron, G.J., Cardullo, F.M., & Young, L.R. Study and design of high g augmentation devices for flight simulators. AFHRL-TP-80-41, AD-A109 127. Williams AFB, AZ: Operations Training Division, December 1981. Project 6114, Contract F33615-77-C-0055, Singer Company — Link Division. NTIS.** The physiological effects of accelerated flight are considered to contain perceptual information important to vehicle control and contribute to defining flight envelopes accessible to the pilot. As such, these effects, or acceptable surrogates thereof, must be considered for inclusion within ground-based devices designed to train pilots for their flight mission. This study investigates the physiological effects of accelerated flight within the cardiovascular musculoskeletal, visual, auditory, tactile, and respiratory systems. The study advances conceptual designs of research-oriented devices thought capable of inducing, in the unaccelerated state, the perception of accelerated flight physiological effects. The authors conclude that one of the most important effects impacting vehicle control and successful mission execution is loss of visual acuity under accelerated flight conditions and propose a dual effect matrixed liquid crystal variable transparency visor to replicate this effect. A math model to simulate the effect is also presented. The study contains a bibliography of 277 references pertinent to accelerated flight physiological effects and equivalent simulation device design. The study presents an appendix containing an annotated bibliography of 133 references. (544 pages)

42 **Clymer, S.J. Software partitioning schemes for advanced simulation computer systems. AFHRL-TR-80-42 (Part I, AD-A096 187; Part II, AD-A096 456). Williams AFB, AZ: Operations Training Division, February 1981. Project 6114, Contract F33615-78-C-0013, Systems Division, Teledyne Brown Engineering. NTIS.** The overall objective of this study was to design software partitioning techniques that can be used by the Air Force to partition a large flight simulator program for optimal execution on alternative configurations. The results were a mathematical model which defines characteristics for an optimal partition and a manually demonstrated partitioning algorithm design which implements heuristic controls based on the mathematical model statement. (462 pages)

43 **Clymer, S.J. Advanced multiple processor configuration study. AFHRL-TR-80-43, AD-A101 919. Williams AFB, AZ: Operations Training Division, May 1981. Project 6114, Contract F33615-79-C-0003, Systems Division, Teledyne Brown Engineering. NTIS.** This document constitutes the Final Report for the Advanced Multiple Processor Configuration Study performed by Teledyne Brown Engineering (TBE) under Contract No. F33615-79-C-0003 with the United States Air Force Human Resources Laboratory (AFHRL). The overall objective of this study was to provide the Air Force with techniques for determining the effect of alternative multiple processor configurations on training simulator performance. This report summarizes the analysis and presents the baseline set of techniques identified by this study. Recommendations are made concerning the adaptation of these techniques for computation subsystem designs prior to their prototype development. (124 pages)

44 **Cascio, W.F., & Bernardin, H.J. Court cases relevant to employment decisions: Annotated bibliography. AFHRL-TR-80-44, AD-B055 755L. Brooks AFB, TX: Manpower and Personnel Division, February 1981. Projects 7719 and 7734, Contract F41689-79-C-0040, McFann-Gray & Associates, Incorporated. DTIC.** This annotated bibliography consists of 232 court cases dealing with adverse impact, unequal opportunity or pay, and bias in personnel selection, classification and evaluation systems. In reviewing case law from January 1971 to 1980, the authors attempt to summarize only those cases that appear to have potential relevance for Air Force personnel programs or policies. Each annotation provides the case reference, case source, court decision,

critical cases cited as a basis for the decision, evidence of adverse impact, evidence of job-relatedness or validity, type of selection procedure, factors impacting the decision, effects of expert testimony and implications for personnel policy. (478 pages)

45 **Eddowes, E.E., DeMaio, J.C., Pierce, B.J., Eubanks, J.L., Lyon, D.R., Killion, T.H., & Nullmeyer, R.J. Skills maintenance and reacquisition training research program: Tactical Air Command preliminary evaluation. AFHRL-TR-80-45, AD-A095 826. Williams AFB, AZ: Operations Training Division, March 1981. Project 1123. NTIS.** The objective of this study was to determine if flying skills could be identified, defined, and measured. It was part of a program to develop quantitative, objective procedures for the efficient management of aircrew training.

Fighter pilots were interviewed to select sample tasks, specify pilot actions required to perform them, and identify and define the skills involved in their performance. Analyses of the pop-up weapons delivery and low altitude tactical formation tasks identified six skills: planning, recheck, discriminating, anticipating, deciding, and controlling. Skill measurement procedures in which pilots rated their bombing and formation flying performance were developed. Skill ratings were collected to evaluate the measurement procedures.

Contingency chi square analyses disclosed significant relationships between skill ratings and bomb scores. Multiple regression analyses of formation ratings indicated that position keeping and visual lookout were significant components of formation performance.

The validity and generalizability of pop-up and low altitude tactical formation skill measurement techniques were investigated in a subsequent operational test using aircrew personnel of five fighter wings. Data from this evaluation confirmed the findings of the earlier measurement development efforts. These results were interpreted as evidence of the validity of the skill measurement approach. (28 pages)

46 **Rueter, F.H., Bell, T.R., & Malloy, E.V. Capacity of Air Force operational units to conduct on-the-job training: Development of estimation methodology. AFHRL-TR-80-46, AD-A091 228. Lowry AFB, CO: Logistics and Technical Training Division, October 1980. Project 1121, Contract F33615-78-C-0058, CONSAD Research Corporation. NTIS.** This technical report documents the development and initial empirical testing of a practical methodology for estimating the capacity of Air Force operational units to conduct on-the-job training (OJT). The methodology is based on a conceptual model of OJT capacity that describes the complex interrelationships among the level and quality of mission performance achieved, and the amount and quality of training provided, by an operational unit. The unit's capacity to conduct OJT is then determined as the maximum amount of training sustainable by the unit without compromising established training quality and mission performance standards.

The model has been empirically tested by estimating its basic structural equations, to the extent possible, using existing data for six operational units. Despite substantial limitations in data availability, the empirical analyses reveal, for all units studied, a persistent and strong inverse relationship between the training load of a unit and the mission performance quality of the unit. These favorable results indicate that further development of the OJT capacity estimation methodology can reasonably be expected to significantly enhance Air Force training management capabilities. (88 pages)

47 **CAE Electronics Limited. Instructor-simulator interface design. AFHRL-TR-80-48, AD-A098 849. Williams AFB, AZ: Operations Training Division, April 1981. Project 6114, Contract F33615-78-C-0006, CAE Electronics Limited. NTIS.** Most flight simulators in service today are operated from instructor stations where design requirements have been established by subjective opinion, past experience, and space and equipment constraints. In contrast, crew stations of simulators, being replicas of aircraft crew compartments, reflect painstaking, systematic efforts in human engineering and pilot evaluation. To improve the overall quality of simulation, then, efforts should be directed at improving the efficiency and operability of instructor facilities. The objective of this study is to develop a method of evaluating the degree to which an instructor/operator station (IOS) design bridges the gap between human characteristics and machine requirements. An objective evaluation methodology should assist the designer in assessing a tentative IOS design by identifying devices and functions responsible for poor system performance. A secondary objective of the study was to apply this tool to evaluate the effectiveness of various interface layouts and devices. The primary purpose of this report is to describe the development, test, and application of a computer-assisted evaluation technique which resulted from this study. (216 pages)

48 **Hatterick, G.R., & Price, H.E. Format options and procurement of technical orders. AFHRL-TR-80-49, AD-A099 448. Wright-Patterson AFB, OH: Logistics and Technical Training Division, May 1981. Project 1710, Contract F33615-78-C-0016, BioTechnology, Incorporated. NTIS.** This report outlines research leading to the development of the guidelines for selection of format options and procurement of technical orders (T.O.). Previous research by Air Force and other DOD agencies has resulted in the development of several improved techniques for creating, and formats for presenting, technical data for maintenance. Application of these techniques and formats for operational use has been hindered by the fact that technical data managers frequently do not have sufficient information on the improved techniques and formats to allow them to procure the improved data. This report documents the development of guidelines and an information source to fill this need.

A thorough review of the state of the art in developing, presenting and procuring technical data was accomplished to provide the basis for developing the guidelines. This was accomplished first by reviewing available formats, specifications, and applicable literature and then by conducting extensive interviews with government and industry personnel who are knowledgeable of, and experienced in, current technical data procedures. The next phase involved analysis of these data, the selection of candidate formats, the development of descriptions of the formats, development of criteria for selecting formats, and development of guidelines for procuring data.

The preparation of the T.O. managers guidelines was governed by identified informational needs as well as by information available for inclusion. Other considerations in developing the guidebook were the arrangement and organization of the documents for maximum usefulness, provision of information in an optimal format and level of detail, and inclusion of features to preclude premature obsolescence. The guidebooks are a practical reference document, which deal both with the normal process of T.O. development and acquisition and with considerations for selection of format-based techniques. The information is presented in a manner that assists the T.O. manager with decision making but does not limit that decision capability. (34 pages)

49 **Hatterick, G.R., & Price, H.E. Technical order management and acquisition. AFHRL-TR-80-50, AD-A099 705. Wright-Patterson AFB, OH: Logistics and Technical Training Division, May 1981. Project 1710, Contract F33615-78-C-0016, BioTechnology, Incorporated. NTIS.** In past years, research by Air Force and other DOD agencies has resulted in the development of several more effective techniques for developing and for presenting technical data for maintenance. Application of these development techniques and improved presentation formats for operational use has been hindered by the fact that technical data managers frequently do not have sufficient

information available on the improved techniques and formats to allow them to select and procure the improved data. The guidelines developed by this effort can be used by personnel who develop technical data for the Air Force and by those who manage such efforts. A thorough review of the state of the art in developing, presenting and procuring technical data was accomplished to provide the basis for developing the guidelines. This was accomplished first by reviewing available formats, specifications, and applicable literature and by then conducting extensive interviews with government and industry personnel who are knowledgeable of, and experienced in, current technical data procedures. The next phase involved analysis of these data, the selection of candidate formats, the development of descriptions on the formats, development of criteria for selecting formats and development of guidelines for procuring data.

This report provides specific information and guidance for the acquisition and management of Air Force technical orders (T.O.). The report provides the following information: an overview explaining the guidebook scope, organization, and contents accompanied with an explanation of how to use the guidebook. The Air Force T.O. system is described, along with the basic governing publications. Organizational responsibilities associated with T.O.s, including the T.O. manager role are provided. Once the user has become familiar with the preliminary information, the guidebook provides information and guidelines concerning Job Performance Aid systems, format options, format option selection, familiarization of users with new formats, T.O. requirements determination, and factors of T.O. acquisition management. (408 pages)

50 **Hatterick, G.R., & Price, H.E. Technical order managers reference data. AFHRL-TR-80-51, AD-A099 779. Wright-Patterson AFB, OH: Logistics and Technical Training Division, May 1981. Project 1710, Contract F33615-78-C-0016, BioTechnology, Incorporated. NTIS.** In past years, research by Air Force and other DOD agencies has resulted in the development of several more effective techniques for developing and for presenting technical data for maintenance. Application of these development techniques and improved presentation formats for operational use has been hindered by the fact that technical data managers frequently do not have sufficient information available on the improved techniques and formats to allow them to select and procure the improved data. The guidelines developed by this effort can be used by personnel who develop technical data for the Air Force and by those who manage such efforts. A thorough review of the state of the art in developing, presenting and procuring technical data was accomplished to provide the basis for developing the guidelines. This was accomplished first by reviewing available formats, specifications, and applicable literature and by then conducting extensive interviews with government and industry personnel who are knowledgeable of, and experienced in, current technical data procedures. The next phase involved analysis of these data, the selection of candidate formats, the development of descriptions on the formats, development of criteria for selecting formats and development of guidelines for procuring data.

This report can be used as a basic reference publication by all individuals involved in Acquisition and Management of Air Force Technical Orders. The report provides the following information: developments in procedural data formats, job performance aid concepts and techniques, format test and evaluation, and format option selection data. The report also contains a comprehensive listing of requirement and guideline documents which are available for use in the preparation and acquisition of technical manuals and related data. A military specification and military standards cross-reference table is provided for quick reference to specific information. (282 pages)

51 **King, G.F., & Askren, W.B. Human resources, logistics and cost factors in weapon system development: Demonstration in the full scale development phase of aircraft system acquisition. AFHRL-TR-80-52(I), AD-A096 731. Wright-Patterson AFB, OH: Logistics and Technical Training Division, February 1981. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** This report documents the final part of a three-part demonstration of

the coordinated human resources technology (CHRT) on an aircraft acquisition program. CHRT is an integration of five human resource technologies: maintenance manpower modeling; human resource in design trade-offs; instructional system development; job guide development; and system ownership costing. The CHRT methodology also includes a consolidated data base (CDB) which services the five integrated technologies. CHRT was conceived and developed (a) to assess the impact of system design and support plans on human resource, logistics, and cost throughout acquisition, and (b) to facilitate the implementation of an integrated personnel, training, and technical manual support approach. In this part of the demonstration, CHRT and the CDB were applied to the avionics and landing gear systems of the Advanced Medium STOL[1] Transport (AMST) using data projected for the minimum engineering development phase. This phase may be considered similar to full-scale development but lesser in scope. The following results were achieved. First, manpower requirements, training requirements, technical manual requirements, reliability, maintainability, and system ownership costs were assessed and quantified for several avionics and landing gear design and support alternatives at various levels of system detail. Second, a sample integrated training program and technical manual were prepared for a selected landing gear maintenance task. Third, the consolidated data base was continued and expanded for both the avionics and landing gear systems. (94 pages)

52 **King, G.F., & Askren, W.B. Human resources, logistics and cost factors in weapon system development: Demonstration in the full scale development phase of aircraft system acquisition — Appendixes B to R. AFHRL-TR-80-52(II), AD-A096 732. Wright-Patterson AFB, OH: Logistics and Technical Training Division, February 1981. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** The coordinated human resource technology and the consolidated data base were demonstrated in the full-scale development phase of weapon system acquisition. The results of this demonstration are reported in Volume I. This volume consists of Appendixes B through R to that demonstration report and provides additional details of the demonstration. (152 pages)

53 **Magarinos, J.R., & Coleman, D.J. Wide angle, color, holographic infinity optics display. AFHRL-TR-80-53, AD-A096 890. Williams AFB, AZ: Operations Training Division, March 1981. Project 1958, Contract F33615-77-C-0030, Farrand Optical Company, Incorporated. NTIS.** This project demonstrates the feasibility of producing a holographic compound spherical beamsplitter mirror with full color response. Furthermore, this holographic beamsplitter was incorporated into a Pancake Window display system as a replacement for the classical glass spherical beamsplitter and its performance and color capabilities have been demonstrated. (98 pages)

54 **Magarinos, J.R., Coleman, D.J., & Lenczowski, T. Low cost, wide angle infinity optics visual system. AFHRL-TR-80-54, AD-A105 508. Williams AFB, AZ: Operations Training Division, September 1981. Project 1958, Contract F33615-76-C-0055, Farrand Optical Company, Incorporated. NTIS.** Holographic beamsplitter spherical mirrors have been introduced in the Pancake Window visual simulators as a low-cost and low-weight substitute for the classical glass beamsplitter spherical mirrors. The goal of this project was the production of a three-channel visual simulator consisting of a mosaic of three holographic Pancake Windows in which these beamsplitter spherical mirrors are used. The field of view of the complete display is 45° vertical and 140° horizontal and will be used to demonstrate a dynamic, unprogrammed visual simulation imagery generated by T.V. camera/model and gantry image generator.

[1]STOL - Short takeoff and landing

Prior to the production of these holograms, holographic research was carried out to investigate and resolve problems which have affected the quality and the repeatability of the final product. Specific attention was given to holographic ghost images which seriously impaired the contrast and the resolution of the images produced by the holographic Pancake Window and to the effects of environmental controls. The final production of the holographic beamsplitter was delayed by a stability problem in the wet cell used to support the holographic plate during the holographic exposure.

The phosphors in the CRT displays were originally designed to be P-44 narrow band phosphors but were later changed to a wide-band emission phosphor. The reason for this was a wavelength peak response shift of the holograms with large field-of-view angles. The use of a wide-band phosphor, although it penalized the transmission of the holographic Pancake Window, required less stringent wavelength peak location in the manufacture of these holographic beamsplitter mirrors.

The optical performance of these windows proved the feasibility of the holographic optical elements. As compared with a classical Pancake Window system in which classical glass mirrors are used, the performance of these holographic windows was inferior, not because of inherent limitations, but because of cosmetics, uniformity, and hologram quality which could be improved with present technology. (144 pages)

55 **Ideen, D.R., & Kantor, J.E. Introduction of women into Titan II missile operations. AFHRL-TR-80-55, AD-A097 209. Brooks AFB, TX: Manpower and Personnel Division, March 1981. Project 7719 and 7734. NTIS.** The objectives of this research were to evaluate the performance of the initial women entering Air Force Titan II launch career fields and to determine if women encounter any gender specific problems during Titan II operations. The women entering these fields, and their male peers, were surveyed during each stage of training and after accruing experience in the operational missile squadrons. Additionally, both academic and simulator training performance scores, operational upgrade scores, and operational supervisory evaluations were obtained on these personnel. With only one exception (on the rating of instructor efficiency, where men rated the instructors higher than did women), no significant differences were found between men's and women's perceptions of the training experience or performance in training. In the operational missile squadrons, the only area in which men and women crew members differed was on the number of women that they indicated could be assigned to a crew if that crew was to be able to handle all the physical requirements of the job. The operational supervisors also indicated that they had some concern about this issue, but did rate the training and overall performance of men and women as equal. Overall, very few differences were found between men and women concerning their attitudes, perceptions, and performance in Titan II training and operations. (52 pages)

56 **Glasgow, Z., Simkins, M.L., & Guerrieri, J.A. Job performance appraisal system training program. AFHRL-TR-80-56, AD-A094 380. Brooks AFB, TX: Manpower and Personnel Division, January 1981. Project 7719, Contract F33615-79-C-0011, Applied Science Associates, Incorporated. NTIS.** The Civil Service Reform Act of 1978 requires each government agency to develop a performance-based employee appraisal system. The purpose of this study was to determine how to effectively train more than 200,000 Air Force civilian employees to use the Job Performance Appraisal System (JPAS) designed by the Air Force. Experimental comparisons were made of the differing versions of two basic instructional prototypes: instructor-led and self-instructional. Results demonstrate that each approach teaches all occupational levels equally well, provided the instructor-based training is led by someone who is very knowledgable in the system. However, students respond significantly more positively to instructor-led training than self-instructional training. (36 pages)

57 **Denton, R.L. Air Force Human Resources Laboratory annual report — fiscal year 1979. AFHRL-TR-80-57, AD-A092 839. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, September 1980. (Covers all AFHRL projects.) NTIS.** *This report* comprehensively describes the organizational structure of the Air Force Human Resources Laboratory and the functions of its Divisions and Operating Locations. It presents the technical achievements of the Laboratory for Fiscal Year 1979, synopsizes *promising on-going research* projects, discusses the available technical resources, and lists publications and presentations by Laboratory personnel during Fiscal Year 1979. (82 pages)

58 **Semple, C.A., Cotton, J.C., & Sullivan, D.J. Aircrew training devices: Instructional support features. AFHRL-TR-80-58, AD-A096 234. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Canyon Research Group, Incorporated. NTIS.** *This report presents relationships between aircrew* training device (ATD) instructional support features and training requirements. Instructional support features include ATD hardware and software capabilities that permit instructors to manipulate, supplement or otherwise *control student learning experiences*. The instructional features addressed are (a) freeze; (b) automated demonstrations; (c) record and replay; (d) automated cuing and coaching; (e) manual and programmable sets of initializing conditions; (f) manual and programmable *malfunction control*; (g) ATD-mounted audio visual media; (h) automated performance measurement; (i) automated performance alerts; (j) annunciator and repeater instruments; (k) closed circuit television; (l) automated adaptive training; (m) *programmed mission scenarios*; (n) automated controllers; (o) graphic and text, readouts of controller information; (p) computer controlled threats; (q) computer managed instruction; (r) recorded briefings; (s) debriefing aids; and (t) hardcopy printouts. Each feature is discussed, as *appropriate, in terms of* (a) its operation, (b) related features, (c) instructional values, (d) observed applications, (e) utility (use-related) information, (f) related research, and (g) design considerations. (180 pages)

59 **Headquarters Air Force Human Resources Laboratory. Fiscal year 1982 — Air Force technical objective document. AFHRL-TR-80-59, AD-A093 484. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, January 1981. (Covers all AFHRL projects.) NTIS.** This document provides the academic and industrial Research and Development (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) Manpower and Force Management, (b) Weapon Systems Logistics Maintenance and Technical Training, and (c) Air Combat Tactics and Training. (20 pages)

60 **Sher, L.D. Flight simulator: Use of spacegraph display in an instructor/operator station. AFHRL-TR-80-60, AD-A101 951. Williams AFB, AZ: Operations Training Division, July 1981. Project 6114, Contract F33615-79-C-0013, Bolt Beranek and Newman, Incorporated. NTIS.** SpaceGraph is described as a new computer-driven display technology capable of showing space-filling images, i.e., images that are truly three-dimensional. This report details the findings on how this new technology can be used in, and in conjunction with, the Instructor/Operator Station (IOS) of a flight simulator.

In current practice, the location, altitude, and flight attitude of a simulated aircraft are graphically shown to the instructor/operator on flat screens. This dimensionally-mismatched form of data *presentation creates a greater* workload on the instructor/operator who must integrate several flat presentations into a mental construct of performance in three-dimensional space. Such space-filling data should be shown with a space-filling display, now that one exists.

Unexpectedly, student pilots were also able to use the display directly. As a training aid intermediate between "flying" one's hands in the classroom and "flying" the big simulators, it would appear to be a new kind of low-cost, part-task training vehicle. It offers the realism of computer-produced flight dynamics but with a view of the aircraft rather than out of the aircraft. (34 pages)

61 **Stenger, A.J., Zimmerlin, T.A., Thomas, J.P., & Braunstein, M. Advanced computer image generation techniques exploiting perceptual characteristics. AFHRL-TR-80-61, AD-A103 365. Williams AFB, AZ: Operations Training Division, August 1981. Project 6114, Contract F33615-78-C-0020, Technology Service Corporation. NTIS.** The study objectives involve applying psychological knowledge of visual perception to improve real-time computer image generation (CIG) simulators. The primary objective is to suggest and identify CIG algorithms for visual simulation that improve the training effectiveness of CIG simulators. The secondary objective is to identify areas of basic research in visual perception that have a significant impact on improving CIG technology. The project proceeded in a sequence of three phases. The first phase entailed observing existing CIG simulators. During the second phase, existing perceptual knowledge was studied in light of the capabilities and limitations of exisiting CIG simulators. In the third phase, improved CIG algorithms were developed and relevant areas for further perceptual research were identified. (332 pages)

62 **Carson, R.T., Grinberg, J., & Bleha, W.T. Liquid crystal light valve color projector. AFHRL-TR-80-62, AD-B056 200L. Williams AFB, AZ: Operations Training Division, April 1981. Project 1958, Contract F33615-77-C-0035, Hughes Aircraft Company. DTIC.** The evolution of the full color projection technique as applicable to the trichromatic Holographic Pancake Window is discussed. The performance requirements of the projector as required by the Pancake Window are explained in detail. The approach to meeting the Pancake Window requirements are discussed, including methods of solving unique problems. A complete description of the projector is given, including assembly, manufacturing of major sections and components with complete electrical, optical, and mechanical explanations. A detailed description of the results of the final testing is given with explanation of test conditions. A report on a cadmium sulfide activated light valve response time study (Appendix E) is included, as well as a report on silicon activated light valve research (Appendix F). (160 pages)

63 **Semple, C.A. Simulator training requirements and effectiveness study (STRES): Executive summary. AFHRL-TR-80-63, AD-A094 381. Wright-Patterson AFB, OH: Logistics and Technical Training Division, January 1981. Project 1710, Contract F33615-77-C-0067, Canyon Research Group, Incorporated. NTIS.** Seven technical reports have been prepared to date for the Simulator Training Requirements and Effectiveness Study (STRES). One is this Executive Summary, which is designed to serve two purposes. One purpose is to summarize the content of the other six reports, which address the following aircrew training device (ATD) issues: ATD fidelity; instructional support features; utilization of ATDs in aircrew training programs; ATD life cycle costs; and worth of ownership. Program objectives in each area are set forth, together with summaries of technical report content dealing with each objective. Additional topics addressed are plans for future research and the abstract bibliography that was prepared as part of the program. The second purpose of the Executive Summary report is to present a master index to other program technical reports so that readers have a unified source for identifying detailed information bearing on training device information covered in other program technical reports. (52 pages)

64 **Lord, R.E., Kumar, S., & Schmidt, R.A. Multiple-instruction, multiple-data path computers: Parallel processing impact on flight simulation software. AFHRL-TR-80-64, AD-A104 506. Williams AFB, AZ: Operations Training Division, August 1981. Project 6114, Contract F33615-79-C-0009, Denelcor, Incorporated. NTIS.** The purpose of this study was to evaluate the parallel processing impact of MIMD (Multiple-Instruction Multiple-Data Path) computers on Flight Simulation Software. Basic mathematical functions and arithmetic expressions from typical Flight Simulation Software were selected and run on a MIMD computer to evaluate the improvement in execution time that results from the parallel architecture of this type of computer. Recommendations as to the types of tasks which are optimally suitable for this computer architecture are made, together with the improvement in execution speed to be expected. (102 pages)

65 **Dempsey, J.R., & Fast, J.C. Likelihood Function Estimation (LIFE) model: Utility in the development of an enlistment standard. AFHRL-TR-80-65, AD-A095 929. Brooks AFB, TX: Manpower and Personnel Division, February 1981. Project 2077, Contract GSA-7CP-78-202, Kentron International, Incorporated. NTIS.** The prototype LIFE model was used in the development of an alternative Air Force enlistment standard designed to increase the number of qualified accessions with no increase in first term attritions. This enlistment standard was tested operationally in October 1978 by the Air Force Recruiting Service in Project IMAGE. The initial results of Project IMAGE are discussed. The prototype LIFE model was enhanced to improve its data handling capabilities and the maximization algorithm. Using the enhanced model, new prediction equations were developed, and a comparison was made between the IMAGE equation and the new LIFE equation developed using a 1975 data base. (26 pages)

66 **Friedman, D., Steinberg, A., & Ree, M.J. Adaptive testing without a computer. AFHRL-TR-80-66, AD-A097 353. Brooks AFB, TX: Manpower and Personnel Division, March 1981. Project ILIR, Contract F33615-79-C-0018, Research Applications, Incorporated. NTIS.** Three prototypes of paper-and-pencil based adaptive tests were developed, refined and developed in sufficient quantities for administration to groups of forty subjects. Two aptitude areas were employed in each prototype. These were Word Knowledge and Arithmetic Reasoning. A total of 711 Basic Airmen Recruits were administered the prototypes in both aptitude areas as well as traditional paper-and-pencil tests of both areas. Additionally, enlistment scores on the Armed Forces Qualification Test (AFQT) and scores for selector composites (AI) were available for each subject. It was found that the adaptive tests correlated highly with like-named paper-and-pencil tests and correlations with AFQT and the AIs were about the same for traditional tests and adaptive tests. The adaptive tests showed a large advantage in time of administration ranging from savings of one-third to one-half. It is anticipated that a full adaptive test battery based on the prototypes would allow for the addition of about six more aptitude areas. This could provide better measurement by enabling more data to be collected on each examinee. (20 pages)

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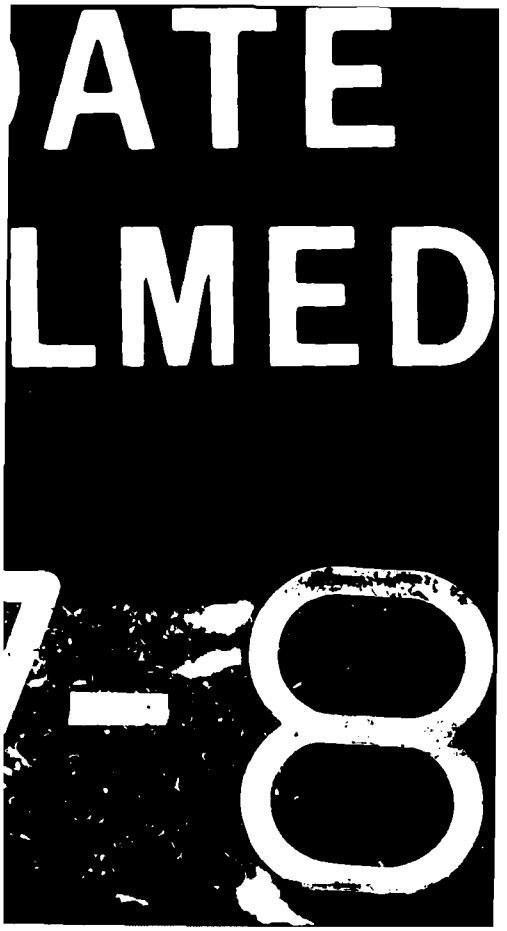
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