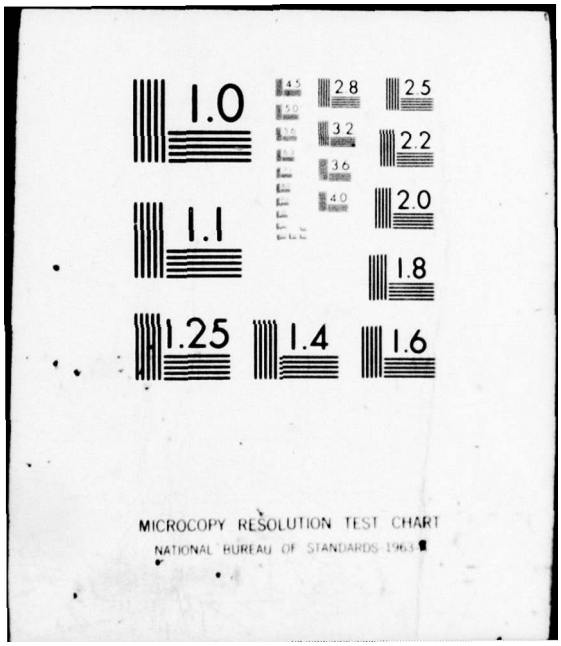
AD-A036 159 ARMY TRAINING SUPPORT CENTER FORT EUSTIS VA F/G 5/9
TEST AND EVALUATION OF THE ARMY'S CH-47 HELICOPTER FLIGHT SIMUL--ETC(U)
JAN 77 J TOOMEPUU

UNCLASSIFIED NL

1 OF 1
AD A036159

END

DATE FILMED
3-77


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963

# TEST AND EVALUATION OF THE ARMY'S CH-47 HELICOPTER FLIGHT SIMULATOR

BY:

JURI TOOMEPUU
US ARMY TRAINING SUPPORT CENTER
FORT EUSTIS, VA 23604



PRESENTATION AT THE THIRD DOD/NASA SIMULATION TECHNOLOGY COORDINATION GROUP MEETING, 18 JANUARY 1977, NAVAL TRAINING EQUIPMENT CENTER, ORLANDO, FLORIDA 32813



1473

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|---|---|---|
| 1. REPORT NUMBER<br>N/A | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>(6) Test and Evaluation of the Army's CH-47 Helicopter Flight Simulator, | | 5. TYPE OF REPORT & PERIOD COVERED<br>6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>(10) Juri Toomepuu | | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS<br>US Army Training Support Center<br>ATTN: ATTSC-TD<br>Fort Eustis, VA 23604 | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS<br>(12) 27p. |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>US Army Training Support Center<br>ATTN: ATTSC-TD<br>Fort Eustis, VA 23604 | | 12. REPORT DATE<br>(11) 18 Jan 77<br>13. NUMBER OF PAGES<br>29 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) | | 15. SECURITY CLASS. (of this report)<br>UNCLASSIFIED<br>15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

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

18. SUPPLEMENTARY NOTES

Presented at the Third DOD/NASA Simulation Technology Group Meeting, 18 Jan 77, Naval Training Equipment Center, Orlando, Florida 32813

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

| | | |
|---|---|---|
| Army training | Cost effectiveness | Development Testing |
| Aviation training | Training Effectiveness | Research Programs |
| Flight simulation | Cost and Opnl Eff Anal | Research Development |
| Training devices | Cost and Trng Eff Anal | Test and Evaluation |
| Transfer of training | Operational Testing | Materiel Acquisition |

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

This report gives an overview of the Army's current efforts to test and evaluate the prototype CH-47 Helicopter Flight Simulator (CH47FS). This effort includes a combined development and operational test (DT/OT II) and a Cost and Training Effectiveness Analysis (CTEA). The CH47FS is the first prototype of the Army's new generation flight simulators with six degrees of freedom motion system which incorporate a video camera/terrain board visual system. The current evaluation represents a significant advance in the procedures and methods for validation of the Army's stated flight simulator requirements. (Cont'd)

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

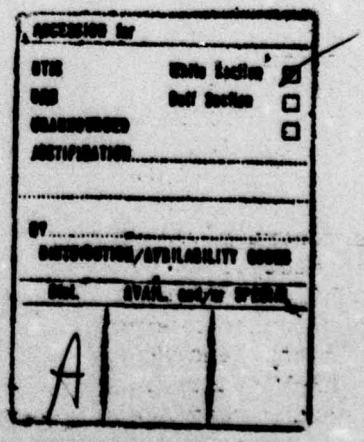
409 823

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Item 20. Abstract.

During the operational test, transfer of training experiments will be conducted for both institutional and unit pilot training, and objective and subjective training effectiveness data will be collected. The CTEA, using data generated by the test, will evaluate the simulator cost and training effectiveness for various training packages, defined in terms of the extent of substitution of aircraft by simulator in pilot training. A Basis of Issue Plan (BOIP) model for flight simulators, based on mathematical programming techniques, will be developed, and a proposed BOIP for the CH47FS prepared as part of the CTEA. The report lists operational and technical issues for additional evaluation of flight simulators.



## TABLE OF CONTENTS



## FIGURES

# TEST AND EVALUATION OF THE ARMY'S CH-47 HELICOPTER FLIGHT SIMULATOR

## INTRODUCTION

The latest and the most ambitious effort to validate the Army's multihundred-million-dollar flight simulator program is the evaluation of the prototype CH-47 Flight Simulator (CH47FS), currently underway at the US Army Aviation Center (USAAVNC), Fort Rucker, Alabama.

This evaluation includes a combined development and operational test (DT/OT II) conducted by the US Army Aviation Board, and a Cost and Training Effectiveness Analysis (CTEA) sponsored by the Army Training Support Center and conducted by the Deputy Chief of Staff for Combat Developments Study Group of the Aviation Center.

The CH47FS is the first prototype of the Army's new generation flight simulators with six degrees of freedom motion system, which incorporate video camera/terrain board visual system.

The trainee station, from the pilot's seat forward, duplicates the CH-47 cockpit. The instructor station, which is located behind the pilots seat in the cockpit, has displays for monitoring trainee performance, and controls for the built-in instructional features of the simulator and for adjustment and variation of training conditions.

The test started 17 Jan 77, and is expected to be completed in July 77. The CTEA started several months before the test, and, because most of the data for the analysis will be generated by the test, will extend three months beyond the test completion date.

The cost effectiveness of flight simulators has been quite adequately demonstrated by airlines for pilot transition training and proficienty evaluation, and by the military services for many additional research and training missions. However, because flight training requirements for the military services vary greatly between services, and between different commands within services, many questions pertaining to training and cost-effectiveness of military flight simulator programs still remain to be answered.

The Army's current test and study effort is designed to answer some of these questions. This evaluation will address the issues of verification of the anticipated benefits of the CH47FS program, justification of further expenditures, and the optimization of the cost and training effectivenss of the CH47FS program.

## OPERATIONAL TEST

The operational test will measure the transfer of training from the simulator to the aircraft for both institutional and unit training. The

24 experimental group and the same number of control group subjects for the institutional transfer of training experiment will come from among the aviators enrolled in the regular CH-47 Aviator Qualification Course classes at Fort Rucker. The unit training experiment is conducted using aviators assigned to CH-47 operational units, 16 aviators will be used as experimental subjects and the same number as members of the control group.

## Institutional Training Experiment

An overview flow chart of the institutional training test plan is depicted on Figure 1.

The pre-experimental activities start with the modification of the current program of instruction and training guide to allow instructors to take advantage of the instructional features of the simulator, such as automated demonstration programs, freeze, playback, etc. Each maneuver is then analyzed to determine and define specific tasks contained in the maneuver, and establish performance evaluation criteria and methods. As part of the pre-experimental activities, the instructors will undergo a two week training course provided by the manufacturer and an additional two week Experimental Procedures Course conducted by the test personnel.

The experimental and control subjects will then be selected. They will be matched, due to lack of better data, on the basis of their prior flight experience.

A flow chart of the procedures for the experimental group is depicted on Figure 2. The subjects will be trained to the established criterion for each task and maneuver, or until it is evident that the expenditure of additional time and effort is not justified by the rate of improvement. The following data, numerically designated on the flow chart as indicated, will be collected during the simulator training phase of the experiment:

The number of times each maneuver was practiced (1).

An evaluation score of the trainee's performance on each trial (2).

Time spent practicing each maneuver (3)

A listing of tasks or maneuvers that could not be learned to criterion (4).

The total time of simulator training (5).

Evaluation scores for performance of each task or maneuver during the final simulator checkride (6).

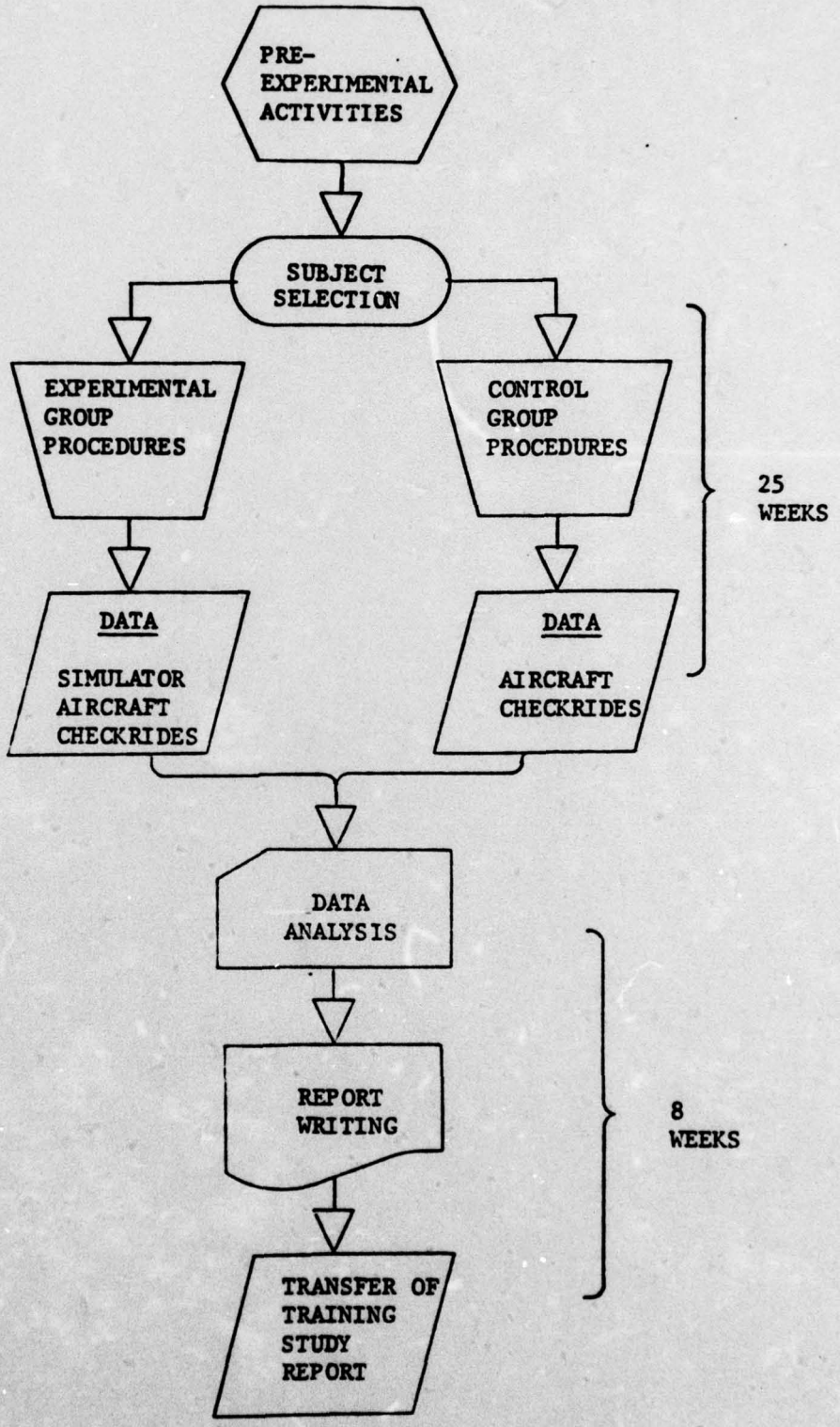



Figure 1. Overview Flow Chart of Transfer of Training Experiment

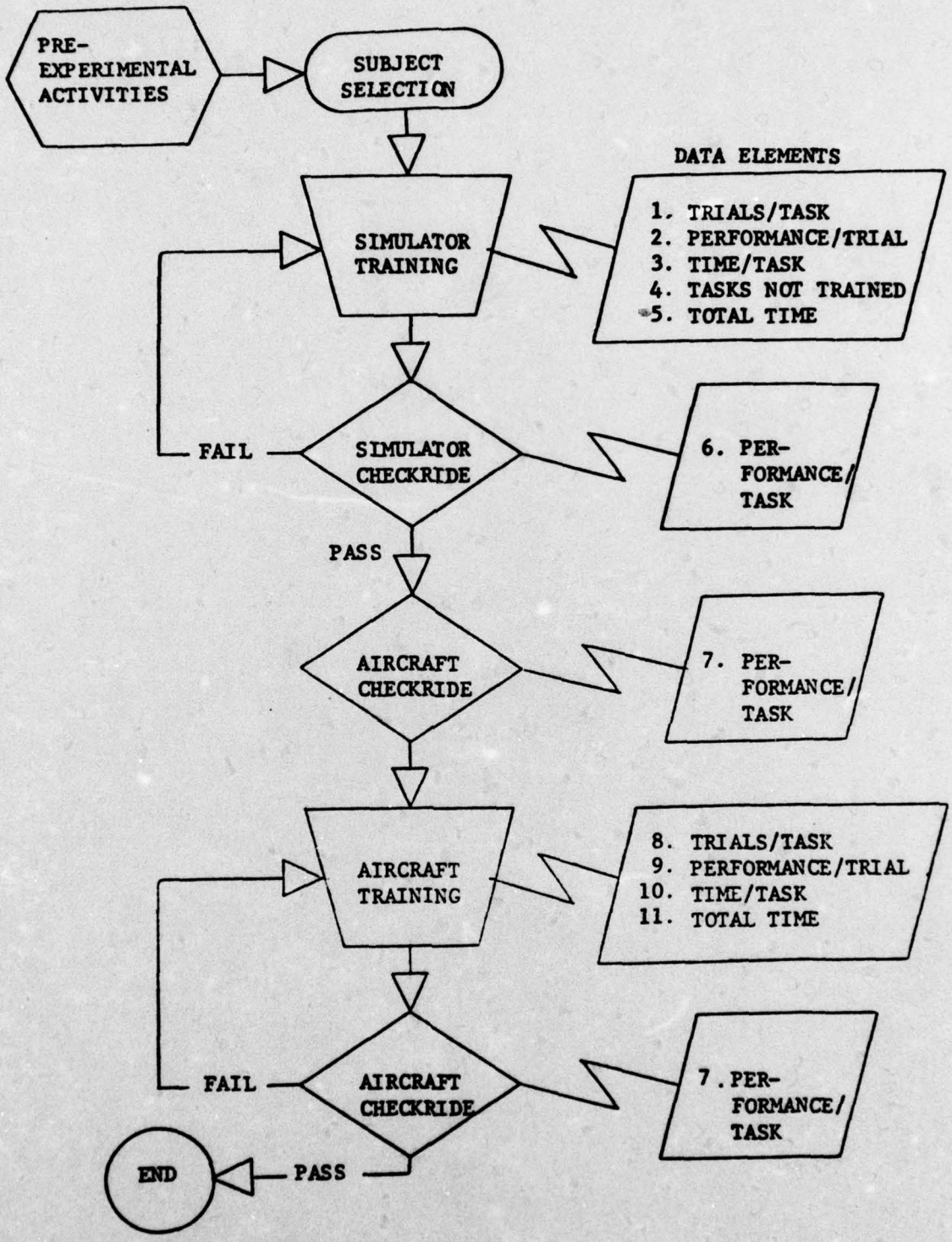



**Figure 2. Flow Chart of Experimental Group Procedures, Institutional Training**

After passing the simulator checkride, the subjects, without further training, will take an aircraft checkride (7).

Following the checkride, training in the aircraft will be conducted. First the tasks and maneuvers that the subject was unable to pass on the checkride, and then the tasks and maneuvers that were not covered in the simulator training; such as preflight procedures and water and slope operations.

The data collected during this phase includes:

The number of times each maneuver was practiced (8).

The evaluation score for each trial (9).

The time spent practicing each maneuver (10).

The total time of aircraft training (11).

At the end of this phase the final checkride will be given during which the trainee's evaluation score for each task and maneuver is recorded.

The control group receives all of its training in the aircraft. The flow chart of the control group procedures is depicted on Figure 3. The training will include all the tasks and maneuvers taught to the experimental group, and the same data will be collected.

## Unit Training Experiment

The transfer of training experiment for unit training differs from the institutional training experiment in several important aspects. The training program and guide are designed to include tasks and maneuvers considered to be critical for proficiency maintenance training. The subjects will start out by taking a checkride. The members of the experimental group will then come to Fort Rucker for simulator training for a two or three day period once every four weeks, while the members of the control group will remain with their units, but will not fly except CH-47 missions considered essential.

At the end of the six months allocated for the experiments all subjects will take a final aircraft checkride. For the experimental group, the same data that were collected for institutional training experiment simulator rides, will be collected (data elements 1 through 6). In addition, the time that each subject flew the aircraft, the types of missions and maneuvers flown, and evaluation scores for the initial and final checkrides will be recorded (data elements 12 and 7).

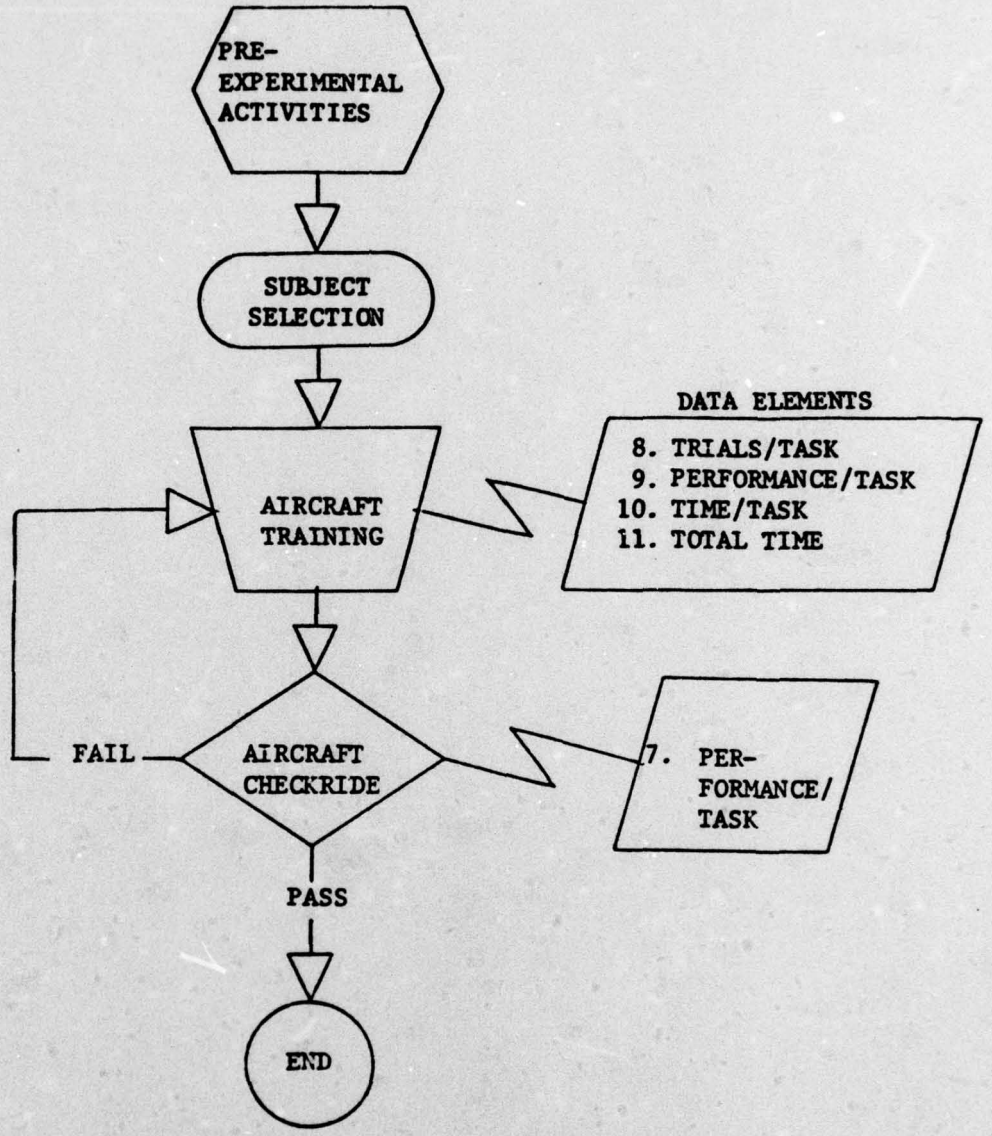



**Figure 3. Flow Chart of Control Group Procedures, Institutional Training**

For the control group, in addition to their evaluation scores on the checkride (data element 7), data will be collected to record the time on missions, including the types of missions and maneuvers flown (data element 12). Figures 4 and 5 depict flow charts for both groups.

## COST AND TRAINING EFFECTIVENESS ANALYSIS

The data collected during the test will provide the major portion of the input for the other, equally important, part of the evaluation effort, the CH47FS Cost and Training Effectiveness Analysis (CTEA).

### Alternate Training Packages

The study will evaluate the simulator cost and training effectiveness for various institutional and unit training packages which are defined to include the hardware used for training (i.e. the simulator, the aircraft, and the associated equipment), the method of its utilization, and the necessary software and training literature. The following training packages will be addressed:

#### Institutional Training

1. Use of the CH-47 only (baseline).

2. Maximum use of the CH47FS supplemented by the CH-47 only for maneuvers and procedures that cannot be practiced or performed in the flight simulator.

3. Use of the CH47FS and CH-47, in accordance with a POI determined by the study agency as study progresses.

#### Unit Training

1. Use of the CH-47 only (baseline).

2. Maximum use of the CH47FS supplemented by the CH-47 only for maneuvers and procedures that cannot be practiced or performed in the flight simulator.

3. Use of the CH47FS and the CH-47, in accordance with a POI determined by the study agency as study progresses.

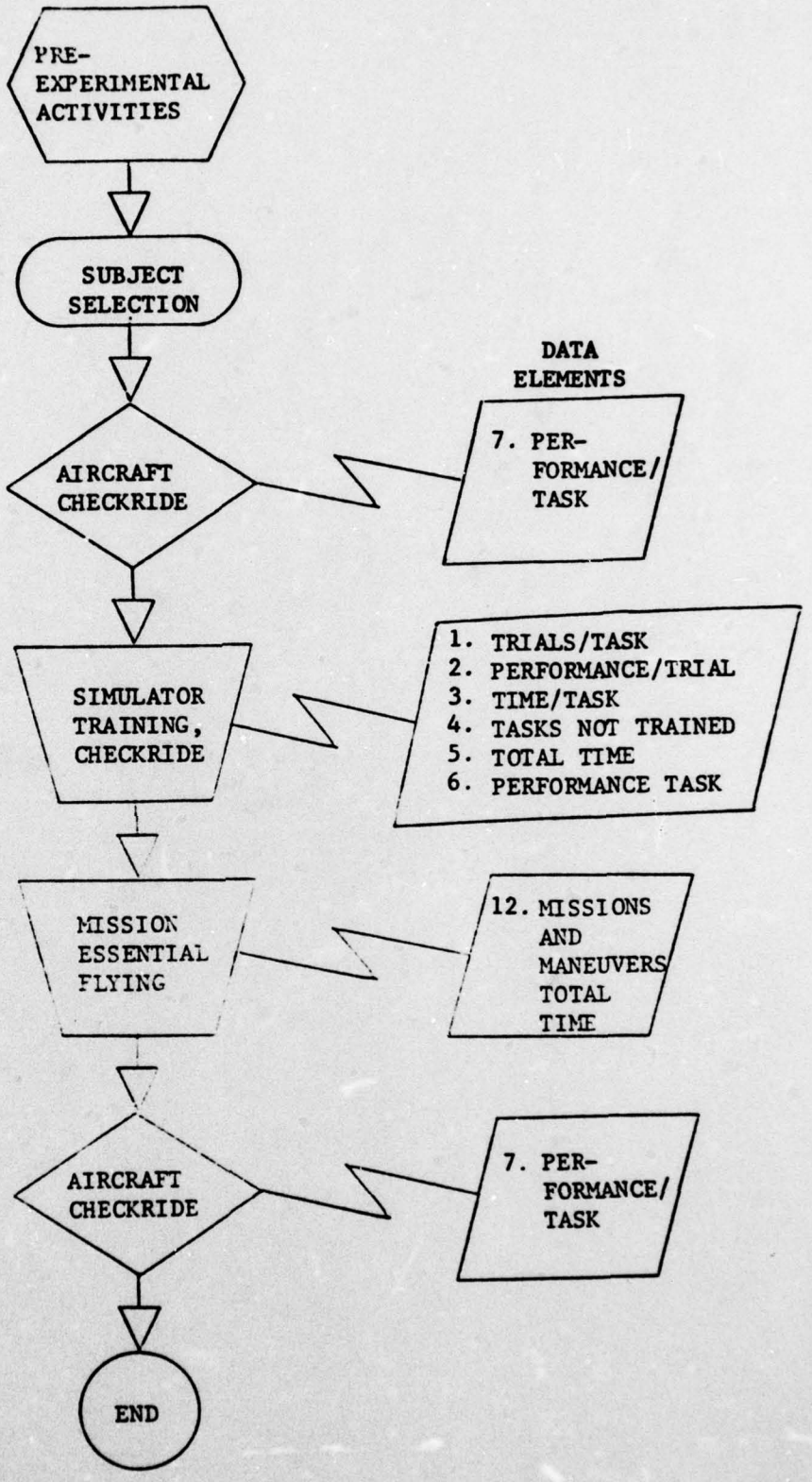



**Figure 4. Flow Chart of Experimental Group Procedures, Unit Training**

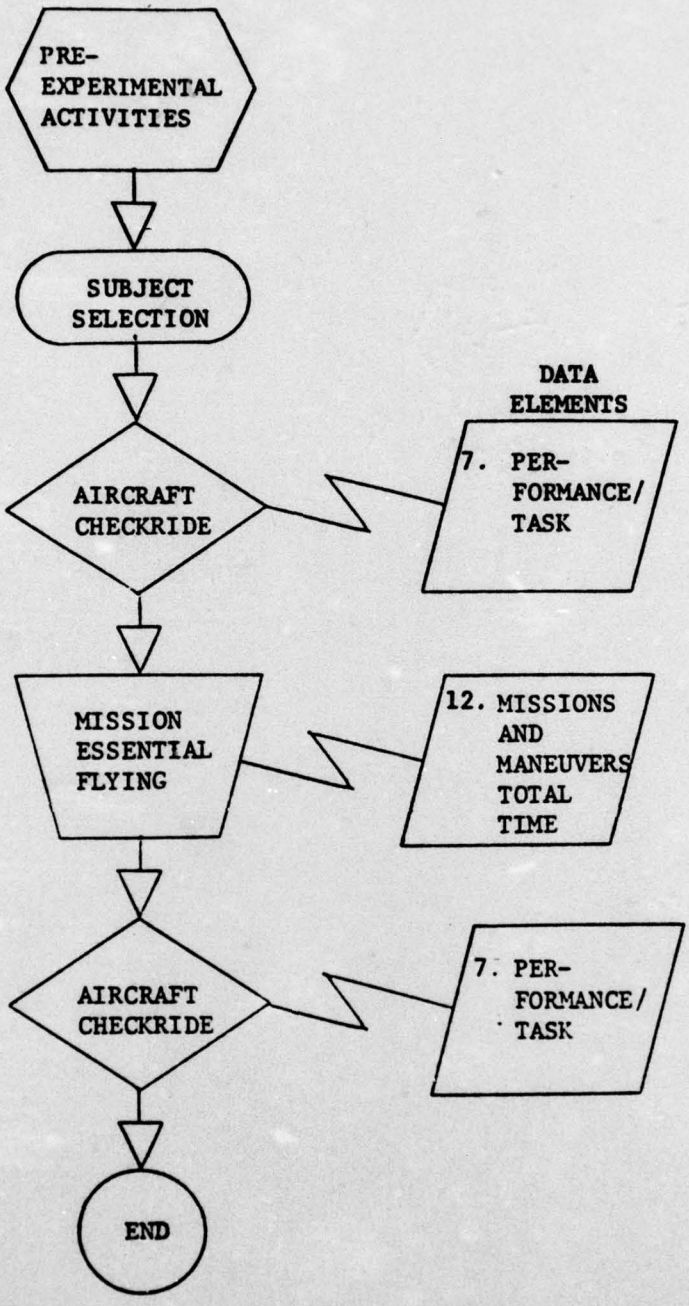



**Figure 5. Flow Chart of Control Group Procedures, Unit Training**

## Objectives

The objectives of the CTEA are:

1. Determine the training effectiveness of each alternate training package.

2. Estimate the pertinent costs of each alternate training package.

3. Determine the cost and training effectiveness of each alternate training package.

4. Rank order the alternate training packages on the basis of appropriate quantitative cost and training effectiveness measures, and judgemental evaluations of the situations in which the alternates are expected to be used.

5. Prepare a recommended CH47FS basis of issue plan (BOIP) for the preferred packages.

6. Ascertain the impact each alternate training package will have upon Army-wide combat readiness of Army's CH-47 assets.

## Essential Elements of Analysis

The following questions must be answered to meet the objectives of the study:

1. What are the costs of the alternate training packages?

2. What are the training costs per aviator for the alternate training packages?

3. At what point in the life cycle of the alternate training packages (which include the use of the CH47FS) will their costs be equal to the costs of the baseline training packages (using the CH-47 only)?

4. What is the training effectiveness of each alternate training package?

5. What is the relative cost and training effectiveness of each alternate training package?

6. What flight maneuvers and procedures (if any) cannot or should not be practiced in the simulator? What flight procedures and maneuvers (if any) can or should be practiced in the simulator only?

7. To what extent will the training received by the aviator in the CH47FS be transferred to actual operation of the aircraft? (i.e., what is the training transfer ratio?)

8. What is the recommended mix of simulator and aircraft training?

9. What are the potential contributions of the CH47FS to combat readiness training?

10. What are the safety benefits of the CH47FS, in terms of accident costs and casualty rates, that may be expected from less exposure of aviators to training in aircraft?

11. For each year in the study time frame, what is the projected aviator input for the CH-47 AQC?

12. What should be the basis of issue of the CH47FS?

13. On the basis of cost and training effectiveness, should the CH47FS simulate the CH-47D? If so, what are the resulting costs?

14. What are the technical, schedule, and cost risks associated with the CH47FS program?

15. What are the reliability, availability, and maintainability characteristics of the CH47FS, and how do these characteristics affect the cost and training effectiveness of CH-47 aviator training?

16. What are the resource implications of each alternate training package, considering, in addition to the costs/benefits measured in dollars, the requirements for manpower, fuel, training airspace, areas, facilities, time, and environmental consequences?

17. Can a reduction in cost be achieved by a modification of the CH47FS in light of maneuvers that should not be practiced in the simulator?

18. What are the flight standardization advantages/disadvantages of each alternate training package?

## Methodology

The rank ordering of the alternatives and selection of the preferred training packages will be made on the basis of a variable cost/fixed effectiveness analysis and judgemental evaluations of the situations in which the alternates are expected to be used.

### Effectiveness Analysis

The following measures of training effectiveness (MOTE), computed from the data generated by the operational test, will be used:

Aviator performance evaluation scores.

The hours of training necessary to provide a CH-47 Aircraft Qualification Course (institutional training) student with the skills necessary to enable him to successfully complete the aircraft type qualification examination (i.e., to achieve a minimum score of 70) under the meteorological conditions which allow for safe flight of the aircraft and permit performance of required maneuvers and skill demonstration.

The hours of training necessary to provide a CH-47 aviator (unit training) with the practice necessary to maintain the skills required to successfully complete the aircraft examination ride (i.e., to achieve a minimum score of 70) under the meteorological conditions cited above.

For each of the three institutional training package alternatives (i.e., (1) CH-47 only, (2) simulator only, and (3) a mix of simulator and aircraft training), the mean number of hours of training and the mean aviator performance score on the aircraft checkride will be computed. For the third alternate the preferred mix of simulator and aircraft training will be determined using the Cumulative Training Effectiveness Function, CTEF, expressed by:

$$CTEF = \frac{A_C - A_E}{S_E}$$

where

$A_E$ = mean number of hours to train the task to criterion, using only the aircraft.

$S_E$ = mean number of hours to train the task to criterion, or to the highest proficiency practically obtainable, using the simulator only.

$A_E$ = mean number of hours (if any) to train the task to criterion in aircraft, following $S_E$ hours of training in the simulator

If the CTEF for a task>1, the task is more effectively learned in the simulator. If the CTEF for a task≤1, the training effectiveness or the simulator is equal to, or less than the effectiveness of the aircraft, and other factors (e.g., cost) must be considered.

For unit training, proficiency baseline will be established by the mean aviator performance score on the initial aircraft checkride, and the mean number of hours of training and mean performance scores on the final checkride, computed as for institutional training. Similarly, determination of the preferred mix of simulator and aircraft training for the third alternate will be computed as for institutional training.

Cost Analysis

The life cycle cost estimate (LCCE) for alternate training packages for both institutional and unit training will be determined in terms of training cost per aviator for each alternate, and total cost for each alternate.

Training cost per aviator for $i^{th}$ alternate, $tc_i$, is expressed by:

$$tc_i = (H_a \times C_a) + (H_s \times C_s)$$

where

$H_a$ = Number of aircraft hours

$C_a$ = Cost per aircraft hour

$H_s$ = Number of simulator hours

$C_s$ = Cost per simulator hour

The total cost for the $i^{th}$ alternate, $TC_i$, is expressed by:

$$TC_i = P \times tc_i$$

where

P = The number of pilots trained

To determine these cost estimates, the following subanalyses will be conducted:

1. LCCE will be developed for flight simulator buy sizes of one to ten units. Additionally, the modification cost of converting a CH47FS from a CH-47C to a CH-47D aircraft simulator will be determined.

2. LCCE (adjusted to FY78 dollars) for the CH-47C and CH-47D aircraft to be purchased for training will be determined.

3. Scheduling, technical, and cost risks associated with the CH47FS will be identified, and their impact upon costs will be addressed.

In addition, a side analysis will be conducted to determine the safety benefits in terms of costs and casualties avoided by training in the CH47FS in lieu of the CH-47 aircraft. This analysis will be requested from the US Army Agency for Aviation Safety (USAAAVS).

Basis of Issue Plan

Because a current generation flight simulator can be considered for all practical purposes a nearly ten-million-dollar permanent installation, the number of simulators procured, and their locations, must be carefully determined. To accomplish this, a mathematical model will be developed for determining the optimum Basis of Issue Plan (BOIP) for flight simulators. A recommended BOIP for the CH47FS will be prepared as part of the CTEA.

The BOIP model will be based on previously developed mathematical programming models (e.g., Heuristic Warehouse Location Program developed by Kuehn and Hamburger), and consider aircraft and aviator locations, numbers of aviators with specific qualifications and flight status categories, costs of transportation, aviator densities within various radii of proposed simulator locations, specific training needs, and other relevant factors, all of these projected over the expected life of the simulators.

## ADDITIONAL EVALUATION REQUIREMENTS

The ongoing evaluation of the CH47FS represents a significant advance in the procedures and methods for validation of the Army's stated flight simulator requirements. However, because of time and resource constraints, many questions pertaining to cost and operational effectiveness of flight simulators remain to be answered.

To find answers to these questions, future simulator evaluation efforts should address the following additional operational and technical issues:

1. Relative contribution of simulator subsystems and components to effectiveness of training.

2. Suitability of the simulator for other than initial aircraft qualification and CRF training.

3. Criteria needed for selection of members of test and control groups to minimize biasing of test results by matters extraneous to the test objectives.

4. The effect of sequencing of simulator and aircraft training on training effectiveness.

5. The effect of trainee and instructor aptitudes and experience on the effectiveness of simulator training.

6. The relative effectiveness of training to criterion levels, as opposed to training for specified training periods.

7. The relevance of fidelity of simulation to training objectives.

8. The effect of trainee and instructor attitudes on the effectiveness of simulator training.

9. Establishment of standards for instructor qualification.

10. The effect of training program content on training effectiveness.

11. The effect of instructional features of the simulator on training efficiency and effectiveness.

12. The effect of instructional techniques on training efficiency and effectiveness.

13. Establishment of requirements for tactical situation simulation.

14. Effect of "G" cues on the performance of specific maneuvers and on training effectiveness of the simulator.

## APPENDIX A

## REFERENCES

### 1. Military Publications

#### a. Army Regulations

(1) 5-5, The Army Study System
(2) 11-8, The Cost Analysis Program
(3) 37-13, Economic Analysis and Program Evaluation of Resource Management.
(4) 37-38, Weapon/Support Systems Cost Categories and Elements
(5) 70-1, Army Research, Development and Acquisition
(6) 70-10, Test and Evaluation During Development and Acquisition Cycle.
(7) 70-31, Standards of Technical Reporting
(8) 71-2, Basis of Issue Plans
(9) 71-3, User Testing
(10) 71-7, Military Training Aids and Training Aid Centers
(11) 71-9, Materiel Objectives and Requirements
(12) 95-1, Army Aviation: General Provisions and Flight Regulations
(13) 95-63, Army Aviation Standardization and Instrument Training
(14) 380-5, Safeguarding Defense Information
(15) 1000-1, Basic Policies for Systems Acquisition by the Department of the Army.

#### b. DA Pamphlets

(1) 11-2, Research and Development Cost Guide for Army Materiel Systems
(2) 11-3, Investment Cost Guide for Army Materiel Systems
(3) 11-4, Operating and Support Cost Guide for Army Materiel Systems
(4) 11-5, Standards for Presentation and Documentation of Life Cycle Cost Estimates for Army Materiel Systems
(5) 11-25, The Life Cycle Management Model

#### c. Field Manuals.

(1) 1-1, Terrain Flying
(2) 1-15, Aviation Company, Battalion, Group and Brigade
(3) 1-51, Rotary Wing Flight
(4) 1-55, Guide for the Operation of Army Airfields
(5) 1-60, Army Air Traffic Management in the Combat Zone
(6) 1-105, Aviator's Handbook
(7) 10-13, Supply and Service Reference Data
(8) 21-6, How to Prepare and Conduct Military Training
(9) 55-1, Army Transportation Services in a Theater of Operations
(10) 55-15, Transportation Reference Data
(11) 57-35, Airmobile Operations
(12) 61-100, The Division
(13) 90-1, Employment of Army Aviation Units in a High Threat Environment

(14) 100-5, Operations of Army Forces in the Field
(15) 101-10-1, Staff Officers Field Manual: Organizational, Technical, and Logistical, Unclassified Data
(16) 101-20, US Army Aviation Planning Manual

d. TRADOC Publications

(1) Reg 11-8, Cost and Operational Effectiveness Analysis (COEA) in the Materiel Acquisition Process
(2) Reg 71-3, Acceptance and Assignment of New Combat Development Tasks
(3) Reg 71-4, TRADOC Standard Scenarios
(4) Reg 71-6, Contract Support Policies, Procedures and Administration
(5) Reg 71-9, User Testing
(6) Reg 702-1, Combat Development Program for RAM
(7) Pam 11-8, COEA Handbook
(8) Pam 71-3, Combat Developments Study Writing Guide
(9) Pam 71-8, Analyzing Training Effectiveness
(10) Pam 350-8, Interservice Procedures for Instructional Systems Development
(11) TRADOC Supplement 1 to AR 71-2, Basis of Issue Plan

e. Miscellaneous

(1) AMC/TRADOC Materiel Acquisition Handbook
(2) USATRASANA Cost and Training Effectiveness Analysis (CTEA) Handbook (Draft)
(3) The Army Force Planning Cost Handbook
(4) DA Approved Qualitative Materiel Requirement (QMR) for a Synthetic Flight Training System (SFTS)(Rotary Wing), TDR 027.
(5) Development Plan for SFTS (Rotary Wing), Volume III, CH-47 Operational Flight Trainer
(6) Medium Lift Helicopter (MLH) CH-47 Modernization Program Concept Formulation Package, 14 July 1975
(7) ARTEP 57-55, Army Training and Evaluation Program for Combat Aviation Battalion (Infantry and Airborne Division).
(8) Air Force Master Plan: Simulators for Aircrew Training, Final Report, Dec 1975, ASD/XR-TR 75-25.
(9) Letter, ATTSC-TD, TRADOC, 28 Oct 76, subj: Training Development Study Directive: Cost and Training Effectiveness Analysis (CTEA) of the CH-47 Flight Simulator (CH47FS) ACN 23879
(10) Study Plan: Cost and Training Effectiveness Analysis (CTEA) of the CH-47 Flight Simulator (CH47FS). US Army Aviation Center, Ft Rucker, AL, 3 December 1976.
(11) Specification for CH-47C Helicopter Flight Trainer with Visual System. Engineering Development Unit, Device 2B31, 342-547D, 22 May 74 w/Amendment 1, dtd 7 Mar 75, Naval Training Equipment Center, Orlando, FL
(12) Outline Test Plan, Operational Test (OTII) for the CH-47C SFTS (2B31) OTN-137, 18 Nov 76.
(13) Allen, John L. "The Coming Payoffs of Improved Flight Simulators." Commanders Digest, US Department of Defense, Vol. 19, No. 16. Washington: US Government Printing Office, 29 July 1976.

(14) Holman, Garwin L. "CH-47 Flight Simulator Transfer of Institutional Training Test Plan," and "CH-47 Flight Simulator Transfer of Unit Flying Test Plan," Tabs A and B to Incl 2 to Study Plan: Cost and Training Effectiveness Analysis (CTEA) of the CH-47 Flight Simulator, US Army Aviation Center, Fort Rucker, AL, 3 Dec 76

2. Studies

a. Adams, J. A. Research and the future of Engineering Psychology. American Psychologist, 1972, 27, 615-622.

b. Adams, J. A. and McAbee, W. H. A Program for a Functional Evaluation of the GAM-83 Melpar Trainer. USAF: APGC-TN-61-41, Eglin AFB, FL, Oct 1961

c. Bryan, G. L. and Regan, JJ. Training System Design. In Van Cott, H. P. and Kinkade, R. G. (Ed.) Human Engineering Guide to Equipment Design. (Rev. ed.) Washington: Government Printing Office, 1972.

d. Caro, P. W. Some Current Problems in Simulator Design, Testing and Use. Paper presented at the Working Group on Training and Simulation, the 38th Military Operations Research Symposia of the Military Operations Research Society, Fort Eustis, VA, 9 Dec 76.

e. Caro, P. W. Equipment-Device Task Commonality Analysis and Transfer of Training. Technical Report 70-7, Human Resources Research Organization, Alexandria, VA, June 1970.

f. Caro, P. W. Some Factors Influencing Transfer of Simulator Training. Third Flight Simulation Symposium Proceedings, Royal Aeronautical Society, London, 1976.

g. Caro, P. W. Isley, R. N., and Jolley, O. B. Mission Suitability Testing of an Aircraft Simulator. Technical Report 75-12, Human Resources Research Organization, Alexandria, VA, June 1975.

h. Caro, P. W. Aircraft Simulators and Pilot Training. Professional paper 6-74, Human Resources Research Organization, Alexandria, VA, May 1974.

i. Gagne, R. M. Training Devices and Simulators: Some research issues. American Psychologist, 1954, 9, 95-107.

j. Gagne, R. M., Foster, Harriet, and Crowley, Miriam E. The Measurement of Transfer of Training. Psychological Bulletin, 1948, 45, 97-130.

k. Greer, G. D., Smith, W. D., and Hatfield, J. C. Improving Flight Proficiency Evaluation in Army Helicopter Pilot Training. Technical Report No. 77, Human Resources Research Office, Alexandria, VA, May 1962.

l. Isley, R. N. and Miller, E. J. The Role of Automated Training in Future Army Flight Simulators. Technical Report 76-27, Human Resources Research Organization, Alexandria, VA. August 1976.

m. Jacobs, R. S. and Roscoe, S. N. Simulator Cockpit Motion and the Transfer of Initial Flight Training. Technical Report ARL-75-18/AFOSR-75-8, Aviation Rsch Laboratory, Institute of Aviation, Univ of IL, Savoy, IL, Nov 1975.

n. Jeantheau, G. G. Handbook for Training Systems Evaluation. Technical Report NAVTRADEVCEN 66-C-0113-2, Naval Training Device Center, Orlando, FL, Jan 1971.

o. Koonce, J. M. Effects of Ground-Based Aircraft Simulator Motion Conditions upon Prediction of Pilot Proficiency. Technical Report ARL-74-5/AFOSR-74-3, Aviation Rsch Laboratory, Institute of Aviation, Univ of IL, Savoy, IL, April 1974.

p. Mackie, R. R., Kelley, G. R., Moe, G. L., and Mecherikoff, M. Factors Leading to the Acceptance or Rejection of Training Devices. Technical Report NAVTRAEQUIPCEN 70-C-0276-1, Naval Training Equipment Center, Orlando, FL, August 1972.

q. Meister, D., Sullivan, D. J., Thompson, E. A., and Finley, D. L. Training Effectiveness Evaluation of Naval Training Devices. Part II: A Study of Device 2F66A (S-2E Trainer) Effectiveness. Technical Report NAVTRADEVCEN 66-C-0113-2, Orlando, FL, January 1971.

r. Murdock, B. B., Jr. Transfer Design and Formulas. Psychological Bulletin, 1957, 54, 313-326.

s. Osgood, C. E. Method and Theory in Experimental Psychology. New York: Oxford University Press, 1953.

t. Povenmire, H. K., Alvares, K. M., and Damos, D. L. Observer-Observer Flight Check Reliability. Technical Report LF-70-2, University of Illinois Institute of Aviation, Savoy, IL, October 1970.

u. Povenmire, K. H. and Stanley, R. N. The Incremental Transfer Effectiveness of a Ground Based General Aviation Trainer. Technical Report ARL-72-9/AFOSR-72-4, Aviation Rsch Laboratory, Institute of Aviation, Univ of IL, Savoy, IL, May 1972.

v. Roscoe, Stanley, N. . Incremental Transfer and Cost Effectiveness of Flight Training Simulators. Technical Report ARL-74-9/AFOSR-74-5, Aviation Research Laboratory, Institute of Aviation, Univ of IL, Savoy, IL, August 1974.

w. Toomepuu, J. Army Flight Simulator Programs From the User's Viewpoint. Paper presented at Topical Review, Training Devices and Flight Simulators, Office of Director of Defense Research and Engineering, Washington, D. C, 12 May 1976. AD A029266

x. Toomepuu, J. Determining the Cost-Effectiveness of Flight Simulator Motion Systems. Paper presented at the Second DOD/NASA Simulation Technology Meeting, Moffett Field, CA, 21 July 1976.

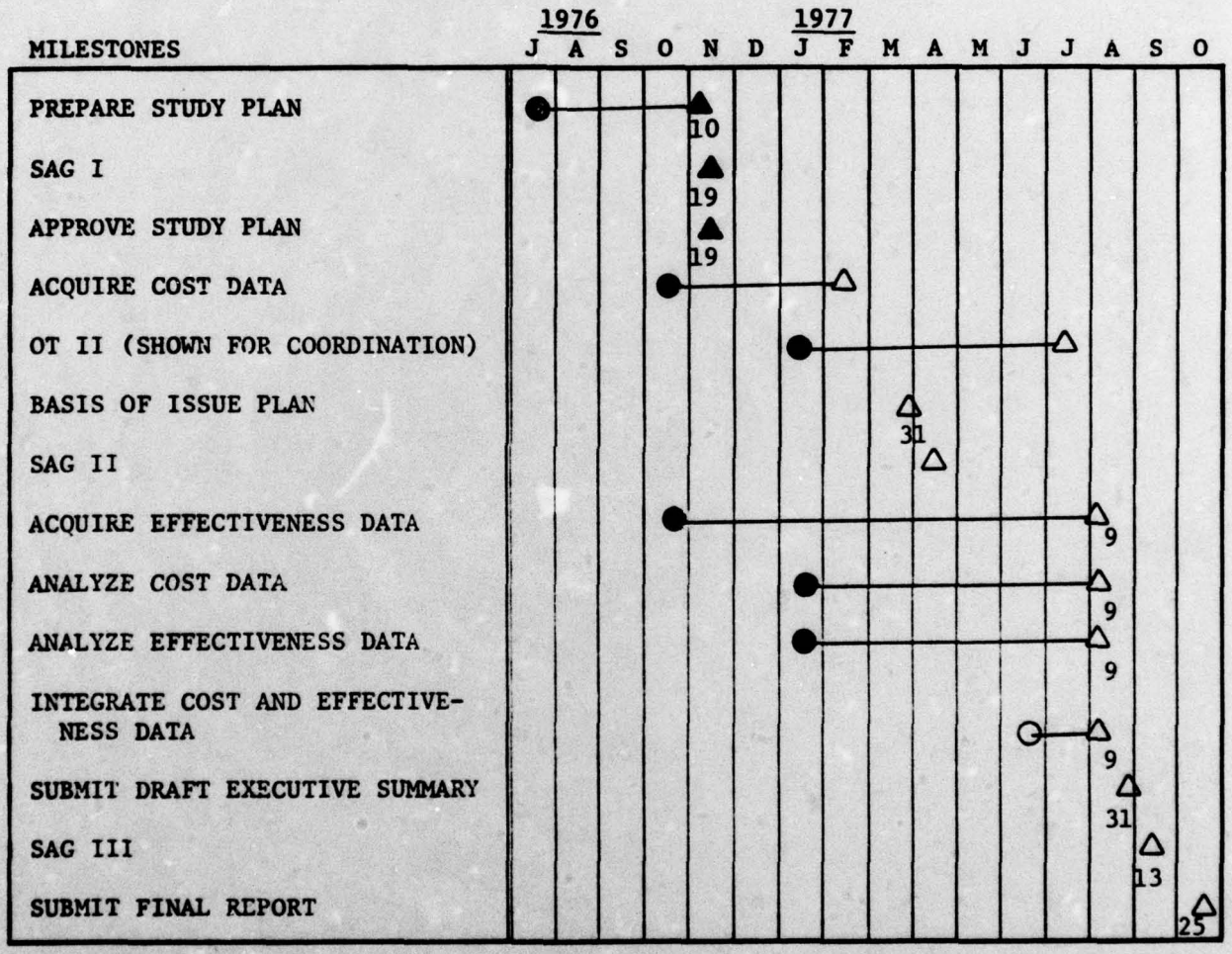
y. Toomepuu, J. Are Our Military Training Simulator Requirements Valid? Presentation at the American Institute of Aeronautics and Astronautics Visual and Motion Simulation Conference, Dayton, OH, 27 Apr 1976.

z. US Army Aviation Test Board, Final Report, Expanded Service Test UH-1H Field Unit Subsystem of Synthetic Flight Training System (SFTS) (Device 2B24), Ft Rucker, AL, April 1974.

aa. Williges, R. C., Hopkins, L. O., and Rose, D. J., Effects of Aircraft Simulator Motion Cue Fidelity on Pilot Performance. Technical Report ARL-75-11/AFOSR-75-4, Aviation Rsch Laboratory, Institute of Aviation, Univ of IL, Savoy, IL, June 1975.

## APPENDIX B

## CH47FS CTEA MILESTONE SCHEDULE



APPENDIX C

MINUTES OF THE CH47FS CTEA SAG I

DEPARTMENT OF THE ARMY

CH-47 FLIGHT SIMULATOR COST AND TRAINING EFFECTIVENESS ANALYSIS
STUDY ADVISORY GROUP

19 November 1976

SUBJECT: Minutes of Study Advisory Group Meeting I (SAG I)

1. The SAG was convened 18 Nov 76, 0900 hours, in building 506, USAAVNC, Ft Rucker, Alabama. The purpose of the meeting was to brief the SAG members on the CH47FS system and Operational Test (OT II) plan, to review the draft study plan, and to provide guidance to the study group.

2. A list of attendees and the agenda are attached as inclosures 1 and 2, respectively.

3. Opening remarks by Mr. Toomepuu, Deputy Chairman, emphasized the importance of the study. The study can be expected to have a great impact on Army aviation training and combat readiness and the expenditure of hundreds of millions of dollars. The scope and methodology of this study can be expected to make it a model for future flight simulator cost-effectiveness studies.

4. Briefing on the CH47FS system was presented by Mr. Paul Walker, DAC, PM TRADE.

5. Briefing on the Operational Test (OT II) was presented by CPT McGaugh, DCD, USAAVNC and Dr. Holman, Army Research Institute, Ft Rucker Field Office. CPT McGaugh gave an overview of the OT II plan and Dr. Holman gave the plan for determining the transfer of training from the simulator to the aircraft.

6. The study plan discussion was led by CPT Mowdy, USAAVNC CH47FS CTEA Project Officer. The effectiveness methodology was briefed by Mr. Songy and the cost methodology by MAJ Wallace, members of the USAAVNC CH47FS CTEA Study Group.

7. Recommendations from TRASANA, TRADOC DCSCD (Analysis Office), and other agencies concerning revisions to the draft study plan were consolidated, reviewed, and incorporated as appropriate. After careful consideration of all recommendations, the SAG unanimously recommended the submission of the plan as amended by the SAG to the TRADOC Deputy Chief of Staff for Training for approval.

8. The meeting adjourned 1200 hours, 19 November 1976.

2 Incl
as

FOR JURI TOOMEPUU, DAC
ERNEST A. SMART
COL, AR
SAG Chairman

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

CH-47 FLIGHT SIMULATOR COST AND TRAINING EFFECTIVENESS
STUDY ADVISORY GROUP MEETING (SAG) I
18 November 1976

LIST OF ATTENDEES

1. Members of the SAG:

| | | AUTOVON |
|---|---|---|
| Mr. Juri Toomepuu, DAC, Deputy Chairman | USA Tng Spt Center, ATTSC-TD | 927-4812-4813 |
| LTC Matt Kambrod | HQDA, DAMO-ODA | 225-0094/7761 |
| Mr. Paul Walker, DAC | DARCOM, DRCPM-TND-AV | 791-4615/5378 |
| MAJ James Joyner | FORSCOM, AFOP-AV | 588-4177/3971 |
| Mr. Richard S. Maccabe, DAC | USAAVNC, ATZQ-D | 558-5317/5416 |

2. Observers:

| | | |
|---|---|---|
| LTC W. L. Schneider | USAAVNC, ATZQ-D-SG | 558-3489 |
| LTC R. S. Stebbins | USAAVNC, ATZQ-D-SG | 558-3489 |
| MAJ R. Benson | USAAVNC, ATZQ-D-MT | 558-3489 |
| MAJ W. Kone | USAAVNC, ATZQ-TD-TAD-A | 558-6390/6876 |
| MAJ D. W. Kummer | USAAVNC, ATZQ-T-GFT-RW | 558-2289/4290 |
| MAJ. J. Stevens | USAAVNC, ATZQ-D-MT | 558-2405/5805 |
| MAJ. W. J. Wallace | USAAVNC, ATZQ-D-SGC | 558-5418/6316 |
| CPT G. Daniel | USAAVNC, ATZQ-T-GFT-RW | 558-4086/5987 |
| CPT H. W. Hayes | USAAVNC, ATZQ-D-SGA | 558-3485/2701 |
| CPT T. Maertens | USAADTA, STEBG-B-L | 558-3402 |
| CPT G. Magrath | USAADTA, STEBG-TS-L | 558-3013 |
| CPT M. F. McGaugh | USAAVNBD, ATZQ-OT-GS | 558-6407 |
| CPT T. C. Mowdy | USAAVNC, ATZQ-D-SGA | 558-3485/2701 |
| CPT W. L. Tillman | USAAVNC, ATZQ-D-SGC | 558-5418/6316 |
| CPT D. M. Young | USAAVNC, ATZQ-T-RTM-TM | 558-3603/3217 |
| CWO W. L. Finley | USAAAVS, IGAR-AR-LC | 558-4202/3198 |
| CWO J. E. Sefers | USAAVNBD, ATZQ-OT-GS | 558-6407 |
| Mrs. E. Berta | USAAVNC, ATZQ-D-SGC | 558-5418/6316 |
| Mr. W. R. Brown | USAAAVS, IGAR-TA | 558-4806/2091 |
| Dr. J. Dees | USA Aviation Board | 558-6578/2875 |
| Mr. J. M. Ellis | USAAVNC, ATZQ-D-SGC | 558-5418/6316 |
| Mr. J. H. Gray | USAADTA, STEBG-PD-P | 558-2101 |
| Mr. D. Hall | USAAVNC, ATZQ-TD-TAD | 558-5619 |
| Dr. G. Holman | ARI Field Unit, P. O. Box 476 Fort Rucker, AL 36360 | 558-6987/6980 |
| Mr. R. Ledbetter | USAAVNC, ATZQ-T-GFT-O | 558-5095 |
| Mr. W. G. Parsons | USAAVNC, ATZQ-RM-CM-CA | 558-5483 |
| Mr. C. Songy | USAAVNC, ATZQ-D-SGE | 558-2307/4908 |
| Mrs. S. Thorpe | USAAVNC, ATZQ-D-SGA | 558-3485/6316 |
| Mr. K. J. Young | USAAVNC, ATZQ-D-SGA | 558-3485/6316 |
| Mr. Dale Hall | USAAVNC, ATZQ-TD-TAD | 558-5619 |



INCL 1

DEPARTMENT OF THE ARMY
CH-47 FLIGHT SIMULATOR
COST AND TRAINING EFFECTIVENESS ANALYSIS STUDY ADVISORY GROUP

STUDY ADVISORY GROUP MEETING I (SAG I)

AGENDA

18 November 1976

0900 - WELCOME . . . . . .COL SAUERS (DCD, USAAVNC)

0910 - INTRODUCTORY REMARKS . . . . . MR. TOOMEPUU (ACTING SAG CHAIRMAN)

0920 - SYSTEMS OVERVIEW . . . . . .MR. PAUL WALKER (PM, TRADE)

0940 - OT II . . . . . .CPT MCGAUGH (DCD, USAAVNC)

DR. HOLMAN (ARI)

1015 - STUDY PLAN BRIEFING . . . . . .CPT MOWDY (CTEA PROJ OFF)

(EEFECTIVENESS) MR. SONGY (ORSA DAC GS-12)

(COST) MAJ WALLACE (CH, COST BRANCH)

1130 - LUNCH

1230 - STUDY PLAN BRIEFING . . . . . .CPT MOWDY (CTEA PROJ OFF)

1400 - WORK SESSION, REVIEW OF THE STUDY PLAN AND FORMULATION OF GUIDANCE . . . . . .MR. TOOMEPUU (DEP SAG CHMN)

1600 - COMMENTS BY DA SAG MEMBER . . . . . .LTC KAMBROD (HQDA)

1615 - ADJOURN

19 November 1976

0900 - WORK SESSION AND DRAFTING OF MINUTES . . . . . MR. TOOMEPUU (DEP SAG CHMN)

1200 - ADJOURN





INCL 2