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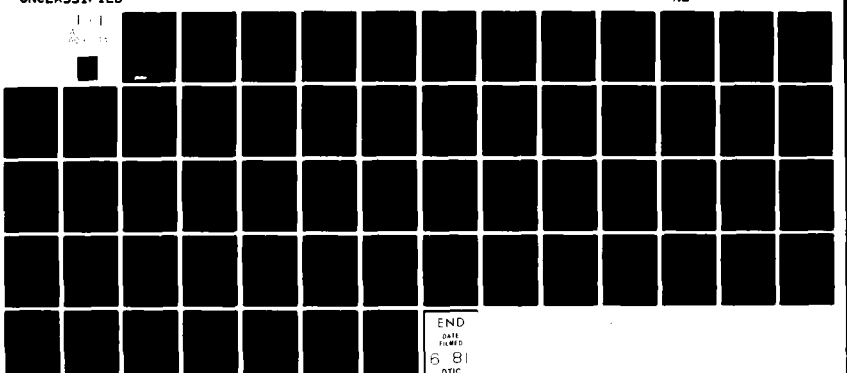

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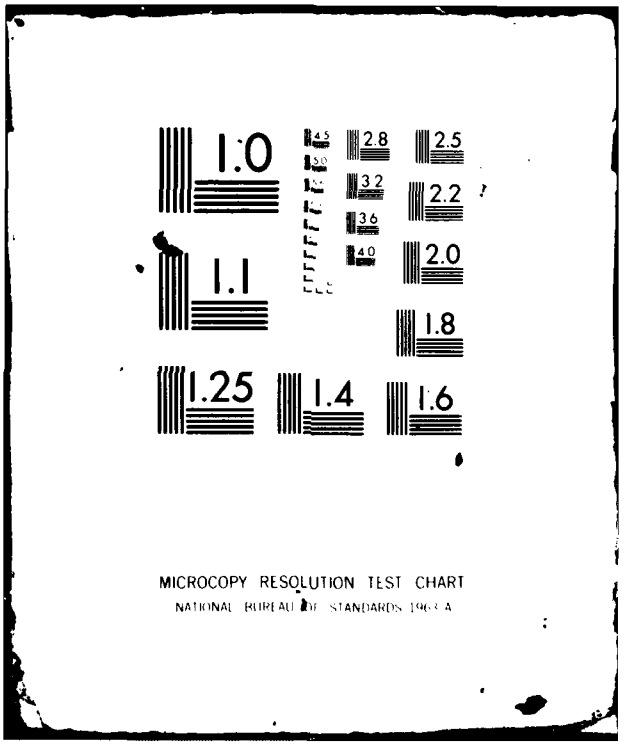
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Report on

21 F-16 AIRCREW TRAINING DEVELOPMENT PROJECT.

Contract No. F02604-79-C8875

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A USER'S GUIDE TO THE
F-16 TRAINING DEVELOPMENT REPORTS

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Prepared in support of CDRL no. B069

by

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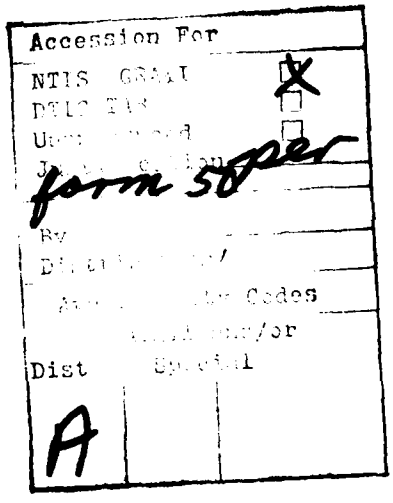
PREFACE

This report was created for the F-16 Aircrew Training Development Project contract number F02604-79-C8875 for Tactical Air Command to support CDRL no. B069. The project entailed the design and development of an instructional system for the F-16 RTU and instructor pilots. During the course of the project a series of development reports was issued describing processes and products. A list of those reports is contained on the next page. The user is referred to Report No. 34, A Users Guide to the F-16 Training Development Reports, for an overview and explanation of the series, and Report No. 35, F-16 Final Report, for an overview of the Instructional System Development Project.



F-16 AIRCREW TRAINING DEVELOPMENT PROJECT REPORTS

Copies of these reports may be obtained by writing the Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314. All reports were reviewed and updated in March 81.

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EXECUTIVE SUMMARY

The F-16 Aircrew Training Development Project is thoroughly documented by a series of 35 individual development reports. This report describes the organization of the report series and provides a one page executive summary of each report. While the final report, No. 35, is designed to summarize the four year development effort in a single document, report No. 34 is designed to index the report series for those readers who desire additional information concerning a particular event or phase within the program.

CONTENTS

		Page
Preface		i
F-16 Aircrew Training Development Project Reports		ii
Executive Summary		v
1.0 ORGANIZATION OF THE REPORT SERIES		1
2.0 EXECUTIVE SUMMARIES		2
2.1 Report No. 1:	Program Work Plan	6
2.2 Report No. 2:	Revious ISD Program Review	7
2.3 Report No. 3:	Data Collection and Management Forms Report	8
2.4 Report No. 4:	Review of Existing F-16 Task Analysis	9
2.5 Report No. 5:	Derivation, formatting, and use of Criterion-Referenced Objectives (CROs) and Criterion-Referenced Tests (CRTs)	10
2.6 Report No. 6:	F-16 Task Analysis, Criterion-Referenced Objectives, and Objectives Hierarchy Report	12
2.7 Report No. 7:	Task Analysis Methodology Report	13
2.8 Report No. 8:	Objectives Hierarchy Analysis Methodology Report	15
2.9 Report No. 9:	Goal Analysis Report	16
2.10 Report No. 10:	Data Base Update Procedures Report	17
2.11 Report No. 11:	Data Automation of Task and Goal Analysis: Exiting System Review and Recommendation	19

2.12 Report No. 12: Management System Needs and Design Concept Analysis 21

2.13 Report No. 13: F-16 Pilot and Instructor Pilot Target Population Study 22

2.14 Report No. 14: Recommendations for the F-16 Performance Measurement System . . 23

2.15 Report No. 15: Program/System Constraints Analysis Report 25

2.16 Report No. 16: A Study of Media Production and Reproduction Options For the F-16 Project 26

2.17 Report No. 17: Computer Managed Instruction For the F-16 Project 28

2.18 Report No. 18: F-16 Implementation and Management Plan Report 30

2.19 Report No. 19: Quality Control Plans, Procedures, and Rationale For the F-16 Pilot Training System 31

2.20 Report No. 20: F-16 Media Selection and Utilization Plan Report 32

2.21 Report No. 21: F-16 Instructional System Cost Study Report 34

2.22 Report No. 22: Recommendations For F-16 Operational Flight Trainer (OFT) Design Improvements 35

2.23 Report No. 23: F-16 Instructional Sequencing Plan Report 36

2.24 Report No. 24: F-16 Coursewares and Syllabi Delivery Schedule 38

2.25 Report No. 25: F-16 Instructor/Course Manager Training Requirements Report . . . 39

2.26 Report No. 26: F-16 Pilot Media Selection 40

2.27 Report No. 27: F-16 Instructional System Design Alternatives 41

2.28 Report No. 28: F-16 Instructional System Basing Concept 43

2.29 Report No. 29: Task Listings and Criterion-Referenced Objectives for the Instructor Pilot (IP) F-16 Training Program 44

2.30 Report No. 30: F-16 Training System Media Report 45

2.31 Report No. 31: F-16 Training Media Mix 46

2.32 Report No. 32: F-16 Training Media Support Requirements 47

2.33 Report No. 33: F-16 Training Media Constraints and Limitations 48

2.34 Report No. 34: A User's Guide to the F-16 Training Development Reports 49

2.35 Report No. 35: F-16 Final Report 50

A USER'S GUIDE TO THE F-16 TRAINING DEVELOPMENT REPORTS

1.0 ORGANIZATION OF THE REPORT SERIES

The 35 Development Reports in the F-16 Report series fall into the following five general categories: (1) problem analysis, review, and feasibility studies, (2) methodology reports, (3) data base documents, (4) system operating manuals, and (5) summary reports. The reports in each category are listed below:

Problem analysis, review, and feasilbility studies.

- Program Work Plan (#1)
- Previous ISD Program Review (#2)
- Data Collection and Management Forms (#30)
- Review of Existing F-16 Task Anaylsis (#4)
- Data Automation of Task and Goal Analysis Existing System Review and Recommendations (#11)
- Management System Needs and Design Concept Analysis (#12)
- Program/System Constraints Analysis Report (#15)
- A Study of Media Production and Reproduction Options For the F-16 Project (#16)
- Computer Managed Instruction for the F-16 Training Program (#17)
- Recommendations for F-16 Operational Flight Trainer (OFT) Design Improvements (#22)
- F-16 Instructional System Design Alternatives (#27)
- F-16 Training Media Constraints and Limitations (#33)

Methodology Reports

- Derivation, Formatting, and Use of Criterion-Referenced Objectives (CROs) and Criterion-Referenced Tests (CRTs) (#5)
- Task Analysis Methodology Report (#7)

Objectives Hierarchy Analysis Methodology Report (#8)

F-16 Media Selection and Utilization Plan Report (#20)

F-16 Instructiona Sequencing Plan Report (#23)

F-16 Training System Media Report (#30)

F-16 Training Media Mix (#31)

F-16 Training Media Support Requirements (#32)

Data-Based Documents

F-16 Task Analysis, Criterion-Referenced Objective, and Objectives Hierarchy Report (#6)

Goal Analysis Report (#9)

F-16 Pilot and Instructor Pilot Target Population Study (#13)

F-16 Coursewares and Syllabi Delivery Schedule (#24)

F-16 Instructor/Course Manager Training Requirements Report (#25)

F-16 Pilot Media Selection (#26)

Task Listings and Criterion-Referenced Objectives For the Instructor Pilot Training Program (#29)

System Operating Manuals

Data Base Update Procedures Report (#10)

Recommendations For the F-16 Performance Measurement System (#14)

F-16 Implementation and Management Plan Report (#18)

Quality Control Plans, Procedures, and Rationale For the F-16 Pilot Training System (#19)

F-16 Instructional System Cost Study Report (#21)

F-16 Instructional System Basing Concept (#28)

Summary Reports

A User's Guide to the F-16 Training Development Reports (#34)

F-16 Final Report (#35)

These five categories of documents were generated in a roughly chronological order. First a series of instructional analysis was performed, which determined the content and structure of the F-16 Training Program. Second, a series of methodology reports was issued, documenting the techniques utilized in the analysis, design, and development of the program. Third, the data bases generated during analysis, design and development were recorded for future use in maintaining and modifying the training system. Fourth, the operating manuals or instructions to users were generated, which described the system and its operation. Finally, the entire history and output of the four year program was reviewed, consolidated and recorded in the summary reports. A more detailed description of the major categories follows:

Problem analysis, review, and feasibility studies: These investigations were conducted prior to the development of the F-16 training system in order to ensure the design of an effective and efficient system. These reports examine the problems to be solved, the resources available to implement solutions, and the primary solution alternatives. They go on to recommend preferred solutions, such as heavy reliance on computer-assisted and computer managed-instruction.

Methodology Reports: The second group of reports are related to ISD procedures such as analysis of tasks, analysis to produce the hierarchy of instructional objectives, selection of instructional media, and generation of syllabi. In conducting these analytical studies the project staff refined or extended some existing methods and procedures. In other cases it was necessary to invent new procedures appropriate to specific development problems, such as the measurement of incoming student abilities. Separate reports have been prepared in order to describe the methodological innovations. These methodology reports also describe some of the problems encountered and attempt to compare and contrast the procedures employed with existing methodologies.

Data Base Documents: The product of the task analysis process was an inventory of F-16 pilot tasks. This task listing was subsequently used to generate a pool of criterion-referenced objectives. The objectives were used in generating the course syllabus and also the media selections. The output data obtained from these studies constitute the data base for the F-16 training system. The contents of the data base are stored on the memory disk of a word processor where they can be readily updated and listed. The contents are also documented in the data base reports.

Since the F-16 is an emerging weapon system, it is necessary to periodically update the data base as changes in the aircraft or its operational procedures are initiated by the Air Force. Specific procedures for keeping the data base current and complete are described in project report no. 10, "Data Base Update Procedures Report". To the extent that the data base is inadequate, incomplete, or out of date the training system will be deficient.

System Operating Manuals: The F-16 training system is a complex assemblage of instructional components and management procedures. Some of the management procedures are actually subsystems within the main system. The "F-16 Implementation and Management Plan Report" presents an overview of the entire system and prescribes procedures for installing the system. The other system operating manuals are a series of handbooks containing and utilizing the various subsystems in the prescribed manner. Training wing commanders, ISD monitors, OTD team members, and other Air Force personnel responsible for administering the F-16 training system should become very familiar with these documents and should refer to them frequently.

These manuals are intended to be working documents. They should also be revised as changes in the subsystems are introduced and as experience with the prescribed procedures accumulate.

Summary Reports: These two documents represent after-the-fact description of the processes utilized and products developed during the development effort. They describe the state of the program in March of 1981, when the civilian contractor completed the initial development work. It is recommended that the OTD team issue yearly updates to the Final Report, documenting the changes made to the F-16 Training System.

2.0 EXECUTIVE SUMMARIES

This section contains a one to two page Executive Summary of each report in the F-16 Aircrew Training Development series. These summaries are included in the front matter of their respective Reports and have been lifted from them verbatim. The size and scope of the summary does not reflect the magnitude of its corresponding report, which may contain anywhere from 10 to 1,000 pages.

2.1 Report No. 1: Program Work Plan

EXECUTIVE SUMMARY

In order to allow precise scheduling and monitoring of the F-16 Instructional Systems Development effort, a detailed work plan for the project is outined. This work plan involves nine phases, each of which is divided into numerous tasks. Phase sequence plans show the tasks to be performed in each phase of the project and define the input/output interdependencies that exist between them.

Phase I (1 task) involves a review of the contract proposal and a briefing to USAF and contractor/subcontractor personnel. Phase II (6 tasks) involves development of the detailed work plan (this document), a review of the existing F-16 task analysis, the design of data collection and management forms, the development of a task and goal analysis work plan, and the design of the format for criterion-referenced objectives (CROs) and tests to be used in the training program. Phase III (13 tasks) involves the completion of a task analysis, goal analysis, and system constraints analysis. The major outcomes of these analyses are the selection of tasks for training and the development of CROs and tests. Phase IV (24 tasks) represents the major design phase of the project and includes course and syllabus design, media analysis and selection, design of the instructional management and quality control system, and definition of the instructor/course manager requirements. Phase V (9 tasks) involves the development and production of the courseware (including instructor/course manager courses) and the development of the instructional management system. Phase VI (10 tasks) involves validation and revision of the training system, simulator certification, the development of basing concepts, data base management, and the development of the project Final Report.

For each task within each phase, a detailed list of events is provided in tabular format with columns for personnel and completion dates. This allows the present work plan to be used as a detailed progress monitoring instrument and also facilitates easy revision to the work plan during the course of the project.

2.2 Report No. 2: Previous ISD Program Review

EXECUTIVE SUMMARY

The F-16 Instructional Systems Development (ISD) effort represents the most comprehensive application of ISD principles and procedures for pilot training yet conducted within the Air Force. In order to avoid the shortcomings and problems of previous Air Force applications of ISD, a careful analysis of past Air Force ISD programs has been accomplished to determine: (1) the lessons which have been learned that relate to the F-16 efforts and (2) those problems that have presented the most difficulty in the application of ISD technology to pilot training. This report summarizes the results of that analysis.

Interviews were conducted with ISD personnel from A-7, A-10, F-15, and F-4 communities. Conclusions drawn from the results of the interviews are as follows:

1. Ensure command support and understanding of F-16 ISD programs and principles is maintained.

2. Man ISD teams adequately and with trained ISD specialists.

3. Document all F-16 efforts including rationales for all decisions and policies for use in future programs.

4. Provide sufficient support for data handling and access, i.e., a dedicated ISD ADP system.

5. Establish a joint ISD/FLIT team to coordinate and smooth the way from Fighter Lead-in Training to Combat Crew Training (CCT) squadrons.

6. Tactics training will be a problem area. Experimentation and use of other fighter aircraft experience will be necessary.

7. Review thoroughly the A-10/F-15 ISD experience for insight in establishing the line of division between CCT subjects and continuation training subjects.

8. Special attention should be paid to alternate training methods to substitute for the unavailability of trainers in the initial phases of the F-16 training project.

9. Objective evaluation, (CROs and CRTs), must be developed in close cooperation with STAN/EVAL personnel.

2.3 Report No. 3: Data Collection and Management Forms Report

EXECUTIVE SUMMARY

This report details the forms developed for organizing and storing the voluminous ISD data/information generated by the F-16 training project. The forms are designed to accommodate continually changing data relative to hundreds of tasks, instructional objectives, and production elements. Although the forms are the product of experience in manually operated systems, they are compatible with computer based data systems. The formats used have been changed and modified as necessary as F-16 ISD procedures have changed.

This report presents a sample and description of the forms used in the analysis and design phases of the program, that is (1) tasks listing and objectives hierarchy analysis (task listing/objectives hierarchy worksheet and task specification worksheet), (2) media selection (hands-on media selection forms, media by capability matrices, media priority by segment sheet, and media selection tally sheet), (3) personnel management (weekly time summary sheet), (4) production management (production management forms, weekly progress report, and production tracking chart), and (5) pre-implementation evaluation (student attitude questionnaire).

The fact that the forms illustrated and described were designed and redesigned during the F-16 project is not of concern, since forms are management tools to serve the thought processes, and not vice versa. Tools in any industry are designed/redesigned to meet the changing requirements of that industry.

Despite their susceptibility to change, it is recommended that great care be taken in providing the data called for by the forms because they are the product of experience gained from other ISD projects. Also, by early development of these forms, data collection was timely and systematic, resulting in the savings of time and money.

Data bases required for an automated ISD management system have all been defined, should automation be implemented after the contractor has left the F-16 training program.

2.4 Report No. 4: Review of Existing F-16 Task Analysis

EXECUTIVE SUMMARY

A task analysis is a very critical and fundamental component of an ISD project since it ultimately determines what tasks and contents will be included in the training program. The existing task analysis for the F-16 pilot compiled by General Dynamics was analyzed in terms of the specific requirements of the F-16 training program. Five major criteria were used:

1. Appropriate level of detail.

2. Adequacy of coverage of job tasks.

3. The mission orientation (rather than equipment orientation) of the analysis.

4. Appropriate scope of behaviors.

5. Logical consistency of task breakdown.

The level of detail and scope of this existing task analysis were found to be adquate. The coverage of job tasks was found to be inadequate and in need of revision. The mission orientation of the existing analysis was considered to be weak in the areas of tactics, premission planning, and air-to-surface combat. The logical consistency of the analysis was found to be weak and in need for revision in the areas of air maneuvers and system operations.

It was concluded that the existing F-16 task analysis would be helpful as a suggestive tool, but additional analysis is required to provide a solid foundation for the F-16 ISD effort. Areas particularly needing attention are those behaviors associated with cognitive performance (e.g., air-to-air or air-to-surface combat, mission planning, navigation, etc.) as opposed to equipment operation.

2.5 Report No. 5: Derivation, Formatting & Use of CROs & CRTs

EXECUTIVE SUMMARY

An integral part of the F-16 instructional design process involves the development of criterion-referenced objectives (CROs) and criterion-referenced tests (CRTs). This report defines both CRO and CRT as used in the F-16 project. It also specifies procedures and conventions that were used to write them.

There are several benefits associated with the use of CROs and CRTs. By following the procedures described in this report, a team of minimally trained people can produce a clear definition of the contents of a training program. The problems of not knowing where to start, guesswork, and confusion are eliminated when this systematic approach is used.

CROs represent specific behavioral statements about expected student performance after the completion of instruction. The conditions and standards of acceptable performance are also part of this statement. Specifying instructional outcomes in terms of student performance has a number of advantages:

1. CROs are related directly to actual job performance.

2. CROs provide a focus for the student in the form of a statement describing what he should be able to do.

3. CROs provide a source of feedback to the student by offering him a chance to compare his performance with the required performance, which in turn means that a large part of the instruction becomes self-guided.

The CRTs are a logical extension of the CROs. They measure the attainment of the CROs. Since the CROs consist of actual job performance objectives, the CRTs provide the instructor and the student with a profile of the student's strengths and weaknesses on job performance. CRTs for the measurement of CROs have the following minimal characteristics.

1. A description of the environment and equipment required in the test setting.

2. A description of the problem situation.

3. A set of instructions to the student describing the performance expected.

4. A description of the evaluator of the behavior to be measured or noted.

5. A set of evaluation rules for rating each measurement to determine mastery.

6. A method or form for the evaluator to record the results of the measurements.

7. A rule for combining individual measurements in a task or course into a pass/fail statement.

In summary, CROs and CRTs tell all personnel involved in pilot training just exactly what should be taught, what should be learned, and what level of competence is expected.

2.6 Report No. 6: F-16 Task Analysis, CRO, Objectives Hierarchy

EXECUTIVE SUMMARY

This report contains the F-16 pilot training task listing, criterion-referenced objectives (CROs), objectives hierarchies, and coursemap. A task listing is the logical breakdown of a task or job into its component subtask. For instructional purposes, each of these subtasks is then converted into a CRO complete with conditions and standards for successful performance. The interrelationship of the CROs is identified and represented in a hierarchical arrangement.

For example, the major task of "performing the duties of an F-16 pilot" was divided into the following 11 subtasks:

1. Premission planning
2. Pretakeoff procedures
3. Takeoff
4. Departure
5. Enroute procedures
6. Air refueling
7. Combat
8. Recovery
9. Landing
10. Post-flight procedures
11. Mission debriefing

Each of these subtasks were then broken down into smaller performances. For instance, under premission planning such tasks as collect weather data, collect operations data, etc. were identified. These performances form the basis of the CROs. This reduction in task complexity provides the logical rationale for the hierarchical arrangement.

All tasks relevant to the F-16 training program are listed in this report. This provides the foundation for all subsequent instructional design and development activities.

2.7 Report No. 7: Task Analysis Methodology Report

EXECUTIVE SUMMARY

A well done task analysis reduces waste from too much instruction while at the same time ensures important skills are taught. Task analysis is a process of breaking a job into an inventory of component tasks called a task listing. The task listing must provide an accurate, comprehensive list of all tasks performed on a job in order for a training program to include instruction of relevant behaviors. The task listing forms the foundation from which every major activity in the instructional development process follows. Its importance is therefore paramount.

The task listing procedure used in the F-16 project involved the following steps:

1. Listing of all responsibility areas for a given job.
2. Listing of all major missions within each responsibility area.
3. Dividing missions into phases.
4. Listing of all tasks for each phase by means of a mental "walk through" with a subject matter expert (SME).
5. Organizing tasks so that all levels of tasks are independent.
6. Identifying all unusual conditions in tasks which may require additional training.
7. Examining current course curricula, technical manuals, equipment, etc. for possible omissions.
8. Reviewing task listings with SME(s) outside of the analysis team.

Since turnover in personnel involved in the original F-16 task analysis can be expected, the methodology used for the analysis is outlined in this report. The ability to acquaint new personnel with the specific steps of the analysis is important for several reasons. The analysis was done on an emerging weapons system and changes in the task listing can be expected. Personnel must know how to incorporate new tasks within the existing task listing. Also, following an outlined methodology decreases the chances of omissions or unnecessary "reinventing the wheel." Informed decisions on task changes and listing will lead to optimal growth of the F-16 training program.

Because the task listing must be seen as an evolving document, the secondary purpose of this report is to suggest procedures and role assignments that would facilitate the management and updating of the task listing. To ensure proper maintenance of the task listing, it is recommended that organizational roles and responsibilities for task listing changes be clearly defined and the required information channels be established via routine procedures. In addition, a number of resources should be accessible, such as word processing, necessary personnel, and reproduction facilities.

2.8 Report No. 8: Objectives Hierarchy Analysis Methodology Report

EXECUTIVE SUMMARY

Objective hierarchy analysis is the process of identifying the specific instructional performances students must achieve in order to master the behaviors indicated in a task listing. The objectives identified in the hierarchy analysis should include all of the categories of behavior required to prepare students for on-the-job performance. These categories include verbal behaviors, motor behaviors, and intellectual skills. The objective hierarchy analysis procedure used in the F-16 project included the following steps:

1. A task is selected.
2. Subtasks are listed.
3. Decision-making behaviors (classification and rule using) are identified.
4. Motor control behaviors are identified.
5. Verbal support (summarization) requirements are identified.
6. Minor tasks are grouped for instruction.
7. Dangerous and excessively expensive behaviors are scaled back.
8. Knowledge-base requirements are determined.
9. Remaining tasks are eliminated (pruning).
10. A new task is selected and processing begins again.

In order to facilitate the updating and revision of the objectives hierarchies, the maintenance responsibilities of various ISD personnel and the related support requirements are described.

2.9 Report No. 9: Goal Analysis

EXECUTIVE SUMMARY

Goal analysis is the process of translating instructional goals into observable indicator behaviors which can be taught and measured. In order to develop a list of goals for the F-16 pilot training program, a literature review was conducted and experienced F-4 pilots were interviewed to identify the attributes and attitudes characterizing a successful combat pilot. From these data, a list of eleven major goals was identified. These goals are:

1. A high standard of preparation.
2. Excellent physical fitness.
3. Highly self-relient.
4. Timely and decisive in actions.
5. Situational awareness during flight.
6. Detailed knowledge of enemy tactics, capabilities, and weaknesses.
7. Highly flexible and resourceful.
8. Foresight.
9. Competitive and aggressive in combat.
10. Maintain composure in combat.
11. Possess a high degree of discipline.

For each goal, indicator behaviors and characterisitics to be incorporated into the instructional system to facilitate these goals were identified. This information will be important in the development of the performance measurement system as well as the quality control of the F-16 training project.

2.10 Report No. 10: Data Base Update Procedures Report

EXECUTIVE SUMMARY

This report describes procedures for updating the following five major ISD data bases:

1. Pilot task analysis.

2. Goal analysis.

3. Criterion-referenced objectives (CROs).

4. Objectives hierarchies.

5. Program reports.

These data bases are divided into two types which require updating; interdependent data bases and isolated data bases.

The interdependent data bases include the task listings, CROs, and objective hierarchies. Because these lists are highly interrelated changes in one listing requires changes in the other two lists. As an example, changes in the heads-up display (HUD) of the aircraft might require that all HUD related tasks are examined for updating. Changes in the task listing may require changes in the objectives hierarchy and the CROs involving the HUD. Thus, changes in an interdependent data base require changes in related data bases.

Isolated data bases such as reports, i.e., the target population study, can be changed and updated without affecting other data bases. Isolated data bases are independent and changes in one data base will not require the updating for rewriting of other data bases.

Changes to these data bases arise from two sources; external and internal. External changes derive from sources outside the ISD process such as equipment modifications, changes in tactics, or different student entry skills. Internal changes are those revisions which derive from the ISD process itself such as a need for changes as pointed out by a program evaluation.

The process of changing the data bases starts when a member of the contractor staff or OTD team becomes aware of the need for a change to data base documents or reports. A hard copy of the pertinent data is obtained by that person and proposed changes are inserted into these printouts and the appropriate revision forms. The changes are reviewed by appropriate personnel and if approved all areas affected by the change are noted and the

change is incorporated into the appropriate document/report data bases. The procedure described is a general overview of the data update procedures. The report includes specific steps for updating both interdependent and isolated bases as well as the task revision and report revision forms to be used.

2.11 Report No. 11: Data Automation of Task and Goal Analysis

EXECUTIVE SUMMARY

Development report no. 11 reviews the existing data automation system for task and goal analysis before making recommendations (1) concerning the use/nonuse of automatic data processing (ADP) in support of task and goal analysis processing and (2) proposing a suitable automated system, if automation is recommended:

Two possible methods of utilizing ADP support are discussed: (1) as an authoring aid and (2) to assist in record keeping, validation, and updating of task and goal lists.

Although ADP could be used during the early authoring stage of task and goal analysis by providing automatically sequenced prompts ("how to do it" displays), it is not recommended for two reasons.

1. The interactive nature of the analysis processes (frequent reconsideration, juggling, and rewriting of task/subtask hierarchies) is better handled on a large working surface where alternatives are all in view for arrangement and possible modificiation.

2. Subtle judgements are included in analyses which are best handled by experienced training analysis specialists.

ADP is well suited for handling the accumulation, storage, and recall of the hundreds of F-16 tasks and the task numbers, behaviors, conditions, standards, and CRO data for each of the F-16 tasks. Validation reviews and updating are also handled easily by ADP.

The existing TAC ADP system uses the Burroughs 550 computer system and is described in TACM 50-300. This system provides good ADP support in reducing information survey time. However, it has important shortcomings involving:

1. Card input time and storage: All program input is recorded on punched data cards. This is a cumbersome system because task data must be coded and formatted, cards must then be punched by a qualified keypunch operator and hand carried to the data automation unit. Stored cards are subject to jumbling and require a substantial staffing

2. Off-line operation turnaround time: Data extraction is not rapid. It usually requires several hours because the user does not interface directly with the program. The user must

submit cards, which are stacked/queued to await processing and the final printout.

3. Program maintenance/user sophistication: The present system is powerful, but effective use requires a project staff member with a good working knowledge of the computer program.

4. The lack of a goal analysis program: The present program analyzes tasks but not goals.

Recommendation: We recommend using the DEC WPS-8 Word Processing System. This system is now used at the F-16 project office. The system is very cost effective and offers immediate support for task and goal analysis. Although it lacks some of the formatting abililities of the present system, it has a powerful sorting ability and also other major advantages i.e., (1) incorporates micro-electronics for size-reduction, (2) is a self-contained microprocessing system with a printer, therefore, eliminating cumbersome punch cards, (3) interface is direct through a keyboard and screen, (4) work is performed on-line so turnaround time is immediate (5) storage is on convenient flexible diskettes, each of which holds over 3,000 punchcards (6) operation is simple, and doesn't require a program language code. Secretaries usually develop the basic skills in one week of concentrated practice/training.

We feel the benefits of the DEC-WPS-8, many of which are readily available, will provide the USAF F-16 program with a modern, responsive, and flexiblle ADP system. Not only is the system inexpensive but it should result in extensive savings of time and money.

2.12 Report No 12: Training Management System

Needs Analysis

EXECUTIVE SUMMARY

Within TAC the complexity of the weapons systems is increasingly rapid. There is also a corresponding increase in the training requirements for these systems. In order to develop and maintain an efficient and effective training program within realistic constraints of manpower and training resources, the management system should be responsive to the following needs:

1. Lifetime maintenance of the training program.
2. Standardization of the approach to modifying the training system.
3. A method of exploring varying program alternatives.
4. Quick response.
5. Early detection of problems.
6. Flexibility to meet changing needs.
7. Self-monitoring capabilities.
8. Capability to deal with large amounts of data.
9. Establishment of a historical data base.
10. Redundant management of information.
11. Operation of the system at the user level of training managers, instructors, and students.

Existing training management systems were reviewed and were found to be deficient in terms of their capabilities of meeting the above needs. For example, none of the systems have provided adequate support for the initial ISD effort, nor were they found to be adequate for long term support of an ISD project.

Based on the identified needs and the information gained by examining previous and existing training management systems, a system is described which has the potential capability of meeting the needs of the F-16 training project. This system is a mix of procedures, personnel, support capabilities, and organizational structures that will facilitate the planning, management, and implementation of the F-16 program over the life cycle of the aircraft.

2.13 Report No 13: F-16 Pilot and Instructor Pilot Target Population Study

EXECUTIVE SUMMARY

A target population study provides a detailed description of incoming student characteristics and focuses on prior training and entry-level skills relevant to the training program being designed. The F-16 target population study involved the following major activities.

1. A review of existing student population studies.

2. Interviews with training personnel and graduates.

3. An incoming student inventory using the F-16 pilot task listing.

The data obtained from F-4 and F-15 profiles indicates that the initial F-16 IPs will be considerably more experienced than IPs later in the program. This suggests that the initial IP syllabus will need to be changed to reflect this characteristic. Data obtained from the F-4 and F-15 conversion and course population suggests a similar difference between initial and subsequent students, particularly in the area of tactical knowledge.

Student pilots for the B (basic) F-16 course will normally have graduated from the USAF Undergraduates Pilot Training (UPT) program and the Fighter Lead-in Training (FLIT) program. The selection of students; their educational background, physical characteristics, psychological background, and flight experience; and the training syllabi of UPT/FLIT are examined. This data was used to develop a skill profile of the incoming B students to be used in other F-16 instructional design/development activities.

2.14 Report No 14: Recommendations for the F-16 Performance Measurement System

EXECUTIVE SUMMARY

The major purpose of this report is to present "state of the art" recommendations for developing the F-16 PMS. Before the recommendations are made, theoretical and practical concerns that a PMS must address are presented. Theoretical issues such as reliability, validity, and the rule linking measurement to grades are seen as fundamental to the measurement process. But these concepts must be implemented within real world constraints.

Since regulations, for example TACR 50-31, determine the structure and content of performance measurement practice, these documents were reviewed and their guidelines evaluated in terms of existing systems within the Air Force. The A-10, F-15, and F-4 systems were reviewed. The direction provided by TACR 50-31 ranges from precise prescriptions to very broad guidelines. This has both good and bad points. On the one hand, the broadness of the guidelines allows flexibility for individual training systems to adapt to local needs. However, the lack of specifics on critical matters like grade interpretation, the remediation process, and the function of gradeslips are seen as ambiguous areas that might lead to confusion.

The final section of the report presents a proposal for the F-16 PMS. Although specific proposals are made on the tools to be used, personnel involved, and record keeping incorporated in the PMS, this summary will present only the highlights of the proposed system. The major innovations are as follows:

1. Use of automated academic tests and quizzes.

2. Concern with higher level evaluation rather than rote memorization (where appropriate).

3. Use of a comprehensive student progress report.

4. Improved gradeslips that will identify student strengths and weaknesses.

5. Procedures for proficiency advancement.

6. Measurement of both part and whole tasks.

7. IP instruction in performance measurement.

8. Automated record keeping.

At this time, the final decisions on what the PMS will look like have not been made. The PMS that will be used for the F-16 training program will be described in report number 18, F-16 Implementation and Management Plan Report.

2.15 Report No. 15: Program/System Constraints Analysis Report

EXECUTIVE SUMMARY

The development and implementation of a training system is carried out in the presence of certain constraints which impact the effectiveness or efficiency of the training. These constraints include operating policies and regulations, existing facilities and equipment, characteristics of the student population, and personnel availability. The task of the contractor team was to investigate and identify constraints likely to affect the F-16 instructional system design and describe system design restrictions imposed by them. Such information will be used by the contractor team in designing the F-16 instructional system to accomodate those constraints identified. and by USAF/TAC agencies in an effort to mitigate the effects of these constraints whenever/wherever possible. Such efforts should result in increased communication between the contractor team and USAF/TAC agencies in coordinating possible changes.

The constraints operating in the F-16 environment were categorized as due to:

1. Limited data.
2. Existing regulations.
3. Resource limitations.
4. Existing programs.
5. Given inputs.
6. Environmental factors.
7. Expected system changes.

For each constraint, specifics have been identified and the data source, probable impact on system, possible actions, and implications are discussed.

Some constraints identified such as weather, range availability, and air space are "hard" and must be accomodated by the training system. Other constraints such as USAF/TAC regulations and policies, trainer delivery schedules, or student flow could be changed to be more compatible with the training program. Finally, some constraints such as facilities and media available are within the scope of the training system and can be modified. As a result of this study analysis, the F-16 ISD effort has been able to better plan the training program within existing system constraints.

2.16 Report No. 16: A Study of Media Production and Reproduction Options for the F-16 Project

EXECUTIVE SUMMARY

The on-time production of instructional materials is a critical factor in the successful implementation of the F-16 training system. It is estimated that the total production requirements for the B, IP, and Continuation Courses will be 405 workbooks, 405 slidetape sets, and 90 videotapes. In addition, another 1,012 pages of printing will be required for handbooks, tests, and checklists. These estimates were based on the number of segments suggested by the task listing document and certain assumptions regarding the nature of the workbooks and tapes required.

The production and reproduction capabilities located at Hill AFB, Ogden, Utah were examined to determine if the production and reproduction needs of the F-16 project could be met there. Production refers to the development of original instructional materials (both prototype and final) and the preparation of reproducible masters. Reproduction is the duplication of camera-ready masters, slides, audio and videotape masters for distribution to users.

The Hill AFB printing, photo lab, and television center capabilities are seen as adequate to support the reproduction requirements of the F-16 project as presently estimated.

In the area of production, it appears that the printing shop does not have the capacity to handle the volume of F-16 requirements for print layout and design. However, printing can provide enlargement/reduction capability for the proportion of photostatic copies to be used in workbook paste-up in addition to a moderate amount of printing samples and proof copies. A working relationship with Detachment 8, which operates the Ogden Air Logistics Center Television Center, is recommended, provided that some adjustment of priorities is made and if adequate provision can be made for technical and instructional direction by the contractor. The graphics unit, as presently staffed, could support the F-16 project in the production of graphics. Certain constraints and considerations in the production of F-16 photography make it imperative that photographers be contractor supplied although it would be advantageous to establish a working agreement with the Hill AFB photo lab for additional support in surge/crisis situations.

Major concerns in the establishment of this interface between government-supplied and contractor-supplied agencies and personnel are accountability, communication, and control. The

contractor is accountable for instructional and technical quality and the cost and timeliness of the product. Problems can result in the communication of necessary directions and specifications between producing agencies. The concern over control deals with the loss of control on the part of the contractor over those who are producing a contract deliverable for which the contractor is responsible

2.17 Report No 17: Computer Managed Instruction for tne F-16 Training Program

EXECUTIVE SUMMARY

The computer managed instructional (CMI) system required for tne F-16 training program must include components for automatic testing, record keeping, student scheduling, inventory tracking, and instructional prescriptions. The testing components must provide facilities for test grading, diagnostic testing, and test security, as well as adequate student feedback capability. It must also permit the evaluation of instructional effectiveness and facilitate course revision. The student records component must encompass bibliographic information, training performance data, report generation of records, and multiple sorting capabilities. The scheduling component must provide the capabilities for tne optimized scneduling of student learning activities and training resources. This scheduling capability must exist at the levels of syllabus and weekly and daily timetables. Tne inventory component must provide short- and long-term information on all resource utilization and availability, including personnel, equipment, facilities, and supplies. The prescriptive component must provide tne capability to generate individualized student learning schedules based upon student performance data, as well as training resource availability and utilization.

Five existing instructional systems which could serve as the basis for tne F-16 CMI system are surveyed. For each of the systems a functional description and examples of input/output are provided. Tne five systems studied were AFORMS, TICCIT, VTS, Navy CMI, and AIS. None of the five systems surveyed could satisfy all of tne capabilities required in tne functional specifications for tne F-16 training environment, and the limitations of each are mentioned.

A cost benefit analysis considered tne general cost benefits applicable to the F-16 environment. These include savings in the amount of training time required, more effective utilization of training resources, improved quality control, increased standardization and flexibility in tne training system, and greater field deployability and expandibility. Specific cost considerations for tne F-16 program were made by extrapolating from data on the F-4/F-15 training programs. The specific cost savings projected on tnis basis were a time reduction of two weeks in course durations, or 25 student salaries for the training period; 10 man years of instructor time per course; and 17 full-time administrative support personnel.

The conclusion of the study considered the five systems surveyed in the report in terms of functional capabilities, operational status, remote capability, training status, and cost factors. Although any of the five system could b used as a basis for the F-16 CMI system, it was recommended that VTS is presently the most suitable system, because it a) meets nearly all of the functional requirements, b) is relatively inexpensive, c) is basically a "stand-alone" system, d) is currently in use for aircrew training and is an approved military training device, and e) has sufficient scope to support a full-scale training system.

2.18 Report No 18: F-16 Implementation and Management Plan Report

EXECUTIVE SUMMARY

This report presents plans and procedures for implementing, using, and maintaining the F-16 pilot training system. The goals of the report are to: (1) describe the F-16 pilot training system and the administrative context in which it is designed to function, (2) recommend specific policies and procedures for implementing and operating the F-16 training system, and (3) to coordinate and tie together all of the plans and documents produced during the development of the training system.

In addition to specifying and describing the roles of personnel required to operate the F-16 training system, the forms needed to store and record data generated by this system are also presented. Specific explanations about who fills out the form, how it is filled out, and its disposition after completion is given.

The report concludes by listing and describing the major criteria that can be used to evaluate the adequacy of any instructional system and how the system described in this document measures up to each criterion. This proposed management system represents a step in the right direction, but it does not significantly impact costs as it is believed a computer managed system would.

2.19 Report No 19: Quality Control Plans, Procedures, and Rationale for the F-16 Pilot Training System

EXECUTIVE SUMMARY

Quality control is a fundamental component of the ISD process. In order to develop and maintain an efficient and effective training system, it is essential to monitor the system and make improvements on the basis of feedback data obtained from evaluation. Quality control procedures are applicable at three main stages in the development and implementation of a training system:

1. The developmental evaluation state (preimplementation).
2. The operational monitoring state (implementation).
3. Graduate evaluation (follow-up).

Common shortcomings of previous evaluation efforts in military ISD are:

1. Too narrow in scope.
2. Inappropriate data collected.
3. Incorrect analysis or interpretation of data.
4. Results are not utilized to rectify weaknesses in system.

The quality control plan for the F-16 project attempts to avoid these shortcomings. The developmental procedure will involve small-scale tryouts for the individual instructional segments followed by larger group tryouts with multi-segment materials. The operational monitoring stage will involve evaluation of data produced by the performance measurement system (PMS) which includes routine and systematic data collection procedures. The graduate evaluation stage will involve three types of data to be collected for each graduating class:

1. Task specific proficiency ratings.
2. Results of STAN/EVAL check ride, simulator check, and final examination.
3. Graduate evaluation questionnaires and structured interviews with graduates.

To assist in these three stages of quality control, evaluation specification checks are provided at six major checkpoints in the training cycle.

2.20 Report No 20: F-16 Instructional System

Cost Study Report

EXECUTIVE SUMMARY

Media selection is the process of minimizing the costs due to media acquisition, use, or maintenance while maximizing the likelihood of consistent instructional effectiveness. Media selection for aircrew training involves two major categories of media:

1. Media intended for use in learning centers, ranging from workbooks to computer-assisted instruction.

2. Simulator or training devices which are intended to provide "hands-on" practice.

Factors which must be considered in the media selection process include cost, ability of a device to implement specific instructional strategies, motivating capabilities, and the popularity of the media device with the student population. Some of the constraints to be considered in the F-16 environment include the necessity of premature media decisions, the late arrival of training devices, the varying availability of media cross training sites, the exisiting media production facilities, the tentative nature of the instructional content, the required mixture of type "A" and "B" aircraft, and the varying availability of flight time across training sites.

The media selection process begins with a complete list of the criterion-referenced objectives (CROs) from the objectives hierarchy analysis. These objectives are divided into academic (i.e., learning center learning activities) and training device categories, and then classified in terms of taxonomic levels. Instructional strategies appropriate for each level of learning required are then specified.

Associated with each strategy is a media requirements profile. All constraints affecting media selection for each objective are also specified. The available media are listed, and those media which meet the strategy requirements and constraints are retained. The instructional requirements for each objective are then identified and alternative media configurations are determined. The production, use, and maintenance costs associated with each alternative are estimated. A media decision model is then used to identify alternative media for each objective. The total costs of each media assignment alternative are then computed and reviewed.

For those objectives identified as requiring training devices, additional media selection steps are required. It is necessary to identify behavior elements contributing to task difficulty. These elements are mapped into corresponding levels of training devices ranging from low fidelity, non-interactive devices (e.g., cardboard mock-ups) to high fidelity, highly interactive devices (e.g., operational flight trainers). The F-16 aircraft is assigned only when complete fidelity is instructionally necessary. The possible configurations for each training device are specified, along with the time requirements associated with each configuration. The cost of each configuration is then estimated and the best configuration selected.

The media selection process is a dynamic one and the procedures described extend over the lifetime of the F-16 training system. To aid in the standardization and documentation of the media selection process, a set of forms are provided which assist in the data collection and decision-making steps.

2.21 Report No. 21: F-16 Instructional System Cost Study Report

EXECUTIVE SUMMARY

All training program designs must eventually be translated into a set of resources required to support training activities and the costs associated with these resources. Resource requirements vary depending upon the type, amount, and complexity of the training to be conducted and generally cover a very broad spectrum of support needs. The detailed assessment of training requirements is the result of a training support requirements analysis (TSRA) which can then be used to generate specific cost figures.

The F-16 instructional system represents a complex system in which the training resources required range from equipment such as aircraft, simulators, and trainers to personnel such as flight instructors, academic instructors, course managers, and administrative support personnel. The spectrum of resources also includes media devices, training materials, training facilities, and subtraining systems for the preparation of system personnel. The purpose of this report is to provide a tool for calculating resource support requirements and associated costs of the F-16 pilot and instructor pilot instructional system based upon the data available at any point in system operation.

Recomputation should be carried out using this cost study at any time the effects of a real or contemplated change to the input conditions are of interest to system managers. Such changes include system design changes (e.g., heavier use of self-study, elimination of personnel through job consolidation, or changes in management procedures), syllabus requirements changes (e.g., through addition or subtraction of aircraft sorties, through the addition of new training devices, or through the addition of new academic content), and student load changes.

It is not the purpose of this report to provide a model for operational or logistic planning. Because the model does not include a time component, it is not useful for resource scheduling or resource allocation purposes. Furthermore, the model assumes a steady state training system with smooth instructor and student flow. Almost all input variables are averages. This means that the model does not compute resources needed for peak loads or "surges" on the training system or the effects of class build-ups, student attribution or resource unavailability. For these types of operational factors, a training system management model is needed.

2.22 Report No 22: Recommendations for F-16 Operational Flight Trainer (OFT) Design Improvements

EXECUTIVE SUMMARY

Because the training development contractor has been involved early in the life cycle of the aircraft, the F-16 project provides an opportunity for instructional developers to provide input to the design of training devices to be developed for the F-16 training system. Some of the capabilities already incorporated in the design of the F-16 Operational Flight Trainer (OFT) such as freeze, performance replays, and automated measurement are highly desirable instructional features. In addition, it is recommended that capabilities be provided by grade sheet production, simulator setup and off-line debriefings, mission status and look-ahead, a self-instructional capability, and a "help" capability for instructors. Two problems with the physical arrangement of the OFT for training demonstrations were identified. A series of principles were specified for the formatting of instructional displays. A number of recommendations were made regarding the design of the OFT for simulating aircraft malfunctions. Finally, recommendations were made in terms of designing the OFT to accomodate growth and changes over the F-16 training system lifespan.

While the involvement of the ISD team in the simulator design process has been helpful in identifying design deficiencies, participation prior to simulator procurement in future projects would result in training devices which are more closely aligned to the requirements of the training system.

2.23 Report No 23: F-16 Instructional Sequencing

Plan Report

EXECUTIVE SUMMARY

This report details the rationale and procedure for sequencing (syllabus building) the pilot and instructor pilot (IP) syllabi of the F-16. Principles of instructional sequencing are presented and descriptionS given of the F-16 sequencing process and syllabus revision procedures.

Development of a syllabus involves evaluation of (1) student entry level skills, (2) training and instructional goals/objectives, (3) availability of training resources, and (4) the behavior expected of graduates. The development of a syllabus is based upon a set of learning principles. Three examples are:

1. Speed of forgetting (forgetting begins almost immediately unless there is prompt testing or rapid use of new information).

2. Interference (learning of some tasks interferes with the learning of other tasks when they possess similar but confusing differences. Remembering that final approach speeds of 155, 140, and 150 kts are characteristic of the F-4, F-16, and A-7 respectively is more difficult than remembering final approach speeds of 155 and 60 for the F-4 and piper cub respectively).

3. Transfer (prior learning of some skills enhances the learning of another skill. Skill at proper scanning of instruments for IFR flight gained in one aircraft will facilitate the same task in another aircraft).

The syllabus structure must be linked to the criterion-referenced objectives as well as the career performance goals of the students. To generate a syllabus a model must exist which describes the necessary steps to acquire a skill. For the F-16 this involves:

1. Academic training: Base preparation for task execution (workbooks, tape/slides, videotapes, lectures, discussion groups, and tutorials).

2. Practice in limited simulated performance environment: Simulators, mockups, CPT, dead aircraft.

3. Practice in real world performance environment or near real world environment. OFT, WST, actual aircraft.

Specific procedures for generating the F-16 syllabus involve:

1. Definition of the mastery models and terminal performance tests.

2. Determination of the desired levels of performance for each task (given by the CRTs).

3. Determination of the syllabus structure based upon aircraft as the only training device.

4. Determination of non-aircraft training devices to preserve aircraft utilization.

2.24 Report No 24: F-16 Coursewares and Syllabi Delivery Schedule

EXECUTIVE SUMMARY

This document performs the two-fold purpose of (1) describing the schedule whereby all course materials will be delivered to the Air Force and (2) presenting the B course syllabus that will be utilized to schedule the presentation of those course materials to the RTU students. It represents a historical document only, reflecting a delivery schedule proposed in 1979 and the latest version of the syllabus available in early 1981. It was significant as a deliverable item in 1979, as it documented for the Air Force precisely what it was getting and when it would be arriving.

This document describes the development of four separate courses with unique syllabi: the B/C course, TX course, IP course, and continuation training course. This original contractor requirement was subsequently reduced to include a B course only, so the IP and TX syllabi included represent primarily the efforts of the OTDT, while the continuation training requirement was deleted altogether.

2.25 Report No 25: F-16 Instructor/Course Manager Training Requirements Report

EXECUTIVE SUMMARY

A task listing indicates what instructional activities will be performed by F-16 academic instructors (or course managers) and flight instructors (both simulator and aircraft). The academic instructor tasks include authoring activities as well as the implementation and administration of instructional activities in the learning center. Flight instructor tasks include conducting and supervising training sessions for all interactive and non-interactive training devices and actual training sorties in the F-16 "A" or "B" aircraft. These later tasks involve demonstration and evaluation of basic aircraft operation, emergency procedures, and tactical maneuvers.

2.26 Report No 26: F-16 Pilot Media Selection

EXECUTIVE SUMMARY

This report contains three types of information. The F-16 task listing represents a detailed and organized collection of all the major tasks which an F-16 fighter pilot must perform. The criterion-referenced objectives represent the testing situations that correspond to each major task and ensure that students are accountable for these tasks. The objectives hierarchies break down each task in the task list into a sequence of academic prerequisite objectives that are designed to lead to mastery of the task itself.

The document is divided into 11 sections, corresponding to 11 mission subtasks, from "1.1 Perform Premission Planning" to "1.11 Perform Mission Debriefing". Each of these sections is further subdivided into tasks, criterion-referenced objectives, and objectives hierarchies. Thus, the major sections are sequenced according to the major phases of flight, while the subsections present an orderly elaboration of tasks into criterion-referenced objectives. Ths report, like other data base documents, is an evolving record of decisions which must be periodically updated to remain useful.

2.27 Report No 27: F-16 Instructional System Design Concept

EXECUTIVE SUMMARY

The purpose of this report is to present the alternative designs for the F-16 Replacement Training Unit (RTU) constraints and costs involved in their use. Though the system is capable of administering several courses of instruction at once, the costs reported are those for training B/C course students only.

While the primary purpose of a training system is to deliver instruction, there are additional functions which must be performed in order to ensure that the instructional process remains maximally effective. Many of these auxilliary functions do not need to be performed when only one set of students is to be trained; however, long term effectiveness is severly degraded if they are ignored when designing a system that will continue for a number of classes. The complete set of functions recommended for inclusion in the F-16 training system is specified in Attachment I, and is organized in terms of subsystems.

Five basic options are described in terms of their assets, limitations, and costs. These options are as follows:

Option I (Manual System) A systematically designed and updated system where the academic portion of the course is taugnt largely through existing instructional media (printed material, audio tapes and slides, supplemented occasionally by videotape presentations). Mediated instruction is self-paced to allow review of material or restudy of portions of lessons any time the student wishes. Use of academic instructor time to present information is minimized so that instructors can maximize the time spent dealing with individual problems and questions. Use of training devices and aircraft is carefully integrated with self-paced and classroom instruction so that the student can derive maximum benefit from equipment use through complete and thorough preparation. Centralized record keeping and administrative functions, as well as distributed scheduling functions, are carried out using form driven procedures such that lesson updates, data base changes, etc., are handled as efficiently as is possible without automated data processing support.

Option II (Basic CMI-augmented System) This option adds automated data processing support for centralized administrative and distributed scheduling functions. By keeping track of individual student progress as well as student response to individual lessons on line, individualized syllabus options are more readily generated and specific instructional deficiencies are more readily identified and corrected. In this way, the mediated, self-paced instruc-

tional plan detailed in Option I is more fully utilized while support personnel spend less time performing clerical duties and have more time to plan for systematic improvements.

Option III (Basic CMI, CAI, and part-task Training System). This option adds the capability of computer-assisted instruction (CAI) and computer controlled part-task hands-on training to the computer management package whose impact is described in Option II. These new capabilities allow learner control at the learning strategy level so that in addition to individual syllabus prescription, students also benefit from the ability to select the method of studying each lesson that best suits their individual cognitive style. Since CAI-mediated lessons allow the unique self-tailoring in instructional presentation by many students simultaneously, individual differences in learning style are better accommodated. In addition to a greater degree of individualization in academic instruction, the addition of computer controlled part-task hands-on training allows the system to provide more and better training in basic psychomotor tasks, providing greater amounts of monitored hands-on instruction while increasing instructor availability for supervising higher order hands-on training in more complex training devices.

Option IV (Full CMI, CAI, and Integrated part-task Training System with Automated Performance Resource Capability). Under this option, the capabilities described in Option III are expanded to increase the amount of instruction that can be placed under learner control with the addition of an automated performance measurement system. Such a system allows the measurement and recording of student performance at any point in his indiviudal program of instruction. This in turn allows more accurate diagnosis of individual problem areas and instructional deficiencies. Such a performance measurement system need not be restricted to academic instruction only, but can also encompass the measurement and recording of student performance on computer controlled hands-on training.

Option V (Addition of Automated Performance Measurement). This option expands the performance measurement system to incorporate automated performance measurement of in-flight tasks through the use of Air Combat Maneuvering Instrumentation. This allows precise, objective measurement of in-flight performance, as well as student self-evaluation by means of the recording and playback features of the system. By adding this capability, the precision of diagnosis of individual problems in actual job performance is greatly enhanced, allowing for maximally useful remediation.

2.28 Report No 28: F-16 Instructional System Basing Concept

EXECUTIVE SUMMARY

The purpose of this report is to present a concept for the basing of F-16 Replacement Training Unit (RTU) training sites and a mechanism for determining the configuration and training resource requirements at each site. The basing concept is presented first, defined by the location at which instructional system functions are carried out, either in centralized or distributed form. A resource calculation tool, called the Training Support Requirements Analysis (TSRA), is given in the form of a step-by-step job aid usable by all levels of TAC training management.

The scope of this report covers the basing concept from the standpoint of instructional system function and efficiency of system operation. Factors related to operational squadron and wing economics and concepts of weapon employment are not dealt with here, since those considerations are beyond the scope of training analysis. In making basing decisions it is assumed that TAC will consult this and other data and that all factors will be weighed together in due proportion.

The general basing concept for the F-16 training system is defined in terms of system functions. Attachment I contains a list of the functions which the F-16 training system is designed to execute. Some functions are directly involved in the instruction of students and must be carried out in a distributed fashion, with those functions being executed at each training site. Other functions not directly related to instruction of students but nonetheless critical may be carried out in a centralized fashion at one location within the system (presumably by an Operations Training Development (OTD) team).

The TSRA worksheets included in Section 3.0 allow Air Force personnel to determine the exact requirements for Instructor personnel (flight, simulator and training device, classroom and learning center), support personnel (instructor and student support, as well as learning center operators), office space and furnishings, learning center media equipment, training device equipment, learning center facilities (study area, checkout area, learning center operator's office, storage area, classrooms, training device space, and student lounge) and training device personnel and facilities.

2.29 Report No. 29: Task Listings and Criterion-Referenced Objectives for the Instructor Pilot F-16 Training program

EXECUTIVE SUMMARY

This report contains two lists: The IP course task list and the IP course CROs. The task list represents a comprehensive inventory of the major tasks an F-16 pilot should be able to perform, while the CROs represent the major testable subtasks, or performance objectives he must master to demonstrate proficiency in the major tasks. The CROs are derived from the task list through hierarchical analysis, and are used to generate the criterion-referenced tests (CRTs) that control student progress through the F-16 training system.

2.30 Report No 30: F-16 Training System Media Report

EXECUTIVE SUMMARY

This document lists the 32 academic media types and 20 simulation media types selected for possible inclusion in the F-16 training program, and provides a detailed description of each in terms of its instructional features, training capability, life cycle costs, hardware and software characteristics, manpower requirements and facilities requirements. This information is presented in the form of matrix, tables, which list media characteristics and indicate the extent to which each medium possesses those characteristics.

This historical document was produced not only to document the F-16 media pool, but as a preliminary input to the instructional media selection process. The 52 media could not be selected and assigned in either the cost benefit analysis or media analysis without first characterizing them in terms of the variables listed earlier. Once this process was complete, the media were utilized in the instructional media selection process (see Development Report No. 20, F-16 Media Selection and Utilization Plan Report, and Development Report No. 31, F-16 Training Media Mix) and would have been utilized in a detailed cost benefit analysis, had that requirement not been cancelled by the contracting officer.

2.31 Report No 31: F-16 Training Media Mix

EXECUTIVE SUMMARY

The media selection process utilized in this program is documented in three separate reports. Report No. 20, "F-16 Media Selection and Utilization Plan Report", describes the initial 31 step procedure designed to select instructional media for various categories of objectives. Report No. 31, "F-16 Training Media Mix", describes the 15 step procedure actually employed on the project. Report No. 26, "F-16 Pilot Media Selection", provides the raw data used in the selection process. Taken together, they provide a detailed description of the rationales employed, procedures followed, data generated, recommendations made, and media mix utilized.

Media selection consists of assigning instructional media to groups of objectives in such a way as to maximize training effectiveness while minimizing training costs. All objectives are sorted into one of two major categories: academic objectives and hands-on objectives. Both sets are then processed along parallel channels, whereby the requirements of each objective are computer matched to the capabilties of each medium. This produces a prioritized list of media to match each objective. These objectives are then grouped into lessons, trainer sessions, or sorties according to commonalities of both content and medium. Later, during the syllabus building process, these lessons, sessions, and sorties are sequenced into a functional curriculum.

2.32 Report No 32: F-16 Training Media Support Requirements

EXECUTIVE SUMMARY

Training media support requirements are those personnel, facilities, equipment, and materials/supplies that must be purchased, installed, and maintained in order to operate any given instructional medium. These requirements may be viewed as costs to be considered before deciding to procure a given medium or media mix, or resources that must be secured and in place before an instructional system can open its doors to students. In either case, they represent "hidden costs" that have not always been adequately considered before establishing an instructional system.

Section 1.0 describes the purpose of the document as well as the general format and approach. Section 2.0 provides a comprehensive list of training media support requirements, including a description of each resource. Section 3.0 lists all of the potential training media, both academic and performance, and provides tables which specify the support requirements of each. Section 4.0 lists general considerations to be weighed when evaluating the support requirements of various media.

2.33 Report No 33: F-16 Training Media Constraints and Limitations

EXECUTIVE SUMMARY

The purpose of this report is to list and discuss the constraints and limits of the various instructional media employed in F-16 training, with the purpose of targeting these limitations for future upgrading. The five major limitations include: (1) the limited number of training devices available, (2) the unavailability of certain types of training devices, (3) the inability to impact the design of training devices because of the exceptionally long procurement cycle, (4) the use of less than optimal devices, and (5) the limited range of media available for implementation in the F-16 training system.

The report identifies four conditions that acted to predispose the media selection process to the constraints identified above. First, the F-16 syllabus had to be constructed to meet preexisting aircraft use level expectations instead of allowing instructional considerations to drive the use level. Second, major training devices were designed and procured before specific training uses for those devices were generated. Third, no instructional design expertise was employed during the initial stages of training device design and procurement. Finally, adequate funds and command attention were not directed to the procurement of major F-16 training devices.

Based upon these constraints and limitations, the report makes six specific recommendations: (1) establish and execute a plan for system growth that will eventually minimize these constraints, (2) design simulated practice environments an scenarios that take fullest advantage of the capabilities of existing training devices, (3) maintain and update the data-based syllabus created during the development phase and utilize feedback from evaluations to adjust the syllabus, (4) examine the training functions allocated to each training device to consider possible reassignment to other media, (5) employ state-of-the-art training techniques to increase the efficiency of training device utilization, and (6) carefully monitor training device use and availability to ensure the fullest use of training device time.

2.34 Report No 34: A User's Guide to the F-16 Training Development Reports

EXECUTIVE SUMMARY

The F-16 Aircrew Training Development Project is thoroughly documented by a series of 35 individual development reports. This report describes the organization of the report series and provides a one page executive summary of each report. While the final report, No. 35, is designed to summarize the four year development effort in a single document, report No. 34 is designed to index the report series for those readers who desire additional information concerning a particular event or phase within the program.

2.35 REPORT NO 35: FINAL REPORT

EXECUTIVE SUMMARY

This report outlines the major activities of the F-16 Aircrew Training development Project, a four-year, two and one half million dollar Instructional Systems Development effort sponsored by the Tactical Air Command to design a comprehensive training program consist of a 5 1/2 month Basic Course, a 2 1/2 month Transition Course, and a 35 volume report series which describes the methodology used to develop those courses.

The program consisted of six phases, which provide the overall organization for the report. The project is reviewed on a phase by phase basis, the lessons learned from each phase are reviewed, the lessons learned from the overall project are reviewed, and conclusions and recommendations are provided.

Phase I lasted only two weeks and required a single deliverable item, the Phase I Review. During this period the contractor and government representatives held general discussions and reviewed in detail the 70 CDRL Item Descriptions. This Phase was completed as planned.

Phase II was to last four weeks, allowing the development of a detailed work plan for the entire program. The contractor also reviewed previous ISD efforts (e.g., A-7, A-10, F-4 and F-15), design the data collection and management forms to be used during the program, review the General Dynamics task listing for applicability to the training program, and develop formats for documenting bothe criterion-referenced objectives and criterion-referenced tests. This proved to be more difficult an assignment than originally predicted, and Phase II ended with only 5 of the 9 assigned deliverables complete.

Phase III was the first really substantial phase, spanning 3 1/2 months and requiring delivery on 13 contract items. Task analysis, goal analysis and objectives hierarchy analysis were to be conducted and periodically updated. Target population studies for the various F-16 courses were to be conducted, as were the development of the initial criterion-referenced objectives and criterion-referenced tests. The performance measurement system plan would be devised, the program/system constraints analyzed, and the printing and reproduction facilities identified and employed.

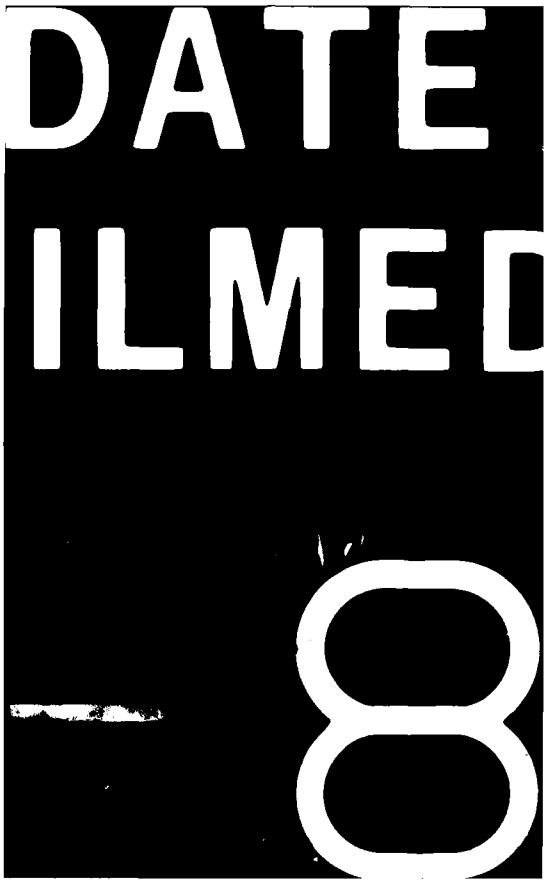
Phase IV was to be the first of 4 year long phases, requiring 29 CDRL items, twice as many as any other phase. It represented the completion of the analysis phase of the program, and included sensitivity analysis, cost benefit analysis, media selection, recommendations for a data automation system, the development of a performance measurement system, and the development of planning documents for course design and course management. During this phase the project moved form Luke AFB, Arizona, to Hill AFB, Utah.

Phase V was to be 12 months long, requiring the delivery of only 9 CDRL items. The analysis and design. Phases would now be wares, syllabi, management system, program, and the continuation training plan.

Phase VI was to be the course implementation phase, again lasting 12 months. The Conversion Course and Instructor Pilot Course would begin, and those course materials would be revised based on student performance. The continuation program would be developed, to be implemented along with the Basic Course during the next phase. Unfortunately, the class date for the first Basic Course was March 1980 and lesson production for the Basic Course had not begun until August of 1979. But the Air Force modified the contract at the end of Phase V, moving the Conversion Course and Instructor Pilot Course into Phase VII.

Phase VII was too be the second implementation phase, when both the Basic Course and Continuation Training program would begin. The revision and validation of all courses would continue throughout the phase. But again, the contract was by now quite out of sync with the original phasing plan. The Basic Course had already been implemented in Phase VI, a full 10 months before it was originally planned for. Continuation training was still a controversial subject at TAC headquarters, and the OTD team was unable to provide the contractor with clear guidance as to how to proceed. Consequently, the Air Force decided to extend Phase VI an additional six months to complete all work it actually wanted to complete, and simply eliminate Phases VII and VIII. Phase VIII was originally to last only 3 months anyway, consisting of update and revision to all courses and the drafting of the Final Report. It was reasoned that since the Basic Course had begun 10 months early, it would have its year long revision cycle by March 1981. So Phase VI was expanded to accomodate all the work programmed for Phases VI, VII and VIII that the Air Force was still interested in. This involved the revision of the B Course, the final update of all 35 Project Reports, and the authoring of the Final Report.

After discussing each phase in depth, the report concludes with a section on lessons learned and recommendations to future developers of weapons systems that may help in their planning efforts. Also, the report contains three appendices. The Statement of Work, Evaluation Data, and sample course materials are included.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