LEVEL II ①

AD A099940

F-16 AIRCREW TRAINING DEVELOPMENT PROJECT,

Contract No. F02604-79-C8875

TASK ANALYSIS
METHODOLOGY REPORT.

DEVELOPMENT REPORT, No. 7,
MARCH 1981

Prepared in fulfillment of CDRL no. B019

by

A.S./Gibbons
Courseware, Inc.

COURSEWARE, INC.
10075 Carroll Canyon Rd.
San Diego, CA 92131
(714) 578-1700

81 6 09 007

PREFACE

This report was created for the F-16 Aircrew Training Development Project contract no. F02604-79-C8875 for the Tactical Air Command to comply with the requirements of CDRL no. B019. 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 follows this 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, Vir-
ginia 22314. All reports were reviewed and updated in March 81.

Gibbons, A.S., Rolnick, S.J., Mudrick, D. & Farrow, D.R. Program work
plan (F-16 Development Report No. 1). San Diego, Calif.:
Courseware, Inc., September 1977, March 1981.

Thompson, A., Bath, W., & Gibbons, A.S., Previous ISD program review
(F-16 Development Report No. 2). San Diego, Calif.: Courseware,
Inc., September 1977, March 1981.

Wild, M., & Farrow, D.R. Data collection and management forms report
(F-16 Development Report No. 3). San Diego, Calif.: Courseware,
Inc., September 1977, March 1981.

Gibbons, A.S. Review of existing F-16 task analysis (F-16 Development
Report No. 4). San Diego, Calif.: Courseware, Inc., June 1977,
March 1981.

Gibbons, A.S., & Rolnick, S.J. Derivation, formatting, and use of
criterion-referenced objectives (CROs) and criterion-referenced
tests (CRTs) (F-16 Development Report No. 5). San Diego, Calif.:
Courseware, Inc., September 1977, March 1981.

Rolnick, S.J., Mudrick, D., Gibbons, A.S. & Clark, J. F-16 task
analysis, criterion-referenced objective, and objectives hierarchy
report (F-16 Development Report No. 6). San Diego, Calif.:
Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. Task analysis methodology report (F-16 Development
Report No. 7). San Diego, Calif.: Courseware, Inc., October 1978,
March 1981.

Gibbons, A.S. Objectives hierarchy analysis methodology report (F-16
Development Report No. 8). San Diego, Calif.: Courseware, Inc.,
October 1978, March 1981.

Mudrick, D., Gibbons, A.S., & Schmidt, R.F. Goal analysis report
(F-16 Development Report No. 9). San Diego, Calif.: Courseware,
Inc., February 1978, March 1981.

Rolnick, S.J., Mudrick, D., & Thompson, E.A. Data base update
procedures report (F-16 Development Report No. 10). San Diego,
Calif.: Courseware, Inc., October 1978, March 1981.

Mudrick, D., & Pyrz, K.E. Data automation of task and goal analysis:
Existing system review and recommendation (F-16 Development Report
No. 11). San Diego, Calif.: Courseware, Inc., September 1977,
March 1981.

O'Neal, A.F., & Smith, L.H. Management System needs and design concept analysis (F-16 Development Report No. 12). San Diego, Calif.: Courseware, Inc., December 1977, March 1981.

Gibbons, A.S., Thompson, E.A., Schmidt, R.F., & Rolnick, S.J. F-16 pilot and instructor pilot target population study (F-16 Development Report No. 13). San Diego, Calif.: Courseware, Inc., September 1977, March 1981.

Schmidt, R.F., Gibbons, A.S., Jacobs, R. & Faust, G.W. Recommendations for the F-16 performance measurement system (F-16 Development Report No. 14). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Thompson, E.A., & Gibbons, A.S. Program/system constraints analysis report (F-16 Development Report No. 15). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S., & Rolnick, S.J. A study of media production and reproduction options for the F-16 project (F-16 Development Report No. 16). San Diego, Calif.: Courseware, Inc., February 1978, March 1981.

O'Neal, A.F., & Kearsley, G.P. Computer managed instruction for the F-16 training program (F-16 Development Report No. 17). San Diego, Calif.: Courseware, Inc., July 1978, March 1981.

Wilcox, W.C., McNabb, W.J., & Farrow, D.R. F-16 implementation and management plan report (F-16 Development Report No. 18). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Sudweeks, R.R., Rolnick, S.J., & Gibbons, A.S. Quality control plans, procedures, and rationale for the F-16 pilot training system (F-16 Development Report No. 19). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S., Axtell, R.H., & Hughes, J.A. F-16 media selection and utilization plan report (F-16 Development Report No. 20). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Thompson, E.A., Kearsley, G.P., Gibbons, A.S., & King, K. F-16 instructional system cost study report (F-16 Development Report No. 21). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Jacobs, R.S., & Gibbons, A.S. Recommendations for F-16 operational flight trainer (OFT) design improvements (F-16 Development Report No. 22). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Gibbons, A.S. F-16 instructional sequencing plan report (F-16 Development Report No. 23). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

Farrow, D.R., & King, K. F-16 coursewares and syllabi delivery schedule (F-16 Development Report No. 24). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Rothstein, L.J., Hibian, J.E., & Mudrick, D. F-16 instructor/course manager training requirements report (F-16 Development Report No. 25). San Diego, Calif.: Courseware, Inc., October 1978, March 1981.

O'Neal, A.F., & O'Neal, H.L. F-16 pilot media selection (F-16 Development Report No. 26). San Diego, Calif.: Courseware, Inc., March 1979, March 1981.

Gibbons, A.S. F-16 instructional system design alternatives (F-16 Development Report No. 27). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S. F-16 instructional system basing concept (F-16 Development Report No. 28). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

O'Neal, H.L., & Rothstein, L.J. Task listings and criterion-referenced objectives for the instructor pilot F-16 training program (F-16 Development Report No. 29). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Bergman, D.W., & Farrow, D.R. F-16 training system media report (F-16 Development Report No. 30). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S., O'Neal, A.F., Farrow, D.R., Axtell, R.H., & Hughes, J.A. F-16 training media mix (F-16 Development Report No. 31). San Diego, Calif.: Courseware, Inc. October, 1979, March 1981.

Farrow, D.R. F-16 training media support requirements (F-16 Development Report No. 32). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Gibbons, A.S. F-16 training media constraints and limitations (F-16 Development Report No. 33). San Diego, Calif.: Courseware, Inc., September 1979, March 1981.

Farrow, D.R., & Kearsley, G.P. A user's guide to the F-16 training development reports (F-16 Development Report No. 34). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.

Farrow, D.R., & Clark, J. F-16 Final Report (F-16 Development Report No. 35). San Diego, Calif.: Courseware, Inc., January 1981, March 1981.

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 responsbilities 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.

CONTENTS

CONTENTS (cont.)

TASK ANALYSIS
METHODOLOGY REPORT

1.0 INTRODUCTION

This report describes the task analysis methodology used
during the development of the F-16 task listing and references
the methodology recommended for its maintenance throughout the
life of the F-16 instructional system. Future instructional
system managers must understand the analysis process by which the
F-16 task listing was produced and the process by which to main-
tain it in updated form. The wide influence of the task listing
on the instructional system and the importance of maintaining the
task listing in updated status is emphasized in this report as a
fundamental requirement to the longevity and currency of F-16
training.

The report is written in four sections. Section 2.0 of the
report briefly describes the purpose and characterisitics of a
task listing and the relation of task listing to other instruc-
tional development processes. Section 3.0 describes in a step-
by-step fashion the task analysis procedure used for generation
of the F-16 pilot and instructor pilot task listing. Section 4.0
summarizes the need for continual update and maintenance of the
task listing, references a generalized procedure for update which
is contained in a separate project report, and recommends main-
tenance organizational roles and resources for accomplishing the
maintenance task.

2.0 RATIONALE

This section describes the purpose of task listing, the desirable qualities of task listings, and the relation of task listing to other instructional development processes.

2.1 Purpose

Task analysis is a process of decomposing or analyzing a job into an inventory of component tasks called a task listing. The need for task listing arises from the requirement for instructional developers to focus training courses directly upon the skills their courses are intended to teach. Including too much training in a course escalates costs unnecessarily, yet reducing course content without a strong rationale opens the possibility that important content is not being taught and important skills are not being trained. Task analysis is a logical, systematic inventorying process developed so that courses can train directly to job-relevant behaviors. It seeks to produce an accurate, comprehensive list of all tasks performed on a job.

2.2 Review of Existing F-16 Task Listing

A report was issued early in the F-16 project (project report no. 4, "Review of Existing F-16 Task Analysis") which reviewed an existing F-16 task listing for use in F-16 training development. That report called attention to the required characteristics of an instructional development task listing in contrast to task listings intended for other purposes (e.g., human factors engineering for equipment, job task allocation, etc.). The desirable qualities of an instructional development task listing given in that report have been quality control items for the F-16 task listing. Those qualities are:

1. Appropriate level of detail (depth). Task listing should include tasks at a sufficient level of detail for training purposes but does not need to include the extreme level of detail required for other task listing uses.

2. Adequate coverage of job tasks (range). Task listing should cover all aspects of the job being analyzed, including tasks carried out in team interactions and under all working conditions.

3. Mission orientation. Task listing should be oriented along the lines of the job holder's behavior, and not relative to specific equipment to be operated.

4. Job scope limitation. Task listing should contain only job-related behaviors.

5.   Logically consistent organization. Logic used in task listing should be observed consistently throughcut

2.3 Relation of Task Listing to Other Instructional Development Processes

The task listing is the cornerstone document of a skill-oriented training system. The dependence of virtually every other training product in the instructional system upon the task listing is illustrated in Figure 1. Criterion-referenced objectives (CROs) and objectives hierarchies are generated directly from a beginning point supplied by the task listing, and the syllabus is constructed of individual elements which come directly from those three analysis documents. Media selections are made for those separate elements as they occur in the syllabus. The entire inventory of instructional media presentations, training device session specifications and grade slips, along with the training device, instructor, and student assistance documents produced to support all three are based on the syllabus. None of these can be generated without the task listing.
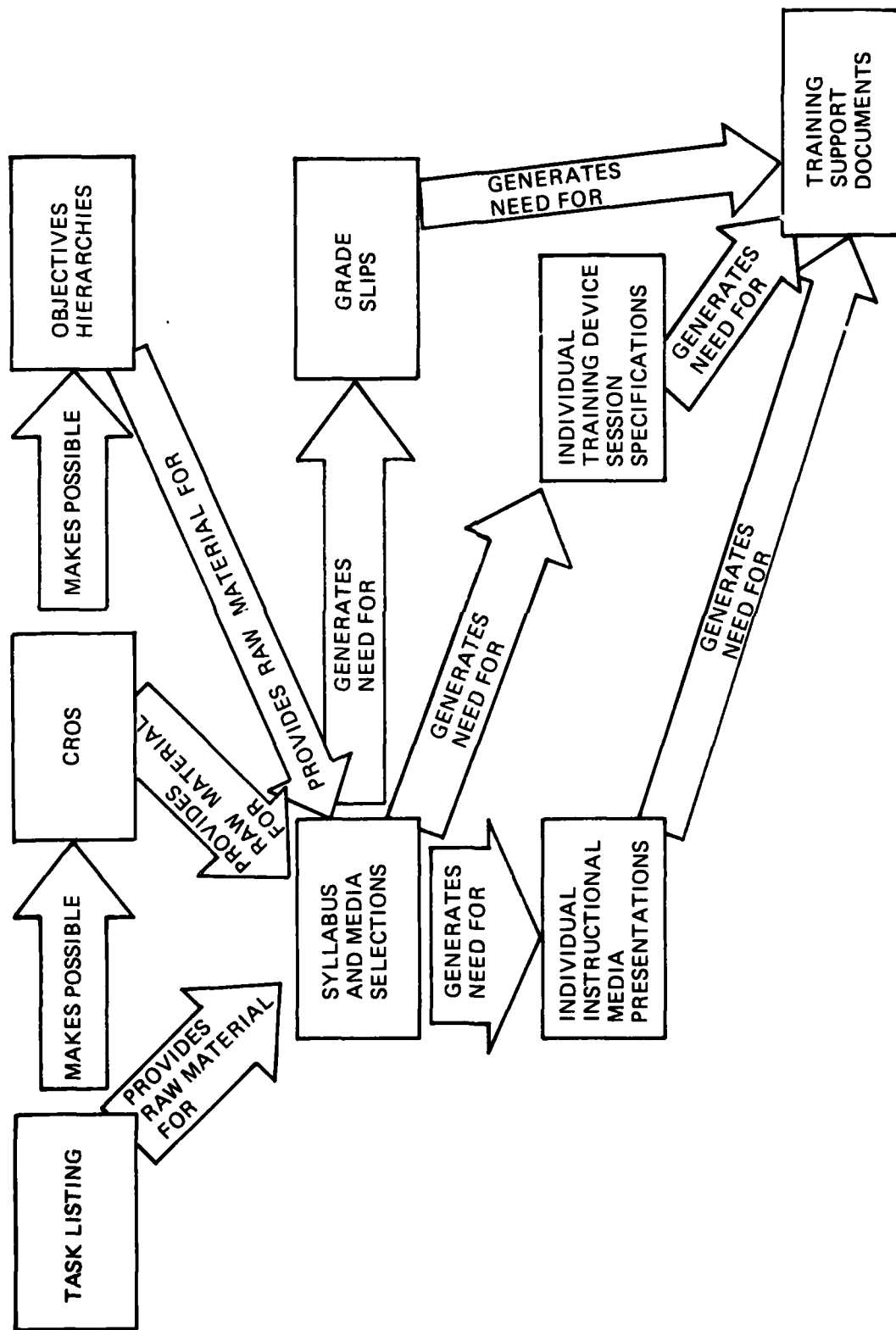
Figure 1 -- Relations of Training Products to Task Listing

3.0 TASK ANALYSIS PROCEDURES

This section presents a step-by-step description of the procedure for task analysis used for F-16.

3.1 Step 1: List the Major Responsibility Areas Within a Job

A job is usually made up of a small number of main responsibility areas which take up major portions of job time. If the job holder does not perform in each of these major responsibility areas he is not performing the complete job. It is possible for a person to be fully qualified in one job area and inexperienced in another. The first step in task listing is to identify major responsibility areas within a job.

It may be difficult to decide what the major responsibility areas are for a given job. Some jobs may have no more than one major responsibility area. For jobs where there are more than one, the following keys may help in identifying them:

1. A major responsibility area takes up major portions of job time.

2. A major responsibility area is more or less independent from other major responsibility areas. Only one responsibility can be performed at any one given time.

3. There is usually a title which names the major responsibility area.

4. Special equipment is often used in one responsibility area but not in others.

5. The procedures executed within responsibility areas are usually much different, not only in form but in intent. An example of major responsibility areas for a pilot might be:

    a. Perform operational flying duties.

    b. Perform light field maintenance duties when isolated from central maintenance facility.

    c. Maintain a current personal copy of all pertinent aviation bulletins and regulations.

3.2 Step 2: List the Major Missions Within One Responsibility Area

Within one major responsibility area it may be possible to identify, but not in every case, major missions which are carried

out within that responsibility area. A mission is a set of activities performed by the work unit of which the individual is a part in order to accomplish a specific significant goal. A mission is usually performed by a system of individuals rather than a single individual. Furthermore, a mission has a beginning and an end with a sequence of activities designed to accomplish the objectives of the mission. The designation of aircraft missions is meaningful, and the meaning of "mission" commonly used in aircrew terminology equates to the meaning used here. An example of missions within aircrew training might include: Combat Air Patrol (CAP) missions, sweep missions, Close Air Support (CAS) missions, escort missions, search and rescue missions, and reconnaissance missions.

In the generation of a task listings steps following the mission identification will identify mission phases and tasks within those phases. Mission profiles for an aircraft are usually similar in most respects, and in many cases are·identical to each other. The phases and tasks within them are often the same, with only a few significant differences. To eliminate the high degree of repetitiousness in task listing structure which results from this similarity and to simplify the task listing bookkeeping procedure, the F-16 missions have been removed from this level of the task listing and placed in an appropriate position in the listing subordinate to mission phases. In that position they retain the listing of subtasks which are unique to them, so that no tasks are lost to the task listing. It is important to realize that though this changes the form of the task listing, it does not represent an abandonment of the logical guidelines for analysis and does not lead to omitting tasks from the listing.

3.3   Step 3:   Select a Mission and Divide it into Phases

Within most missions there are phases of the mission which can be identified. Division into phases is something often accomplished in a doctrinal publication. A phase is characterized by the following:

1.   It can be given a name.

2.   It has a logical beginning and end point.

3.   It occupies an exclusive time slice.

4.   All phases taken together describe the entire mission. Examples of the phases of a pilot's mission are premission planning, preflight inspection and checklists, taxi and takeoff, departure, enroute navigation, air refueling, combat, recovery, landing, post flight, and debrief.

3.4 Step 4: Walk Through Each Phase, Listing All Tasks

When phases of mission have been identified, it is simple for an expert performer to walk mentally through each step of the phase, naming the individual tasks which are performed. A task (1) is a significant activity with a name, (2) has an observable beginning and end point, (3) usually results in a consistent product, and (4) usually includes a consistent sequence of specific behaviors, sometimes called subtasks.

3.5 Step 5: Reorganize Tasks So That All Tasks on a Level are Independent

Task statements at each level in the analysis should be independent of each other, and neither subordinate nor superordinate to each other. When listing the major tasks performed during a phase, it is important to see that all tasks at the same level are independent of each other. That is, tasks and subtasks should not be mixed within the same level. There are two reasons for this. First, by including lower level performance statements at higher levels of the analysis, the analysis logic is broken down and the task listing cannot be readily interpreted. Second, a major task can be forgotten or misplaced when the logical organization which helps to ensure against it is violated. The process for determining whether one task is subordinate to another is to review each task in turn and ask "Is this task part of the execution of any other task at this level?" If the answer is yes, then the lower-level task should be moved to the lower level and placed beneath the tasks which subsume it.

3.6 Step 6: Select Next Responsibility Area, Mission, or Phase for Analysis

When the breakdown of one responsibility area into missions, phases, and tasks has been completed the others remain to be analyzed in the same way. This necessitates recycling through the analysis process until all areas have been analyzed.

3.7 Step 7: Identify all Extraordinary Situations Encountered for each Mission, Phase, or Task, and List all Additional Tasks Required

Performance of tasks under unusual conditions often requires extra training because somewhat different procedures are used. These cases should be identified and listed as separate tasks.

This step of the task analysis procedure consists of asking for each task and subtask which the analysis has identified, "Are there any conditions under which this task is performed which require deviations from the normal procedure?"

Significantly different tasks are often created by perform-
ance conditions of night-time operations, heavy weather, heavy
aircraft loading, high levels of threat, system degradation, or
mission degradation.

3.8 Step 8: Examine Hardware, Current Course Curricula, Technical Manuals, and Other Publications for Possible Omissions

Omitting tasks from task listing through oversight can be
expensive and embarrassing. Furthermore, if training is designed
from an incorrect task listing the result can be dangerous.
Technical sources should be examined for possible omissions to
the task listing. Technical sources include hardware specifica-
tions for any equipment to be operated, current course curricula,
and technical manuals. These sources will help to uncover areas
not dealt with by the analysis. Special performance situations
not covered by the analysis are often discovered through consul-
tation of these sources.

3.9 Step 9: Review Task Listing with Outside Qualified Performer

It may be that the information in the manuals has been
updated or changed, or it may be that techniques used by experi-
enced performers are somehow different from what is expressed in
the manuals. It may also be found that the expert helping with
the analysis has a basic misunderstanding or a personal opinion
which is reflected in the analysis. To prevent the damage to the
task analysis that problems of this sort can cause, the task
listing should be reviewed by qualified, experienced subject
matter experts from outside the analysis team. This analysis
should require each reviewer to examine not only the content of
each task but its logical relationship to other tasks.

4.0 TASK LISTING UPDATE

This section emphasizes the continual need for revisions and
update of the F-16 pilot and instructor pilot task listing. It
refers to a generalized procedure for making updates and recom-
mends organizational roles to make that process possible.

4.1 Need for Continual Task Listing Update Procedure

Because of the pervasive effects of the task listing on
other instructional products and documents, it becomes of prime
importance to the intructional system manager and maintainer to
ensure that the task listing is continually kept current. This
is very difficult to accomplish for an emerging weapon system
such as F-16 simply because of the large number of changes which
can be expected in aircraft configurations and equipment, oper-
ational procedures, and concepts of operation and employment.
The job of updating the task listing is made more difficult by
the sheer size of the F-16 task listing (over 900 tasks). Still
another complication arises from the fact that the flow of vital
information which would give rise to task listing changes
presently excludes those charged with task listing maintenance,
the F-16 OTD Team.

A previous section of this paper (Section 2.3) emphasized
the dependence of virtually every other instructional system
product on the task listing during instructional development.
The need for continuous update and maintenance of the task list-
ing as a major activity even after development has been completed
is underscored by the scenario created if no maintenance is
carried out. When information changes occur and the task listing
does not experience a responsive change the course objectives,
syllabus, instructional media presentations, device session spec-
ifications, and grade slips become obsolete to the extent of the
change. It does not take long before the number of changes out-
weighs the amount of information which has remained the same, and
at that point or well before it the instructional portion of the
instructional system becomes inefficient and ineffective. On the
other hand, if information is funnelled to the OTDT and provision
is made for revising the task listing, the other affected items
may also be changed to reflect a current status and avoid the
problems.

4.2 Procedure for Task Listing Update

A procedure for task listing update is contained in project
report no. 10, "Data Base Update Procedures". That report con-
tains both the procedures for task listing update and the proce-
dures for updating documents affected by task listing changes as
well.

9

4.3 Organizational Responsibilities for Task Listing

To ensure proper maintenance of the task listing according to the procedures described above it is recommended that: (1) Organizational roles and responsibilities be clearly defined and that (2) required information channels be established and kept open on a continual basis. The organizational roles described on Table 1 are suggested as a minimum set necessary to carry out task listing update, dissemination, process supervision, and product quality control.

The assignment of the bulk of the duties to the OTDT task listing specialist is in keeping with the recommendation that the F-16 instructional system be maintained by a trained and organized team of instructional development specialists. Non-OTD Team roles defined in Table 1 are also of critical importance and will in some cases require formation of special communication links between the agencies cooperating to keep the F-16 task listing data base updated and correct.

4.4 Support Required for Task Listing Maintenance

To support the task listing maintenance process at least the following resources are considered essential:

1. Adequate word processor support, or data processing support with equivalent or better location, economic, and turnaround characteristics. (In this respect see project report no. 11, "Data Automation of Task and goal Analysis, Existing System Review and Recommendations.") Removing the mechanization physically from local OTDT control is considered extremely undesirable.

2. Adequate training in task listing methodology and specific F-16 task listing maintenance conventions and procedures for the OTDT task listing specialist.

3. Access to fully qualified personnel capable of and willing to participate in the detailed process of task listing validations. This should include sufficient travel funds for the OTDT specialist to either travel to the validating experts work site or bring the expert to the OTDT site.

4. Access to information sources, including travel costs to visit information sources for data gathering when necessary.

5. Adequate reproduction facilities to produce intermediate versions of task listing modifications for validation purposes without undue delay. A reproduction photocopier local to the OTDT site is strongly recommended.

10

6. Adequate production facilities to reproduce approved
    modified task listing for dissemination. Base printing
    facilities should be appropriate for this task.

TABLE 1--Organizational roles for F-16
task listing (TL) maintenance

Organization/Person		Responsibility
OTDT/TL Specialist	1.	Identify possible new sources of information influencing TL update.
	2.	Gather information from all old and new sources regarding changes in aircraft, tactical employment, or missions which call for changes in TL.
	3.	Execute TL changes as required by incoming information.
	4.	Conduct content and technique validation of the TL with extra-OTDT aircraft and instructional development specialists.
	5.	Obtain agreement of OTDT and other controlling agencies on TL changes.
	6.	Oversee insertion of changes into TL data base.
	7.	Produce new TL versions and disseminate to appropriate persons.
OTDT/Leader	1.	Coordinate and arrange extra-OTDT TL asistance contacts such as experts for validation and information producing organizations.
	2.	Ensure use of standard TL modification prodedures.
	3.	Train new OTDT TL specialists or obtain training for them.
	4.	Approve TL changes at OTDT level.
TAC HQ/DOOS	1.	Supply OTDT with current information regarding concept of

Table 1--(cont.)

Organization/Person	Responsibility
	aircraft employment and desired training emphasis.
	2. Supply command emphasis necessary to establish and keep open direct information channels.
OT & E	1. Supply OTDT with current information regarding aircraft operational characteristics and tactical employment concepts.
ASD	1. Supply OTDT with current information regarding planned changes to aircraft engineering.
Airframe Contractor	1. Supply OTDT with current information regarding aircraft capabilities and limitations and aircraft configurations and equipment changes.
4444th OS (Luke)	1. Periodically conduct review of F-16 TL to insure updated TL condition and observance of standard TL modification procedures.
	2. Supervise dissemination of updated TL documents.

DATE ILMED

−8