F-16 AIRCREW TRAINING DEVELOPMENT PROJECT

Contract No. F02604-79-C8875

F-16 INSTRUCTIONAL SYSTEM COST STUDY REPORT,

DEVELOPMENT REPORT No. 21

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Prepared in fulfillment of CDRL no. B035, B039, B040 and partial fulfillment of CDRL nos. B025, B026, B033, B038, B044

by

G.P. Kearsley
A.S. Gibbons
K. King
Courseware, Inc.

E.A. Thompson
Hughes Aircraft Company

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

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 nos. B035, B039, and B040 and the partial requirements of CDRL nos. B025, B026, B033, B038, and B044. 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, Virginia 22314. All reports were reviewed and updated in March 81.

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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.

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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.

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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.

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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.

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I.1 PURPOSE

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 anytime 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.

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I.2 SCOPE

The content of this report contains guide lines for the calculation of training support resource requirements in the areas of:

Instructional personnel--computation of numbers of instructors and course managers required and associated costs.

Instructional personnel support--computation of required numbers of instructor and student administrative (clerical) support personnel and associated costs.

Instructional materials--computations of requirements and associated costs for the reproduction and physical self maintenance of instructional materials, including the cost of student-retainable materials.

Training devices--computation of the number and cost of both learning center media devices (e.g., slide projector, tape players, and carrels) and hands-on training devices (e.g., simulators, trainers, and aircraft).

Training device support--computation of requirements and associated costs for training device operators, maintainers, managers, special training device facilities, not including costs for maintenance equipment or spare parts inventories.

Student support--costs of tempory duty (TDY) for training purposes.

Learning center operations--requirements and associated costs for equipping and operating a learning center, including personnel facilities, and equipment costs.

Development support--requirements and associated costs for development personnel, equipment, and supplies for both initial development and subsequent revision or instructional materials.

Facilities--computation of requirements and associated costs for physical facilities, including all instructional person-

nel office space and special training facilities such as learning centers or training device facilities.

Resource requirements for each of these areas are expressed in terms of the personnel, equipment, facilities, materials, and supplies required for the conduct of the F-16 aircrew training under the provisions of the "F-16 Implementation and Management Plan," project report no. 18.

This report covers computations for all resources which may be needed at some point during the lifetime of the F-16 training program. Not all these resources will be required at all times during training system operation. Some resources required in initial stages of system implementation may become unnecessary in later stages, and vice versa. The introduction of a computer assisted instruction (CAI) or computer managed instruction (CMI) system will replace some resources. During computation, unused resources should be appropriately zeroed if they are not to be used in a particular configuration of the system.

All training resources which are directly and uniquely required for the F-16 training program have been included within the domain of this study. Personnel, facilities, equipment and materials which would be shared with other training systems (e.g., range facilities) or would be part of general USAF operation (e.g., procurement specialists, recreational, mess facilities, etc.) have been excluded. In addition, it has been assumed that requirements and costs should be calculated at the wing level although this model could be used for smaller (e.g., squadron) or larger (e.g., command) levels if desired.

I.3 METHOD

Prior to development of the approach to be taken for the F-16 cost study, a limited review of the literature on resource analysis, selection, and allocation was conducted. The purpose of the review was to ensure appropriate consideration of previous analyses and study results pertaining to resource requirements for possible applicability to the F-16 cost study task.

A few aircrew cost studies provided relevant background for the present report. The study conducted for the B-1 aircrew training project (Reef and Ring, 1975) compared variations in the cost of system components relative to overall system performance. However it was assumed that all versions or configurations of the system were equally effective which is a dubious assumption. For example, existing media selection (including trainer configuration) was assumed correct rather than being a varying parameter within the cost model. The B-1 study found that cost benefits could be obtained by varying the crew ratio, basing concepts, siting of training equipment, total number of trainers, and substitution of trainers for aircraft.

The "Method of Designing Instructional Alternatives" (MODIA) cost derivation model (Petruschelle and Carpenter, 1973) is embedded in the entire MODIA process which guides the development of a design of an instructional system. MODIA is designed to be a highly proceduralized, decision-oriented process for determining instructional system characteristics. The inputs into MODIA are therefore dependent upon the terminology and the classification schemes upon which the design procedures are based. To the extent that a person uses the entire MODIA process, the terms which reach the cost analysis as inputs are meaningful. But to the extent that the philosophy of the developer is different from the MODIA model, the MODIA model will not generate useful information. In principle, if it were known what cost evolutions the MODIA model executed, it would be possible to identify and select those which were independent of the underlying philosophy of developmental terms and incorporate them into a general purpose cost-derivation model.

The present report attempts to provide a detailed methodology for training system cost estimation which incorporates the valuable features of previous work such as the B-1 effort and MODIA. It also attempts to respond to the cost data required by other F-16 studies such as the cost-benefit study of "Computer Managed Instruction for the F-16 Training Program," project report no. 17 or the "F-16 Implementation and Management Plan Report," project report no. 18 and will serve as the basis for future cost/benefit studies in the F-16 program. It should be noted that the present study is not a cost/benefits study itself as it includes no computations for benefits. It can be used as a cost/benefits study though, if the user attaches benefits to various training system configurations and compares the costs computed by this study for these different configurations.

I.4 ANALYSIS CONSTRAINTS

At the time of the analysis and during the preparation of this report, the F-16 programmed flying training (PFT) plan for the 1980 time frame, which was to have been provided to the contractor early in the program, was not yet available from Tactical Air Command (TAC) Headquarters. In the absence of the PFT, data needed for the F-16 training beginning in 1980, were not available for use in the analysis. Nevertheless, cost study efforts were continued in order to maintain program schedule.

Development of the analysis was continued taking into account the missing PFT data. As PFT data become available, they can be inserted in the appropriate formula for analysis computations as required.

II. TRAINING SYSTEM RESOURCE REQUIREMENTS

Resources are required for the duration of some or all of the learning events in the training course syllabus. Associated with each learning event is a resource type or set of resource types, e.g., aircraft, simulators, instructors, classrooms, learning center carrels, course managers, or administrative support personnel.

In the analysis of training support requirements for the F-16 Aircrew Training Development Project the overall approach taken can be visualized as depicted in the flow diagram of Figure 1.

As shown in Figure 1, the first information needed for conducting the analysis includes the system design and resulting syllabus, the media selected for training the syllabus events, and the student load or throughput. This last item, student load, requires having data available which include the total number of students in F-16 training at any one time and, particularly in the case of the F-16, a breakout is needed of the number of students in the training course at any one time falling into one of the following student categories:

1. Instructor pilot (IP) course students
2. Conversion (C) course students
3. Transition (TX) course students
4. Basic (B) course students

Having the student data, syllabus requirements data, and the media selection data, the main thrust of this study is to determine the training support resource requirements for the areas shown in Figure 1 in terms of personnel, equipment, facilities, and materials and supplies. Detailed discussion of each of these areas is provided in the following sections.

II.1. INSTRUCTIONAL PERSONNEL REQUIREMENTS

The instructional personnel category includes flight instructors, academic instructors, simulator instructors, trainer instructors, learning center instructors, and course managers.

Given the total training hours required for an instructor category, and the number of hours each type of instructor is normally available for teaching each year, the number of instructors needed for academic, flight, simulator, trainer, and learning center instruction is computed by dividing the instructional hours required in each category by the average number of hours per year that each type of instructor is available to teach (computations 1-5).

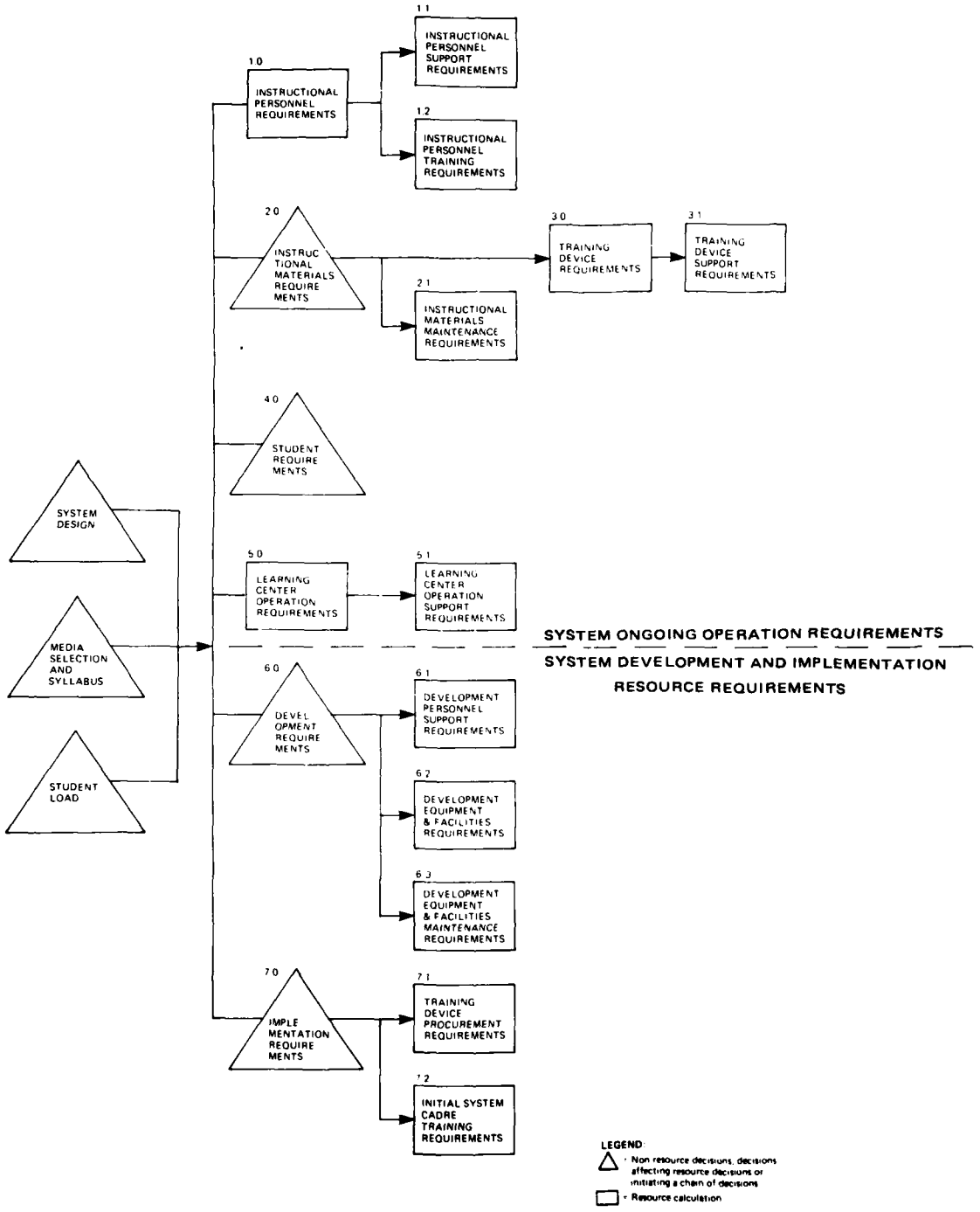

Figure 1 – F-16 Training Support Requirements Analysis (TSRA) Flow Diagram

It sould be noted that although the computations are made separately for each category of instructor, the same instructor could fulfill the role of different types of instructor. Proper consideration must be given to the actual instructor time vs hours devoted to the performance of other duties, e.g., administration, proficiency training, TDY, etc. For this reason, the number of instructors calculated are full time eqiova;emts rather than actual number of instructors.

The flight, simulator and training instruction hours per student must include time spent in briefing/debriefing, filling out gradeslips, and any other instructional activity directly related to actual or simulated sorties.

Learning center instructor requirements also take into account learning center operation hours and level of instructor presence required during those hours (computation 5).

The training course management personnel (if required) are typically computed as a fixed number plus a percentage of the number of instructors. Thus, the number of course managers required at the squadron level equals a fixed number of course managers plus a variable number of instructors (computation 6).

TO BE COMPUTED:

1. Flight instructors required (aircraft only) per year per course (FI).

2. Academic instructors required (lecture and discussion group only) per year per course (AI).

3. Simulator instructors required (operational flight trainer (OFT)/weapons system trainer (WST), independent assessment station (IAS)/dynamic systems simulator (DSS) only) per year per course (SI).

4. Trainer instructors required (cockpit familiarization trainer (CFT), egress procedures trainer (EPT), only) per year per course (TI).

5. Learning center instructors required per year per course (LCI).

6. Course managers required per year per course (CM).

REQUIRED INPUT DATA:

Comp No.	Data	Source
1.	Flight instruction hours required per student per course (FIS)	Syllabus totals

	Max hours/year instructor is available to fly (FIm)	TACM 25-5
	Number of classes/year/course (CY)	TAC HQ
	Average students/class/course (CS)	TAC HQ
2.	Academic instruction hours/student (AIS)	Syllabus
	Max hours/year available (AIm)	TACM 25-5
	Average instructional group size (IGS)	Variable (local policy)
3.	Simulator instruction hours/student (SIS)	Syllabus
	Max hours/year available (SIm)	TACM 25-5
4.	Trainer instruction hours/student (TIS)	Syllabus
	Max hours/year available (TIm)	TACM 25-5
5.	Available learning center operating hours per week (ALCH)	Variable (local policy)
	Number of weeks in course (WC)	Syllabus
	Number of learning center instructors on duty at one time (IOD)	Variable (local policy)
	Maximum hours per year learning center instructor is available for instruction (LCIm)	TACM 25-5
6.	Fixed number of course managers (CMf)	Variable (local policy)
	Variable number of course managers per instructor (CMv)	Variable (local policy)
	Total number of instructors (IT)	Formulas 1-5

COMPUTATIONS:

1. $FI = \frac{FIS \times (CY \times CS)}{FIm}$ (Formula 1)

Where:

FI = Flight instructors required/year/course
FIS = Flight instruction hours/student/course
CY = Number of classes/year/course
CS = Average students/class/course
FIm = Max hours/year flying instructor is available to fly with students (assumes standard workday and week)

2. $AI = \frac{AIS \times (CY \times CS)}{AIm \times IGS}$ (Formula 2)

Where:

AI = Academic instructors required/year/course
AIS = Academic instruction hours/student/course

AIm = Max hours/year academic instructor is available for academic instruction
IGS = Average instructional group size

3. $SI = \frac{SIS \times (CY \times CS)}{SIm}$ (Formula 3)

Where:

SI = Simulator instructors required/year/course
SIS = Simulator instruction hours/student/course
SIm = Max hours/year simulator instructor available for simulator instruction

4. $TI = \frac{TIS \times (CY \times CS)}{TIm}$ (Formula 4)

Where:

TI = Trainer instructors required/year/course
TIS = Trainer instruction hours/student/course
TIm = Max hours/year trainer instructor available for trainer instruction

5. $LCI = \frac{ALCH \times WC \times IOD}{LCIm}$ (Formula 5)

Where:

LCI = Number of learning center instructors required/year/course
ALCH = Available learning center operation hours/week
WC = Number of weeks/course
IOD = Number of learning center instructors on duty at one time
LCIm = Maximum hours per year learning center instructor is available

6. $CM = CMf + (CMv \times IT)$ (Formula 6)

Where:

CM = Number of course managers/year/course
CMf = Fixed number managers per instructor
CMv = Variable number of managers per instructor
IT = Total number of instructors

and where

$IT = (FI + AI + SI + TI + LCI)$ (Formula 7)

II.1.1 Instructional Personnel Support Requirements

Two types of personnel are computed in this section: those who support instructors and therefore vary with the number of instructors, and those who support general requirements generated by student record keeping needs and vary with the number of students. Also computed in this section are facilties, equipment, and materials and supplies for instructional personnel support.

A. Instructor Supporting Personnel

Administrative and clerical personnel are required to support all instructional personnel determined in Section II.1. The duties of instructor support personnel include clerical, record keeping, reporting, and general administrative functions for instructors. This allows greater quantities of instructor time to be freed for instructional duties. These personnel are distinct from the learning center operation personnel and are strictly clerical in function. They may be made up of a detachment from the squadron clerical complement. These administrative people are computed, as were the managers, based upon a fixed number plus a percentage of the number of instructors in the group for which the syllabus is designed (i.e., wing or squadron) (computation 1).

B. General Student Support Personnel

The personnel who provide centralized, squadron based clericl support to the academic program maintain student records, monitor the student schedules and, in general, perform functions at the squadron level which vary with the number of students in the course.

Thus, the number of academic administrative support personnel required at the squadron level equal a fixed (minimum) number of administrators plus a variable number of administrators times the average student load (computation 2).

TO BE COMPUTED:

1. Number of instructor support personnel required (ISP).

2. General (student support personnel) (SSP).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Fixed number of instructor support administrators (ISPF)	Variable (local policy)

Variable number of administrative personnel per instructor (ISPV)	Variable (local policy)
Total number of instructors (IT)	Formula 7
2. Fixed number of student support administrators (SSPF)	Variable (local policy)
Variable number of administrative personnel per student (SSPV)	Variable (local policy)
Average student load per course (ASL)	TAC HQ

COMPUTATIONS:

1. ISP = ISPF + (ISPV x IT) (Formula 8)

Where:

ISP = Instructor support personnel
ISPF = Fixed number of instructor support administrators
ISPV = Variable number of administrative personnel per instructor
IT = Total number of instructors

2. SSP = SSPF + (SSPV x ASL) (Formula 9)

Where:

SSP = Student support personnel required based on the average student load for a specific course
SSP = Fixed number of student support personnel per student
SSPV = Variable number of student support personnel per student
ASL = Average student load/course

C. Instructor, Course Manager, and Administrative Support Facilities

Working areas must be computed for (1) all varieties of instructor, (2) course managers, (3) instructor support administrative personnel, and (4) student support administrative personnel. For ease of planning new instructional systems locations, computations are made separately for flight, trainer, and simulator instructors (computation 1), learning center, academic instructors and course managers (computation 2), instructor support administrative personnel (computation 3), and general (student) support administrative personnel (computation 4). Computations are provided for a minimal office space requirement (56 square feet) large enough to accommodate only a desk, chair and filing cabinet and an optimum office space (70 square feet) with room for a second chair and bookcase.

TO BE COMPUTED:

1. Flight and simulator instructor office space (OSFI).

1a. Flight and simulator instructor minimum office space (OSFIm).

2. Trainer, learning center, course manager and academic instructor office space (OSAI).

2a. Training and learning center, course manager and academic instructor minimum office space (OSAIm).

3. Instructor support administrative office space (OSSI).

3a. Instructor support administrative minimum office space (OSSIm).

4. General (student) support administrative office space (OSSG).

4a. General (student) support administrative office space minimum (OSSGm).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Number of flight instructors required per yr/course (FI)	Formula 1
	Number of simulator instructors required per yr/course (SI)	Formula 3
2.	Number of trainer instructors required per yr/course (TI)	Formula 4
	Number of academic instructors required per yr/course (AI)	Formula 2
	Number of course managers required per yr/course (CM)	Formula 6
	Number of learning center instructors required per yr/course (LCI)	Formula 5
3.	Number of instructor support personnel (ISP)	Formula 8
4.	Number of general (student) support personnel (SSP)	Formula 9

COMPUTATIONS:

1. OSFI = (FI + SI + TI) x (70 sq. ft.) (Formula 10)

1a. OSFIm = (FI + SI + TI) x (55 sq. ft.) (Formula 11)

Where:

OSFI = Office space required for flight and simulator instructors, optimum
OSFIm = Office space required for flight and simulator instructors, minimum
FI = Number of flight instructors per year per course
SI = Number of simulator instructors per year per course
TI = Number of trainer instructors

2. OSAI = (AI + CM + LCI) x (70 sq. ft.) (Formula 12)

2a. OSAIm = (AI + CM + LCI) x (55 sq. ft.) (Formula 13)

Where:

OSAI = Trainer, learning center and academic instructor and course manager office space, optimal
OSAIm = Trainer, learning center, academic instuctor and course manager office space, minimum
AI = Number of academic instructors
CM = Course managers
LCI = Learning center instructors

3. OSSI = ISP x 70 sq. ft. (Formula 14)

3a. OSSIm = ISP x 55 sq. ft (Formula 15)

Where:

OSSI = Instructor support administrative office space
OSSIm = Instructor support minimum administrative office space
ISP = Instructor support personnel

4. OSSG = SSP x (70 sq. ft.) (Formula 16)

4a. OSSGm = SSP x (55 sq. ft.) (Formula 17)

Where:

OSSG = General (student) support administrative office space
OSSGm = General (student) support minimum administrative office space
SSP = General (student) support personnel

D. Instructor and Administrative Support Equipment

Equipment required for the administrative personnel supporting the instructors, course managers and administrative support personnel includes the following:

a. Typewriters
b. Photocopy machines
c. Desk calculator
d. Office furniture (desks, chairs, file cabinets, book shelves)
e. Schedule boards

Computation of needs for these items should take place on an individual basis for each training site. They should be included only to the extent that they are dedicated to F-16 training system requirements and not shared with other USAF functions.

E. Materials and Supplies

Standard USAF office materials and supplies will be required by the administrative support personnel staff. In addition student training records/forms materials and supplies will be required. These will be supplied by the wing squadron and by the OTD team. In most cases, these materials/supplies will not be F-16 unique.

II.1.2 Instructional Personnel Training Requirements

The ongoing training of the instructional personnel staff will consist of the IP upgrade course and specialized training in the techniques of instruction which will be applicable to both flying instruction and academic instruction.

The IP upgrade course will require the same types of instructional resources (personnel, equipment, facilities, materials/supplies) as the overall pilot training programs. The training development contractor will provide a complete instructional systems development (ISD) effort including a syllabus for the IP upgrade course. On the basis of this syllabus, the training resource requirements for the IP upgrade course can be derived through the use of the procedures and methods documented in this report, applied to that course specifically.

II.2 INSTRUCTIONAL MATERIALS

Instructional materials requirements for the F-16 IP course, the C/TX course, and the B course are derived from the respective course syllabi. These instructional materials may include:

Student workbooks
Tape/slide programs
Videotape programs
Instructor and student device session guides
Gradesheets
Tests and test keys

The training development contractor will provide the initial complement of instructional materials for F-16, therefore no computations are made in this section. A description of the materials and amounts provided is given in the "F-16 Pilot Media Selection and Syllabi," project report no. 24. Maintenance of instructional materials is described in Section II.2.1 of this report. The instructional system will be maintained by the AF after completion of contractual obligations.

II.2.1 Instructional Material Maintenance Requirements

Instructional materials maintenance requirements fall under two main headings. The first is shelf maintenance, or that set of duties prescribed to store, inspect, inventory, provide spaces, and order replacements for instructional materials. The second is revisions and reproduction, which involves internal changes to instructional presentations. Computations for this second variety of maintenance are carried out according to guidelines presented in Section II.6 and following sections.

This section pertains to the shelf maintenance of instructional materials. Personnel and facilities must be calculated.

A. Personnel

Shelf maintenance will be accomplished by the learning center operation personnel, whose requirement is computed in Section II.5. Separate computations of those personnel are not, therefore, required in this section.

B. Facilities

Shelf maintenance will occur at learning center operator work areas within the learning center. Requirements for these facilities are computed in Section II.5.

II.3 TRAINING DEVICE REQUIREMENTS

A. Equipment

Training devices used for F-16 training will be of two types: (1) academic or learning center training devices and (2) performance related or simulation training devices. The training devices listed in this section have been selected because:

1. some training devices (i.e. OFT/WST, CFT, EPT) were selected and procured before the development contractor began work; and

2. the remaining training devices (i.e., slide projectors, audiotape players, videotape players, bare carrels) were selected in an informal selection process conducted due to timing requirements connected with their procure ment.

A formal media and training selection process is underway. The results will be reported in project report nos. 24 and 26, "F-16 Pilot Media Selections and Syllabi", and "F-16 Instructor/Course Manager Media Selection and Syllabus". The results of that formal process will not be applied to training at initial F-16 training sites, but depending upon TAC administrative decisions, may be applied to subsequent sites. When those selections are made and approved, this section of this cost study report will accommodate calculations attendant to the changed devices.

It should be noted that a critical training device, namely the F-16 aircraft, is not discussed in this section. It is assumed that the requirements associated with the use of aircraft in training (e.g., hanger facilities, operating costs, maintenance, etc.) are included in the overall cost figure for aircraft use. The number of aircraft hours required for training is a direct function of the desired student throughput, syllabus demands, and training system design. Munitions used in sorties are also not discussed (although their costs are included in Section III under Materials and Supplies.

TO BE COMPUTED:

1. Total training devices to be procured (TVTE).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Total training device time/student required in hours per course (TTDT)	Syllabus
	Percentage of retried training sessions (PRTS)	Variable
	Total training device time available in hours per course (TTDA)	TAC
	Training device downtime in hours per course	Variable

COMPUTATION:

1. $$TVTE = \frac{(TTDT \times NS \times PRTS) + (TTDT \times NS)}{TTDA - TDD}$$ (Formula 18)

Where:

TVTE = Total training devices to be procured
TTDT = Total training device time/student required in hours
PRTS = Percentage of retried training sessions
TTDA = Total training device time available in hours
TDD = Total training device downtime in hours

Note: This computation must be completed separately for each training device

Learning Center Training Devices

Learning center training devices consist of bare carrel (computation 1) audiovisual carrels (computation 2), and videotape carrels (computation 3). Total media device requirements are arrived at by summing the number of devices required to support each course to be taught using the learning center. An assumption of the computations in this section is that bare carrel needs will depend upon the number of workbooks and tests in a given course and that all workbook study will be done in carrels. Note: the terms tape/slide and audiovisual are used interchangablely.

TO BE COMPUTED:

1. Number of bare study carrels required (BSC).

2. Number of tape/slide study carrels required (AVSC).

3. Number of videotape study carrels required (VTSC).

4. Total carrels required (LCT).

REQUIRED INPUTS:

Comp No.	Data	Source
1.	Total number of workbook segments per course (WBS)	Syllabus
	Average number of minutes per workbook segment (MWS)	Estimated or as measured
2.	Total number of tape/slide segments in the course (TSS)	Syllabus
	Average number of minutes per tape/slide segment (MSS)	Estimated or as measured
3.	Total number of videotape segments in the course (VTS)	Syllabus
	Average number of minutes per videotape segment (M/S)	Estimated or as measured

COMPUTATIONS:

1. $$BSC = ASL \times \frac{\frac{(WBS \times MWS)}{60} \times CS}{ALCH \times WC}$$ (Formula 19)

Where:

BSC = Number of bare study carrels required per course
WBS = Workbook segments per course
MWS = Avg number of minutes per workbook segment
WC = Number of weeks in the course
ALCH = Available learning center operating hours per week
CS = Average class size/course
ASL = Average student load per course

2. $$AVSC = ASL \times \frac{\frac{(TSS \times MSS)}{60} \times CS}{ALCH \times WC}$$ (Formula 20)

Where:

MSS = Average number of minutes per tape/slide segment
AVSC = Audiovisual study carrels required per course
TSS = Tape/slide segments in the course.

3. $$VTSC = ASL \times \frac{\frac{(VTS \times MVS)}{60} \times CS}{ALCH \times WC}$$ (Formula 21)

Where:

MVS = Average number of minutes per videotape segment
VTSC = Videotape study carrels required per course
VTS = Videotape segments in the course

4. $$LCT = BSC + AVSC + VTSC$$ (Formula 22)

Where:

LCT = Total study carrels required

B. Facilities

Facilities (building space) are required for two groups of training devices, learning center-based devices, and squadron or wing based devices. Learning center device facility requirements are computed in Section II.5. Squadron-based device facilities are computed in this section. All device computations must include allocations of space for the device as well as access and instructor/observer space. Devices should be located in well-lit areas with isolation being desirable if possible to damper sound

from the device media equipment. Headsets must be attached to devices if isolation is not possible. The CFT and EPT must have close access to 110/220 VAC, 50/90 HZ, single phase three wire power sources. The audiovisual, videotape, and bare carrels must have access to 110 VAC normal wall outlets.

Only devices which will be local to F-16 training sites, are set up for F-16 purposes, and are under F-16 control are subject to calculations in this section. This eliminates the IAS/DSS (AF Logistics Command owned) and the advanced simulator for pilot training (ASPT) (ATC owned.)

Squadron or Wingbased Devices

The CFT requires a eight foot long by 5 foot wide space for the equipment itself. For clearance on the three nonentry sides, a minimum of 2 feet is suggested. On the fourth entry side a 3 foot access and instructor/observer space is needed. The total floor space required for the CFT is approximately 140 square feet.

The cockpit mockup requires a 6 foot long by 5 foot wide space for the equipment. A minimum of 2 feet of clearance on the sides and 3 feet of access at the back for the instructor/ observer space is recommended. The total floor space required for the mockup is 81 square feet.

The EPT requires a space 12 feet long, 5 feet wide and 9 1/2 feet high. The recommended amount of access space for all four sides is 2 1/2 feet with an access clearance of 4 feet on the entry side, making the total area of floor space require approximately 200 square feet.

The OFT will require a special building of its own at each F-16 training location. These buildings will have unique design criteria (power, air conditioning, etc.) as specified by the OFT contractor.

II.3.1 Training Device Support Requirements

II.3.1.1 Personnel

The personnel required for training device support includes equipment operators, managers and training device maintenance and repair personnel.

A. Equipment Operators and Managers

The numbers of equipment operators and managers required are computed based upon the numbers and types of trainers and devices

required to support the course syllabus requirements and associated learning events assigned to these equipment types.

For the F-16 training program the trainers and devices include the OFT--and eventually the WST, the CFT, the EPT, tape/slide equipment, and the video equipment.

Present planning calls for each F-16 Tactical Fighter Trainer Squadron (TFTS) to be equipped with the following equipment for which a squadron equipment operator (SEO) and a squadron equipment manager (SEM) will be required for each squadron.

a. CFT
b. Sound/slide carrels
c. Videotape playback units
d. Cockpit mockup--16 TFTS only

Each wing will also require a learning center equipment manager with responsiblity for the following learning center equipment:

a. CFT
b. Sound/slide carrels
c. Videotape carrels
d. Cockpit mockup

In addition, each wing will require a wing equipment operator (WEO) and wing equipment manager (WEM) for the OFT/WST.

B. Training Device Maintenance and Repair Personnel

The numbers and types of maintenance specialists personnel required to support the trainers and devices are computed based upon the total number and type of trainers and devices required to support the training program and the projected meantime between failures (MTBF) and meantime to repair (MTTR) rates for the trainers and devices--both of which relate to equipment availability for training. When considering equipment MTTR and availability, one must also take into account projected spare availability in order for maintenance personnel to be able to perform their tasks.

For the F-16 training system, maintenance specialists will be required for the following trainers and devices:

a. Simulator (OFT/WST)
b. CFT
c. EPT
d. Videotape players
e. 35mm slide projectors
f. Audiotape players

C. Simulator (OFT) Personnel

Some of the data relating to maintenance factors for the F-16 simulator are classified and are not presented in th. report. It can be said that the simulator maintenance team, which for Hill AFB, will be under the 388 Tactical Fighter Wing (TFW)/Development Technical Team (DTT), will consist of 17 USAF TAC enlisted personnel. These personnel will range in rank from a senior master sergeant team chief to the airman level. The team composition will consist of the following technical specialties:

a. Missile trainer--AF speciality code (AFSC) 341 x 7
b. Digital flight simulator--AFSC 341 x 4
c. Digital nav/tactics training--AFSC 341 x 6

In addition, one of the total of 17 team members will be an administrative specialist and another will be a supply specialist, both of whom are required in support of the maintenance activities.

D. CFT Personnel

The F-16A CFT is designed to provide a capability for self-paced instruction in both normal and emergency cockpit procedures using step-by-step audiovisual programs which present the procedures listed in the F-16A Flight Crew Checklist to the student.

For presentation of the audiovisual programs, the trainer will be equipped with a rear projection system, a 35mm slide projector, and an audiotape cassette player, all of which will require periodic maintenance.

In accordance with the F-16A CFT, Development Exhibit AFSC/ENET-76-2A, 27 February 1978, maintenance of the trainer will be accomplished by one airman of the appropriate AFSC.

E. EPT Personnel

The EPT will be used in training and familiarizing the student with ingress/egress procedures for the F-16. The trainer will permit the instructor to observe and evaluate student responses in normal and emergency cockpit egress, ingress and ejection procedures.

The trainer contains mechanical and electrical components which will require adjustments, servicing, replacement and other maintenance on a periodic basis. The design/development exhibit for the trainer specifies that maintenance of the device will be accomplished by one airman of the appropriate AFSC. This trainer may be used for oth operational and maintenance training. If so, the appropriate proportion of shared time is all that needs to be included in the cost calculations.

F. Videotape and Audiotape Players and 35mm Slide Projector Personnel

As stated earlier in this report, videotape playback units, audiotape players and 35mm slide projectors will be located at the F-16 training squadrons and at the learning center. The largest number of these devices will be located in the carrels at the learning center. It is recommended that the maintenance be centralized and that the responsibility for maintaining all of these devices, both at the learning center and at the squadrons be given to the learning center maintenance support personnel. Support personnel requirements for the center are discussed in Section II.5.1.1.

II.3.1.2 Equipment

Equipment required for training device support, is that associated with each of the maintenance specialists needs in the performance of his assigned maintenance task.

The maintenance and repair equipment required by the simulator personnel is to be specified by the simulator contractor for those tools or equipment which are not part of the standard technician tool kit of AF issue.

Both the CFT and EPT development exhibits call for these devices to be designed to be maintained with "standard hand tools". It is assumed this is meant to be covered by standard AF issue for these maintenance technicians.

For the videotape players, 35mm slide projectors, and the audiotape players, the standard electronic technician tool kits and electronic shop bench checkout and repair equipment will be required.

II.3.1.3 Facilities

The facilities required for training device support include:

a. Offices for maintenance personnel
b. Repair (shop) work areas
c. Storage for spare parts
d. Maintenance equipment storage

As stated in Section II.3 under facilities, the OFT contractor is responsible for the design of the simulator building, including offices and workspace specifications for the maintenance team personnel.

For the squadron CFT's, it is assumed that office and work space for the regular squadron maintenance activities will be sufficient for meeting the needs of the CFT technician. Space

for the technician maintaining the CFT located at the academics learning center will be provided at the center (see Section II.5).

Offices and work space for personnel maintaining the 35mm slide projectors, audiotape players, and the videotape players will also be located at the learning center and are discussed in Section II.5.

II.3.1.4 Materials and Supplies

Materials and supplies required for training device support consist of spares required for the different types of devices based upon projected failure rates for the devices.

Spare provisioning recommendations for the OFT will be the responsiblity of the OFT contractor, the Singer Company, Link Division.

Spare requirements for the CFT and EPT will be specified by USAF ATC, responsible for developing and producing these two devices.

Spares for the videotape player units, 35mm slide projectors, and the audiotape players, all of which are commercial units, will be required as set forth in the selected vendor/manufacturer's manuals, or recommendations from vendor representatives.

II.4 STUDENT REQUIREMENTS

II.4.1 Personnel

As can be seen throughout previous sections of this report and in sections to follow, the given number of students to be trained, the student flow or throughput, is one of the driving factors, along with the syllabus, which determines the training support requirements.

II.4.2 Other

Prior to the availability of the F-16 OFT, provision of TDY funds will be required for student and instructor travel to Williams AFB, for training sessions in the AF Human Resources Laboratory (AFHRL) ASPT. The amount of funding required is dependent upon the student load projected for the first half of 1980, and the number and duration of the training sessions called for in the course syllabus.

TDY funds will also be required in cases where students are sent to a replacement training unit (RTU) on a TDY basis. It is not presently clear what proportion of F-16 students will be sent to RTU on this basis. For those cases, which will depend on the individual situations of the students, the formula below will also suffice.

TO BE COMPUTED:

1. Total TDY funds required (TDYR).

REQUIRED INPUT DATA:

Comp No.	Data	Source
1.	Number of students (NS)	TAC HQ
	Number of instructors (NI)	Variable
	Number of trips (NT)	Syllabus
	Travel costs per trip (TC)	USAF accounting standards
	Length of each trip in days (Avg) (ND)	Syllabus
	Cost per day per student, excluding travel (CD)	USAF accounting standards

COMPUTATIONS:

1. $TDYR = (NS + NI) \times (NT \times (TC + (ND \times CD)))$ (Formula 23)

Where:

TDYR = Total TDY funds required per year
NS = Number of students on TDY
NI = Number of instructors on TDY
NT = Number of trips
ND = Length of each trip in days (avg)
TC = Travel costs per trip
CD = Cost per day per person, excluding travel

II.5 Academic/Learning Center Operation Requirements

The initial F-16 training program learning center for Hill AFB has been designated the 388th TFW academic center. Following implementation of the initial training syllabi, learning centers will be established at all F-16 RTU locations.

A. Personnel

Personnel required for the operation of the learning center excludes learning center instructors (Section II.1) and includes

a learning center operators who will be responsible for the control and checkout of training media programs and materials. They will perform shelf maintenance of instructional materials. They will also have responsibility for keeping learning center records on student use of the media equipment, dates of use, and the instruction completed by the students.

Based upon a review of other learning center operations, in particular the 58th TFTW learning center at Luke AFB, and considering the results of research on learning centers and their operation contained in the literature, it is estimated that a minimum of two AF specialists having the appropriate AFSC will be required for learning center operation during a 12-hour shift. However, the work load on these workers once student load achieves its highest level will be very heavy, and there is a possibility that an additional worker may be needed.

B. Equipment

Equipment required for learning center operation includes: (1) storage and funishings for the library/checkout area, (2) student classroom equipment, (3) discussion room equipment, (4) student lounge furnishings, and (5) learning center operator office furnishings.

(1) Storage Space

TO BE COMPUTED:

1. Workbook storage space (WSS).
2. Tape/slide material storage space (TSSS).
3. Videotape storage space (VTSS).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Total number of workbooks per course (WBC)	Syllabus
	Space required per copy (SC)	Actual materials
2.	Total number of tape/slides per course (TSC)	Syllabus
	Space required per tape/slide (SS)	Actual material
3.	Total number of videotapes per course (VTC)	Syllabus
	Space required per videotape (SVT)	Actual material

COMPUTATIONS:

1. WSS = WBC x SC (Formula 24)

Where:

WSS = Workbook storage space/course
WBC = Number of workbooks per course
SC = Space required per workbook

2. TSSS = TSC x SS (Formula 25)

Where:

TSSS = Tape/slide material storage space/course
TSC = Number of tape/slide segments per course
SS = Space required tape/slide

3. VTSS = VTC x SVT (Formula 26)

Where:

VTSS = Videotape storage space/course
VTC = Videotapes per course
SVT = Space required per videotape

(2) Student Classroom Equipment

For classroom use on moveable (wheeled) tables, one only of the following to be stored at this learning center:

a. Slide projector, tape player (synchronized) combination,
b. Videotape player and monitor.

For large classroom (capacity = 30 students and instructor), suggested equipment is:

a. Projection screen
b. 30 chairs with folding writing area arms
c. Chalkboards
d. Instructor lecturn

For small classroom (capacity = 10 students and 1 instructor) suggested equipment is:

a. 10 desks and chairs
b. Projection screen
c. Chalkboard

(3) Discussion Room

For discussion room, equipment suggested is:

a. Chalkboard
b. 10 chairs with folding writing area arms

(4) Student Lounge

Suitably furnished for 10 to 20 students with:

a. Comfortable chairs and couches
b. Storage lockers

(5) Operator Offices

Learning center offices should include:

a. 2 office desks
b. 2 desk chairs
c. 1 bookcase
d. 3 file cabinets

C. Facilities

Facility requirements for operation of the learning/academic center consists of the space requirements associated with the carrels and the areas listed above.

Learning center carrel space requirements are based upon the standard carrel presently in use by the TAC in the majority of its installations. These carrels are federal stock number (FSN) 6910004260872 and measure 49 by 49 inches. When appropriate aisle and access space is taken into account, each carrel installation requires a total of 38 square feet.

TO BE COMPUTED:

1. Total carrel space required in learning center (TCS).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Total study carrels required (LCT)	Formula 21

COMPUTATION:

1. TCS = LCT x 38 (Formula 27)

Where:

TCS = Total carrel space in learning center (square feet)
LCT = Total carrels required

The carrel room should be carpeted, well lighted, and should have acoustic walls and ceilings. Adequate electrical power must be provided for the carrels having audiovisual equipment. In addition this area should be shielded for presentation of classified audiovisual presentations.

A media library checkout area is required adjacent to the media carrel study area for storage and checkout of the workbooks, tape/slide programs, and the video programs. This must be a secure area to accommodate those materials/programs containing classified data. Based on an investigation of the 58 TFTW learning center at Luke AFB and its library/checkout area, the review of learning center studies performed in the past, and considering the total number of materials and programs being developed for F-16, the media library/checkout area should measure approximately 24 feet by 8 feet for a total of 192 square feet.

Student Classrooms

A large, formal, student classroom (lecture room) is required. This room should be sized to accommodate 30 students. At the initial training site only, this room must also have space to display the 1:1 cockpit mockup being developed for F-16 training. Should the decision be made to allocate mockups to future training sites, room for the equipment should be allowed in those large classrooms also.

A small classroom is required to handle about ten students and an instructor. This room will be used for small group meetings or as a second classroom when the large classroom is occupied.

The small discussion room required must be large enough to contain the CFT and a maximum of ten students and the furnishings specified previously. It will be used for discussion group meetings.

Student Lounge

To provide an informal instruction and discussion area, a lounge should be available. It should be of a size sufficient to accommodate a coffee/soft drink refreshment area, couches and

chairs and storage areas for reading materials. Sizing of the area should be based on the 10 to 20 student capacity figure.

Operator Offices

Office space for the learning center operator(s) is required. The optimum space allocated for each operator should be 70 square feet, with a minimum allowance of 55 square feet.

D. Materials and Supplies

Materials and supplies required for operation of the learning center consists of standard AF issue for the operation personnel offices.

II.5.1 Academic/Learning Center Operation Support Requirements

II.5.1.1 Personnel

Personnel required in support of operation of the learning center include a learning center supervisor and a media device maintenance technician.

The learning center supervisor will be responsible for overall operation and scheduling of the center facilities and supervision of the operation personnel and the maintenance technician. The supervisor responsibility may be assumed by one of the two recommended learning center operators described in Section II.5 under Personnel.

The maintenance technician will be responsible for maintaining 35mm slide projectors, audiotape playback units, and videotape player units belonging to the learning center. In addition, he will also maintain, with assistance as required from the squadron, the sound/slide and video equipment located at the squadrons. This technician will only be necessary in those cases where no media repair facility exists which can be conviently accessed on a daily or weekly basis by the learning center operators. Where such a facility exists, this position may be eliminated.

II.5.1.2 Equipment

Support equipment required for learning center operation includes the equipment required by the maintenance technician in performing the necessary maintenance and repair of the media devices. It is assumed this will include the standard AF issue of an electronics technician's tool kit and associated bench

check, trouble shooting, and repair items, e.g., volt/ohm meter, soldering gun, oscilloscope, etc.

In addition to the above equipment, office equipment (desk, chair, bookcase, file cabinet) will be required for the learning center supervisor.

II.5.1.3 Facilities

Office space will be required for the center supervisor of the established area of 70 square feet, optimum, and 55 square feet minimum. This space will only be needed when the learning center supervisor is other than a learning center operator.

An appropriate equipment maintenance area is also required to accommodate a work bench and maintenance equipment storage when that function is handled at the learning center.

II.5.1.4 Materials and Supplies

Materials and supplies required are standard AF office issue of supplies, and the normal consumable maintenance supplies such as solder, wire, resistors, capacitors, bulbs, and so forth.

II.6 DEVELOPMENT REQUIREMENTS

The previous sections of the report have described the resource requirements involved in the delivery aspects of the F-16 training program. This section describes the resource requirements involved in the ongoing revision and generation of the curriculum materials and media themselves. This includes the development personnel, support and maintenance personnel, and equipment and materials involved in the development process. The contractor provides all of these resources in the initial development of the training program, however the AF must take over these development functions upon contrator departure and for the lifetime of the training program.

Data derived from contractor historical data have been provided in this section to allow estimates to be generated when the number and nature of revisions/additions to the training program of development costs are known.

A. Personnel

For the design, development and production of the course materials discussed in the previous section, certain categories of ISD specialist personnel are required. The categories of ISD

specialists needed in the training course development process include:

a. Instructional designers
b. Subject matter experts
c. Secretarial support
d. Media specialists (artists/graphics)

For a revision phase of an ISD effort the following tasks need to be considered in the development of manpower projections.

a. Sequencing and grouping of objectives (syllabus development)
b. Development of lesson specifications for each objective
c. Development of a quality control plan
d. Development of an implementation plan

In determining the personnel requirements associated with the accomplishment of each of these tasks, the data presented in Figure 2 are of value. These data represent the contractor's best judgment, based on previous experience, as to the level of effort required per unit of measure to perform the design tasks. To calculate manpower requirements using this figure, it is necessary to express the work in the appropriate units and multiply by the stated manpower requirement. For example, to develop lesson specifications for four new objectives would involve the following computations:

Instructional designer: .5 x 4 = 2 manhours (avg.)
Subject matter expert: 1 x 4 = 4 manhours (avg.)
Secretarial support: .25 x 4 = 1 manhour (avg.)
Artist/graphics support: 1 x 4 = 4 manhours (avg.)

Once the lesson specifications have been developed, the actual lesson authoring and formative evaluation can start. This activity includes the following tasks:

1. Lesson materials authoring
2. Lesson materials prototype development
3. Lesson materials small group tryout
4. Lesson materials revision
5. Lesson materials final production

The types of personnel and the amount of manpower of each type needed to perform these tasks depends on the presentation media to be used for each lesson. The manpower estimates for these tasks for each media type used in the F-16 syllabus are presented in Figure 3 through 11. These figures are used in the same way as Figure 2.

TASK	Unit of Measure	Instructional Designer	ISD Team Subject Matter Experts	Secretarial Support	Artist/ Graphics Support
Syllabus Development	Per job	25 15 - 35	25 15 - 35	10 5 - 20	10 5 - 20
Syllabus Update	Per job update	5 3 - 7	5 3 - 7	2 1 - 3	2 1 - 3
Lesson Specifications Development	Per objective	.5 mhs .2 - 1 mhs	1 mhs .5 - 3 mhs	.25 mhs .1 - .5 mhs	1 mhs 0 - 2 mhs
Lesson Specifications Update	Per job Per update	10 5 - 15	20 15 - 30	10 5 - 15	10 5 - 15
Quality Control Plan Development	Per project	25 15 - 30	5 2 - 8	2 1 - 3	1 0 - 2
Quality Control Plan Update	Per project Per update	5 2 - 7	1 .5 - 2	1 .5 - 1.5	1 0 - 2
Implementation Plan Development	Per project	25 15 - 30	12 6 - 18	2 1 - 3	1 0 - 2
Implementation Plan Update	Per project Per update	5 2 - 7	2 1 - 3	1 .5 - 1.5	1 0 - 2

1. All estimates are in mandays unless otherwise specified.
2. First number represents mean, second numbers represent range.

FIGURE 2 -- MANPOWER ESTIMATES FOR DESIGN PHASE ISD TASKS

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.5/0.5	0.5/0.5	1.0	0	0	0.5	0	0	0	1.0	0
PROTOTYPE PRODUCTION	0.26	0.26	0.26	0	0	4.0	0	0.5	0	0.5	1.0
TRYOUT	0.25	0	0	0	0	0	0	0	0	0	0
REVISION	0.5	0.5	0.26	0	0	0.2	0	0	0	0.5	0
FINAL PRODUCTION	0.25	0.25	0	0	0	⑤ 1.0	0	0.5	0	1.0	⑤ 0.25
TOTAL	0.5/ 1.76 2.26	0.5/ 1.51 2.01	1.52	0	0	5.7	0	1.0	0	3.0	1.25

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 3 – SYSTEM AND DECISION-MAKING-SCENARIO WORKBOOK PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.13/ 0.13	0.13/ 0.13	0.2	0	0	⑤ 0.25	0	0	0	⑤ 0.5	0
PROTOTYPE PRODUCTION	0.13	0.13	0.13	0	0	⑤ 1.0	0	0.13	0	0.13	0.25
TRYOUT	0.13	0	0.13	0	0	0.5	0	0	0	0	0
REVISION	0.13	0.13	⑤ 0.25	0	0	0.1	0	⑤ 0.13	0	0.13	0
FINAL PRODUCTION	0.13	0.13	0	0	0	⑤ 0	0	⑤ 0	0	0.25	0.25
TOTAL	0.13/ 0.65 .78	0.13/ 0.52 .65	0.71	0	0	1.85	0	0.26	0	1.01	0.5

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 4 – PROCEDURE, CALCULATION, AND MEMORY WORKBOOK PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.13/ 0.13	0.13/ 0.13	0.2	0	0	⑤ 0.25	0	0	0	⑤ 0.5	0
PROTOTYPE PRODUCTION	0.13	0.13	0.13	0	0	⑤ 1.0	0	0.13	0	0.13	0.25
TRYOUT	0.13	0	0.13	0	0	0.5	0	0	0	0	0
REVISION	0.13	0.13	⑤ 0.25	0	0	0.1	0	⑤ 0.13	0	0.13	0
FINAL PRODUCTION	0.13	0.13	0	0	0	⑤ 0	0	⑤ 0	0	0.25	0.25
TOTAL	0.13/ 0.65 .78	0.13/ 0.52 .65	0.71	0	0	1.85	0	0.26	0	1.01	0.5

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 5 – CHECKLIST WORKBOOK PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.13/ 0.13	0.13/ 0.13	1.0	⑤ 0	0	0	⑤ 0.5	0	0	0.13	0
PROTOTYPE PRODUCTION	0.07	0.07	⑤ 0.5	⑤ 0	0	0	⑤ 2.0	0.13	0	0.13	0
TRYOUT	0.13	0	0	⑤ 0	0	0	0	0	0	0	0
REVISION	0.13	0.13	0.25	0.13	0	0	0	0	0	0.07	0
FINAL PRODUCTION	0.13	0.13	⑤ 0.5	⑤ 0	0	0	0.5	⑤ 0.13	⑤ 0	0.5	⑤ 0
TOTAL	0.13/ 0.59 .72	0.13/ 0.46 .59	2.25	0.13	0	0	3.0	0.26	0	0.83	0

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 6 – INSPECTION SLIDE/WORKBOOK PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.13/ 0.13	0.13/ 0.13	⑤ 1.5	⑤ 0	0	0	0	0	0	0.13	0
PROTOTYPE PRODUCTION	0.07	0.07	⑤ 0.5	⑤ 3.5	0	0	0	0	0	0.13	0.25
TRYOUT	0.13	0	0	0	0	0	0	0	0	0	0
REVISION	0.13	0.13	⑤ 1.0	0	⑤ 1.0	0	0	0	0	0.07	0
FINAL PRODUCTION	0.13	⑤ 0.25	⑤ 0.5	⑤ 0.5	⑤ 7.0	0	0.5	0	⑤ 1.0	0	0
TOTAL	0.13/ 0.59 .72	0.13/ 0.58 .71	3.5	4.0	8.0	0	0.5	0	1.0	0.33	0.25

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 7 – MALFUNCTION IDENTIFICATION AND MEMORY DRILL TAPE/SLIDE PROGRAM PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.5/0.5	0.5/0.5	⑤ 1.5	⑤ 0	0	0	0	0	0	0	0
PROTOTYPE PRODUCTION	0.13	0.13	⑤ 0.5	⑤ 3.5	0	0	0	0	0	0.13	0.25
TRYOUT	0.13	0	0	0	0	0	0	0	0	0	0
REVISION	0.13	0.13	⑤ 1.0	0	⑤ 1.0	0	0	0	0	0.13	0
FINAL PRODUCTION	0.13	⑤ 0.25	⑤ 0.5	⑤ 0.5	⑤ 7.0	0	0 5	0	⑤ 1.0	0	0
TOTAL	0.5/ 1.02 1.52	0.5/ 1.01 1.51	3.5	4.0	8.0	0	0.5	0	1.0	0.26	0.25

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 8 – PLANNING/PRINCIPLES, AVIONICS PROCEDURES, AND CLASSIFICATION TAPE/SLIDE PROGRAM PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP	TV DIRECTOR	TV CREW
	①	②		③	③	③				④			
AUTHORING	0.5/0.5	0.5/ 0.25	3.0	⑤ 0.25	0	0	0	0	0	0.25	0	⑤ 2.0	0
PROTOTYPE PRODUCTION	0.13	0.13	0.25	⑤ 0.75	0	0	0	0	2.0	0.25	⑤ 0.25	⑤ 2.0	⑤ 2.0
TRYOUT	0.13	0	0	0	0	0	0	0	0	0	0	0	0
REVISION	0.25	0.25	0.75	0.25	0	0	0	0	0	0.13	0	⑤ 0.25	0
FINAL PRODUCTION	0.25	0.25	0.25	0	0	0	0	0	0.34	0	0	⑤ 1.0	⑤ 1.0
TOTAL	0.5/ 1.26 0.76	0.5/ 0.88 1.38	4.25	1.25	0	0	0	0	2.34	0.63	0.25	5.25	3.0

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 9 – VIDEOTAPE PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.5/0.5	0.5/0.5	0.2	0.25	0	⑤ 0.25	0	0	0	0.25	0
PROTOTYPE PRODUCTION	0.13	0.13	0.13	1.0	0	1.0	⑤ 0.5	0	0	0.25	0.5
TRYOUT	0.25	0.25	0	0	0	0	0	0	0	0	0
REVISION	0.25	0.25	0.13	0.13	0	⑤ 0.13	0	0	0	0.13	0
FINAL PRODUCTION	0.25	0.25	0	1.0	0	1.0	0.34	0.13	0	0.5	1.0
TOTAL	0.5/ 1.38 1.88	0.5/ 1.38 1.88	0.92	2.38	0	2.38	0.84	0.13	0	0.13	1.5

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 10 – LECTURE OUTLINE PRODUCTION TIMES (IN MANDAYS)

	INSTRUCTIONAL DESIGNER	SME	SCRIPTWRITER/ EDITOR	TAPE/SLIDE ARTIST – OGDEN	TAPE/SLIDE ARTIST – SAN DIEGO	TECH ARTIST	PHOTOGRAPHER	PROOFREADER	NARRATOR	WORD PROCESSOR OPERATOR	PASTE-UP
	①	②		③	③	③				④	
AUTHORING	0.25/ 0.25	0.25/ 0.25	0.16	0	0	⑤ 0.2	0	0	0	⑤ 0.4	0
PROTOTYPE PRODUCTION	0.1	0.1	0.1	0	0	⑤ 0.8	0	0.1	0	0.1	0.2
TRYOUT	0.13	0.13	0	0	0	0	0	0	0	0	0
REVISION	0.1	0.1	⑤ 0.2	0	0	0.08	0	⑤ 0.1	0	0.1	0
FINAL PRODUCTION	0.1	0.1	0	0	0	⑤ 0	0	⑤ 0	0	0.2	0.2
TOTAL	0.25/ 0.68 .93	0.25/ 0.68 .93	0.46	0	0	1.08	0	0.2	0	0.8	0.4

NOTES:

1 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/CONSOLIDATION TIME

2 DOUBLE ENTRIES IN THIS COLUMN: INTERVIEW TIME/RESEARCH TIME

3 BREAKDOWN OF CATEGORIES DUE TO F-16 PROJECT STAFFING CONSTRAINTS OR NEEDS

4 SECRETARY TIME FROM ATTACHMENT I IS CONTAINED IN WORD PROCESSOR TOTALS

5 ESTIMATE VARIES SLIGHTLY FROM ATTACHMENT I DATA DUE TO PECULIAR F-16 PROJECT CONDITIONS OR INSTRUCTIONAL FORMATS

FIGURE 11 – DESIGN SESSION GUIDE, GRADESLIP, AND TEST PRODUCTION TIMES (IN MANDAYS)

B. Facilities

The facilities required for the development personnel include appropriate office spaces and the necessary technical working areas.

The number of office spaces required is dependent upon the number of people required in development of the course. The office space square footage required should be computed using the procedure presented in previous sections of this report.

Technical work areas will be required for the artist/graphics personnel. (See Section II.6.2.)

II.6.1 Development Personnel Support Requirements

II.6.1.1 Personnel

Personnel resources required in support of the training course development staff include secretarial and administrative/management personnel.

Secretarial support required in direct support of the syllabus development and development of course materials has been discussed in Section II.6 and estimated figures presented in Figures 2-11. Indirect secretarial support such as project correspondence, memos, etc. will also be required.

A course development manager/administrator will be required for overall project responsibility.

II.6.1.2 Equipment

Equipment required for the support personnel includes secretarial (desks, chair, typewriter, files, etc.) and office equipment (desk, chair, bookcase).

II.6.1.3 Facilities

Office space for the course manager and the secretary/typist will be required. The desirable office space has been discussed in previous sections.

II.6.1.4 Materials and Supplies

Materials and supplies required include the standard office needs. This includes paper, pencils, typewriter ribbons, note pads, forms, and other such consumables.

II.6.2 Development Equipment and Facility Requirements

II.6.2.1 Personnel

Personnel requirements considered here are the operators for the development/production equipment. The personnel categories required for equipment operation include the following:

1. Photocopy operator
2. Video recording/production equipment operator
3. Audio recording/editing equipment operator

For the initial F-16 training program development and production requirements the contractor provides these personnel. Subsequent to the contractual period these operators are provided by either TAC, if they have chosen to develop their own internal capability, or an agency or group that has been designated to provide TAC with development and production support.

II.6.2.2 Equipment

A wide variety of equipment is required for course development. Equipment is needed for development and production of the lesson segments (workbooks, tape/slide, and videotape programs), creation, storing, and retrieval of data base files, and other course development functions. The equipment items required include:

1. Photocopy machine
2. Word processor
3. Positive camera
4. Camera table
5. Special artists tables
6. Light tables
7. Photographic equipment
8. Infrared copier
9. Video recording/production equipment
10. Audio recording/editing equipment

Production and duplication is required for the media types selected to present the various course segments. In the case of the F-16, production and duplication is required for student workbooks, tape/slide programs, and videotape programs.

At the time of this preliminary requirements analysis, plans call for the production of the text of the original student workbooks on the project word processors, with any graphic art required produced by the project art staff. With the original text stored on the word processor, content changes, updates, or modifications can be readily accomplished with a minimum of delay.

Production and duplication equipment associated with development of the tape/side programs includes audiotape recording and duplication devices and photographic equipment for photographing photo-ready art, producing 35mm slides, and 35mm slide duplications. Production of finished original audiotapes will require access to a suitable recording studio or booth. In addition, the audiotape production equipment must have the capability for music and sound effect dubbing as required.

All of the above tape/slide equipment and associated capabilities presently exist within the F-16 training development contractor (Courseware/Hughes) team, and no additional equipment will need to be acquired for the initial effort. Once contractual obligations are complete, however, this capability will have to be acquired by the F-16 OTD organization or arrangements made for outside support in the development and production of new programs and the modification or updating of existing tape/slide programs.

II.3.2.3 Facilities

Facility requirements for course development are those associated with the printing of student workbooks, the processing of 35mm film for tape/slide programs to be produced, and the processing of audio- for the videotapes for those instructional segments produced in the video medium.

The major printing load for the F-16 training course will result from the production and duplication of student workbooks. The planning for the original F-16 training site, Hill AFB, calls for the original copies of the workbooks to be produced on the project word processors. Due to the large number of workbooks and the number of copies required to meet the student load needs, duplication will be accomplished by a printing service outside the project. Whenever possible the base reproduction/printing services will be utilized. If a situation should arise where the reproduction volume on schedule cannot be accommodated by the base services, then the use of an off base reproduction/printing vendor will be required.

The manner in which printing service facility requirements will be met at future F-16 training sites will depend upon the base selected and whether or not adequate services are available at that location.

Darkroom/film processing facilities are required. All film processing for the original master tape/slide programs will be accomplished by the F-16 contractor. All film processing for duplicate copies of the master slides for the tape/slide programs will be accomplished by the AF.

As mentioned above for printing services facilities, this is the plan for the initial F-16 training to be conducted at Hill

AFB. An alternate approach may be required at subsequent training locations and as additional programs are developed after the contracted effort is ended.

Audiotape processing facilities are required for both the tape/slide programs and the videotape programs produced for the course. Processing of the audiotapes for the tape/slide master kits and audio for the master videotape programs to be delivered will be accomplished by the contractor. The audio processing required for the duplication of these masters will be handled by TAC.

The same comments apply here as they did in the previous discussions of printing and film processing facilities and services. Future audio- and videotape processing for F-16 training following contractor departure will have to be planned based upon what type of services facilities are available to TAC to meet F-16 training program needs.

In addition to the facilities discussed above, space is required for the artist/graphics staff required for the visuals to be developed for the student workbooks and the art work for the tape/slide programs.

II.6.2.4 Materials and Supplies

The materials and supplies required include the following resource categories:

1. Paper supplies
   a. Photocopy paper
   b. Writing pads
   c. Word processor paper

2. Art supplies
   a. Marker pens/paints
   b. Tapes/lettering
   c. Brushes

3. Still photograph supplies
   a. Film
   b. Processing chemicals
   c. Slide mountings
   d. Slide trays

4. Videotape supplies
   a. Videotapes/cassetts

5. Audio supplies
   a. Audiotapes/cassettes

The amount of paper required is a function of the number of written instructional segments, guides and audiovisual scripts to

be produced and the number of revisions to be made (computation 1). Art supplies are a function of the amount of art required (workbooks, slides) and the number of revisions involved (computation 2). Photographic supplies are a function of the number of photographs required and the number of retakes necessary (computation 3). Videotape and audio supplies are a function of the number of video- and audiotapes in the syllabus (computation 4 and 5). It should be noted that these computations are for development only and do not take into account the duplication required to make the total number of copies of workbooks or tapes required for instruction.

TO BE COMPUTED:

1. Total paper required per course (TPS).

2. Total art required per course (TAR).

3. Total photographs required per course (TPR).

4. Total videotapes required per course (TVTR).

5. Total audiotapes required per course (TATR).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Total tests/gradeslips per course (TGS) Total discussion/device guides per course (DDG) Average number of pages per segment (NPS) Average number of pages per guide (NPG) Average number of pages per test (NPT) Average number of drafts/revisions/retakes (NDR)	Estimated Estimated
2.	Average number of pieces of art per segment per course (NAS)	Estimated
3.	Average number of photographs per segment (PPS)	Estimated
4.	Average number videotape frames per segment (NVS)	Estimated
5.	Average number of audiotape units per segment (NATS)	Estimated

COMPUTATIONS:

1. TPS = NDR x ((WBS + TSS + VTS) x NPS) + (DDG x NPG) + TGS x NPT) (Formula 28)

Where:

TPS = Total paper required per course
WBS = Total workbook segments per course
TSS = Total tape/slide segments per course
VTS = Total videotape segments per course
NPS = Average number of pages per segment
NDR = Average number of drafts/revisions/retakes

2. TAR = (WBS + TSS) x NAS x NDR (Formula 29)

Where:

TAR = Total art required per course
NAS = Average number of pieces of art per segment

3. TPR = (WBS + TSS) x PPS x NDR (Formula 30)

Where:

TPR = Total photographs per course
PPS = Average number of photographs per segment

4. TVTR = VTS x NVS x NDR (Formula 31)

Where:

TVTR = Total videotapes required per course
NVS = Average number of videotape frames per segment

5. TATR = TSS x NATS x NDR (Formula 32)

Where:

TATR = Total audiotapes required per course
NATS = Average number of audiotape units per segment

II.6.3 Development Equipment and Facilities Maintenance Requirement

II.6.3.1 Personnel

Certain types of specialist personnel are required for the performance of maintenance tasks that may be required for the development equipment and facilities discussed in Section II.6.2. As has been stated before, the initial F-16 training program development and production is a contractor responsibility and the accomplishment of any necessary maintenance tasks will be carried out by the contractor's personnel. Once the contracted effort

ends these maintenance tasks and who will accomplish them becomes a concern of TAC or the agency providing development and production support to the program.

The equipment and facilities of concern include:

1. Photocopy machine
2. Word processor
3. Photographic equipment and processing equipment and facilities
4. Video and audio equipment and processing facilities

In the case of the photocopy and word processor equipment, responsibility for maintenance depends on whether or not the equipment is purchased or leased and whether a maintenance policy has been procured. It is most likely that in either case (purchase or lease) a maintenance policy would be procured, since maintenance of these devices is highly specialized and not presently covered in the AFSC structure.

For items three and four above, it is very likely that an AF agency will be providing these services and would, therefore, provide the necessary maintenance personnel.

II.6.3.2 Equipment

The same comments apply, in general, to maintenance equipment requirements for development equipment and facilities maintenance as they did to maintenance personnel requirements discussed above. However, if TAC or the OTD team acquires the development and production capability and assumes responsibility for the maintenance of development equipment and facilities, they will need to supply their maintenance personnel with the necessary maintenance equipment.

II.6.3.3 Facilities

Facility requirements will be those associated with provision of the necessary maintenance/repair spaces for the accomplishment of development equipment maintenance/repair tasks. Here again, the same comments hold true as they did for personnel and equipment requirements discussed earlier.

II.6.3.4 Materials and Supplies

The requirements here consist of maintenance supplies and replacement parts for the development/production equipment. The responsibility for ensuring that these requirements are met falls to the agency or group providing the maintenance services.

II.7 IMPLEMENTATION REQUIREMENTS

A. Personnel

The personnel category, as presented and discussed here, refers to the initial student inputs to the F-16 training program developed under the ISD contract due to be implemented commencing January 1980. The four student personnel categories are expected to be:

1. B Course--graduates of udergraduat pilot training (UPT)/ fighter lead-in training (LIT)
2. C Course--first assignment instructor pilots (FAIPS)
3. TX Course--fighter experienced conversion students
4. IP Course--fighter experienced upgrading to F-16 instructor

B. Equipment

The equipment requirements implementation of the course have been discussed in previous sections. (See Sections II.1.2 and II.3.0.)

C. Facilities

Facility requirements associated with implementation of the training course have likewise been covered in earlier sections (See Sections II.1.2 and II.3.0.)

D. Materials and Supplies

For materials and supplies requirements for implementation refer to Sections II.1.2, II.2.0, and II.3.0.

II.7.1 Training Device Procurement Requirements

II.7.1.1 Personnel

It is not within the scope of the training support requirements analysis or the intent of this report to set forth the requirements as to the number of procurement personnel required for the procurement of training devices for the instructional system being developed. However, members of the ISD team do get involved in the procurement process by participating in such activities as design reviews for training devices being procured to ensure proper consideration of the instructional attributes of such devices.

II.7.1.2 Equipment

No applicable.

II.7.1.3 Facilities

Not applicable.

II.7.1.4 Materials and Supplies

Not applicable.

II.7.2 Initial System Cadre Training Requirement

II.7.2.1 Personnel

Prior to implementation in January 1980 of the F-16 training program developed under the ISD concept, it is necessary, as it is with all systems first entering the operational inventory, to establish the instructional staff cadre for the program.

Personnel requirements for the instructional cadre are basically the same as those discussed in Section II.1.2 for the ongoing instructional staff for F-16 training. Both flight and academic instructors are required for training of the initial instructional cadre.

For the F-16 program, cadre training will begin at Edwards AFB, California, and continue at Hill AFB for ground training and flying training.

Ground training consists primarily of completion of assigned reading on the aircraft and its systems with General Dynamics and AF personnel available for clarification of any questions.

Flight training for the initial F-16 instructional cadre is given by pilot members of the F-16 Joint Test Force (JTF) will begin at Edwards AFB and continue at Hill AFB.

At the present time, four initial cadres are scheduled to complete training on 31 December 1978 and report to the 388th TFW on 2 January 1979, where they will be available for the first F-16 interim training class consisting of one student from the Netherlands.

II.7.2.2 Equipment

Equipment required for cadre training in this case is a given, i.e., JTF aircraft. In addition a CFT is scheduled to be available in September 1978.

II.7.2.3 Facilities

Facilities, likewise, are a given for the initial cadre training, consisting of those facilities available at Edwards AFB, and assigned to the F-16 JFT.

II.7.2.4 Materials and Supplies

Instructional material requirements for cadre training are being met with the use of exisiting documents for the aircraft and its systems and other JFT test documentation. Videotapes developed by the JFT are also available.

III. COSTS

The previous section of this report provided a discussion of the training resource requirements for the F-16 program. Where appropriate, computational formulas for estimating the number or amount of personnel, facilities, equipment, or materials were given. This section provides the additional formulas required to generate cost estimates from resource requirement calculations. It is stressed that for the cost estimates generated in this section to be accurate and meaningful, it is essential to know what the cost values used represent. For example, the costs obtained for the operation of a trainer may include maintenance but a separate cost calculation may exist for trainer maintenance. In this case, the maintenance value of the cost figure should be subtracted to give the true operating cost.

It is also important to distinquish between capital (one time) costs and operating (ongoing) costs in performing the calculations in this section. Capital costs will mostly occur once at the beginning of a project, operating costs will span the lifetime of the training program and may need to be calculated on a continuing basis (i.e., annually). The end result of this section is to classify all F-16 training system costs into either initial or operating costs.

A. Personnel

The major cost variable associated with personnel costs are salaries. Salaries used in the following calculations are assumed to include base pay, flight pay, subsistance allowance and housing allowance.

COSTS TO BE COMPUTED:

1. Costs of flight instructors per year (CFI).
2. Costs of academic instructors per year (CAI).
3. Costs of simulator instructors per year (CSI).
4. Costs of trainer instructors per year (CTI).
5. Costs of learning center instructors per year (CLCI).
6. Costs of course managers per year (CCM).
7. Costs of instructional support personnel per year (CISP).
8. Costs of student support personnel per year (CSSP).
9. Cost of learning center operator (CLCO).

10. Costs of learning center supervisors (CLCS).

11. Costs of instructional designer (CID).

12. Costs of subject matter experts (CSME).

13. Costs of development secretarial support (CDSS).

14. Costs of media specialists (CMS).

15. Costs of production specialists (CPS).

16. Costs of TDY (TDYR).

17. Costs of training device maintenance specialists (CTDMS).

18. Costs of training equipment managers (CTEM).

19. Costs of training device operator (CTDO).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Flight instructor per course per year (FI)	Formula 1
	Annual salary of flight instructor (SFI)	TAC
2.	Academic instructors per course per year (AI)	Formula 2
	Annual salary of academic instructor (SAI)	TAC
3.	Simulator instructors per course per year (SI)	Formula 3
	Annual salary of simulator instructor (SSI)	TAC
4.	Trainer instructor per course per year (TI)	Formula 4
	Annual salary of trainer instructor (STI)	TAC
5.	Learning center instructors per course per year (LCI)	Formula 5
	Annual salary of learning center instructor (SLCI)	TAC
6.	Course manager per course per year (CM)	Formula 6
	Annual salary of course manager (SCM)	TAC
7.	Instructional support personnel per year per course (ISP)	Formula 8
	Annual salary of instructional support personnel (SISP)	TAC
8.	Student support personnel per year per course (SSP)	Formula 9
	Annual salary of student support personnel (SSSP)	TAC

9.	Learning center operators (LCO)	Local
	Annual salary of learning center operators (SLCO)	TAC
10.	Learning center supervisors (LCS)	Local
	Annual salary of learning center supervisors (SLCS)	TAC
11.	Instructional designers mandays required (ID)	Figures 2-7
	Cost of instructor designer per manday (SID)	TAC
12.	Subject matter experts mandays required (SME)	Figures 2-7
	Cost of subject matter experts per manday (SSME)	TAC
13.	Development secretarial support mandays required (DSS)	Figures 2-7
	Cost of development secretary support per manday (SDSS)	TAC
14.	Media specialist mandays required (MS)	Figures 2-7
	Cost of media specialists per manday (SMS)	
15.	Production specialist mandays required (PS)	Figures 2-7
	Cost of production specialists per manday (SPS)	TAC
16.	Total TDY funds required per year (TDYR)	Formula 23
17.	Total training device maintenance specialists required per year (TTDMS)	TAC
	Annual salaries of training device maintenance specialists (STDMS)	TAC
18.	Total training equipment managers required per year (TTEM)	TAC
	Annual salaries of training equipment managers (STEM)	TAC
19.	Total training device operators required per year (TTDO)	TAC
	Annual salaries of training device operators (STDO)	TAC

COMPUTATIONS:

1.	CFI = FI x SFI	(Formula 33)
2.	CAI = AI x SAI	(Formula 34)
3.	CSI = SI x SSI	(Formula 35)
4.	CTI = TI x STI	(Formula 36)

5. CLCI = LCI x SLCI (Formula 37)

6. CCM = (CMF + CMV) x SCM (Formula 38)

7. CISP = ISP x SISP (Formula 39)

8. CSSP = SSP x SSSP (Formula 40)

9. CLCO = LCO x SLCO (Formula 41)

10. CLCS = LCS x SLCS (Formula 42)

11. CID = ID x SID (Formula 43)

12. CSME = SME x SSME (Formula 44)

13. CDSS = DSS x SDSS (Formula 45)

14. CMS = MS x SMS (Formula 46)

15. CPS = PS x SPS (Formula 47)

16. CTDMS = TTDMS x STDMS (Formula 48)

17. CTEM = TTEM x STEM (Formula 49)

18. CTDO = TTDO x STDO (Formula 50)

Not included in the above computations are the costs for the following personnel:

1. Media device maintenance technician
2. Course development manager
3. Students

No computation formulas are provided for these personnel since their costs will depend upon implementation considerations (e.g., vendor/contractor obligations).

B. Facilities

The costs of facilities involve computation of the value of the office and floor space needed for personnel, equipment, and materials. Almost all major facilities costs will be initial building or procurement costs.

TO BE COMPUTED:

1. Cost of office space (COS).

2. Cost of training device space (CTDS).

3. Cost of carrel space (CLSP).

4. Cost of storage space (CSSP).

5. Cost of classroom space (CCSP).

REQUIRED INPUT DATA:

Comp. No.	Data	Source
1.	Value of office space per sq. ft. (VOS)	TAC
	Flight and simulator instructor office space (OSFI)	Formula 10
	Trainer, learning center and academic instructor office space (OSAI)	Formula 12
	Instructor support administrative office space (OSSI)	Formula 14
	General (student) support adminstrative office space (OSSG)	Formula 16
2.	Value of floor space per sq. ft. (VFS)	TAC
	Total training device floor space required (TDFS)	Estimated
3.	Value of carrel space per sq. ft. (VCS)	TAC
	Total carrel space required (TCS)	Formula 27
4.	Value of storage space per sq. ft. (VSS)	TAC
5.	Value of classroom space per sq. ft. (VCLS)	TAC
	Total classroom space required (TCRS)	TACM 25-5

COMPUTATIONS:

1. COS = VOS x (OSFI + OSAI + OSSI + OSSG) (Formula 51)

2. CTDS = VFS x (TDFS) (Formula 52)

3. CLSP = VCS x TCS (Formula 53)

4. CSSP = VSS x (WSS + TSSS + VTSS) (Formula 54)

5. CCSP = VCLS + TCRS (Formula 55)

It should be noted that the following facility costs are not included in the above computations.

1. Training device maintenance personnel office space
2. Repair shop floor space
3. Spare parts storage space
4. Maintenance equipment storage space
5. Course development floor space

The need for these facilities will depend upon implementation details such as whether onsite space is required for training device maintenance.

C. Equipment

The cost of equipment includes the value of all training devices, office equipment, classroom furnishings, learning carrel (complete with media devices), development equipment, and possibly maintenance equipment. Most equipment costs will be initial costs occurring at the beginning of the project; however, some equipment such as training devices will involve operating costs over the lifetime of the training program.

TO BE COMPUTED:

1. Cost of aircraft use per course per year (CAC).
2. Cost of training devices per course per year (CTD).
3. Cost of training device procurement (CTDP).
4. Cost of office equipment required (COE).
5. Cost of classroom furnishings required (CCF).
6. Cost of bare study carrels required (CBSC).
7. Cost of audiovisual carrels required (CAVC).
8. Cost of videotape carrels required (CVTC).
9. Cost of learning center storage furnishings (CLCSF).

INPUT DATA REQUIRED:

Comp. No.	Data	Source
1.	Value of aircraft use for training only (VAT)	TAC
	Total aircraft time requirements per course per year (TATR)	Syllabus
2.	Value of training device use (VTD)	TAC
	Total training device time requirements per course per year (TDTR)	Syllabus
3.	Value of training device (VTE)	TAC/Vender
	Total training devices procured (TVTE)	Formula 18
4.	Value of office equipment (VOE)	TAC/vendor
	Total office equipment required (TOE)	TAC

5.	Value of classroom equipment (VCE)	TAC/vendor
	Total classroom equipment required (TCE)	TAC
6.	Value of bare study carrels (VBSC)	TAC/vendor
	Total bare study carrels required (BSC)	Formula 19
7.	Value of audiovisual study carrels (VAVC)	TAC/vendor
	Total audiovisual study carrels required (AVSC)	Formula 20
8.	Value of videotape study carrels (VVTC)	TAC/vendor
	Total videotape study carrels required (VTSC)	Formula 21
9.	Value of learning center storage furnishings (VLCSF)	Vendor
	Workbook storage space (WSS)	Formula 24
	Tape/slide storage space (TSSS)	Formula 25
	Videotape storage space (VTSS)	Formula 26

COMPUTATIONS:

1. CAC = VAT x TATR (Formula 56)

2. CTD = VTD x TDTR (Formula 57)

3. CTDP = VTE x TVTE (Formula 58)

NOTE: The last two calculations will need to be done separately for each trainer or simulator (e.g., CFT, OFT, EPT) and the separate costs summed to compute the total training device cost.

3. COE = VOE x TOE (Formula 59)

4. CCF = VCE x TCE (Formula 60)

5. CBSC = VBSC x BSC (Formula 61)

6. CAVC = VAVC x AVSC (Formula 62)

7. CVTC = VVTC x VTSC (Formula 63)

8. CLCSF = VLCSF x (WSS + TSSS + VTSS) (Formula 64)

The following equipment costs are not covered by the above computations:

1. Costs of training device maintenance equipment
2. Costs of learning center maintenance equipment
3. Cost of course development equipment
4. Costs of lounge equipment

Whether these costs are to be included or not depends on the particular arrangements made with contractors or whether equipment not specifically part of the F-16 training program is to be shared.

D. Materials and Supplies

The costs of materials and supplies includes the value of all student supplies (e.g., pens, pencils, notebooks), instructional materials (e.g., workbooks, slides, tapes), office supplies and possibly maintenance and course development supplies. The cost of munitions used in target practice and included here also. Some of these costs are initial (such as instructional materials) and others are continuing (such as student supplies).

TO BE COMPUTED:

1. Cost of student supplies per course (CSS).
2. Cost of reproducing instructional materials per course (CIM).
3. Cost of development materials per course (CDM).
4. Cost of office supplies and materials (COSM).
5. Cost of munitions (CAMO).

IMPUT DATA REQUIRED:

Comp. No.	Data	Source
1.	Value of student materials (VSM)	TAC/vendor
	Total students per course (TS)	TAC
2.	Avg. value of reproducing workbook (VRW)	Estimated/ Vendor
	Avg. value of reproducing tape/slide (VRST)	Estimated/ Vendor
	Avg. value of reproducing videotape (VRVT)	Estimated/ Vendor
3.	Value of paper supplies per course (VPS)	Vendor
	Total paper required per course (TPS)	Formula 28
	Value of art supplies per course (VAS)	Vendor
	Total art required per course (TAR)	Formula 29
	Value of photographic supplies per course (VPR)	Vendor
	Total photographs required per course (TPR)	Formula 30
	Value of videotapes supplies per course (VVTS)	Vendor
	Total videotapes required per course (TVTR)	Formula 31

	Value of audiotapes supplies per course (VATS)	Vendor
	Total audiotapes required per course (TATR)	Formula 32
4.	Value of standard set of office supplies and materials (VOSM)	TAC/Vendor
	Total sets of office supplies required per year (TOSM)	Estimated
5.	Value of munitions used (VAMO)	TAC
	Total munitions used per course per year (TAMO)	Estimated

COMPUTATIONS:

1. CSS = VSM x TS (Formula 65)

2. CIM = (VRW x WBC) + (VRST x TSC) + (VRVT x VTC) (Formula 66)

3. CDM = (VPS x TPS) + (VAS x TAR) + (VPR x TPR) + (VVTS x TVTR) + (VATS x TATR) (Formula 67)

4. COSM = VOSM x TOSM (Formula 68)

5. CAMO = VAMO x TAMO (Formula 69)

The above supplies costs do not include the following costs:

1. Training device spares
2. Training device maintenance materials
3. Learning center device spares
4. Learning center maintenance materials
5. Initial cadre materials transfered to RTU use
6. Procurement materials

No computational formulas are provided for these costs since they may be beyond the scope of the training program (i.e., contractor obligations) or depend upon specific implementation considerations.

E. Total Training System Costs

The overall costs of the training system is the summation of the various personnel, facilities, equipment, and materials costs. Those costs must be divided into initial or start-up costs and annual, operating costs.

TO BE COMPUTED:

1. Total initial personnel costs (CPERSI).

2. Total initial facilities costs (CFACI).

3. Total initial equipment costs (CEQIPI).

4. Total initial materials costs (CMATI).

5. Total annual personnel costs (CPERSO).

6. Total annual facilities costs (CFACO).

7. Total annual equipment costs (CEQIPO).

8. Total annual materials costs (CMATO).

9. Total initial costs (CTOTLI).

10. Total annual cost (CTOTLO).

INPUT DATA REQUIRED:

Comp. No.	Data	Source
1.	Costs of ISD procurement (CISD)	TAC
2.	Costs of office space (COS)	Formula 51
	Costs of training device space (CTDS)	Formula 52
	Costs of learning carrel space (CLSP)	Formula 53
	Costs of storage space (CSSP)	Formula 54
	Costs of classroom space (CCSP)	Formula 55
3.	Costs of training device procurement (CTDP)	Formula 58
	Costs of office equipment required (COE)	Formula 59
	Costs of classroom furnishings required (CCF)	Formula 60
	Costs of base study carrels required (CBSC)	Formula 61
	Costs of audiovisual study carrels required (CAVC)	Formula 62
	Costs of videotape study carrels required (CVTC)	Formula 63
	Costs of learning center storage furnishings (CLCSF)	Formula 64
4.	Cost of reproducing instructional materials per course (CIM)	Formula 65
5.	Costs of flight instructors per year (CFI)	Formula 33
	Costs of academic instructors per year (CAI)	Formula 34
	Costs of simulator instructors per year (CSI)	Formula 35
	Costs of trainer instructors per year (CTI)	Formula 36
	Costs of learning center instructors per year (CLCI)	Formula 37
	Costs of course managers per year (CCM)	Formula 38
	Costs of instructional support personnel per year (CISP)	Formula 29

	Costs of student support personnel per year (CSSP)	Formula 40
	Costs of learning center operators per year (CLCO)	Formula 41
	Costs of learning center supervisors per year (CLCS)	Formula 42
	Costs of instructional designers (CID)	Formula 43
	Costs of subject matter experts (CSME)	Formula 44
	Costs of developmental secretarial support (CDSS)	Formula 45
	Costs of media specialists (CMS)	Formula 46
	Costs of production specialists (CPS)	Formula 47
	Costs of TDY (TDYR)	Formula 23
	Costs of training device maintenance specialist (CTDMS)	Formula 48
	Costs of training equipment managers (CTEM)	Formula 49
6.	Costs of facilities maintenance per year (CFM)	TAC
7.	Costs of aircraft use per course per year (CAC)	Formula 56
	Costs of training devices per course per year (CTD)	Formula 57
8.	Costs of student supplies per course (CSS)	Formula 65
	Costs of development materials per course (CDM)	Formula 67
	Costs of office supplies or materials (COSM)	Formula 68
	Costs of munitions (CAMO)	Formula 69
9.	Total initial costs	Formulas 67-70
10.	Total annual operating costs	Formulas 71-74

COMPUTATIONS:

1. CPERSI = CISD (Formula 70)

2. CFACI = COS + CTDS + CLSP + CSSP + CCSP (Formula 71)

3. CEQIPI = CTDP + COE + CCF + CBSC + CAVC + CVTC + CLCSF (Formula 72)

4. CMATI = CIM (Formula 73)

5. CPERSO = CFI + CAI + CSI + CTI + CLCI + CCM + CISP + CSSP + CLCO + CID + CSME + CDSS + CMS + CPS + TDYR + CTDMS + CTEM + CTDO (Formual 74)

6. CFACO = CFM (Formula 75)

7. CEQIPO = CAC + CTD (Formula 76)

8. CMATO = CSS + CDM + COSM + CAMO (Formula 77)

9. CTOTLI = CPERSI + CFACI + CEQIPI + CMATI (Formula 78)

10. CTOTLO = CPERSO + CFACO + CEQIPO + CMATO (Formula 79)

IV. CONCLUSIONS AND SUMMARY

The overall purpose of this document is to describe the full range of resources needed for the development phase of the F-16 training program and associated costs. This analysis is based upon the preliminary data available in the design phase of the project and is subject to modification and revision when initial program implementation data are available. In order to facilitate this type of change, calculation procedures (where applicable) have been described explicitly in the body of this report.

The training resources needed fall into one of four basic categories: Personnel, equipment, facilities or materials/supplies. Requirements in those four basic categories are generated across seven major classes of needs: Instructional personnel, instructional materials, training devices, students, learning center, development, and implementation. A summary of the resource requirements discussed in this report is given in Table 1. This table represents the baseline configuration for the F-16 training system support requirements.

The information needed to generate the resource requirement data includes the program syllabus, the training system design, the media selected, and the expected student load or desired throughput. The effects of changes to these three parameters can be investigated using the present model. Information on student loads or throughput must be based upon the level of F-16 readiness and deployment desired by the USAF. The accuracy and dependability of detailed estimates generated for training resource requirements reflects the quality of the information available for syllabus, media, and student loads/throughput.

The TSRA documented in this report (Section II) is basically focused on the F-16 pilot training program. The overall F-16 training system includes other training requirements such as the initial instructional cadre or the training required for the trainer or simulator maintenance personnel. Complete calculation of the instructional resources needed for these aspects of the F-16 training system can be generated by applying the TSRA to syllabi, media and student throughput data appropriate to each case separately. Thus, the TSRA presented herein is a general model for calculating resource requirements which should be applied to every subsystem of the training development effort.

It should be emphasized that this TSRA is intended as an aid to the training development process. In its present form, it can be used to estimate the resources needed based upon a specified system design, syllabus and desired student throughput. It can be used to compute life cycle costs for the F-16 program. However, since the model does not include adjustments for depreciation or inflation, these cost fluctuations must be incorporated in the values assigned to resources. Thus to calculate the life

SUPPORT TYPE	PERSONNEL	EQUIPMENT	FACILITIES	MATERIALS/SUPPLIES
1.0 Instructional Personnel	Flight Instructors Academic Instructors Simulator Instructors Trainer Instructors LC Instructors	Standard Office Furnishings	Office Space	Standard Office Issue
1.1 Support Personnel	Instructor Support Academic Support	Typewriters Photocopy machines Desk calculator Standard Office Furnishings Schedule boards	Office Space	Standard Office Issue Student Record Forms
2.0 Instructional Materials	Not applicable	Not applicable	Not applicable	Student workbooks Slide/tape programs Videotape programs Instructor guides Grade sheets
2.1 Maintenance	(See sections 1.1 & 6.1)	Not applicable	Not applicable	Not applicable
3.0 Training Devices	(See section 1.0)	F-16 aircraft OFT/WST CFT EPT Cockpit mock-up Learning carrels VTR units	OFT/WST floor space FFT floor space EPT floor space Cockpit mock-up floor space Carrel floor space	Munitions
3.1 Support Personnel	OFT/WST Equip Mgr LC Equip Mgr OFT/WSF Main. Team OFT/WST Operator CFT Maintenance EPT Maintenance	Standard AF issue (Electronic technician tools and shop)	Office space area Repair shop area Parts storage Main Equip Storage	Spare parts Main. materials

TABLE 1 – SUMMARY OF F-16 TRAINING PROGRAM REQUIREMENTS

SUPPORT TYPE	PERSONNEL	EQUIPMENT	FACILITIES	MATERIALS/SUPPLIES
4.0 Students	(See 1.1)	Not applicable	Not applicable	Not applicable
5.0 Learning Center Operation	LC Operators (2)	Classroom furnishings Operators office Media/library furnishings Student lounge furnishings	Classroom area Library/shelf area Carrel space Office space Lounge area	Standard office issue
5.1 Learning Center Support	LC Supervisor LC Media maintenance	Office equipment Media maintenance equipment	Office space Repair shop area Parts storage Main equipment storage	Standard office issue Maintenance materials
6.0 Development	Instructional Designer Subject Matter Experts Media Specialists Production Specialists	Office Equipment	Office space	See section 2.0
6.1 Development Support	Secretaries Development Manager	Secretarial/Office furnishings	Office space	Standard office issue
6.2 Development Equipment	Photocopy operator Word Processing operator Photo equipment operator Video prod. operator Audio prod. operator	Photocopy machine Word processor Positive camera Camera table Artist table Light tables Photographic equip. Infrared copier Video prod. equip. Audio prod. equip.	Printing facility Film processing facility Audio tape facility Video tape facility Office space	Paper Art & photographic materials Audio tapes Video tapes

TABLE 1 – SUMMARY OF F-16 TRAINING PROGRAM REQUIREMENTS (CON'T)

SUPPORT TYPE	PERSONNEL	EQUIPMENT	FACILITIES	MATERIALS/SUPPLIES
6.3 Development Equipment Maintenance	Photocopy main. tech. Word processor main. tech. Photographic equip. maintenance tech. Audio/Video tape equip. main. tech.	Not Applicable	Not Applicable	Not Applicable
7.0 Implementation	UPT/LIT students FAIP Students Conversion Students Upgrading Students	See Section 1.2 and 3.0	See Section 1.2 and 3.0	See Sections 1.0, 2.0, 3.0
7.1 Training Device Procurement	ISD Team Procurement Specialists	Not Applicable	Not Applicable	Not Applicable
7.2 Initial System Cadre	Flight Instructors (JTF) Academic Instructors	JTF Aircraft CFT	See Sections 1.0, 2.0, 3.0,	JTF Test Documentation

TABLE 1 – SUMMARY OF F-16 TRAINING PROGRAM REQUIREMENTS (CON'T)

cycle costs over a five year period, different values would be used for each successive annual computation.

It is highly desirable to have the capability to work backwards in the TSRA, i.e., to be able to estimate the syllabus required or student throughput given certain levels of instructional resources. This would allow the TSRA to be used to explore the consequences of different levels of resources support on F-16 pilot availability. While the present form of the TSRA could be used to do this sort of "what if" analysis, it is a laborious task due to the large number of manual calculations involved. An automated version of this TSRA will be developed which will allow the procedures and calculations to be done in either direction. This type of resource modeling capability has been found to be very important in large scale instructional systems development (Kearsley and O'Neal, 1978) and would be a useful tool for the USAF in planning the F-16 training program.

V. BIBLIOGRAPHY

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APPENDIX

APPENDIX

This appendix provides a set of requiremeent and cost calculations for the B and IP courses of the F-16 program based upon preliminary data available at the time of this report. In many cases, the necessary information was not available, and rough estimates were made. Therefore, all numbers generated in this appendix must be considered as approximate only and used cautiously. Furthermore, while every attempt has been made to include all major training requirements in the model, there are some omissions as indicated in the body of the report. Thus, the requirement and cost calculations which follow are likely to be underestimates of the actual requirements and costs for the full scale F-16 training system.

The limitations of the model described in the introductory section of the report should be reiterated here. The costs of many resources will change over the lifetime of the training program. For example, the operating costs of training devices, salaries or materials will increase over the life span of the training system. The present model does not take these cost fluctuations into account, and therefore, the annual operating costs computed will not reflect such increases or decreases. To accurately reflect such fluctuations, the projected increase or decrease values of resources should be used to generate separate costs for each year of the training program. The model also does not account for fluctuations in student load or resource ultilization but assumes steady flows. The numbers used in this appendix are based upon a steady state system and do not account for peaks and valleys.

A. RESOURCE CALCULATIONS

1.0 Instructional Personnel

The values used and results calculated for instructor personnel requirements are given in Table A-1. The number of instructor hours per student was calculated by dividing the total hours of flight, trainer, simulator, or academic hours required from the syllabus by the average number of students per class or sortie. The maximum instructor hours available is the total available hours that an instructor could teach as specified by TACM 25-5. The available learning center hours/week is based on an assumed five day, 12 hours per day operation, with allowances for 10 percent down time and 15 percent nondemand time, resulting in a nine hour per day utilization. The current plans do not include the use of course managers.

1.1 Instructional Personnel Support Requirements

The values used and results calculated for instructor personnel support requirements are given in Table A-2. It was assumed that one fixed and one variable instructor and student administrator per course would be sufficient. Office space calculations are in square feet. The value for office supplies required is based upon the number of personnel requiring offices.

2.0 Instructional Materials

The instructional materials estimates are given in Table A-3. These estimates were generated by the "F-16 Media Selections and Syllabus," development report no. 24. Munitions are estimated in terms of the number of sorties involving bombing or target practice.

3.0 Training Device Requirements

The values used and results calculated for training device requirements are given in Table A-4. The average length of segments is in minutes. The total aircraft time (in hours) is calculated on the basis of flight sorties specified in the syllabus. Total training devices based upon the number of training hours required for each trainer or simulator (OFT, EPT, CFT) estimated at this time.

4.0 Student Requirements

The only student requirements calculated are those involved in TDY for ASPT at AFHRL. These calculations are given in Table A-5.

5.0 Learning Center Operation Requirements

The values and results calculated for learning center operation requirements are given in Table A-6. The total number of workbooks is equal to the total number of workbook segments, since each workbook equals one segment. The space requirements are in cubic feet.

6.0 Development Requirements

The values and calculations for development requirements are given in Table A-7. All costs for revision and modification of materials are given in terms of the number of hours of development personnel required. It was assumed that over the lifespan of the training program, 75 percent of the materials would have to be revised or modified. Total paper required is in hundreds of sheets.

B. COSTS

1.0 Personnel

The values and calculations for all personnel costs are given in Table A-8. The billeting costs involved the cost of housing, whether on or off base. The course load is the percentage of total time spent upon that activity.

2.0 Facilities

The values and calculations for the facilities costs are given in Table A-9. The value of office space is dollars per square feet. This figure covers the construction but not the operating costs (i.e., utilities and maintenance).

3.0 Equipment

The values and calculations for the equipment costs are given in Table A-10. The value of learning center storage furnishing is in terms of dollars per cubic foot or storage required. The value of the audiovisual and videotape carrels includes the costs of the cost of associated slide and videotape equipment.

4.0 Materials and Supplies

The values and calculations for the materials and supplies costs are given in Table A-11. Student materials includes the cost of notebooks, pens, pencils, etc. The value of reproducing materials includes the cost of the duplication service per workbook or tape. The art supplies include the average amount of tapes, lettering, brushes, marker pens, etc., used for a piece of art. Similarly, photographic, videotape or audiotape supplies includes the average amount of supplies and materials used in completing a tape. Office supplies includes the costs of paper, tape, staples, file folders, stationary, etc.

C. TOTAL TRAINING SYSTEM COSTS

The total training system costs are broken down into initial costs and ongoing annual costs. Table A-12 shows the initial and annual costs for personnel, facilities, equipment and materials. Note that all facilities costs presently calculated are for initial costs. It is assumed that ongoing facility operating costs are considered part of general base operating costs.

Table A-1--Instructional personnel requirements.

	B Course	IP Course	Source
Flight instructor hours/student (FIS)	72	21	Syllabus
Maximum hours/year available (FIM)	1,727	1,727	TACM 25-5
Academic instructor hours/ student (AIS)	88	23	Syllabus
Maximum hours/year available (AIM)	1,727	1,727	TACM 25-5
Simulator instructor hours/ student (SIS)	25	25	Syllabus
Maximum hours/year available (SIM)	1,727	1,727	TACM 25-5
Trainer instructor hours/ student (TIS)	5	5	Syllabus
Maximum hours/year available (TIM)	1727	1727	TACM 25-5
Number of learning center instructors (IOD)	1	1	Estimated
Maximum hours/year available (LCIM)	1,727	1,727	Estimated
Fixed number of course managers (CMF	0	0	Estimated
Variable number of course managers (CMV)	0	0	Estimated
Number of weeks/course (WC)	30	8	Syllabus
Number of clases/year (CY)	8	5	Syllabus
Instructional group size (IGS)	5	5	Estimated
Average number of students/class (CS)	20	10	Estimated
Learning Center hours/week (ALCH)	45	45	Estimated
Flight instructors required per year (FI)	0.6	0.6	Formula 1

Table A-1--Instructional personnel requirements. (Cont.)

	B Course	IP Course	Source
Academic instructors required per year (AI)	1.6	0.1	Formula 2
Simulator instructors required per year (SI)	2.3	0.7	Formula 3
Trainer instructors required per year (TI)	0.4	0.1	Formula 4
Learning center instructors required per year (LCI)	0.7	0.2	Formula 5
Course managers required per year (CM)	0	0	Formula 6
Total instructor required per year (IT)	5.6	1.7	Formula 7

Table A-2--Instructor personnel support requirements.

	B Course	IP Course	Source
Fixed number of instructor support administrators (ISPF)	1	1	Estimated
Variable number of instructor support administrators (ISPV)	1	1	Estimated
Fixed number of student support administrators (SSPF)	1	1	Estimated
Variable number of student support administrators (SSPV)	1	1	Estimated
Number of instructor support personnel/year (ISP)	6.6	4.1	Formula 8
Number of student support personnel/year (SSP)	11.0	11.0	Formula 9
Flight instructor office space (OSFI)	231	196	Formula 10
Academic instructor office space (OSAI)	161	21	Formula 12
Instructor support administrative office space (OSSI)	462	287	Formula 14
Student support administrative office space (OSSG)	770	770	Formula 16
Total sets of office supplies required (TOSM)	29	5	Estimated

Table A-3--F-16 instructional materials.

	B Course	IP Course	Source
Workbooks (WBC)	119	15	Syllabus
Tape/slide (TSC)	21	13	Syllabus
Videotapes (VTC)	0	0	Syllabus
Lectures	33	23	Syllabus
Discussion group guides	70	15	Syllabus
Device session guides	150	20	Syllabus
Grade sheets	70	30	Syllabus
Tests	70	20	Syllabus
Munitions (TAMO)	29	29	Estimated

Table A-4--Training device requirements.

	B Course	IP Course	Source
Total workbook segments (WBS)	119	15	Syllabus
Average length per workbook segment (MWS)	50	50	Estimated
Total tape/slide segments (TSS)	21	13	Syllabus
Average length per tape/slide segment (MSS)	50	50	Estimated
Total videotape segments (VTS)	0	0	Syllabus
Average length per videotape segment (MVS)	30	30	Estimated
Total aircraft time per year (TATR)	84	52	Estimated
Number bare study carrels (BSC)	14.6	3.4	Formula 19
Number sound slide carrels (AVSC)	25.9	3.0	Formula 20
Number videotape carrels (VTSC)	0	0	Formula 21
Total carrels required (LCT)	40.5	6.4	Formula 22
Total training device time/ student (TTDT)	20	20	Syllabus
Percentage of retried training sessions (PRTS)	0.2	0.2	Estimated
Total training device time available (TTDA)	1,350	1,350	Estimated
Training device downtime in hours (TDD)	135	135	Estimated
Total training device maintenance specialists (TTDMS)	17	17	Estimated
Total training device operators (TTDO)	2	2	Estimated
Total training equipment managers (TTEM)	2	2	Estimated

Table A-5--Student requirements.

	B Course	IP Course	Source
Number of students TDY per year (NS)	48	16	Estimated
Number of instructors TDY per year (NI)	16	4	Estimated
Number of trips/student (NT)	1	1	Estimated
Travel costs per trip/student (TC)	200	200	Estimated
Average length of trip/student (ND)	6	6	Estimated
Cost per day/student (CD)	40	40	Estimated
Total TDY funds/year (TTDY)	21,824	7,216	Formula 23

Table A-6--Learning center operation/requirements.

	B Course	IP Course	Source
Total number workbooks (WBC)	119	15	Syllabus
Space per copy (SC)	0.6	0.6	Estimated
Total number slide/tapes (TSC)	21	13	Syllabus
Space per slide/tape (SS)	1.7	1.7	Estimated
Total number videotapes (VTC)	0	0	Syllabus
Space per videotape (SVT)	1.4	1.4	Estimated
Total workbook storage space (WSS)	1428	180	Formula 24
Total slide/tape storage space (TSSS)	71.4	44.2	Formula 25
Total videotape storage space (VTSS)	0	0	Formula 26
Total carrel space (TCS)	2793	252.3	Formula 27

Table A-7--Development requirements.

	B Course	IP Course	Source
Total discussion/device guides (DDG)	220	35	Syllabus
Total tests/grade slips (TGS)	140	50	Syllabus
Average number pages/segment (NPS)	10	10	Estimated
Average number pages/guide (NPG)	5	5	Estimated
Average number art/segment (NAS)	10	10	Estimated
Average number pages/test (NPT)	2	2	Estimated
Average number photographs/ segment (PPS)	0	0	Estimated
Average number videotapes/ segment (NVS)	0	0	Estimated
Average number audiotapes/ segment (NATS)	1	1	Estimated
Average number revisions/retakes (NDR)	4	4	Estimated
Total instructional designer mandays (ID)	15.6	15.6	Estimated
Total subject matter expert mandays (ID)	5.0	5.0	Estimated
Total secretary support mandays (DSS)	5.5	5.5	Estimated
Total media specialists mandays (MS)	24.0	24.0	Estimated
Total production specialist mandays (PS)	10.0	10.0	Estimated
Total paper (100S) (TPS)	111,200	222	Formula 28
Total art (TAR)	5,600	1,120	Formula 29
Total photographs (TPR)	0	0	Formula 30
Total videotapes (TVTR)	0	0	Formula 31
Total audiotapes (TATR)	84	52	Formula 32

Table A-8--Personnel Costs.

	B/IP Course	Source
Annual salary--instructor (SFI, SAI, SSI, STI, SLCI)	21,960	
Annual salary--course manager (SCM)	21,960	Formula 38
Annual salary--instructional support personnel (SISP)	6,768	Formula 39
Annual salary--student support personnel (SSSP)	6,768	
Annual salary of learning center operators (SLCO)	6,768	
Annual salary of learning center supervisors (SLCS)	6,768	
Cost of instructional designer/manday (SID)	109	
Cost of subject matter expert/manday (SSME)	68	
Cost of secretarial support/manday (SDSS)	43	
Cost of media specialist/manday (SMS)	50	
Cost of production specialist/manday (SPS)	68	
Annual salary of training device maintenance specialist (STDMS)	20,000	
Annual salary of training equipment managers (STEM)	10,000	
Annual salary of training device operator (STDO)	10,000	

Table A-8--Personnel costs.

	B Course	IP Course	Source
Total costs of flight instructors/year (CFI)	13,176	43,920	Formula 33
Total costs of academic instructors/year (CAI)	35,136	2,196	Formula 34
Total costs of simulator instructors/year (CSI)	10,963	15,372	Formula 35
Total costs of trainer instructors/year (CTI)	8,784	2,196	Formula 36
Total costs of learning center instructors (CLCI)	15,372	4,392	Formula 37
Total costs of course managers instructors/year (CCM)	0	0	Formula 38
Total costs of instructor support personnel/year (CISP)	44,668	27,748	Formula 39
Total costs of student support personnel/year (CSSP)	59,976	8,968	Formula 40
Total costs of learning center operators/year (CLCO)	6,768	6,768	Formula 41
Total costs of learning center supervisors/year (CLCS)	6,768	6,768	Formula 42
Total costs of instructional designers/year (CID)	1,700	1,700	Formula 43
Total costs of subject matter experts/year (CSME)	340	340	Formula 44

Table A-8--Personnel costs.

	B Course	IP Course	Source
Total costs of secretarial support/year (CDSS)	236	236	Formula 45
Total costs of media specialists/year (CMS)	1,200	1,200	Formula 46
Total costs of production specialists/year (CPS)	680	680	Formula 47
Total costs of training device maintenance specialists (CTDMS)	100,000	100,000	Formula 48
Total costs of training equipment manager (CTEM)	60,000	60,000	Formula 49
Total costs of training device operators (CTDO)	1,002	1,002	Formula 50

Table A-9--Facilities costs.

	B Course	IP Course	Source
Value of office space (VOS)	40	40	Estimated
Value of floor space (VFS)	38	38	Estimated
Value of carrel space (VCS)	40	40	Estimated
Value of storage space (VSS)	40	40	Estimated
Value of classroom space (VCLS)	40	40	Estimated
Total cost of office space (COS)	54,960	50,960	Formula 51
Total cost of training device space (CTDS)	31,198	31,198	Formula 52
Total cost of learning carrel space (CLSP)	111,720	100,928	Formula 53
Total cost of storage space (CSSP)	59,976	8,968	Formula 54
Total cost of classroom space (CCSP)	840	840	Formula 55

Table A-10--Equipment costs.

	B Course	IP Course	Source
Value of aircraft use/hour (VAT)	1,500	1,500	Estimated
Value of training device use/hour (VTD)	50	50	Estimated
Value of training device procurement (VTE)	3,700,000	3,700,000	Vendor
Value of office equipment (VOE)	500	500	Vendor
Value of classroom equipment (VCE)	1,000	1,000	Vendor
Value of bare study carrels (VBSC)	850	850	Vendor
Value of audiovisual study carrels (VAVC)	1,200	1,200	Vendor
Value of videotape study carrels (VVTC)	2,000	2,000	Vendor
Value of learning center storage furnishings (VLCSF)	10	10	Vendor
Annual costs of aircraft use (CAC)	126,000	78,000	Formula 56
Annual costs of training devices (CTD)	500	500	Formula 57
Total costs of training device procurement (CTDP)	21,850,000	21,850,000	Formula 58
Total costs of office equipment (COE)	5,000	5,000	Formula 59
Total costs of classroom equipment (CCF)	15,000	15,000	Formula 60
Total costs of bare study carrels (CBSC)	1,241	289	Formula 61
Total costs of audiovisual study carrels (CAVC)	31,080	36,000	

Table A-10--Equipment costs. (Cont.)

	B Course	IP Course	Source
Total costs of videotape study carrels (CVTC)	0	0	Formula 62
Total costs of learning center storage furnishings (CLCSF)	14,994	2,242	Formula 63

Table A-11--Materials and supplies costs.

	B Course	IP Course	Source
Value of munitions (VAMO)	905	905	Estimated
Value of student materials (VSM)	50	50	Estimated
Average value of reproducing workbook (VRW)	1	1	Estimated
Average value of reproducing tape/slide (VRST)	8	8	Estimated
Average value of reproducing videotape (VRVT)	20	20	Estimated
Value of paper supplies (per 100) (VPS)	.1	.1	Vendor
Value of art supplies (VAS)	.1	.1	Vendor
Value of photographic supplies (VPR)	.5	.5	Vendor
Value of videotape supplies (VVTS)	10	10	Vendor
Value of audiotape supplies (VATS)	2	2	Vendor
Value of office supplies (VOSM)	100	100	Estimated
Total costs of student supplies (CSS)	8,000	2,500	Formula 65
Total costs of instructional materials (CIM)	287	119	Formula 66
Total costs of development materials (CDM)	11,849	2,437	Formula 67
Total costs of office	500	500	Formula 68
Total costs of munitions (CAMO)	26,245	26,245	Formula 69

Table A-12--Total training system costs.

	B Course	IP Course	Source
Initial personnel costs (CPERSI)	2,500,000	2,500,000	Formula 70
Initial facility costs (CFACI)	268,694	192,894	Formula 71
Initial equipment costs (CEQIPI)	21,908,531	21,908,531	Formula 72
Initial materials costs (CMATI)	1,016	119	Formula 73
Total initial costs (CTOTLI)	24,686,296	24,593,704	Formula 78
Annual personnel costs (CPERSO)	428,139	250,404	Formula 75
Annual equipment costs (CEQIPO)	129,000	81,000	Formula 76
Annual materials costs (CMATO)	28,795	28,795	Formula 77
Total annual costs (CTOTLO)	585,934	360,279	Formula 79