AD-A037 050 OPERATIONS RESEARCH INC SILVER SPRING MD F/G 15/7
THE INTEGRATED FACILITIES REQUIREMENTS STUDY (IFRS) PHASE III. --ETC(U)
MAR 71 T N KYLE, R J CRAIG, M C FISK N00025-67-C-0031
UNCLASSIFIED ORI-TR-645-VOL-1 NL

1 OF 1
AD A037050

END

DATE FILMED
4-77

ORI

Operations Research, Inc. A LEASCO Company

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

Operations Research, Inc.

2a. REPORT SECURITY CLASSIFICATION

Unclassified

2b. GROUP ½ - Excluded from General Declassification Schedule

(6) REPORT TITLE

The Integrated Facilities Requirements Study (IFRS) Phase III, Volume I, Summary.

(9) DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final Report, 31 March 1971

(10) AUTHOR(S) (First name, middle initial, last name)

Thomas N. Kyle, W. Liggett, R. Yockman
R. J. Craig, F. McCoy
M. C. Fisk, R. Messalle

(12) 29p.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
(11) 31 March 1971	26	N. A.

8a. CONTRACT OR GRANT NO.

N00025-67-0031 (NBy-78672) New

b. PROJECT NO.

N. A.

(15) d. N00025-67-C-0031

9a. ORIGINATOR'S REPORT NUMBER(S)

(14) ORI-TR-[redacted] 645 - Vol-1
Vol I of II

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

N. A.

10. DISTRIBUTION STATEMENT

Statement No. 1 -
Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES

N. A.

12. SPONSORING MILITARY ACTIVITY

Naval Facilities Engineering Command
Department of the Navy
Washington, DC

13. ABSTRACT

This report summarizes the third phase of the Integrated Facilities Requirements Study (IFRS).

In Phase I, two analytic submodels were developed. The first, a Logistics Support Requirements Generator, estimates personnel, aircraft, and fuel requirements for each phase of undergraduate pilot training at the Naval Air Training Command (NATRACOM). The second, a Pacing Facilities Requirements submodel, calculates facility requirements for each phase of training.

The purpose of the Phase II study was to develop a preliminary total systems IFRS management planning tool (including the two submodels developed in Phase I, as well as Base Loading, Facilities Excess/Deficiency, and Total Cost submodels), and automate the model so that it provides quick, accurate, and relevant information for use in the decision-making process. This Static IFRS model has been in continuous operation since March 1970.

The purpose of the Phase III study was to refine the Static IFRS model and to expand the IFRS concept by developing three additional planning tools for use by Navy decision-makers as follows:

- Dynamic planning tool
- Optimization model

DD FORM 1 NOV 68 1473 (PAGE 1)

970 900

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Facilities						
Requirements						
Dynamic						
Optimization						
Fleet						
Training						
Aircraft						
Pilot						
Simulation						
Programming						
Management						
Planning						
Static						
Air						
Readiness						
Model						

DD FORM 1 NOV 68 1473 (BACK)

Item #13 (Abstract) continued

- Fleet Readiness Training Squadron planning tool.

The Dynamic planning tool simulates the undergraduate pilot training program on a weekly basis whereas the Static IFRS assumes an even annual flow of students. The Optimization model has two segments - a PTR Maximizer that calculates the maximum annual pilot training rate (PTR) possible for a given facilities inventory and a MCON Minimizer that calculates the minimum facility cost phase-to-base assignment for a desired PTR. The Fleet Readiness Training (FRT) model provides planning information for the readiness training squadrons and is designed similarly to the Static IFRS model. The Phase III documentation consists of the following four reports:

- The Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 645
- Development of the Automated Dynamic Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 646
- Development of the Optimization Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 647
- Development of the Fleet Air Readiness Training Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 648.

This volume contains a summary of the three IFRS phases.

OPERATIONS RESEARCH, Inc.

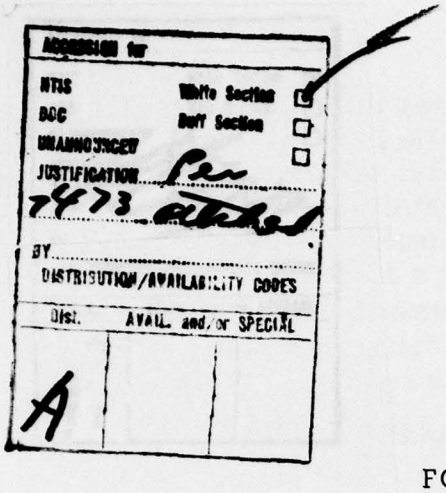
SILVER SPRING, MARYLAND

The Integrated Facilities Requirements Study (IFRS) Phase III

Volume I - Summary

31 March 1971

Prepared under Contract N00025-67-C-0031 (NBy-78672)
for the Navy Facilities Engineering Command
Department of the Navy
Washington, D.C.



FOREWORD

This report summarizes the third phase of the Integrated Facilities Requirements Study (IFRS). It has been prepared for the Systems Analysis Division of the Office of the Assistant Commander for Facilities Planning (Code 20), Naval Facilities Engineering Command (NAVFAC), Department of the Navy, as part of Contract N00025-67-C-0031 (NBy-78672) awarded to Operations Research, Inc., in June 1970.

In Phase I, two analytic submodels were developed. The first, a Logistics Support Requirements Generator, estimates personnel, aircraft, and fuel requirements for each phase of undergraduate pilot training at the Naval Air Training Command (NATRACOM). The second, a Pacing Facilities Requirements submodel, calculates facility requirements for each phase of training.

The purpose of the Phase II study was to develop a preliminary total systems IFRS management planning tool (including the two submodels developed in Phase I, as well as Base Loading, Facilities Excess/Deficiency, and Total Cost submodels), and automate the model so that it provides quick, accurate, and relevant information for use in the decision-making process. This Static IFRS model has been in continuous operation since March 1970.

The purpose of the Phase III study was to refine the Static IFRS model and to expand the IFRS concept by developing three additional planning tools for use by Navy decision-makers as follows:

- Dynamic planning tool
- Optimization model
- Fleet Readiness Training Squadron planning tool.

The Dynamic planning tool simulates the undergraduate pilot training program on a weekly basis whereas the Static IFRS assumes an even annual flow of students. The Optimization model has two segments—a PTR Maximizer that calculates the maximum annual pilot training rate (PTR) possible for a given facilities inventory and a MCON Minimizer that calculates the minimum facility cost phase-to-base assignment for a desired PTR. The Fleet Readiness Training (FRT) model provides planning information for the readiness training squadrons and is designed similarly to the Static IFRS model. The Phase III documentation consists of the following four reports:

- The Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 645
- Development of the Automated Dynamic Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 646
- Development of the Optimization Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 647
- Development of the Fleet Air Readiness Training Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI TR 648.

Volume I of this report, TR 645, contains a summary of the three IFRS phases. Changes made in the Static Phase II model during the Phase III study are documented in Volume II.

These IFRS models were developed and programmed by the staff members of the Economic Analysis Division of Operations Research, Inc., under the direction of Dr. William J. Leininger, vice president and division director, and Thomas N. Kyle, program director. The project team members included R. J. Craig, M. C. Fisk, W. Liggett, F. McCoy, R. Messalle, and R. Yockman.

Mr. Dennis Whang of the Systems Analysis Division of Facilities Planning was contract monitor for NAVFAC. In addition, valuable assistance was provided by many other Navy personnel including, in particular, those in the Office of the Staff Civil Engineer and the Training/Plans Division of the Naval Air Training Command, the Aviation Training Division of the Chief of Naval Operations, and in the Systems Analysis Division of NAVFAC. The authors gratefully acknowledge the contributions made by all of these people to the development of the IFRS models.

SUMMARY

This report summarizes the third phase of the Integrated Facilities Requirements Study (IFRS). The objective of IFRS is to develop a series of automated management planning tools for Navy decision-makers.

The IFRS management planning tools are designed to enhance the management of the naval aviation program. Each model is designed to assist management of either the undergraduate pilot and naval flying officer (NFO) training programs or the Fleet Air Readiness Training Squadrons.

- The IFRS tools for the undergraduate pilot and NFO training programs are:
  - Static IFRS model
  - Dynamic IFRS model
  - Optimization model
- The IFRS tool for the Fleet Readiness Training Squadron is:
  - Fleet Readiness Training (FRT) model.

The purpose of the Static IFRS model is to calculate aircraft, fuel, manpower, facility, and cost requirements as well as facility excesses and deficiencies for alternative training programs as a function of throughput. This model is programmed in a conversational time-share mode and has been operational for over a year.

The purpose of the Dynamic IFRS model is to provide the Navy decision-maker with relevant planning information (e.g., student input, student output, aircraft utilization, instructor utilization, etc.) based on the weekly operations of the undergraduate training program. This model is also presently programmed and operational on a conversational time-share computer system.

The purpose of the Optimization model is to provide the decision-maker with planning information concerning the optimal location of the undergraduate training phases as a function of:

- The pilot training rate
- The existing facilities stock.

This model is presently operational on a batch-processing computer.

The purpose of the FRT model is to calculate the student, instructor, aircraft, and squadron requirements for alternative squadron configurations as a function of one of four variables—student input, student output, aircraft inventory and aircraft operating costs. This model is presently programmed and operational on a time-share computer system. It has been in daily use by CNO since September 1970.

The use of these IFRS tools by Navy decision-makers will benefit the naval aviation program by enhancing effective management in the following ways:

- Frees management from making voluminous routine calculations
- Provides the capability to test and analyze the consequences of alternative decisions
- Quickly generates timely, accurate, and relevant information
- Permits a large set of alternatives to be analyzed in great depth
- Provides a common basis for computing resource requirements and comparing alternatives
- Provides a series of tools to assist in a variety of management problems.

TABLE OF CONTENTS

		Page
	FOREWORD	i
	SUMMARY	iii
	LIST OF FIGURES	vii
I.	INTRODUCTION	1
	OBJECTIVE OF THE IFRS STUDY	1
	Phase I—Development of the Two-Model System for CNATRA; Phase II—Development of a Preliminary Automated Total Systems (i.e., Static) Model for CNATRA; Phase III—Development of a Series of New IFRS Management Tools for the Navy Decision-Makers; Future Phases	
	STUDY END PRODUCTS	4
	The Management Planning Tools; The Relevant IFRS Documentation	
	SIGNIFICANT CONTRIBUTIONS OF THE IFRS STUDY	5
	IFRS Planning Tool Users	
	SATISFACTION OF CONTRACTUAL REQUIREMENTS	7
II.	OVERVIEW OF THE IFRS MANAGEMENT PLANNING TOOLS	9
	INTRODUCTION	9
	THE STATIC IFRS PLANNING TOOL	10
	THE DYNAMIC IFRS PLANNING TOOL	13

THE IFRS OPTIMIZATION MODEL 15
THE FLEET READINESS TRAINING (FRT) MODEL 15
III. CONCLUSIONS AND RECOMMENDATIONS. 17
CONCLUSIONS 17
RECOMMENDATIONS 17

LIST OF FIGURES

		Page
2.1	Overview of the Static IFRS Model	11
2.2	Dynamic Simulation Overview	14

I. INTRODUCTION

OBJECTIVE OF THE IFRS STUDY

1.1 The objective of the Integrated Facilities Requirements Study (IFRS) is to develop a series of automated management planning tools for the naval aviation program that provides the Navy decision-maker with the quick, accurate, and relevant information required to determine the optimum economic utilization of facilities.

1.2 Since the optimum economic utilization of facilities describes that naval aviation program which results in the most economical total systems cost, the IFRS management planning tools must consider all relevant resources required by naval aviation including personnel, aircraft, fuel, spare parts, facilities, etc. Furthermore, the IFRS planning tools must be capable of providing answers to a multitude of "what if" questions concerning the impact postulated changes in the aviation program have on these resources. These changes include changes in the throughput, squadron size, location of squadrons, type of aircraft in the inventory, manning levels, tenants located at each base, etc.

1.3 The development of the IFRS planning tools is to be within the general objective of the overall Naval Facilities Engineering Command (NAVFAC) Shore Installations Facilities Planning and Programming System and is to be completed in several sequential phases.

1.4 Initially, the undergraduate pilot training program of the Chief of Naval Air Training (CNATRA) was selected as a prototype area for testing the feasibility of developing the IFRS concept. In Phase I of the study, the IFRS concept was proven to be feasible, and in the Phase II study, a preliminary automated total systems model was developed for CNATRA's pilot training program. Based on the success of the Phase II model, three new models were

developed in Phase III, and the IFRS concept was expanded into the Fleet Air Readiness Training Squadrons. Each phase was a refinement to and expansion of the previous phase. These phases are complete as of March 1971 and the purpose of each is stated in the following paragraphs.

Phase I—Development of the Two-Model System for CNATRA

1.5 The purpose of the Phase I study was to test the feasibility of the IFRS concept by developing two analytic modules. The first was a Logistics Support Requirements (LSR) module which estimates personnel, aircraft, and fuel requirements for each undergraduate pilot training phase as a function of three key variables:

- Pilot training rate (PTR), which is the total number of pilots to be trained in a 1-year period
- MIX of pilot training, which is the PTR divided into the number of jet, propeller (prop), or helicopter (helo) pilots desired
- MODE of pilot training, which includes the syllabus, concepts, and philosophies of the pilot training program.

This module assumes an even annual flow of students.

1.6 The second was a Facilities Requirements module that calculated the number of units of 10 different facility line items required by each training phase as a function of the LSR module output. These 10 facilities were selected for inclusion on the basis of their critical importance to the training mission, high cost, or sensitivity to changes in the training program. No computer programming was included in the Phase I study. The time period for this phase covered June through December 1968.

Phase II—Development of a Preliminary Automated Total Systems (i.e., Static) Model for CNATRA

1.7 Following the successful completion of Phase I in December 1968, the scope of the original contract was modified to include the development of a preliminary total systems model in Phase II. The following tasks were required to develop this preliminary total systems model:

- Modify the Phase I LSR methodology to account for students from different sources.
- Develop the methodology required to estimate total naval air station (NAS) personnel and aircraft requirements.
- Develop the methodology required to estimate facility requirements by NAS for the 10 facilities in Phase I and for additional facilities.

- Develop the methodology to generate facility excesses and deficiencies by NAS by comparing facility requirements with existing facility assets.
- Develop the methodology to estimate at least 75% of the total system cost (investment plus operations and maintenance) of the pilot training program after costs of military personnel and aircraft acquisition have been deducted.
- Develop time-share computer programs of the complete preliminary total systems model so that it can be readily available to the Navy decision-makers.

The second phase began in July 1969 and was completed in February 1970.

Phase III—Development of a Series of New IFRS Management Tools for Navy Decision-Makers

1.8 Following the completion of Phase II, the original scope of the Phase III study was changed to reflect the need for testing the feasibility of developing different types of planning models as well as expanding the Phase II model. The following tasks were completed in this phase:

- Develop and program a new LSR module for the Fleet Air Readiness Training Squadrons.
- Develop and program a new IFRS Dynamic planning tool that provides the decision-maker with relevant planning information based on the weekly operations of the undergraduate pilot training program.
- Develop and program a new Optimization model for the undergraduate pilot training program that maximizes PTR for a given facility stock or minimizes facility investment cost for a given PTR.
- Incorporate the undergraduate naval flying officer (NFO) student flow into the LSR module of Phase II.
- Refine the Phase II model.

The third phase began in July 1970 and was completed in March 1971.

Future Phases

1.9 Phase III is the final phase of the original IFRS contract. However, it is anticipated that similar management planning tools will be developed by NAVFAC for other commands throughout the Navy's shore establishment.

STUDY END PRODUCTS

1.10 The end products of the three phases include a series of operational management planning tools and 15 volumes of relevant documentation.

The Management Planning Tools

1.11 The four following management planning tools were developed:

- Static IFRS model
- Dynamic IFRS model
- Optimization model
- Fleet Readiness Training (FRT) model.

1.12 The Static, Dynamic, and FRT models are programmed on a time-sharing computer system which ensures that the information provided by the models is available quickly as needed by management. Each of these three models consists of a series of interrelated computer programs and data files carefully organized in a manner that provides the decision-maker with a viable, easy-to-use and economical planning tool. The manager does not have to know the FORTRAN programming language, since each model is programmed in a conversational language which permits direct interaction with the user. The data files are easily changed, thus permitting a large set of alternatives to be analyzed in greater depth.

1.13 The end product of the Optimization model consists of two separate algorithms—a PTR Maximizer submodel and a MCON Minimizer submodel. Both submodels use linear programming to define the optimal phase-to-base assignment and are operational on batch processing computers.

The Relevant IFRS Documentation

1.14 Phase I. The two-model system of the first phase is documented in the following report:

- Integrated Facilities Requirements Study Phase I—Development of the Two-Model System, ORI Technical Report 520, 5 December 1968.

1.15 Phase II. The report on the Static IFRS model developed in Phase II consisted of the following:

- Development of a Preliminary Automated Total Systems Model for the Integrated Facilities Requirements Study (IFRS) Phase II, ORI Technical Report 583, 9 February 1970
  - Volume I, Summary of the IFRS Management Planning Tool

- Volume II, Appendices A through M
- Volume III, User's Manual
- Volume IV, Programmer's Manual.

1.16 Phase III. The Phase III documentation consists of this report and the three additional ORI reports:

- Development of the Automated Dynamic Model for the Integrated Facilities Requirements Study (IFRS) Phase III, ORI Technical Report 646, 31 March 1971.
  - Volume I, Summary of the Dynamic Management Planning Tool
  - Volume II, User's Manual
  - Volume III, Programmer's Manual.
- Development of the Optimization Model for the Integrated Facilities Requirements Study (IFRS), Phase III, ORI Technical Report 647, 31 March 1971.
  - Volume I, Summary of the Optimization Model
  - Volume II, Formulation and Use of the Optimization Model.
- Development of the Fleet Air Readiness Training Model for the Integrated Facilities Requirements Study (IFRS), Phase III, ORI Technical Report 648, 31 March 1971.
  - Volume I, Summary of the Fleet Readiness Training (FRT) Management Planning Tool
  - Volume II, Appendix B: Fleet Air Readiness Training Planning Factors
  - Volume III, FRT User's Manual
  - Volume IV, FRT Programmer's Manual.

SIGNIFICANT CONTRIBUTIONS OF THE IFRS STUDY

1.17 The IFRS study has significantly enhanced the Navy decision-making process by providing the Navy managers with a series of operational planning tools that quickly provide timely, relevant planning information. The use of

these IFRS tools will contribute to better management of the naval aviation program in general and the Naval Air Training Command and Fleet Readiness Training Squadrons in particular in the following ways:

- Frees management from making extensive routine calculations, giving them more time to manage, analyze, and make decisions.
- Provides management with an integrated planning tool that generates timely, accurate, and relevant aircraft, manpower, facilities, and cost information for alternative courses of action.
- Provides the capability to test and analyze the consequences of alternative decisions prior to making the final decision.
- Provides a common basis for computing the resources required for each alternative.
- Permits a large set of alternatives to be analyzed in great depth, since the information is readily available on a time-share computer system.

IFRS Planning Tool Users

1.18 Static IFRS Model Users. The first model developed by the IFRS study has been in daily use by the Aviation Training Division of the Chief of Naval Operations (CNO) since March 1970. Additionally, the Static IFRS model is being used by the Staff Civil Engineer's Office of CNATRA. CNO primarily uses the first module of the model that calculates resource requirements as a function of PTR. CNATRA uses the model primarily for facilities and cost information as well as resource requirements. The output of this model has been utilized in the decision-making process at both offices.

1.19 FRT Model Users. The FRT planning tool has been in daily use by the Aviation Training Division of CNO since it was completed in October 1970. The planning information provided by this model has been the basis for many decisions concerning the Fleet Air Readiness Training Squadrons.

1.20 Dynamic Model Users. The Dynamic model essentially expands the capabilities of the Static IFRS model and thus it is expected that those offices responsible for managing the undergraduate pilot training program will use this planning tool. It is presently anticipated that the Aviation Training Division of CNO will use the student input section of the model while the Training/Plans Division of CNATRA will use the other segments of the model.

1.21 Optimization Model Users. It is anticipated that Headquarters, NAVFAC, will be the initial user of the Optimization model.

SATISFACTION OF CONTRACTUAL REQUIREMENTS

1.22 The terms and conditions of the contract required ORI to complete particular tasks and milestones in this third phase of the IFRS model development. The following listing, which identifies various Phase III activities and end products with the task statement fulfilled by that portion, provides the best indication of satisfaction of contractual obligations.

- Development of the Fleet Air Readiness Training Logistics Support Requirements (LSR) Module—This LSR module was developed and is presently operational in the Aviation Training Division of CNO and is documented in the four volumes of ORI Technical Report 648, Development of the Fleet Air Readiness Training Model for the Integrated Facilities Requirements Study (IFRS) Phase III, 31 March 1971.
- Development of the Dynamic IFRS Model—The Dynamic planning tool was developed and programmed and is documented in the three volumes of ORI Technical Report 646, Development of the Automated Dynamic Model for the Integrated Facilities Requirements Study (IFRS) Phase III, 31 March 1971.
- Development of the IFRS Optimization Model—This developmental model consists of two submodels—the PTR Maximizer and the MCON minimizer. Its development and sample computer runs are documented in ORI Technical Report 647, Development of the Optimization Model for the Integrated Facilities Requirements Study (IFRS) Phase III, 31 March 1971.
- Installation of Time-Sharing Computer Terminal—A time-sharing terminal was installed in the Aviation Training Division of CNO from July 1970 through March 1971. ORI personnel assisted the Navy personnel in the use and operation of the terminal and programs during this period.
- Refinements to Static IFRS Model—The Phase II model was modified in the three following ways:
    - LSR module was expanded to include the undergraduate NFO pipeline as shown in Sections IV and V of Volume II of this report.
    - The regression equations developed in the Phase II study were validated as shown by the working papers submitted to NAVFAC.

- Various computer printouts were changed to better reflect the needs of the decision-maker as shown in Section II of Volume II of this report.

- Documentation—The documentation consists of this overall summary report, the various volumes of the three reports noted above, and modifications to the Phase II documentation. A complete listing of all three phases of the IFRS reports appears in Section II of this report.

II. OVERVIEW OF THE IFRS MANAGEMENT PLANNING TOOLS

INTRODUCTION

2.1 The four management planning tools developed by ORI as part of the IFRS study are designed to enhance the management of the naval aviation program. Each model is designed to assist management in either the undergraduate pilot and NFO training programs of NATRACOM or the Fleet Air Readiness Training Squadrons of the fleet commanders, as shown below:

- IFRS tools for undergraduate pilot and NFO training programs
  - Static IFRS model
  - Dynamic IFRS model
  - Optimization model
- IFRS tool for Fleet Air Readiness Training Squadrons
  - Fleet Readiness Training (FRT) model.

2.2 Each of these IFRS planning tools is a truly unique planning tool and management must know what each one does and does not do. Some of the basic differences follow:

- Each provides answers to different sets of questions posed by managers.
- Each contains specific assumptions concerning the aviation program.
- Each, even though presently operational, is in a different stage of development.

2.3 To enhance the utility of all models and to assist the manager, ORI set up and followed the same ground rules in the development of all models. Thus, uniform terminology, uniform data files, consistent methodology, consistent documentation, etc., were maintained wherever possible.

2.4 Each of these models is briefly discussed in the following paragraphs. For a detailed discussion of each, the manager should refer to the appropriate documentation.

THE STATIC IFRS PLANNING TOOL

2.5 The purpose of the Static IFRS model is to calculate aircraft, fuel, personnel, facility, and cost requirements as well as facility excesses and deficiencies for alternative training programs as a function of the PTR, MIX, and MODE. This model assumes an even annual flow of students and essentially replicates NATRACOM's present planning methodology by simulating the undergraduate training production process on a time-share computer system. As discussed in Volume II of this report, this model is completely operational for the pilot training program and partly operational for the NFO training program. The model consists of 15 separate computer programs and various data files that are carefully grouped into the 5 following discrete modules:

- Logistics Support Requirements (LSR)
- Base Loading
- Facilities Requirements
- Facilities Excess/Deficiencies
- Total Systems Cost.

2.6 The interrelationship of these modules is illustrated in the schematic overview in Figure 2.1. The output of each module is printed by the time-share terminal as well as automatically entered to one or more successive modules. Each of these five modules is briefly discussed as follows:

- Logistics Support Requirements (LSR) Module—The purpose of the LSR module is to calculate aircraft, flight instructors, total officers, total enlisted men, fuel, flight hours, etc., required for each pilot training phase in the Naval Air Training Command as a function of pilot training rate (PTR) and MODE of training (e.g., syllabus, etc.).
- Base Loading Module—The purpose of this module is to provide the decision-maker with the capability to assign each training phase to one of the eight pilot training bases plus a completely

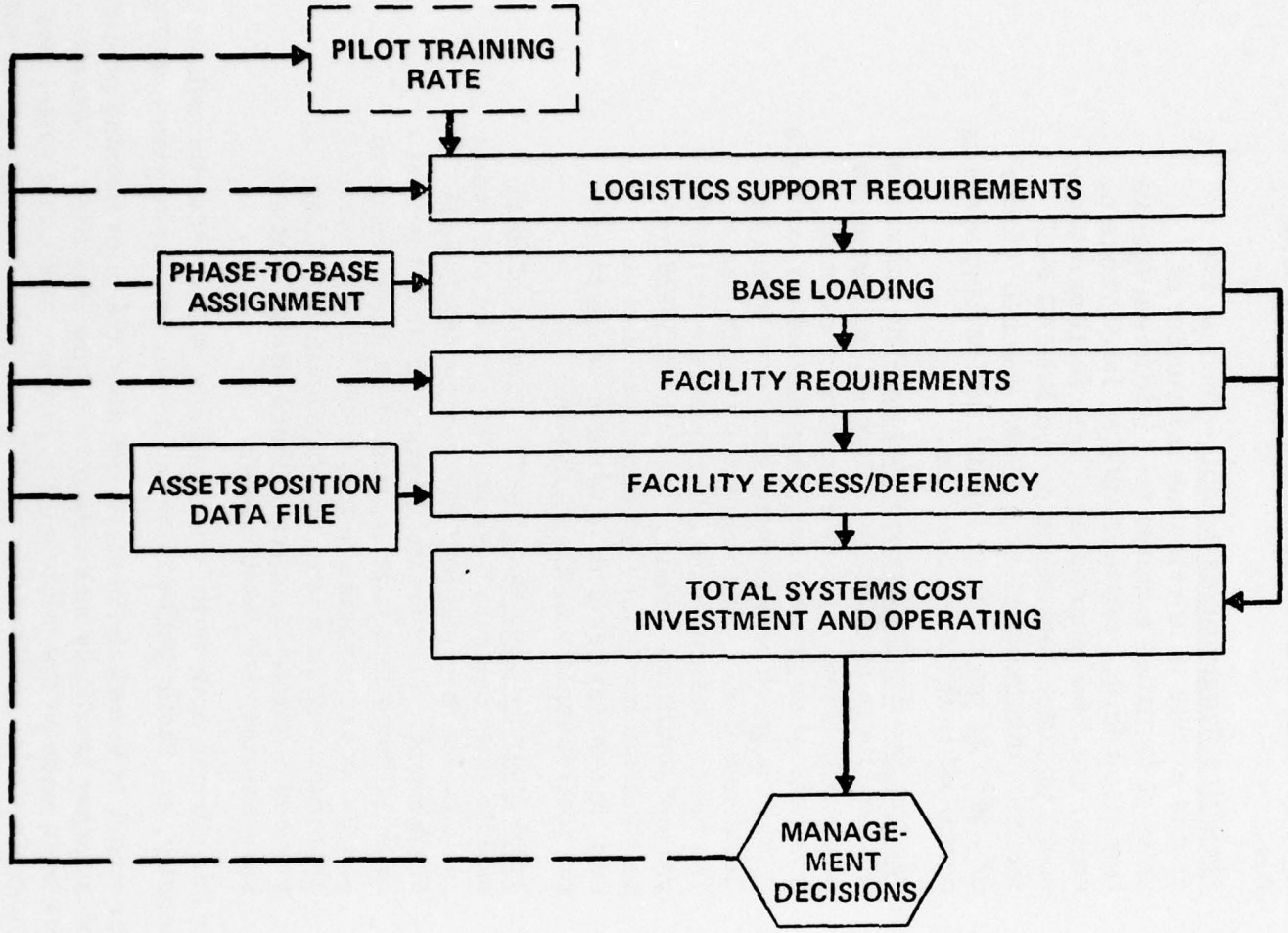


FIGURE 2.1. OVERVIEW OF STATIC IFRS MODEL

new or "phantom" base. Once this assignment is completed, the computer estimates the total manpower (i.e., training phase, tenant, and naval air station) and aircraft requirements for each base. Base specific information (e.g., number of tenants) is contained in a base data file.

- Facilities Requirements Module—The purpose of this module is to calculate the number of units of facilities required for 24 different facility line items (e.g., runways, BOQs, family housing units, etc.) for each base. These facility requirements equations are based on the NAVFAC P-80 facility planning document. Base specific information such as the depth of the aircraft parking apron is contained in the base data file.

- Facility Excess/Deficiency Module—The purpose of this module is to compare the facility requirements calculated above with the inventory of existing facilities at each base and determine where excesses (i.e., too much of a facility) exist and where deficiencies (i.e., not enough of a facility) exist. The Assets Position data file contains a list of the present facilities inventory in both standard and substandard conditions for each base and the decision-maker can decide whether or not to use the total inventory in his analysis.

- Total Systems Cost Module—The purpose of this module is to compute the total investment and operating cost for the specified PTR and phase-to-base assignment. The investment costs include the cost to build those facilities identified as being deficient and the cost to procure new aircraft. The annual operations and maintenance costs include military pay and allowances, aircraft fuel, aircraft support, base support, and fixed costs.

The manager has various options to return to parts of the model throughout each run. Additionally, the Static IFRS can be run to analyze future year requirements.

2.7 This model is extremely flexible and when the pilot training program changes, the manager need only make changes to the data files. Several changes have been made in the pilot training program since this model was developed, and the model continues to provide the Navy decision-maker with relevant and usable planning information through easily implemented model updates.

2.8 The Static IFRS model is documented in the Phase II documentation, ORI Technical Report 583. Refinements to this model completed in the Phase III study are documented in Volume II of this report.

THE DYNAMIC IFRS PLANNING TOOL

2.9 The purpose of the Dynamic IFRS model is to provide the Navy decision-maker with relevant planning information based on the weekly operations of the undergraduate pilot training program. It is presently operational in a time-share conversational mode. This model generally assumes an even weekly flow of students and thus replicates the weekly operations of the pilot training program. This model essentially expands the capability of the LSR module of the Static IFRS model into a detailed operational tool. However, this Dynamic model extends and amplifies management capabilities well beyond the point where the Static IFRS model stopped. The Dynamic model replicates the movement of aircraft, instructors, and students on a weekly basis. These resources and facilities are the factors management can control in the training program.

2.10 The model consists of nine new computer programs and two of the Static IFRS programs that are carefully grouped into the following four modules.

- Current Status
- Student Input
- Student Flow
- Shock.

The interrelationship of these four modules is illustrated by the schematic overview in Figure 2.2. As in the Static model, the output of each module is printed by the time-share terminal for use by the manager as well as automatically entered to the subsequent modules as necessary. The purpose of each module is discussed below:

- Current Status Module—The purpose of this module is to enter those data that define the present status of each training phase for the current week. These data include aircraft inventory, instructor inventory, student load, and student output available for the first week of the simulation.
- Student Input Module—The purpose of this module is to calculate the number of students entering the pilot training program on a weekly, monthly, or quarterly basis.
- Student Flow Module—The purpose of this module is to calculate the student load, student output, student attrites, aircraft utilization, and instructor utilization for each training phase and week of analysis.

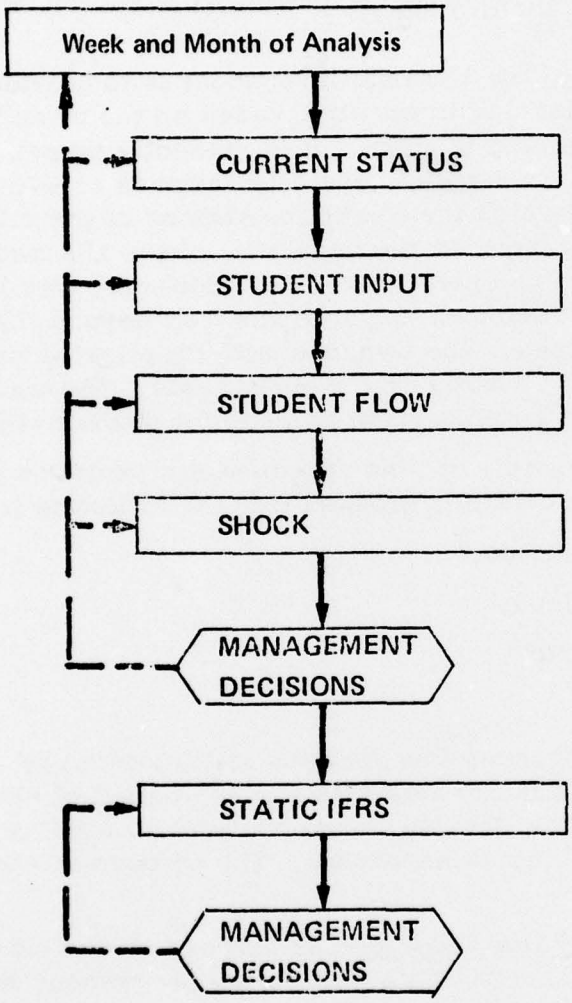


FIGURE 2.2. DYNAMIC SIMULATION OVERVIEW

- Shock Module—The purpose of this module is to provide the manager with a means of changing, or shocking, many of the planning factors entered into the student flow module.
- Static IFRS Model—The manager has the option to enter the Static IFRS model to determine facility requirements and costs.

The Dynamic IFRS model is documented in ORI Technical Report 646.

THE IFRS OPTIMIZATION MODEL

2.11 The purpose of the Optimization model is to calculate the optimal location of each undergraduate pilot training phase. This developmental management tool completed in Phase III consists of two submodels.

- PTR Maximizer—The purpose of this submodel is to calculate the phase-to-base assignment that provides the maximum possible PTR that can be achieved with the existing facility stock at the pilot training bases. This submodel uses linear programming to determine the optimal phase-to-base assignment and is presently operational on ORI's CDC-3100 computer.
- MCON Minimizer—The purpose of this submodel is to calculate the phase-to-base assignment that provides the minimum facilities investment cost for a given PTR. This submodel also uses linear programming and is presently operational on the Navy's UNIVAC 1108 computer.

2.12 The development of these two prototype submodels verifies the feasibility of developing optimization models for facilities management purposes. These two submodels provide the facilities manager with a powerful analytic tool that if used properly will enhance management's capabilities. Both of these submodels are discussed in detail in ORI Technical Report 647.

THE FLEET READINESS TRAINING (FRT) MODEL

2.13 The purpose of the FRT model is to calculate the student, instructor, aircraft, and squadron requirements for alternative squadron configurations as a function of one of four variables—student input, student output, aircraft inventory, and aircraft operating costs. This model assumes an even annual flow of students and essentially replicates the Navy's present planning process by simulating the Fleet Air Readiness Training program on a time-share computer system. The FRT model consists of one module, the LSR module, at this stage

of development (this LSR module is quite similar to the Static IFRS LSR module). It has been in daily use by CNO since September 1970. Its output has been utilized in making many decisions concerning the Fleet Readiness Training Squadrons. The model provides planning information (not just more data) that is critically required by the Navy decision-makers. The FRT model is discussed in detail in ORI Technical Report 648.

III. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

3.1 NAVFAC has sponsored and ORI has developed four separate management planning tools during the first three phases of the IFRS study. Each of these models is operational and enhances the Navy decision-making process by providing the cognizant managers with relevant planning information—not just more data. The utility of two of these models—the Static IFRS and the FRT model—has been clearly demonstrated by their use by Navy managers in both Washington, D.C., and Pensacola, Florida. With these models, managers have a better grasp of the requirements of the squadrons. In fact, many dollars have been saved and resources more fully utilized based on the information provided by these models.

3.2 Much of the information provided by the Dynamic model was previously unavailable to the manager and it is anticipated that this model will become an integral part of the naval aviation management process as soon as the managers become familiar with its total capabilities.

3.3 Similarly, the two optimization submodels—the PTR Maximizer and the MCON Minimizer—provide the facilities manager with a powerful analytic tool that if used properly will greatly enhance management's capabilities. Many benefits derived from the use of these models have been discussed throughout the IFRS documentation and thus are not reiterated. However, at this point, the primary benefit must be again mentioned—the models are operable and they do enhance the manager's capability by providing him with useful planning information.

RECOMMENDATIONS

3.4 ORI strongly recommends that additional IFRS management planning tools should be developed. This will allow more Navy commands to reap the

benefits that have been realized by the pilot training and Fleet Air Readiness Training Squadrons. In particular the following recommendations are made:

- Develop a complete "Static IFRS" model for the Naval Air Force, U.S. Atlantic Fleet. This model should incorporate the FRT model methodology to plan for those readiness training squadrons of the Atlantic Fleet. Additionally, certain features of the Dynamic model should be included as necessary.
- Develop a similar Static IFRS model for the Naval Air Force, U.S. Pacific Fleet.
- Develop comprehensive plans for developing and implementing a total Navy-wide IFRS model. Initially, the IFRS system should include all of the naval aviation programs. Once this is successfully implemented, the IFRS system should be developed for other Navy shore activities.