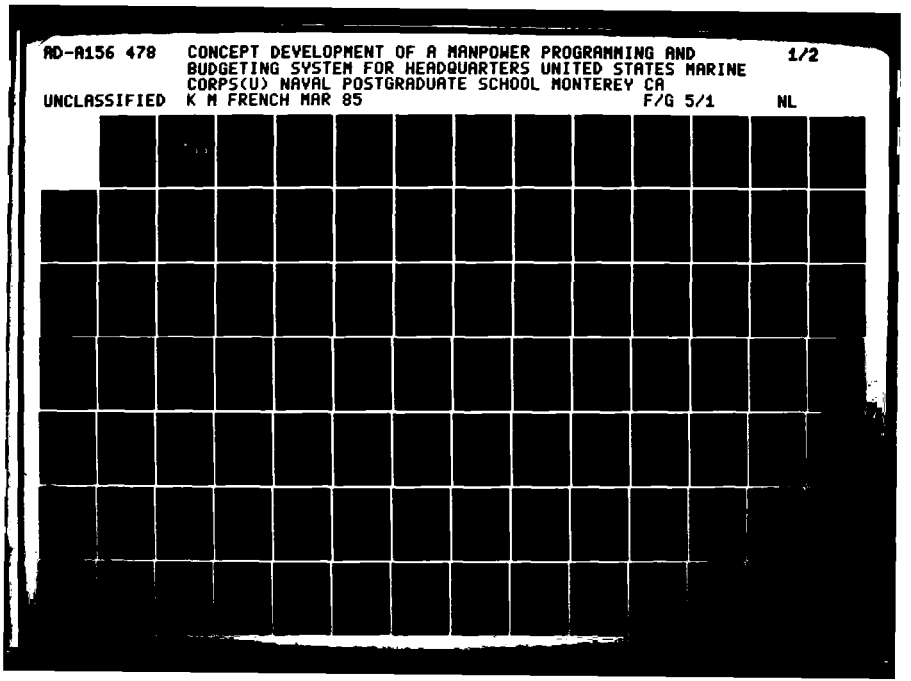
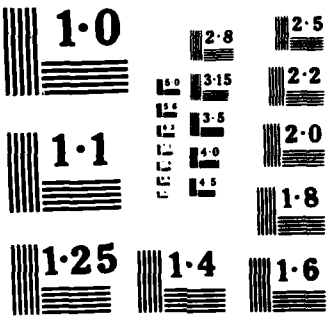
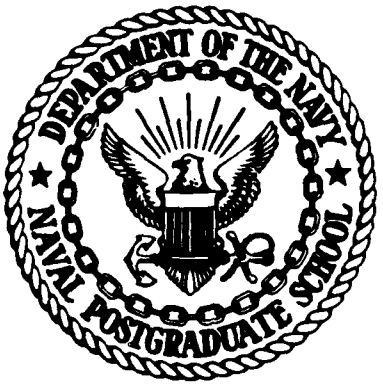

AD-A156 478 CONCEPT DEVELOPMENT OF A MANPOWER PROGRAMMING AND 1/2
BUDGETING SYSTEM FOR HEADQUARTERS UNITED STATES MARINE
CORPS(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA
UNCLASSIFIED K M FRENCH MAR 85 F/G 5/1 NL



NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

(2)

NAVAL POSTGRADUATE SCHOOL
Monterey, California



THESIS

CONCEPT DEVELOPMENT OF A
MANPOWER PROGRAMMING AND BUDGETING SYSTEM FOR
HEADQUARTERS, UNITED STATES MARINE CORPS

by

Kevin M. French

March 1985

Thesis Advisor: Norman Lyons
Co-Advisor: Thomas G. Swenson

Approved for public release; distribution is unlimited

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. A156478 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Concept Development of a Manpower Programming and Budgeting System for Headquarters, United States Marine Corps	5. TYPE OF REPORT & PERIOD COVERED Master's Thesis March 1985
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Kevin M. French	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, CA 93943	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, CA 93943	12. REPORT DATE March 1985
	13. NUMBER OF PAGES 109
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution is unlimited

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

18. SUPPLEMENTARY NOTES

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

manpower, planning, programming and budgeting system, life cycle management, automated information systems

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

This paper documents a Concept Development Phase analysis conducted for the Manpower Plans, Programs, and Budget Section of Headquarters, U.S. Marine Corps. The study fulfills the requirements of Marine Corps Order P5231.1, Life Cycle Management for Automated Information Systems (LCM-AIS). The study analyzed the users' functional requirements and produced documentation required for Concept Development of a Marine Corps Class II automated information system. A Mission Element Need Statement (MENS), (continued)

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

S N 0102-LF-014-6601

ABSTRACT (Continued)

Requirements Statement, Feasibility Study, and Economic Analysis were produced.
The recommendation was to continue development and begin the Detailed Design phase of the system life cycle. The recommended alternative was for a distributed architecture comprised of microcomputers linked by a local area network to provide resource and data sharing. Access to a mainframe processor for support of large database functions will be provided by leased communications lines and remote terminal sessions using the microcomputers The importance of a high level information resource management plan was stressed for successful implementation.

Approved for public release; distribution is unlimited.

Concept Development of a Manpower Programming and Budgeting System for Headquarters, United States Marine Corps

by

Kevin M. French
Captain, United States Marine Corps
B.S., University of Dayton , 1979

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1985

Author: Kevin M. French
Kevin M. French

Approved by: Norman R. Lyons
Norman R. Lyons, Thesis Advisor

Thomas G. Swenson
Thomas G. Swenson, Co-Advisor

Willis R. Greer, Jr.
Willis R. Greer, Jr., Chairman,
Department of Administrative Science

Kneale T. Marshall
Kneale T. Marshall,
Dean of Information and Policy Sciences

ABSTRACT

This paper documents a Concept Development Phase analysis conducted for the Manpower Plans, Programs, and Budget Section of Headquarters, U. S. Marine Corps. The study fulfills the requirements of Marine Corps Order P5231.1, Life Cycle Management for Automated Information Systems (LCM-AIS). The study analyzed the users' functional requirements and produced documentation required for Concept Development of a Marine Corps Class II automated information system. A Mission Element Need Statement (MENS), Requirements Statement, Feasibility Study, and Economic Analysis were produced.

The recommendation was to continue development and begin the Detailed Design phase of the system life cycle. The recommended alternative was for a distributed architecture comprised of microcomputers linked by a local area network to provide resource and data sharing. Access to a mainframe processor for support of large database functions will be provided by leased communications lines and remote terminal sessions using the microcomputers.

The importance of a high level information resource management plan was stressed for successful implementation.

TABLE OF CONTENTS

I. INTRODUCTION 10
A. BACKGROUND 10
B. PURPOSE 10
C. METHODOLOGY 11
D. TERMINOLOGY 12

II. MISSION ELEMENT NEED STATEMENT (MENS) 13
A. MISSION AREA IDENTIFICATION 13
1. Current Environment 14
2. Priority 17
B. DEFICIENCY 17
1. Scope 17
2. Jobs to be Accomplished 19
C. EXISTING AND PROGRAMMED CAPABILITIES 20
1. Current Capability 20
2. Impact 21
D. CONSTRAINTS 21
1. Standardization 21
2. Interfaces 22
E. PROJECT MANAGEMENT 22

III. REQUIREMENTS STATEMENT 23
A. GENERAL 23
1. Purpose 23
B. CURRENT SYSTEM 23
1. Project References 23
2. Existing System 23
3. Problem Description 38
C. REQUIRED CAPABILITIES 39

1. Organizational Structure 40
2. Interface with Other Systems 40
3. Operating Environment 41
4. Communications Requirements 41
5. Classification 42
6. Performance Requirements 42
7. Requirements for Backup Capability 43
D. VALIDATION OF USER REQUIREMENTS 43

IV. FEASIBILITY STUDY 45
A. GENERAL 45
1. Problem and User Requirements 46
2. AIS Guidelines and Constraints 46
3. System Title 46
B. FEASIBLE ALTERNATIVES 47
1. Description of Alternative 1 47
2. Description of Alternative 2 50
3. Description of Alternative 3 53
C. OTHER ALTERNATIVES 54
1. Existing System 55
D. FEASIBILITY DETERMINATION 56
1. Aspects of Technical Feasibility 58
2. General Operational Feasibility Requirement 59
E. ANALYSIS OF ALTERNATIVES 60
1. Alternative 1: Distributed Processing . . 60
2. Alternative 2: Centralized Processing . . 61
3. Alternative 3: Distributed Processing with Network 61
4. Alternative 4: Existing System 61

V. ECONOMIC ANALYSIS 64
A. INTRODUCTION 64
1. Methodology 64

B. OBJECTIVE 65
C. ASSUMPTIONS 65
1. Sunk Costs 66
D. ALTERNATIVES 67
E. COST ANALYSIS 67
1. Background 67
2. Non-recurring Costs 68
3. Recurring Costs 79
F. BENEFIT ANALYSIS 83
1. General 83
2. Discussion of Benefits 84
3. Benefit Ratings 87
G. COMPARISON OF ALTERNATIVES 87
H. SENSITIVITY ANALYSIS 89
1. Reduction of Hardware Costs 90
2. Reduction of Software Costs 91
I. CONCLUSIONS 91
J. RECOMMENDATIONS 98

VI. CONCLUSION 101
A. ANALYSIS OF METHODOLOGY 101
B. RECOMMENDATIONS 102
1. Strategy 102
2. Present Methods 104

APPENDIX A: GLOSSARY OF TERMS 105

LIST OF REFERENCES 107

INITIAL DISTRIBUTION LIST 109

LIST OF TABLES

1. Inputs to the Programming and Budgeting Process 32
2. Outputs of the Manpower Programming and Budgeting System 34
3. Summary of Feasibility Analysis 62
4. Undiscounted Costs: Alternative 1 69
5. Undiscounted Costs: Alternative 2 70
6. Undiscounted Costs: Alternative 3 71
7. Hardware and Software Costs for Alternative 1 . . 72
8. Hardware and Software Costs for Alternative 2 . . 73
9. Hardware and Software Costs for Alternative 3 . . 74
10. Summary of COCCMO Cost Estimates 76
11. COCOMO Estimate for Mainframe Computer Development Charges 80
12. Estimated Monthly Mainframe Operations Costs . . . 82
13. Benefit Analysis Summary 88
14. Benefit Cost Ratio Calculations 90
15. Total Present Value Costs 92
16. Sensitivity Analysis Case 1 93
17. Sensitivity Analysis Case 2 94
18. Sensitivity Analysis Case 3 95
19. Sensitivity Analysis Case 4 96

LIST OF FIGURES

2.1 Headquarters Marine Corps Organization Chart . . . 13
2.2 Major Divisions of the Manpower Dept. 15
2.3 Plans, Programs and Budget Section, MPP-40 16
3.1 Data Flow Diagram of Major Processes 27
3.2 Functional Hierarchy of the Present System 31
4.1 Alternatives to be Evaluated 45
4.2 Feasible Alternatives 47
4.3 System Configuration for Alternative 1: Distributed Processing 48
4.4 System Configuration for Alternative 2 : Centralized Processing 52
4.5 System Configuration for Alternative 3: Distributed Processing With Local Area Network . . 54
4.6 System Configuration for Alternative 4: Existing System 57
5.1 Cost Benefit Analysis 97
5.2 Software Cost Estimation Accuracy Versus Time . . . 99

I. INTRODUCTION

A. BACKGROUND

The purpose of this paper is to conduct a Concept Development Phase analysis of an automated information system for an organization within Headquarters, United States Marine Corps.

The Manpower Department of Headquarters Marine Corps is responsible for coordinating the development and submission of Manpower budgets and programs to support Marine Corps missions. Facets of manpower management and planning processes are currently being automated and upgraded. Before this, the manpower budgeting and programming functions of the Manpower Department have lacked attention to the need for automated processing.

The Manpower budget accounts for approximately 40 per cent of the total Marine Corps operating budget. Most of this amount is stable and predictable. A significant portion (around 35 per cent) of the Manpower budget goes for paying marines who are not actually filling billets in any organization. These are accounted for in the so-called overhead accounts. They are comprised of those marines in one of the following statuses: Patient, Prisoner, Transient or Trainee. These personnel must be budgeted as a separate line in the Marine Corps manpower budget.

B. PURPOSE

The Manpower Department decided that closer control should be kept of these and other manpower budget costs. It was decided that a study should be conducted to define Manpower programming and budgeting requirements to outline

deficiencies in the present methods of doing business and suggest possible courses of action. The Manpower Procedures and Integration Section was directed to carry out the duties of Project Manager for the system development.

C. METHODOLOGY

Information was gathered during two visits to the users' place of business in July and September 1894. A total of seven days was spent on-site gathering data, conducting interviews and observing the work environment. All users were interviewed as were representatives from the requesting office, Manpower Procedures and Integration Section (Code MPI-40).

The study was conducted under the guidelines of [Ref. 1] and [Ref. 2] and constitutes the satisfaction of the requirement to conduct a Concept Development effort and produce the associated life cycle management documents. It is, by definition and intent, a general assessment of the present and required functions and capabilities of the users. The Concept Development phase as prescribed in [Ref. 2: p. 3-3] is not intended to be a detailed design specification. Detailed design commences after the validation of user requirements and operational and technical feasibility.

The chapters of this paper parallel the Life Cycle Management documentation required by [Ref. 2]. The contents of the chapters themselves mirror as closely as possible the required information to be contained within each document. Some repetition is unavoidable. The intent is that requirements and deficiencies begin to emerge in greater detail as the analysis progresses. A point to remember is that all documentation produced in this methodology is updated as the project moves through the development phases.

D. TERMINOLOGY

To provide a better flow of logic within the body of the paper, definitions to key phrases were kept to minimum. Appendix &gloss contains a glossary of terms used in this paper which are unique to this subject. [Ref. 3: p. C-1] constituted the basis for this glossary, which has been annotated as appropriate for the purposes of this study.

II. MISSION ELEMENT NEED STATEMENT (MENS)

A. MISSION AREA IDENTIFICATION

The organization that is the subject of this study is an element of the staff of Headquarters, United States Marine Corps. It falls under the general control of the Deputy chief of Staff, Manpower. Figure 2.1 shows the organization of the major departments of Headquarters, U. S. Marine Corps.

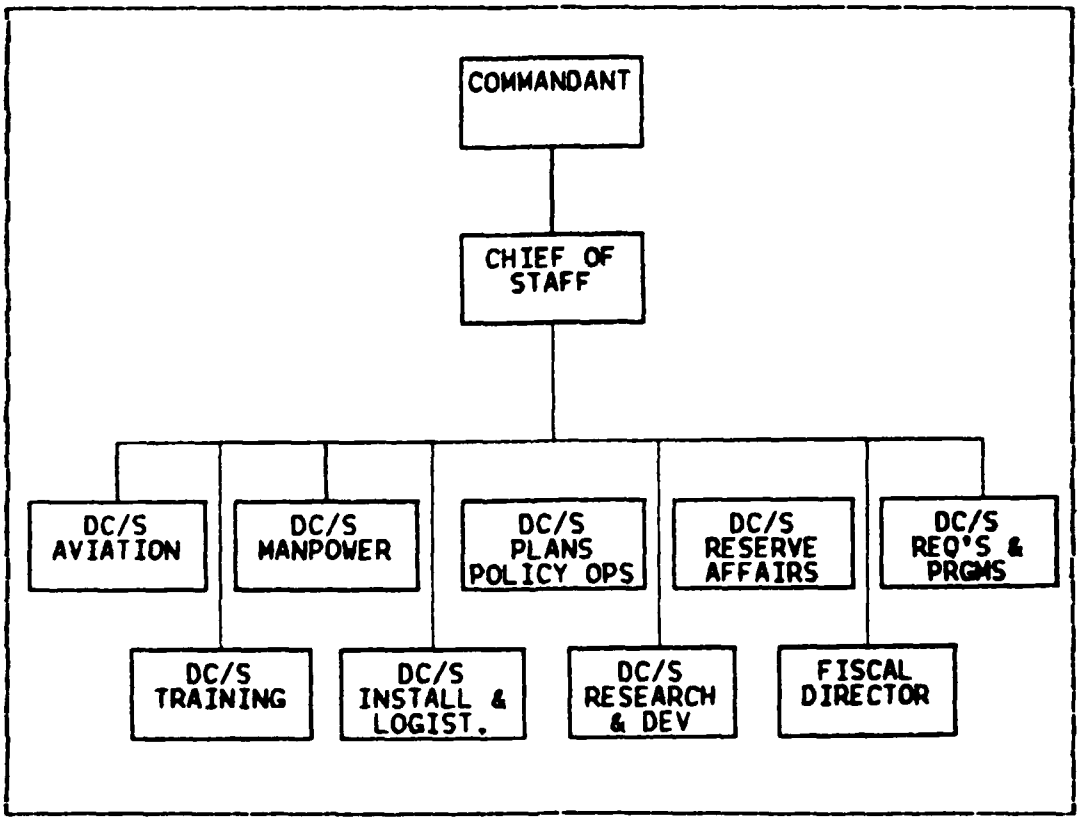


Figure 2.1 Headquarters Marine Corps Organization Chart

The complete descriptive title of the user organization is the Plans, Programs and Budget Section; Manpower Policy, Planning, Programming and Budgeting Branch; Manpower Plans and Policy Division; Manpower Department. Hereafter, it will be referred to by the short title MPP-40. Figure 2.2 shows the position of MPP-40 within the Manpower Department. It is located along with the rest of the headquarters staff in the Navy Annex Building, Arlington, VA.

The mission of MPP-40 is to prepare manpower plans and programs in support of the Marine Corps Planning, Programming and Budgeting System (PPBS) and to prepare, support and justify Marine Corps manpower budgets, statistics and plans in support of the Military Pay, Marine Corps (MPMC) appropriation. Authority for this mission is contained in [Ref. 4: p. 2-16].

1. Current Environment

The Budget and Programs Units are smallest elements within MPP-40. Figure 2.3 shows how MPP-40 is organized to carry out its mission. It is manned by five action officers and four civilian budget analysts. The two units, together with the Plans unit comprise the Plans, Programs and Budget Section of the Manpower Policy, Planning, Programming and Budgeting Branch.

The following are specific tasks which are performed by MPP-40.

1. Coordinate the development and preparation of manpower data and budget analysis in support of Marine Corps participation in the PPBS.
2. Coordinate, validate, and authorize release of all Manpower statistics and related reports to agencies external to the Marine Corps.
3. Maintain historical data on strengths, distribution, promotions, and related subjects to support manpower plans and prepare manpower budgets.
4. Act as liaison with agencies outside the Marine Corps which have a requirement for manpower data.

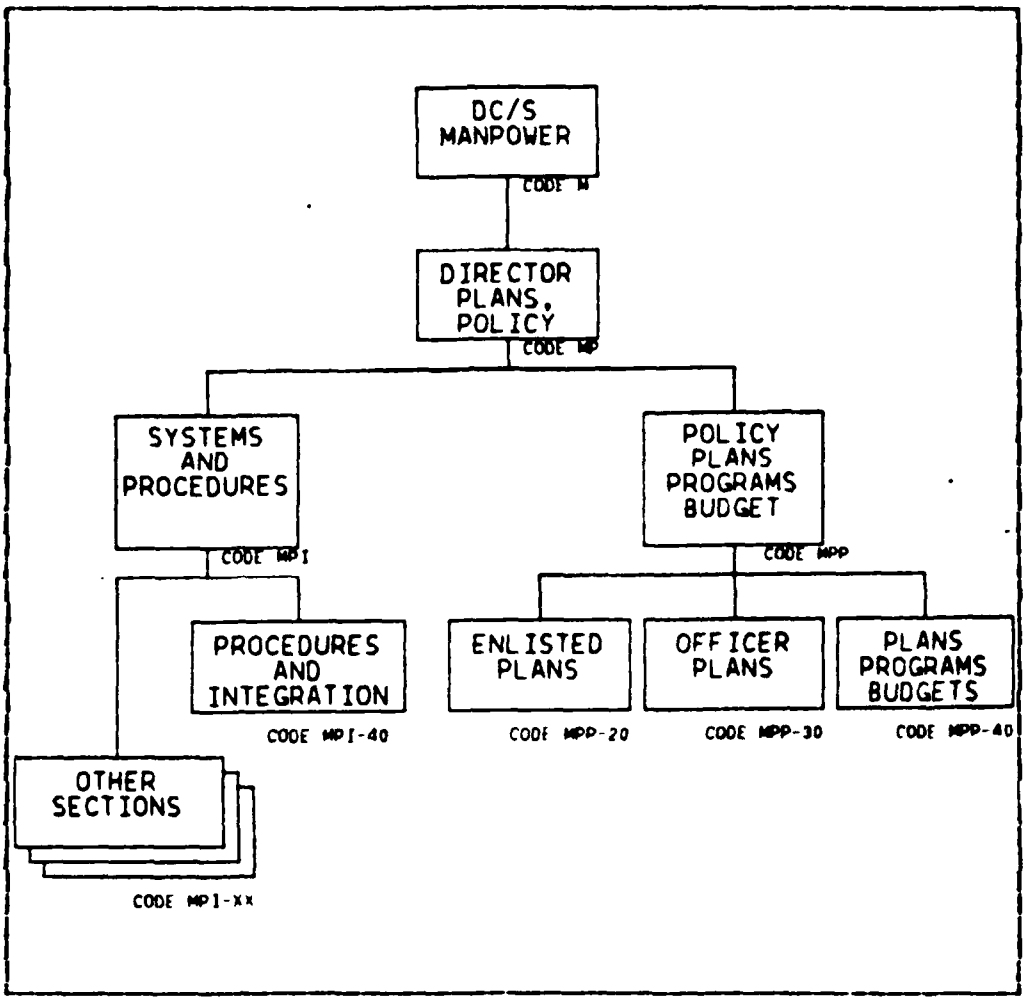


Figure 2.2 Major Divisions of the Manpower Dept.

5. Prepare military manpower budget estimates associated with various management alternatives in support of PPBS.

6. Supervise and review the execution of manpower programs and the MPMC budget.

7. Use the projections and estimates from the Table of Manpower Requirements (T/R) and Troop List to prepare programs and budget estimates.

8. Prepare the Five Year Defense Plan (FYDP) and Manpower Requirements Report.

9. Prepare manpower statistics, reports, analyses and budgets.

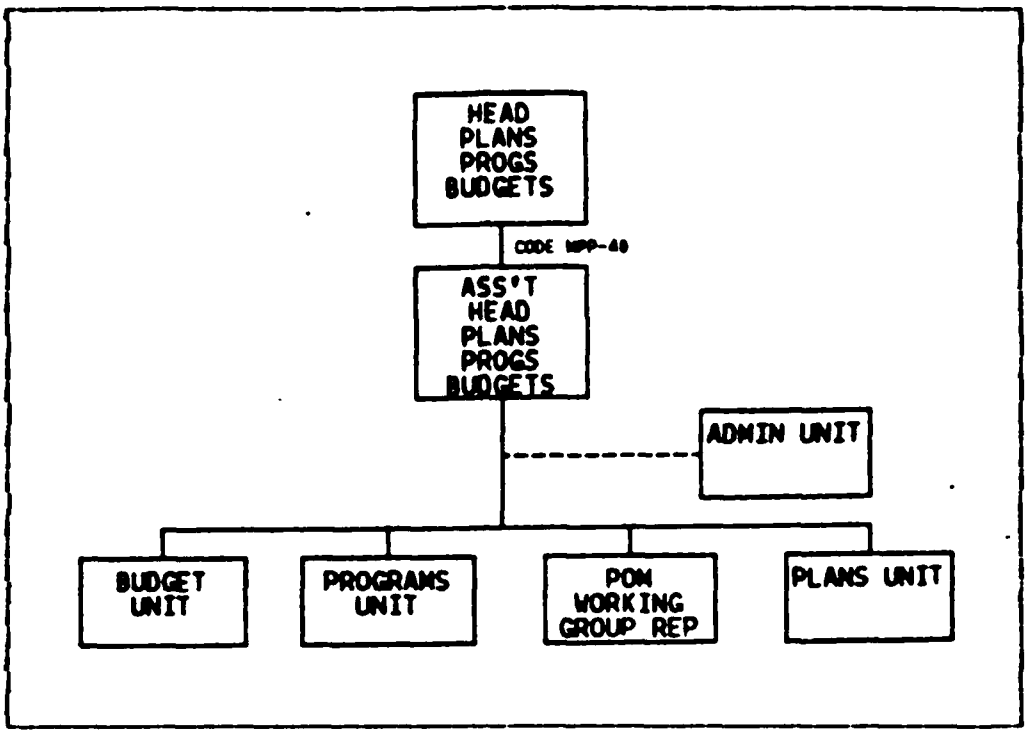


Figure 2.3 Plans, Programs and Budget Section, MPP-40

10. Estimate average man-years and dollar costs for the manpower overhead accounts, Patients, Prisoners, Transients and Trainees T2P2[1] for the Five Year Defense Plan (FYDP).

Nearly all the activities associated with the above tasks are performed manually with the use of spreadsheets and desk top calculators. Automated reports from MMS and HMF are manually verified, corrected and then updated and prepared in final form. Many of the tasks are cyclical (usually monthly) or repetitious in nature. There are also ad hoc requests for information from agencies outside the Marine Corps

---

[1]Marines in this category must be budgeted for aside from those who actually fill billets. Permanent Change of Station costs are budgeted under this category which traditionally bears considerable scrutiny at all levels of oversight.

and the Department of Defense which occur with unpredictable frequency.

There are several automated systems currently being developed with which the section will have to interface, either providing inputs or using their output. They are the Officer Planning System, Enlisted Planning System, Automated Troop List, Table of Manpower Requirements and Navy Headquarters Programming System and Budgeting System (NHPS/BS).[2]

2. Priority

The mission outlined in this MENS has a high priority relative to the other mission needs of the organization. The successful preparation of programs and budgets for the Manpower Department, their justification to higher authorities and the monitoring of their execution is a crucial function at the headquarters level. Successful execution depends on rational, efficient and correct mission performance by the sections. To properly function in an increasingly competitive and complex budgeting and planning arena, the Marine Corps needs to fully exploit all information resources at its disposal.

B. DEFICIENCY

1. Scope

Several problems exist with the methods which the Budget and Plans Units must use to gather, process

---

[2]These are manpower systems which are used to prepare plans and forecasts based on current and programmed structures of the Corps. NHPS/BS is a Navy sponsored system scheduled for implementation in fiscal year 1986. It will provide the means to satisfy Navy budget reporting requirements.

and store data for use in their programs, budgets and reports.

There is a lack of integration of the output of the Officer and Enlisted Planning models and the programming and budgeting process. Output from the models must undergo manual verification, reformatting and editing to be useful to the Programs and Budget units.

The dynamic nature of the POM process causes the budgetary impact of many alternatives to be manually calculated numerous times. Programs and policies are proposed and routinely modified, which causes recalculation of their impact.

There is a lack of an efficient, reliable method with which to monitor actual manpower statistics on a monthly basis. The reports containing information about the manpower levels from the HMF extracts are often inaccurate and unreliable. They must be edited and cross checked with other reports. The information they contain must be transcribed onto spreadsheets so that it may be used for calculations, management reports and stored.

Manpower statistics from prior years are not stored in a readily accessible format for analysis. The information is stored on large spreadsheets. Because of this it is difficult to work with them them. Data must be transcribed onto other working spreadsheets whenever new calculations or analysis is done. This is laborious and error prone.

Redundancy in reports required by outside agencies causes repetitive manual preparation of the same data in different formats. Many of the data elements are repeated in different reports. It is merely presented in different formats and sent to different agencies.

There is inadequate storage space for the hardcopy records and working papers. Working spaces are extremely cramped. There is not adequate room for proper storage of the numerous records which must be kept in perpetuity.

There is no method for analysts to do statistical analysis on the data from prior years without excessively time consuming manual calculations. Once the historical statistics are gathered, all analysis and manipulation is done manually with the aide of desktop calculators. There are no tools with which to perform even elementary statistical analysis.

Present methods of data extraction from the Headquarters Master File (HMF) and Manpower Management System (MMS) are not responsive to the changing requirements of the users' environment. The methods are mostly batch oriented inflexible programs which are not easily modified to allow changes in either format or content.

The method used to forecast the T2P2 accounts is intuitive, not quantifiable. There is no way to calculate with reasonable confidence the rates and costs for future years given changes in manpower policies and programs. The present method uses a simple weighted average to spread the costs of the overhead accounts among grades and across programs. The basis for this method is that it is the most objective method available. It does not provide the accuracy or detail required.

2. Jobs to be Accomplished

The functional outcomes to be accomplished include the following:

1. A method for users to access MMS and HMF files and to edit and validate the information that

they contain so that it may used to prepare management reports and analyses.

2. A method to efficiently and reliably determine actual monthly manpower statistics.

3. The ability to produce required reports without redundant manual and automated processing.

4. Appropriate storage facilities are required for historical data for ease of retrieval and physical security.

5. A method to reliably forecast the overhead accounts for (T2P2) programming and budgeting purposes.

6. A method to explore the program and budgetary impact of management options in terms of force structure or manning issues, i. e., "what if" or gaming capabilities.

C. EXISTING AND PROGRAMMED CAPABILITIES

1. Current Capability

The units currently rely heavily on manual calculations to perform program, budget and statistical analysis. Output from models and files are manually transcribed into the required formats so that the information they contain can be validated and put in useful formats. A Hewlett-Packard minicomputer is used to do limited data manipulation, file maintenance, and graphics. Electronic word processing is used to convert manually prepared reports and computations into smooth documents.

The programmed capability to address the above deficiencies is the design, development and implementation of an integrated system of data extraction, and data manipulation and analysis tools to enhance the unresponsive automated support currently available. Development will proceed under the guidelines of [Ref. 2: pp. 1-12 - 14]. Development will be accomplished in phases over the next two years [Ref. 5: p. 2].

2. Impact

Programming and budget analysis will not be able to increase in sophistication or efficiency until laborious manual procedures are eliminated and the unreliable, inflexible automated portions are remedied. Manpower programming and budget analysis will be of reduced quality from that which is desirable and attainable. Analysts will continue to do excessive clerical work at the expense of fruitful labor.

Increasing congressional interest in manpower budgets is likely to cause a demand for more in-depth analysis not currently available in the present manually driven system. The pressures brought on by projected reductions in the recruit pool in the near term may cause the Marine Corps to require even closer analysis and monitoring of its manpower resources in the approaching scarce resource market. The present system will not allow for an increase in the depth of the analysis of the available information.

D. CONSTRAINTS

1. Standardization

The system must be able to access existing Marine Corps databases and file structures.

The system must be written in a DoD approved language and conform to DoD and USMC automated information system standards and orders.

The proposed solutions must use to the maximum extent feasible existing automated manpower systems.

2. Interfaces

There are automated systems currently under development by the Marine Corps which will provide inputs for the proposed system (Officer Planning System, Enlisted Planning System, Automated Troop List and the enhancements of the Table of Manpower Requirements). In addition, the Marine Corps has opted to participate fully with the Navy Headquarters Programming and Budgeting Systems currently under development. These systems will provide an automated processing and input system for transmitting budget data to the Navy Comptroller (NAVCOMPT). Alternative solutions must be compatible with these current and developing systems.

NHPS/BS will require automated submission by an input terminal of budger data to NAVCOMPT via a local area network. Any proposed system must consider this interface so that internal budget and program development is able to efficiently interface with NHPS/BS.

E. PROJECT MANAGEMENT

Project management for the system will be the responsibility of the Manpower Management Systems Integration and Procedures Section (MPI-40). Staff concurrence will be through the user, Plans, Programs and Budget Section (MPP-40). Staff concurrence and coordination will be made through all organizations that are developing systems with which the planned system may be required to interface. Approval authority to proceed past project milestones rests with the Deputy Chief of Staff for Manpower. [Ref. 5: p. 3]

III. REQUIREMENTS STATEMENT

A. GENERAL

1. Purpose

The purpose of this requirements statement is to provide documentation that may be used to establish user requirements for the Manpower Programming and Budgeting System. It also is a vehicle for the Marine Corps to evaluate the need for an automated system and then to proceed to the concept development phase of the system development life cycle.

This requirements statement is intended for review by the current and potential users of the MPBS as well as those who will be responsible for the technical support of the system and other appropriate USMC managers. This document is prepared in accordance the format specified in [Ref. 2: p. D-1].

B. CURRENT SYSTEM

1. Project References

Information and authority regarding the continued development of this system is found in [Ref. 2] and [Ref. 5].

2. Existing System

a. Mission

The mission of the Plans, Programs, and Budget Section (MPP-40) is to prepare manpower plans and programs in support of the Marine Corps Planning Programming and

Budgeting System (PPBS) as reflected in the Joint Strategic Planning System, Marine Corps Planning System, Program Objective Memoranda (POM), the Five Year Defense Plan (FYDP), and the various Military Personnel, Marine Corps (MPMC) and Operations and Maintenance, Marine Corps (O&M,MC) budget submissions.

The functions of the Programs and Budget Units pertain to the planning, coordination, development and execution of the programs and budgets for the Military Pay, Marine Corps appropriation.

The Programs Unit is responsible for the preparation and adjustment of the Five Year Defense Plan (FYDP), preparation of management reports and calculation of Transients, Trainees, Patients and Prisoners (T2P2) estimates for the outyears of the FYDP. The unit is also the functional sponsor of the Tables of Organization for those Marines who are not assigned to duty within the Marine Corps proper.[3]

The Budget Unit prepares manpower budget estimates and justifications to support Military Pay, Marine Corps (MPMC) appropriation. It develops rates for longevity, dependency and clothing allowances. It manages Manpower's participation in the budget review process conducted by the Department of Navy, Department of Defense, the Executive branch and the Congress. It prepares management reports concerning the status of the current manpower environment.

b. Personnel

The Progams and Budget Units are composed of five officers and three civilian budget analysts. In addition, there is the Head, Plans, Programs and Budget

---

[3]For example, those who are serving with the Department of State or other federal agencies.

Section and the Assistant Section Head. Clerical support is provided by an administrative assistant. The two units, together with the Plans unit comprise the Plans, Programs and Budget Section of the Manpower Policy, Planning, Programming and Budgeting Branch. See Figures 2.2 and 2.3. The Plans unit does not have a requirement for programming or budgeting capability.

The following is a list of personnel presently assigned to the Programming and Budget Units:

1. Force Structure Analyst
2. Operations Budget Officer
3. Programs Officer
4. Program Analyst
5. Officer Budget Officer
6. Officer Budget Analyst
7. Enlisted Budget Officer
8. Enlisted Budget Analyst

These people are supervised by the Head of the Plans, Programs and Budgets Section.

The spaces for all personnel are located in Rcom 4326 of the Navy Annex. The work spaces are extremely crowded. All work and storage spaces are at a premium.

c. Functional Responsibilities

We turn now to a description of the general functional responsibilities of the users. A data flow diagram appears as Figure 3.1. The data flow diagram identifies major processes which MPP-40 performs and depicts the flow of data between them. It is independant of the physical means by which the processes are carried out [Ref. 6: p. 25]. A description of the major processes follows.

(1) Gather Data for Analysis. Gather data from sources such as T/MR, Troop List, Manpower Management System, and Headquarters Marine Corps organizations to include Staff Judge Advocate, Aviation, Training, and Requirements and Programs Departments. Automated reports are a main source if data about personnel. The analyst may have to request special reports or manually reformat data that is received in order to make use of it.

(2) Validate and Store Data and Reports. Store and validate historical data that has been gathered on actual manpower strengths, distribution of grades and years of service, promotions, and related subjects to support manpower plans and prepare manpower budgets. Storage involves all documents produced such as budget proposals, budget submissions, POM initiatives and management reports. Validation may require that data in several reports be cross checked by inspection, manually cross totalling categories, or analyzed based on prior experience for validity. Reporting or data extraction anomalies often cause reports to contain bad data which must be manually corrected. This process normally involves the posting the data to large spreadsheets so that it may be manipulated.

(3) Prepare Reports. Prepare and present management reports concerning strengths, accessions, reenlistments, promotions, losses and manpower costs. Prepare ad hoc reports and briefs on matters of current interest to Manpower officials and senior Headquarters Marine Corps staff. After data has been validated, it must be transcribed again to be put in the proper format for reports. Depending on the report this step usually involves a final transformation when the rough is given to the administrative assistant for word processing.

The section also compiles manpower witness statements for hearings before congressional committees

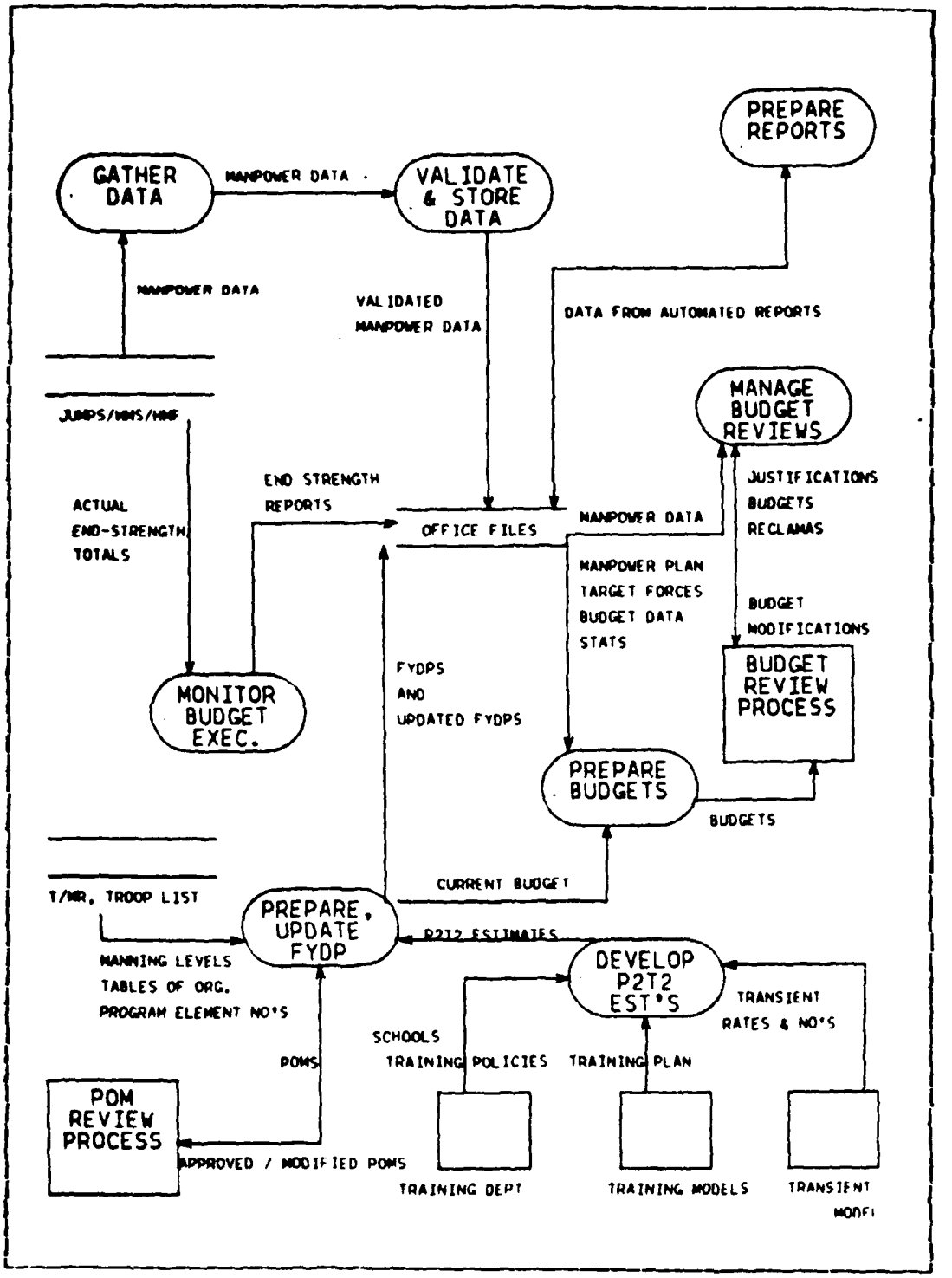


Figure 3.1 Data Flow Diagram of Major Processes

which pertain to military manpower. These are prepared statements for senior officials who must testify.

(4) Prepare Five Year Defense Plan. Current year and outyears of the FYDP are updated based on the approved PCM initiatives. Estimated manyears are broken down by defense program numbers for each of the five years of the FYDP. In addition, the Individuals account is detailed to show the projected manyears for Patients, Prisoners, Transients and Trainees. Changes in the FYDP outyears due to modifications stemming from the POM process are made.

(5) Prepare Budgets. Budget estimates are prepared and submitted throughout the year. They are submitted to the Navy, Department of Defense and Office of Management and Budget. Changes directed by these approval authorities are made by MPP-40. Budget preparation includes the supporting documentation required as background and substantiation by the approval authorities. Manpower plans for Officers and Enlisted which project promotions, accessions and releases, the FYDP, and projected manning levels are used to prepare the manpower budgets. They also develop clothing allowance estimates based on clothing costs and estimated enlisted manyears. The costs of Special Duty pays for certain skills and hazardous duty is also budgeted here.

(6) Manage Manpower Budget Review Process. MPP-40 manages the Manpower Department participation in the MPMC budget review process conducted by the Department of Navy, the Department of Defense, and the Congress, to include coordination of Marine Corps appeals and responses to Program Budget Decisions and Congressional inquiries and decisions when manpower issues are involved. Responses to proposed program or budget cuts are called reclamas. Program Budget Decisions must be answered immediately to

avoid loss of funding. They require the preparation of substantiating information concerning the effects of the proposed cuts. Data for reclamas must be gathered, prepared and staffed through the Headquarters in a matter of hours to meet the required deadlines. The reclama is ordinarily the last chance the Marine Corps has to document the need for manpower funding.

(7) Monitor Budget Execution. Monitor and review the execution of manpower programs and the MPMC budget. Actual by grade strengths and promotion plans are monitored on a monthly basis to ensure compliance with Marine Corps plans and legal end strength ceilings.* They also monitor the accession and release of officers and enlisted Marines to ensure that plans and quotas are met.

(8) Develop T2P2 Account Data. Prepare estimates and monitor actual experience for the P2T2 accounts. Information is gathered from several sources. The Training Department supplies school seat availability data an projections on the seat usage rate. Information on the characteristics of the transient population is developed from historical averages. The Recruit Training Model supplies data on the planned number and location of recruits who will be sent to schools from boot camp. In addition, summary data concerning Transient and Trainee statistics is available from automated reports. From summary data, weighted averaging is used to distribute the costs across grades. Subjective judgment is used to project the future amounts of the T2P2 account based on proposed changes in Manpower policies which would affect the Transient and Trainee populations.

---

*These limits apply to aggregate and to geographical limits on manpower end-strength ceilings.

d. Hierarchical Structure

Figure 3.2 shows the hierarchical relationships of the functions of MPP-40 which have been identified. In this view, the emphasis is on understanding which functions are subordinate in a logical way to other functions. We begin to see the initial structure of the functions on a high level of abstraction. The designer can use this tool and the data flow diagram to verify the view of the system developed thus far with the user. The user can identify and validate the description of the system from the narrative and the graphical representations.

e. Equipment Available

Primarily, the section uses desk top calculators as the primary aide for analysis. Occasionally, a Hewlett-Packard minicomputer is used to produce the detailed listing of the Five Year Defense Plan and some presentation graphics. Two IBM Personal Computers are presently available to the section. The personal computers are able to access and download files from the Headquarters Master File (HMF) at the Marine Corps Central Design and Programming Activity (MCCDPA) in Quantico, VA.

f. Inputs

The programming and budgeting process for the Manpower Department is a complex exercise involving many different activities and sources of information. Many of the flows of the data are not rigidly structured or easily categorized in time phases, chronology or content. A list of inputs is contained in Table 1. Because of the time-phased nature of the POM process some outputs are also used as inputs. For example, the near term years of the Five Year Defense Plan (an output) are used as inputs for budget preparation.

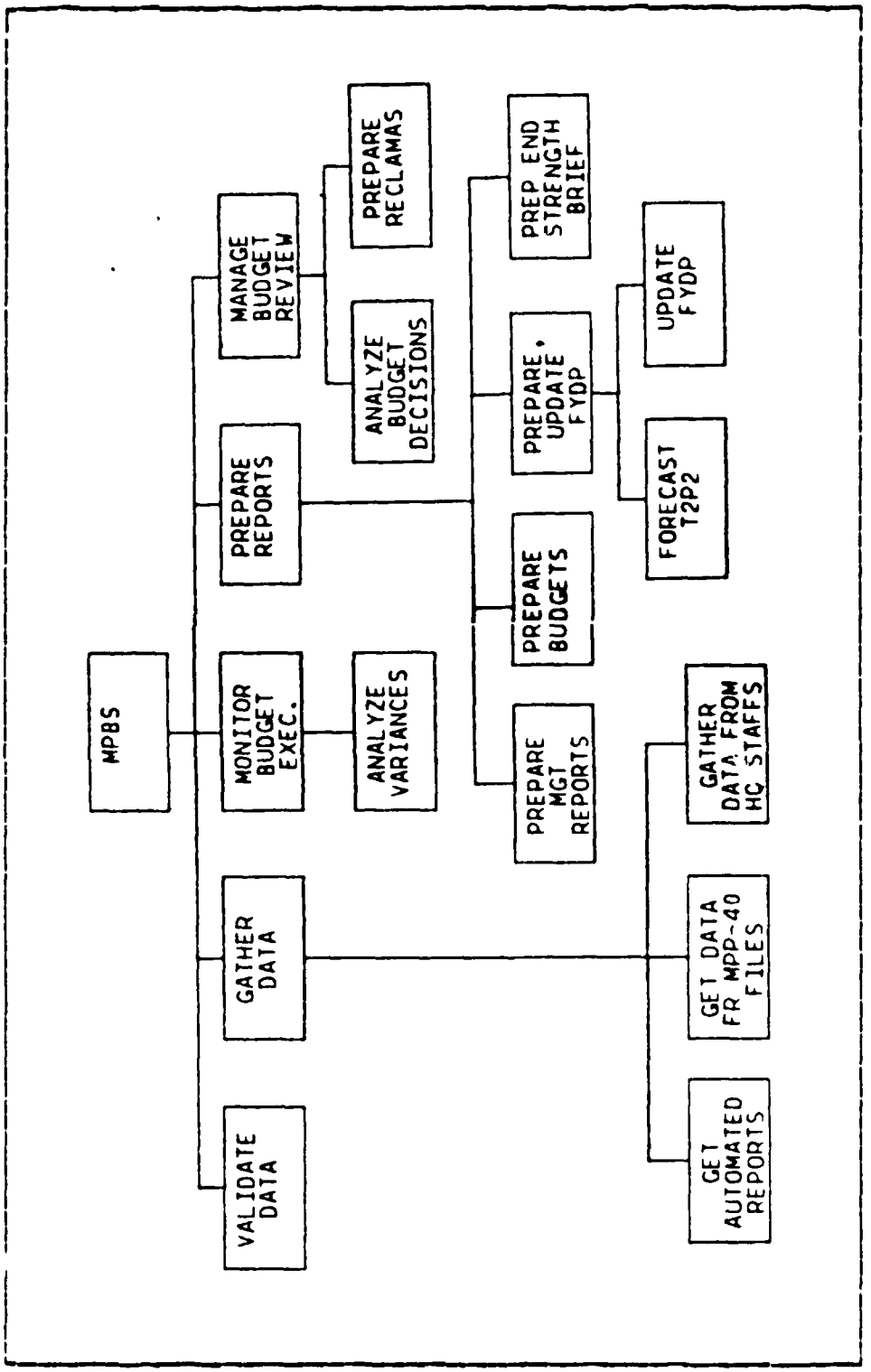


Figure 3.2 Functional Hierarchy of the Present System

TABLE 1

Inputs to the Programming and Budgeting Process

SOURCE	DESCRIPTION
JUMPS/MMS	Manpower Data about individuals
TMR and Troop List	T/O, Manning, Structure data
Transient Flow Model	Transient Line Projections
NAVCOMPT,DoD	Programs targeted for reduction by NAVCOMPT, DcD, OMB
POM Process	Programs, initiatives which have an impact on the MPMC and O&MMC Appropriations
FYDP	Near term years provide manyear base from which budgets, POMs are prepared
Manpower Plan	Used to set goals for USMC manpower levels

(1) Table of Manpower Requirements (T/MR). At present MPP-40 receives periodic reports from the T/MR system. These reports are in hard copy. They contain the organizations within the Marine Corps, their Program Element Numbers (a unique number which identifies a unit to a specific defense program), geographic location codes, and Table of Organization data. The reports are produced in a variety of sorted listings by PEN numbers, combat units and non-combat units, etc. The sections use the Table of Manpower Requirements and Troop List to prepare the FYDP and the Defense Manpower Requirements Report. It should be noted that the T/MR and Troop List Systems are currently

being enhanced and re-designed to provide flexible on-line access to current changes in their databases.

(2) Troop List. This is maintained by the Requirements and Programs Division (R&P). It contains the levels at which the various Tables of Organization will be manned for the current year and the following five years. It is updated annually through the POM process.

(3) HMF and MMS. The units use various extractions from the Headquarters Master File (HMF) and the Manpower Management System (MMS) in preparation of statistics, reports, analyses and budgets. Extensive verification, transcription and preparation of the reports must be performed by budget analysts before they can be used. They must be cross-checked manually with other reports or validated based on the analysts' knowledge of the actual structure, organization, or reliability of the input. The data pertain to specific information connected with personnel transactions of all individual marines. All data concerning a marine is reported to MMS and is posted to an electronic personnel record.

(4) Historical Data. Because of the long range emphasis of the PPBS, data from prior and current year budgets, FYDPs and actual manpower statistics are used when when preparing current proposals and budgets. This historical data is stored in files in the MPP-40 workspaces as hardcopy reports and manual spreadsheets.

(5) Training Division. Information on school seat availability and the school outputs is used.

(6) Staff Judge Advocate. Information on education and numbers of lawyers on active duty are verified with this office.

g. Outputs

Nearly all the outputs of the present system are manually prepared in hardcopy form. For the most part, the information in the reports is manually verified by Structure and Budget Analysts for accuracy and validity. See Table 2. The reports discussed in the following paragraphs constitute a major effort of the analysts on a monthly basis.

TABLE 2
Outputs of the Manpower Programming and Budgeting System

Name	Frequency	Submitted to
FYDP	3 / year	Commandant, NAVCOMPT, DoD, OMB
Budgets	3 / year	NAVCOMPT, DoD, OMB, Congress
Budget Documentation	3 / year	NAVCOMPT, DoD, OMB, Congress
Management Reports	monthly	SecNav, SecDef, Congress
Congressional Witness Stmts	as req'd	Senior HQMC officials

(1) Five Year Defense Plan (FYDP). This a planning document which contains all units in the Marine Corps and their planned level of manning for the next five years in units of manyears. It also contains overhead accounts for manyear acccunting for those marines who are not chargeable to a unit, i.e., Patients, Prisoners, Trainees and Transients.

The preparation and submission of the FYDP is coordinated and adjusted by the Programs section. It is prepared on an annual basis and is updated three times per year as a result of the budget submission process.

(2) Budgets. Manpower budgets are prepared for up to four budget years at a time: the present year and three years in the future. Budgets are submitted three times during the year. They are submitted to the Comptroller of the Navy (NAVCOMPT budget submission), Office of the Secretary of Defense (OSD budget submission) and Office of Management of Budget (OMB).

(3) Budget Documentation. Standard backup data must be prepared for all budget submissions justifying areas of special interest such as special pays, dependency information, enlistment and reenlistment bonuses and civilian and military clothing allowances.

(4) Management Reports. The section produces over ninety reports on a monthly, quarterly, semi-annual and annual basis. A discussion of the most significant reports in terms of mission importance, difficulty and preparation time is included here.

Officer Accessions and Attrition by Grade. This report is prepared monthly. The source of data is an extraction from the MMS data base. The report requires extensive manual audit and purification. It is estimated that the report requires, on average, three man days to prepare.

Monthly End Strength Report. Automated reports on Marine Corps end strength must be carefully cross-checked by various categories to ensure accuracy. This is due to the limit on annual end strengths set by Congress. The data are used for the monthly end strength brief given to the head of the Manpower Department and to the Assistant Commandant.

Location by Country Report. This monthly report is sent to the OSD, NAVCOMPT and SECNAV. Due to ceilings imposed by congress on the numbers of Marines allowed in certain countries, this report must be carefully prepared and cross-checked. Automated reports are verified with reports from sponsors at Headquarters, and unit deployment schedules about the location and latest assignment of individual Marines and units. This report requires approximately 1.5 weeks to prepare.

Civilian Education Report. This monthly report requires an automated MMS extraction to be manually updated based on input from functional sponsors at Headquarters who have contradictory or more reliable data than the report.

Turbulence Report. The analyst calculates a cohort attrition factor on an monthly basis. The process involves transcription of data to a spreadsheet and calculation of attrition factors for cohorts. The process takes approximately three days per month.

Dependency Reports. Data from MMS extraction is applied to spreadsheets to determine by-grade dependency information.

Longevity Reports. MMS extraction provides data which is transferred to spreadsheets for consolidation and analysis. Average length of service for all pay grades is calculated.

Reports for the Commandant. Information of personal interest to the Commandant is gathered on such areas as end strengths, recruiting, accessions, Women Marines, reenlistments, minorities and others as required.

Reenlistments and Retention Rates. This information is calculated by budget analysts from file extractions and used for budget estimation purposes. It is done by occupational field and pay grade.

Expiration of Active Service by Grades. The automated reports which are received contain this data in various forms. The reports are cross checked for validity. This is an aging process that verifies the number of enlisted marines whose contract will expire in the coming six months.

Promotions by Grade. Reports from MMS which detail the promotion of marines are cross checked manually. A spreadsheet which details the gains and losses at each grade due to promotions is updated. Transition rates are calculated and totals are cross footed to ensure that grades are in balance (generally, total promoted is a total promotion gain for the next grade).This reports requires approximately one week per month.

Gross Loss Data by Grade. Loss data from other spreadsheets and reports is posted to this summary spreadsheet. Values are cross totalled to ensure that all losses are accounted for.

Non-EAS Attritions by Grade. Automated reports are verified and posted to a spreadsheet which details losses which are do to reasons other than the expiration of the marines legal obligation to serve.

Women Marine Reenlistments. Reports containing information about reenlistments by women marines are posted to a spreadsheet. A report is sent to the Department of Defense annually. The statistics are used internally by the Marine Corps to monitor the women population.

Other Reports. Most other reports which MPP-40 produces are variants of those discussed above. They are, generally, quarterly or semi-annual summaries of monthly reports. Others are reports which contain information already retrieved, calculated, or verified and present it in different formats according.

3. Problem Description

There is an excessive amount of redundant manual labor done by analysts and action officers to re-format and validate data from automated files in a usable form. Manual spreadsheets are used to reorganize data taken from computer printouts. Data is not received in forms that are useful to analysts.

There is no facility to quickly and easily sort, compare and verify data that is received from automated files. All these activities are done by organizing the data on the spreadsheets. It is difficult and time-consuming to put data in different forms.

The numerous statistical reports which must be compiled require excessive manual transcription. Because statistics are kept on manually prepared spreadsheets, there is no convenient method to gather historical data for inquiries or trend analysis. Monthly actual manpower numbers must be gathered by a cumbersome manual process.

There is inadequate storage space for statistical reports and all reports and working papers.

The method which must be used to gather actual statistics about the T2P2 account is unreliable and time consuming. There is no method to develop accurate estimates for outyear T2P2 account amounts on a by grade, occupational specialty basis.

This method is not suitable because it does not allow the analyst to objectively consider the impact of policy changes on the overhead acccunt. In peace time, the Patients and Prisoners remain stable and are easily and reliably tracked through the automated personnel system. However, the Transients and Trainees data is much more difficult to measure. There are no methods at present to capture the information to the level of detail needed. Data

must be available down to the level where sources and destinations, durations and type of move, the specialty and grade of the member may be captured.

With this level of detail it will be possible to develop meaningful flow rates for various move categories. In addition, the impact of policy changes may be assessed. For example, the impact that a new school requirement for enlisted artillerymen of grades E-7 and above which would be located at Fort Sill, Oklahoma could be assessed. The cost in additional training man years, transient time manyears and permanent change of station funds could be predicted. At present, there is no way to to this.

Present methods of data extraction are not responsive to changing nature of user requirements. The present system of inflexible batch-oriented report production requires users to do excessive manual manipulation of data. Reports cannot be changed without a major effort. Analysts cannot charge formats, sort keys or specify new report extraction parameters without seeking assistance from outside to have the new report programmed.

The present batch-mode, manual labor intensive methods will not provide adequate service since two primary sources of data, T/MR and Troop List, are being enhanced to provide interactive processing. The manual preparation of data and reports will be counterproductive. The full potential benefits of these latter systems will not be gained.

C. REQUIRED CAPABILITIES

The new system should provide at a minimum:

1. A method to quickly, flexibly access MMS and HMF files and to edit and validate the information that they contain
2. A method to efficiently and reliably determine actual monthly manpower statistics.

3. The ability to produce required reports without redundant manual and automated processing.

4. Appropriate storage of historical data for ease of retrieval and physical security.

5. A method to easily explore the program and budgetary impact of management options in force structure or man years, i. e., what if capabilities.

6. A method to forecast the overhead accounts of Transients, Trainees, Patients and Prisoners.

7. A facility to interface to the NHPS/NHBS when it becomes operational.

1. Organizational Structure

The system will operate within the organizational structure of the Manpower Department. See Figure 2.2.

The users of the system will be the Program and Budget Units of the Plans, Programs and Budget Section, Manpower Programs, Plans and Policy Division, Manpower Department. See Figure 2.3.

2. Interface with Other Systems

There are several automated systems currently being developed which will provide inputs to the system or which will require outputs from the system. The following are Headquarters Marine Corps sponsored systems:

1. Officer Planning System (OPS)
2. Enlisted Planning System (EPS)
3. Automated Troop List
4. Table of Manpower Requirements (T/MR)
5. Transient Flow Model

These are batch process systems which provide hardcopy listings of Tables of Organization, unit strengths, and projected levels of personnel. They are being enhanced to provide on-line inquiry, update, and query processing capabilities. The final product will be a redesign of the systems to provide more reliable and flexible information.

The Marine Corps has decided to participate in the design and implementation of two Navy systems, Navy Headquarters Programming System and Navy Headquarters Budgeting System (NHPS/NHBS) [Ref. 7]. The systems are early in the concept development phase. It is not possible to define system interfaces at this point. There is a need to address interface requirements to support Marine Corps participation in these systems at the earliest possible date.

It is not clear at this time to what extent Marine Corps reporting requirements will be changed. The Navy system is targeted to address mainly the automated reporting of budget data to NAVCOMPT and not internal support of collection, analysis, and preparation of data. The system is scheduled for contract negotiation of detailed design and implementation in late 1985. After this, precise interface requirements will be available.

3. Operating Environment

The operating environment for the system is strictly a garrison configuration. There is no requirement for capability to deploy aboard ship or to any other location. Either Marine Corps owned computers or a time sharing service will be used to provide the processing support for the system.

4. Communications Requirements

Detailed communications requirements cannot be addressed at this point in project development. Possible requirements could involve local area network configuration and data link communication to a mainframe computer at a remote site using telephone lines. There is no requirement identified now for access to wide area networks such as the Defense Data Network or the Marine Corps Data Network.

Existing commercial facilities for transmission and switching will be used.

Data to be exchanged would be file extractions from data bases such as MMS and HMF. It is likely that data exchanges would occur at least daily between mainframe and microcomputers, and between microcomputers.

5. Classification

There has been no requirement identified for secure data handling.

6. Performance Requirements

To be useful and acceptable the system must provide the ability to perform those manual processes which now require excessive amounts of time and effort. Report generation and data validation should be able to be accomplished in minutes instead of the delays of days now experienced for report preparation and manual validation.

The system must be accessible to the users and allow flexibility in decision option investigation. They should not have to leave the workspace to perform all facets of data handling, analysis and report generation.

The system should provide the capability to request ad hoc reports from MMS. An acceptable turn-around time would not exceed two hours.

Quality and accuracy of the P2T2 estimates should be measurable against actual experience to measure performance of the estimating process.

More quantitative performance criteria will be defined during subsequent phases of the system development process.

7. Requirements for Backup Capability

Due to the critical nature of the time sensitive programming and budgeting process there must be a provision for alternate processing in case of system failure. This backup capability will be provided through the manual processes presently used. Reliability of vendors and timely maintenance support should be a consideration in the selection process of equipment.

D. VALIDATION OF USER REQUIREMENTS

The manpower resource under any circumstance is a critical one. The Marine Corps is facing a harsh manpower environment for the rest of the decade as the available pool of eligible recruits begins to shrink. Manpower will become an even more scarce resource which will require the application of the most sophisticated tools at the disposal of the Corps.

Because of increasing pressure for federal fiscal restraint, the need for effective manpower management and planning tools becomes vital. Oversight by executive agencies and the Congress can only be expected to intensify in this atmosphere. This will require advanced management tools to keep pace with increasing reporting and analysis requirements.

The present system provides minimum level of utility at a great effort level. It will not meet the more sophisticated data management, reporting, and analysis requirements that will be encountered in an environment of dwindling manpower resources and tightening fiscal controls. An enhanced system with the capabilities described in this requirements statement will be necessary to meet the challenge. In order for the Marine Corps to effectively manage its manpower assets, compete in the manpower resource

market and the increasingly restrictive budget arena, it must have at its disposal every means with which to justify and defend programs and acquire resources to carry out its mission.

IV. FEASIBILITY STUDY

A. GENERAL

The purposes of the feasibility study are to identify alternative approaches tc satisfy the user needs set forth in the Requirements Statement and identify approaches which are operationally and technically feasible.

This feasibility study presents the results of the analysis of alternative approaches to satisfy user requirements which were set forth in the Requirements Statement for the Manpower Programming and Budgeting System (MPBS).

Figure 4.1 below shows the alternative approaches which have been evaluated as possible solutions to the problems outlined in the MENS.

Alternative 1 =>	Distributed Processing. Automated system using a combination of mainframe and personal computers.
Alternative 2 =>	Centralized Processing. Automated system using a mainframe.
Alternative 3 =>	Distributed Processing with Network. Same as Alternative 1, with personal computers networked.
Alternative 4 =>	Existing System. Manual-oriented processing system.

Figure 4.1 Alternatives to be Evaluated

This feasibility study includes the following information:

1. A description of the alternatives recommended for further analysis.

2. A description of the existing system.
3. Discussion of the benefits of the technically and operationally feasible alternatives.
4. Discussion of the basis for selecting the preferred alternatives.

1. Problem and User Requirements

See the Mission Element Need Statement (MENS) and Requirements Statement for the MPBS for discussion of the problem and user requirements.

2. AIS Guidelines and Constraints

During the development of the MPBS, the design must reflect the projected requirements of systems being developed by the Department of the Navy. The Navy Headquarters Programming System (NHPS) and Navy Headquarters Budgeting System (NHBS) are currently early in the concept development stage. It is not known when specific interface specifications will be available. Design of the MPBS should attempt to reduce duplication of effort and hardware required in the proposed Navy systems. MPBS should incorporate flexible design to allow for future changes in Navy reporting requirements. It must also also satisfy internal Marine Corps manpower planning and budgeting requirements.

3. System Title

On approval of the Feasibility Study the title of the system will be the Manpower Planning Programming and Budgeting System (MPBS) [Ref. 5: p. 1].

B. FEASIBLE ALTERNATIVES

It is recommended that the alternatives described in this section be developed conceptually and analyzed as approaches to satisfy the user requirements specified in the MENS MPBS. These alternatives were selected from among four. The alternative that was not selected is discussed functionally under Other Alternative in this chapter.

The feasible alternatives are listed in Figure 4.2.

Alternative 1 =>	Distributed Processing. Automated system using a combination of mainframe and personal computers.
Alternative 2 =>	Centralized Processing. Automated system using a mainframe.
Alternative 3 =>	Distributed Processing with Network. Same as Alternative 1, with personal computers networked.

Figure 4.2 Feasible Alternatives

1. Description of Alternative 1

This is a combination of microcomputer and mainframe processors. Each type of machine is tasked with performing jobs to which it is best suited. This allows flexibility and efficient use of resources. Figure 4.3 shows a simplified view of how such a system would be configured.

The inputs for this alternative are shown in Figure 1 and are discussed in Chapter II.

The outputs for this alternative are shown in Figure 2. They are discussed in Chapter II.

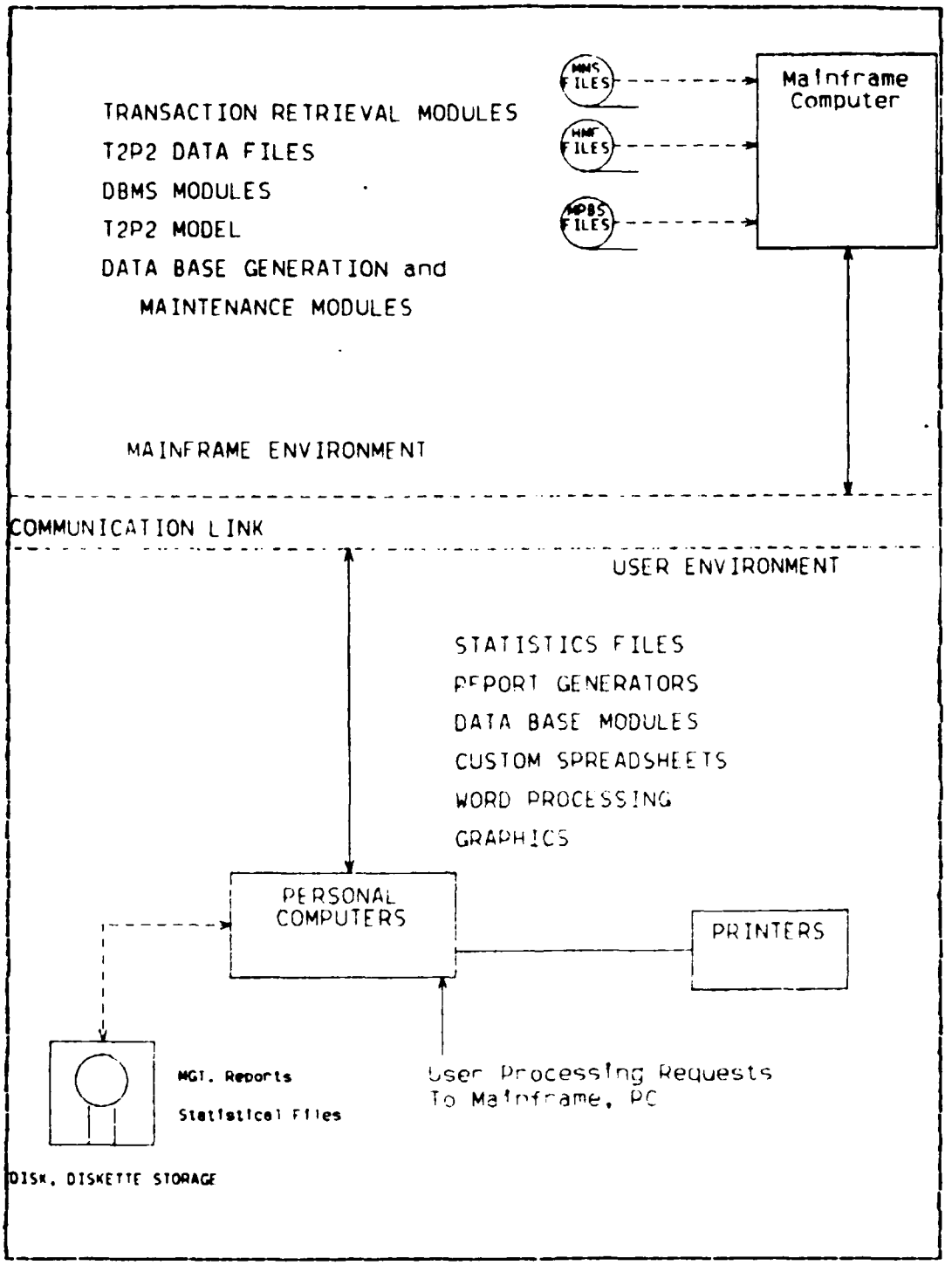


Figure 4.3 System Configuration for Alternative 1: Distributed Processing.

a. Software

For the microcomputer based portions, authorization will be requested to use widely accepted integrated software systems functionally equivalent to Lotus Corporation's Symphony, Ashton-Tate's dBase series of software, and a widely used microcomputer based language such as BASIC or Pascal. Word processing would be accomplished through either an integrated software package or a separate commercial word processing program. Software for mainframe applications will be a written in a Department of Defense approved high level language. Software support for this alternative consists of the following general requirements.

1. Interactive data entry sessions to accept user requests for data storage, retrieval and manipulation.
2. Interactive input sessions to accept user input of parameters for jobs which will be required to be run on a mainframe.
3. A mathematic projection model to forecast transients, trainees, patients and prisoners (T2P2) rates and dollar costs based on user supplied assumptions.
4. File maintenance and interface programs to build required mainframe and microcomputer files which will be used by the modelling program, data base management programs, and automated spreadsheet programs.
5. Transaction retrieval software to gather data concerning the characteristics of Marines in a transient, trainee, patient or prisoner status.
6. Computation and automated spreadsheet programs to prepare management reports, budget submissions, Five Year Defense Plans, etc.
7. Report formatting programs to produce required reports (budgets, POMs, FYDPs, and ad hoc reports).
8. Graphics software to allow users to prepare regular and special graphical analyses with little special training.
9. Word processing software to reduce repetitive drafting and retyping of reports and correspondence.

b. Equipment

Four microccmputers with the following characteristics will be required fcr this alternative:

1. 512K byte Random Access Memcry (RAM)
2. 10 Megabyte internal hard disk drive
3. 360K byte floppy disk drive
4. Monochrome monitor
5. Graphics capability
6. Dot matrix printer
7. Bisynchronous Communications Adapter

There are two options for mainframe processors which could be used by the system. The first is the mainframe processor at the Central Design and Programming Activity, Quantico, Virginia. It is an AMDAHL V/7 series 4 which operates under the TSO (Time Sharing Option) operating system. The second is the Control Data Corporation (CDC) Cybernet System located in Rockville, Maryland, which operates under Network Operating System (NOS).

Leased communications lines to CDPA, Quantico, VA. or CDC, Rockville, Maryland, as applicable will be required to support communications from the personal computers to the mainframe.

2. Description of Alternative 2

This alternative uses a single mainframe processor. The AMDAHL 470 V/7 at the MCCDPA, Quantico, VA or the CDC Cybernet System in Rockville, Maryland are the likely hosts. All significant processing will be performed on the mainframe computer. Users will access the system through direct connected video terminals located in their workspaces. Processing will be a combination of batch and interactive modes. File processing and mathematical forecasting will be done in batch for increased efficiency.

User interfaces will be in interactive mode for requesting reports and processing. Figure 4.4 is a high level view of the basic system configuration.

a. Inputs and Outputs

The inputs and outputs for this alternative are found in Table 1 and Table 2 and are discussed in Chapter II.

b. Software

Word processing would be accomplished through the present stand alone system. Software for mainframe applications will be a written in a Department of Defense approved high level language. Software support for this alternative consists of the following general requirements.

1. Interactive data entry sessions to accept user requests for data storage, retrieval and manipulation.
2. Interactive input sessions to accept user input of parameters for jobs which to be run on the mainframe.
3. A mathematic projection model to forecast transients, trainees, patients and prisoners (T2P2) rates and dollar costs based on user supplied assumptions.
4. File maintenance and interface programs to build required files which will be used by the modelling program and data base management programs.
5. Transaction retrieval software to gather data concerning the characteristics of Marines in a transient, trainee, patient or prisoner status.
6. Report formatting programs to produce required reports (budgets, POMS, FYDPs, and ad hoc reports).

c. Equipment

As in the first alternative there are two options for mainframe processors which could be used by the system. AMDAHL V/7 series 4. at the CDPA, Quantico or the CDC Cybernet System located in Rockville, Maryland.

Leased communications lines to CDPA, Quantico, VA. or CDC, Rockville, Maryland, as required.

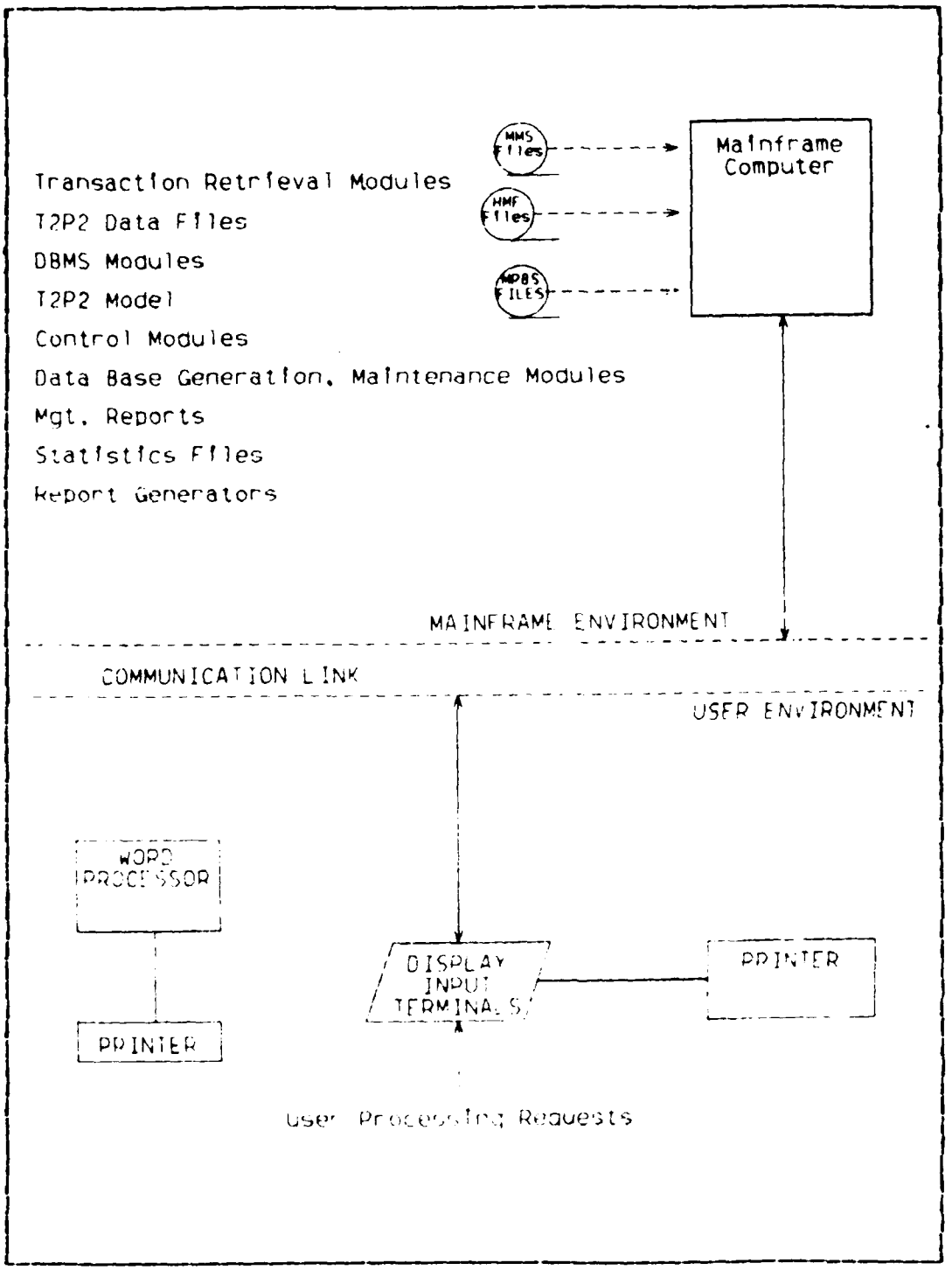


Figure 4.4 System Configuration for Alternative 2 : Centralized Processing.

Three terminal display units of the IBM 32XX series would be required for user interaction.

3. Description of Alternative 3

This alternative is similar to Alternative 1, with tne added capability of a local area network. This feature will allow implementation of an office automation environment within MPP-40. This will allow user to share resources such as printers and fixed disk drives. In addition, this will allow analysts to share data and reports, and access common files on one another's system and on the system's shared disk drive. See Figure 4.5 for a diagram of this configuration. The use of networking technology will enhance the the efficiency and flexibility of administrative functions and allow information to be more easily shared among users.

a. Inputs and outputs

The inputs for this alternative are shown in Table 1 and are discussed in Chapter II.

b. Software

Besides the software required under Alternative 1, commercial network software will be purchased to implement high level network functions such as message handling, error control, network management and network server control.

c. Equipment

Besides to the equipment required in Alternative 1, a network translator, network adapter cards, hook up kits and cables will be required to support the network functions. refblk 15 contains an useful discussion of the hardware and software required for the IBM network.

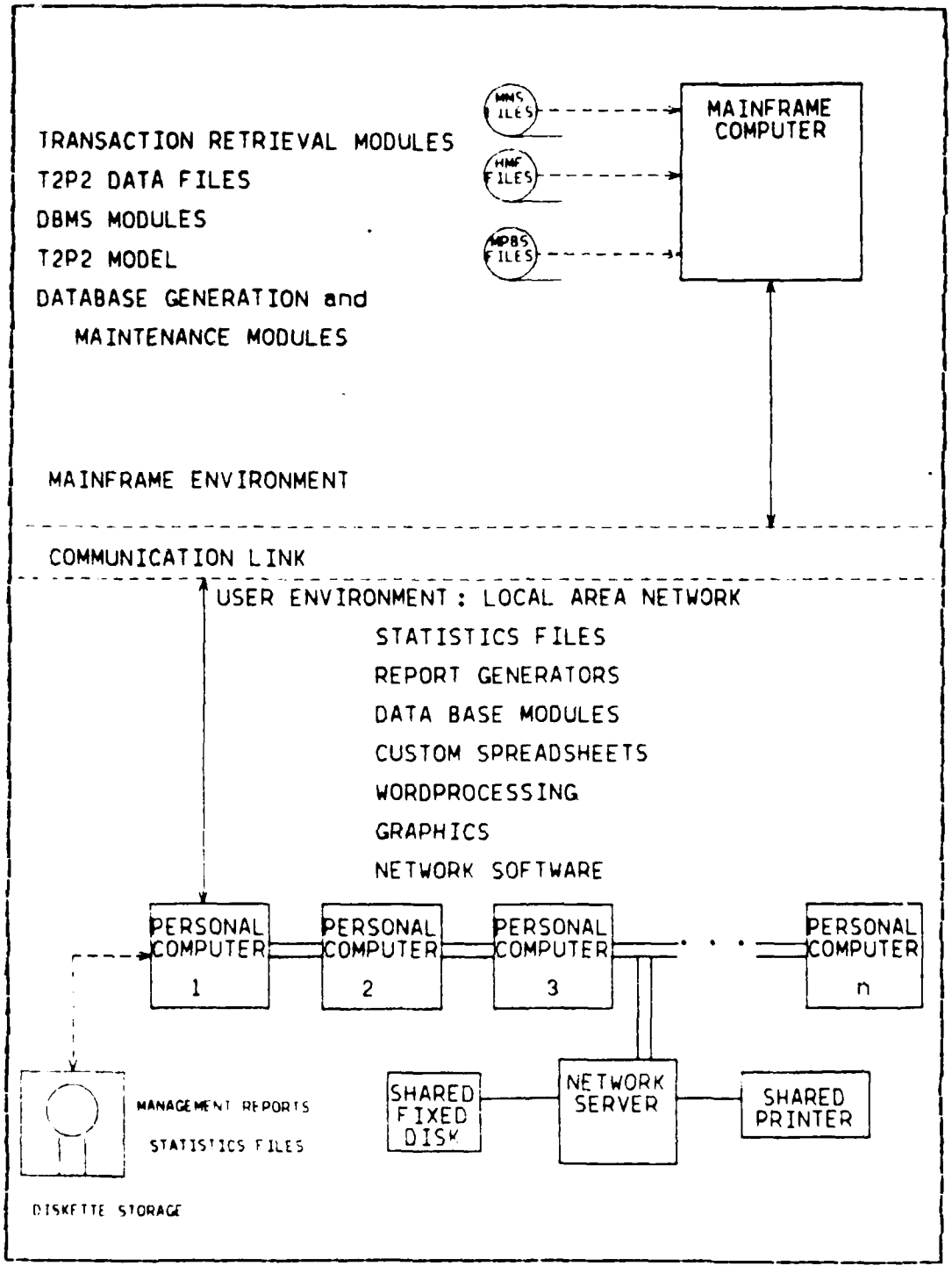


Figure 4.5 System Configuration for Alternative 3: Distributed Processing With local Area Network.

C. OTHER ALTERNATIVES

This section describes the alternatives to satisfy the user requirements specified in the Requirements Statement that were analyzed but not recommended for further development and analysis.

1. Existing System

The following is a high level overview of the functions of the present methods which MPP-40 uses to carry out its mission. Figure 4.6 is a simplified model of existing processing steps.

a. Concept.

Presently most data retrieval and information processing is done manually. Data is transcribed from computer generated listings onto large spreadsheets. From these spreadsheets, analysts organize data, prepare reports and perform analyses. Information for Programming and Budgeting purposes is gathered in this way. This involves much labor intensive reprocessing of automated output because it is not in required formats.

Rates for the Transients and Trainees lines of the Manpower budget are calculated using simple averaging techniques. There is no method for analysts to perform the desired sophisticated studies of future rates.

Manual spreadsheets are stored in file cabinets in cramped workspaces. Because of their size and the number of spreadsheets which must be kept, it is difficult to do statistical or trend analysis on the data. The information kept must be retained indefinitely for future budget analysis. However, the longer it is kept, the more difficult it becomes to extract meaningful information, due to inconsistencies over time in the way the numbers were gathered and calculated and the sheer volume of the data.

Analysts and budget officers must prepare many reports and analyses on a regular basis. They also prepare special reports and studies on request. At present, these are written out longhand, often using transcribed data from the office files. The administrative assistant retypes the information prepared by the analysts in the format required for the occasion, e.g., ad hoc request, routine assorted management reports, budget reclamas, etc.

b. Inputs and Outputs

See Tables 1 and 2 for a summary description of the inputs and outputs of the system.

c. Software

The software used in the present system consists of batch oriented data extraction and report formatting applications used to produce the reports from which the analysts begin their manual processing. Word processing software currently is used on a dedicated wordprocessor by the administrative assistant.

d. Equipment

At present the AMDAHL V/7 series 4 is used to produce the management reports. Word processing is done on a dedicated word processing unit. Graphics are done on a Hewlett-Packard minicomputer shared within the MPP branch.

D. FEASIBILITY DETERMINATION

The purpose of this section is to present the results of analyzing each alternative described above to determine whether it is feasible. The alternatives will be analyzed for operational and technical feasibility.

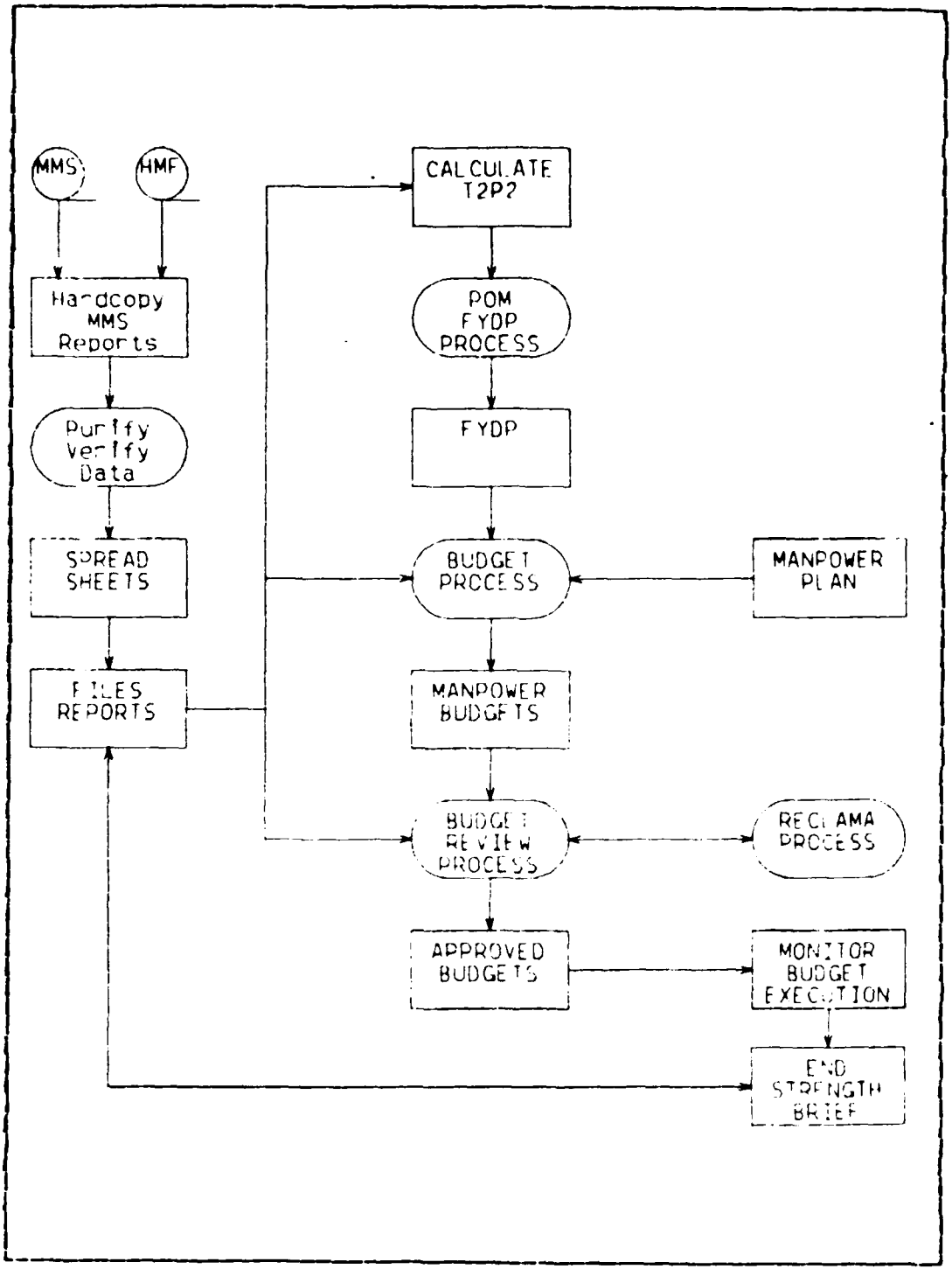


Figure 4.6 System Configuration for Alternative 4: Existing System.

The Marine Corps uses the follcwing definition of feasibility:

> "...feasible suggests what is likely to work or be useful in achieving satisfaction of user requirements." [Ref. 2: p. E-4]

The following is the general criteria which the Marine Corps uses as guidelines when evaluating feasibility:

> "...all aspects of the system should be state-of-the-practice. This includes equipment, software, communications and the means that are used to employ them. The Marine Corps should not be in the information system research and development business. It should not serve as a test bed for unproven technology." [Ref. 2: E-4]

1. Aspects of Technical Feasibility

a. Hardware.

The following are operational and design traits which the hardware must possess to be considered feasible:

1. The hardware used should have sufficient memory capacity and speed to perform the calculations required by the the T2P2 prcjection model.
2. Hardware must have sufficient input and output capacity in order to handle the required data from existing systems.
3. The hardware should have encugh capacity to satisfy throughput requirements. It should be able to produce reports within required time constraints.
4. The hardware must be flexible enough to allow future expansion of processing capacity and peripherals.
5. The hardware must be compatible with existing hardware so that as a minimum, files may be transferred.
6. The hardware must be state-cf-the-practice. It must be a full scale production model, with a record of wide use and acceptance.

b. Software

In order for applicaticns software to be considered feasible they must meet the following criteria:

1. Provide sufficient capabilities to support the required algorithms for construction of complex mathematical models to perfcrm the T2P2 projections.

2. Provide a high level user interface which will allow for a minimum of specialized user knowledge and training.

3. Allow a flexible and simple method to produce regular and special reports.

4. Support the data base and file structure access requirements in existing Marine Corps systems.

5. Allow use of modern structured software design and maintenance techniques.

6. Allow the user to aggregate and view the data in various ways, through data manipulation commands.

7. Provide an acceptable level of accuracy for required computations.

8. Provide for efficient word processing capability.

c. Telecommunications

The proposed system must meet the following requirements:

1. Proposed communications methods for an alternative must use existing communication systems.

2. Telecommunications technology must be reliable and state-of-the-practice.

3. Telecommunications portions of the system must be able to support system perfcrmance requirements. [Ref. 2: p. E-4]

d. System Integration

The proposed system must be able to integrate elements of hardware, software and telecommunications in a low-risk, state-of-the-practice method [Ref. 2: p. E-4].

2. General Operational Feasibility Requirement

This aspect of feasibility involves satisfaction of the user requirements as defined in the MPBS Requirements Statement. They are derived from the criterion that the system must not adversely affect the accomplishment of any mission of the Marine Corps or any of its subdivisions [Ref. 2: p. E-4].

The integration of the system into the local information processing environment must be considered. In addition to satisfying the functional requirements, the alternatives' impacts on the user organization itself must be considered. The following are operational feasibility criteria which will govern the alternatives' evaluation:

1. The alternative must satisfy all functions in the Requirements Statement.
2. The alternative must not adversely affect the present organizational structure of the Manpower Department.
3. The alternative must not require excessive office space.
4. The alternative must not require additional manpower to use or maintain.

E. ANALYSIS OF ALTERNATIVES

The feasible alternatives are:

Alternative 1: Distributed Processing
Alternative 2: Centralized Processing
Alternative 3: Distributed Processing with Network

Each of the alternatives has been evaluated based on the operational and technical feasibility issues above. If an alternative failed any single issue it was considered infeasible and dropped from further consideration [Ref. 2: E-4]. The results of the feasibility determination are summarized in Table 3.

1. Alternative 1: Distributed Processing

This alternative meets all technical and operational feasibility issues. The hardware and software proposed for this alternative are similar to those used in other Marine Corps manpower modeling systems. They are presently

satisfying related functional requirements. The personal computer portion of the alternative involves the use of the widely used personal computer with internal hard-disk and video display terminal. This technology is also widely used throughout the Marine Corps. The integration of these approaches uses a technology which is reasonably mature and common in many office and business data processing operations. The communications systems proposed make use of presently available commercial leased lines. No adverse impact of an organizational nature will occur with this alternative.

2. Alternative 2: Centralized Processing

This alternative meets all technical and operational feasibility issues. The mainframe and communications portions of the proposed method are the same as in Alternative 1. They are presently being used in existing Marine Corps automated manpower systems. This alternative is a variation of Alternative 1. All processing would take place on a mainframe computer. The present word processing equipment would continue to be used.

3. Alternative 3: Distributed Processing with Network

The discussion for this alternative is similar to Alternative 1. Local area network capability meets all operational and technical feasibility criteria.

4. Alternative 4: Existing System

This was determined to be infeasible. The present system does not satisfy the user requirements as outlined in the Requirements Statement for MPBS.

TABLE 3

Summary of Feasibility Analysis

Feasibility Issue	Distributed	Centralized	Distributed Network	Existing
HARDWARE				
Memory capacity for math model	YES	YES	YES	NA
Processing Speed for math model	YES	YES	YES	NA
Input/Output Capacity	YES	YES	YES	NA
Overall Throughput	YES	YES	YES	NA
Expansion Capacity	YES	YES	YES	NA
Ability to retrieve transactions	YES	YES	YES	NO
Reliability	YES	YES	YES	YES
SOFTWARE				
Support Math Model algorithms	YES	YES	YES	NA
High Level User Interface	YES	YES	YES	NO
Flexible report generation	YES	YES	YES	NO
Interface with existing software	YES	YES	YES	NA
Allow Structured design, maintenance	YES	YES	YES	NA
Adequate Applicatcn Software for data handling	YES	YES	YES	NA
Accuracy	YES	YES	YES	NO
Word processing	YES	YES	YES	YES

Table 3

Summary of Feasibility Analysis (cont'd.)

Feasibility Issue	Distributed	Centralized	Distributed Network	Existing
COMMUNICATIONS				
Use existing systems	YES	YES	YES	NA
State-of-the-practice methods	YES	YES	YES	YES
Meet system perfcrmance requirements	YES	YES	YES	NO
System Integration-Standard configuration methods	YES	YES	YES	YES
OPERATIONAL CRITERIA				
Manning	YES	YES	YES	YES
Organizational Structure	YES	YES	YES	YES
Meets all Functional Requirements	YES	YES	YES	NO
Meets space constraints	YES	YES	YES	YES
Additional manpower not required	YES	YES	YES	YES

V. ECONOMIC ANALYSIS

A. INTRODUCTION

This is an economic analysis of the feasible alternatives for the MPBS. Only those alternatives which were recommended in the Feasibility Study will be analyzed in detail. The status quo is not included as it is not considered to be a feasible alternative.

1. Methodology

The analysis of alternatives was conducted using generally accepted economic analysis techniques. [Ref. 8] provides a basis for the general structure of the study.

The software costing portion of the study was done using the Intermediate Constructive Cost Model (COCOMO) developed by Barry W. Boehm. This model estimates the costs, level of development effort and schedule for software projects. It is based on estimates of program size (measured in number of delivered source instructions) and attributes (machine characteristics, type of application, and personnel attributes, to name a few). Estimates of size are based on a high level decomposition of the software product into functional processing subsystems. These subsystems are then sized and rated according to their more narrowly defined functions.

Expected benefits of the system were quantified by weighting them in relative importance. Cost to benefit ratios were calculated for alternatives based on estimates of system costs and anticipated benefits.

A sensitivity analysis was done to ascertain the susceptibility of results to changes in assumptions or the environment.

B. OBJECTIVE

The objectives of the Manpower Programming and Planning System are outlined in the MPBS Requirements Statement. The Requirements Statement contains the functional requirements which must be satisfied by candidate solutions.

The objective of this analysis is to study the feasible alternatives and to determine the most economically justified. This is based on a quantification of costs and benefits associated with a given alternative.

C. ASSUMPTIONS

The following are assumptions and constraints used as the basis for this analysis.

A five year economic life will be used. The discount rate is ten per cent with no differential inflation rate applied [Ref. 8: p. 9-2].

Permission will be obtained to use a language such as BASIC or Pascal for the microcomputer based portions of Alternatives 1 and 3.

Commercially available software for database applications such as Ashton Tate's dBASE III or spreadsheet programs such as Lotus Corporation's Symphony will be used to program a large portion of microcomputer applications.

Contractor support will be used for the detailed design and implementation of the system.

No assumption is made for the source of maintenance labor (i. e., in-house or contractor). For purposes of comparison only, maintenance costs are estimated based on rates for civilian contractors. The source of the maintenance effort would ordinarily be based on the availability, reliability, and level of expertise of in-house versus contractor personnel. We assume that the most cost effective, efficient decision concerning the

source of maintenance labor will be made during the Definition and Design phase. At that time the level of complexity of the project and availability of resources will become more apparent.

Hardware costs are from the latest available General Services Administration (GSA) Schedules [Ref. 10]. Purchased software (off the shelf) applications costs are from the same source.

Mainframe charges are based on commercially available time sharing costs. We recognize that the Central Design and Programming Activity (CDPA), Quantico, Virginia or Control Data Corporation (CDC), Rockville, Maryland may be the actual host site. The analysis will apply an opportunity cost based on commercial charges as if the system were implemented in Quantico.

Direct manpower costs under all alternatives are equal. While we expect there to be an increase in productivity, there are no expected labor savings in manpower costs to the user. Staffing levels under all alternatives will remain at the present levels.

Labor rates used for software estimates vary from $40 to $50 per hour, depending the degree of expertise required [Ref. 11: p. 29], with 152 hours equal to one man month [Ref. 12: p. 59].

1. Sunk Costs

The following items have already been bought or are available to the users. Since they would be available under any alternative, their cost will not be considered in the analysis [Ref. 8: p. 2-5].

Two IBM PC/XT personal computers and one dot matrix printer have already been purchased. They are being used for user written "throw away" programs and report generation. Database and spreadsheet applications were also purchased.

MPP-40 occasionally uses a Hewlett-Packard minicomputer, located in an adjacent office to do reports and graphics generation. This cost will not be considered.

MPP-40 presently has a stand alone wordprocessor, which is used mainly by the administrative assistant. Its cost will be not be considered in the analysis.

The investment costs associated with the computer operations center at the CDPA, Quartico will not be considered.

D. ALTERNATIVES

The alternatives to be evaluated are:

Alternative 1:	Distributed Processing
Alternative 2:	Centralized Processing
Alternative 3:	Distributed Network

A description of the characteristics and capabilities of the alternatives to be evaluated is contained in the Feasibility Study portion of this study.

E. COST ANALYSIS

1. Background

Costs for this analysis are divided into recurring and non-recurring categories [Ref. 8: p. 2-3]. Some costs of the system to be implemented will not be included in the analysis. These are the sunk costs of existing hardware and software and other capabilities which have already been purchased for MPP-40 or are already available. These items were discussed above under Sunk Costs.

Concerning the number of personal computers, we will use the number which must be purchased besides the two already installed. To arrive at the actual number available to users for a given alternative, the two computers presently owned must be added to the numbers we use.

Undiscounted life cycle costs for each alternative are summarized in Tables 4 through 6.

Detailed breakdowns for each alternative by category of expense are contained in subsequent tables. Discussion of costs for each alternative follows.

2. Non-recurring Costs

Non-recurring costs are those costs which may be expected to be incurred only one time, usually at the initiation of the system development life cycle.

a. Equipment Purchases

Depending on the alternative, up to four complete workstation configurations will be required. In addition, at least one draft quality printer (dot matrix), a printer with graphics capability and a letter quality printer will be required. Each workstation will require communications and serial input-output capability.

(1) Alternative 1. This alternative uses a combination of personal computers and a mainframe computer. Investment costs for this alternative are for the microcomputers only. No new mainframe equipment will need to be purchased. Either the Marine Corps owned computer at the CDPA, Quantico or a time sharing service (CDC) will be used.

TABLE 4

Undiscounted Costs: Alternative 1

COST ELEMENT	FY 86	FY87	FY88	FY89	FY90	FY91	COST
Nonrecurring Costs							
Hardware	$ 19,582						$ 19,582
Software	5,820						5,820
Software Development	218,000						218,000
Mainframe Dev. Chgs.	15,990						15,990
Recurring Costs							
Software Maint.	0	23,500	23,500	23,500	23,500	23,500	117,500
Mainframe Chgs.	0	10,908	10,908	10,908	10,908	10,908	54,540
Total	$ 259,392	34,408	34,408	34,408	34,408	34,408	$ 431,432

TABLE 5

Undiscounted Costs: Alternative 2

COST ELEMENT	FY 86	FY87	FY88	FY89	FY90	FY91	COST
Nonrecurring Costs							
Hardware	$ 7,350						$ 7,350
Software	0						0
Software development	188,000						188,000
Mainframe dev. chgs.	21,077						21,077
Recurring Costs							
Software Maint		18,000	18,000	18,000	18,000	18,000	90,000
Mainframe Charges		17,448	17,448	17,448	17,448	17,448	87,240
Total	$ 216,427	35,448	35,448	35,448	35,448	35,444	$ 393,667

TABLE 6

Undiscounted Costs: Alternative 3

COST ELEMENT	FY 86	FY87	FY88	FY89	FY90	FY91	TOTAL COST
Nonrecurring Costs							
Hardware	$ 23,477						$ 23,477
Software	6,500						6,500
Software development	218,000						218,000
Mainframe dev. chgs	15,990						15,990
Recurring Costs							
Software Maint.	0	23,500	23,500	23,500	23,500	23,500	117,500
Mainframe Charges	0	10,908	10,908	10,908	10,908	10,908	54,540
Total	$ 263,967	34,408	34,408	34,408	34,408	34,408	436,007

A total of four additional personal computers will be required. Equipment costs are detailed in Table 7.

TABLE 7

Hardware and Software Costs for Alternative 1

	COST	QUANTITY	TOTAL COST
Hardware			
IBM PC XT	$ 2,992	4	$ 11,968
IBM PC	1,800	0	0
Expansion Option	185	4	740
64Kb Memory	70	16	1,120
Monitor	192	4	768
Graphics Adapter	175	4	700
32XX Emulator	490	3	1,470
Printer Adapter	171	4	684
Cables, misc	150	4	600
Graphics Printer	332	1	332
Matrix Printer	300	4	1,200
Total Equipment Cost			$ 19,582
Software			
Spreadsheet	$ 450	4	$ 1,800
Database	490	4	1,960
Wordprocessing	350	4	1,400
DOS 2.1	40	4	160
Compilers	200	1	200
Programming Aides	50	6	300
Total Software Cost			$ 5,820
Total System Cost			$ 25,402

(2) Alternative 2. This alternative will not require purchase of processors. However, terminal devices will need to be used for data entry and system operation. Also, a printer will be required. See Table 8 for a summary of equipment costs.

(3) Alternative 3. This alternative is similar to alternative 1. Here, however, the personal computers will be networked to provide an office automation

TABLE 8

Hardware and Software Costs for Alternative 2

Hardware	COST	QUANTITY	TOTAL COST
IBM 32XX Terminal	2,000	3	6,000
Installation charges	250	3	750
Total Hardware Cost			$ 7,350

environment. The same number of personal computers will be required as in Alternative 1. However, they will not all need to be IBM/XT or the equivalent. This is because the network will allow sharing of a fixed disk and printer by several users. In addition, network hardware will be required for all personal computers. See Table 9 for a summary of hardware and software costs associated with this alternative. IBM retail prices for network hardware and software were used [Ref. 15: pp. 1-6]. GSA prices were not available.

b. Software purchases

Besides the required operating system software for each new workstation, other software will be needed for development of applications. Under this category, only that software actually purchased outright is included. Custom software development and programming costs are discussed below under Software Development Cost Estimates.

(1) Alternative 1. Electronic spreadsheet, database software, language compilers and software development tools and wordprocessing software will be purchased. These will be used only for the microcomputer

TABLE 9

Hardware and Software Costs for Alternative 3

	PRICE	QUANTITY	TOTAL COST
Hardware			
IBM PC XT	$ 2,992	2	$ 5,984
IBM PC	1,800	2	3,600
50Mb Disk	1,000	1	1,000
64K memory	70	22	1,540
Monitor	192	4	768
Expansion Option	185	4	740
BSync Adapter	168	3	504
Graphics Adapter	175	4	700
32XX Emulator	490	3	1,470
Printer Adapter	171	4	684
Cables misc	250	4	1,000
Graphics Printer	314	1	314
Network Hardware			
PC Net Adapter	695	6	4,170
Net Translator	595	1	595
Cable Kit	39	6	234
Cable, 25 ft. ea.	29	6	174
Total Hardware Cost			$ 23,477
Software			
Network Software	$ 75	6	$ 450
Spreadsheet	450	4	1,800
Database	490	4	1,960
Wordprocessing	350	4	1,400
Compilers	200	1	200
DOS 3.1	65	6	390
Programming Aides	50	6	300
Total Software Cost			$ 6,500
Total System Cost			$ 29,977

portion of the system. All mainframe software will already be available. See Table 7 for a cost break down.

(2) Alternative 2. No software products will need to be purchased if the system is implemented on a mainframe computer. All software required (except custom software) will be readily available.

(3) Alternative 3. Software will be essentially the same as in Alternative 1. Network software will be needed to support data and message communications and device sharing for fixed disks and printers. Costs are detailed in Table 9.

c. System Development Cost Estimation

We have used Boehm's Constructive Cost Model (COCOMO) of the software development life cycle to estimate the costs for the alternatives. Summary data of development costs by alternative appear in Table 10. In order to obtain a more reliable estimate of the size and complexity of the systems being evaluated, they were decomposed into functional sub-systems. This follows the guidance for the Intermediate COCOMO Model [Ref. 12: pp. 147-157]. We emphasize that the decomposition is generic in nature. It is meant only as an estimating tool for the general functions which the software will perform. It is not a design specification in any sense. The functions could be rearranged or consolidated with others. They are used as general guidelines to aide in estimating attributes of the software product required.

The differences in costs for Alternatives 1 and 3 versus Alternative 2 stem from the use of personal computers for program development. Some applications, such as smaller database and report generators would not be developed at all under Alternative 2. In addition, the Model portion of Alternative 2 is significantly larger than than the other two. This reflects the assumption that personal computers could be used to perform some of the math model post processing.

TABLE 10

Summary cf COCOMO Cost Estimates

Effort Measures	Alternative 1 Distributed	Alternative 2 Centralized	Alternative 3 Distributed Network
Development Effort			
Project Schedule in months	8.5	7.5	8.5
Total man months to develop	32	24	32
Delivered Source Instructions	9,500	6,500	9,500
Product Costs (000's) omitted			
Cost per component			
PC Applications	$ 35	$ 0	$ 35
Interfaces	28	30	28
Model	87	105	87
Database	39	39	39
Reports	29	14	29
Total Product Cost	$ 218	$ 188	$ 218
Maintenance Effort (000's) omitted			
Annual Maintenance Costs	$ 23.5	$ 18.0	$ 23.5

d. Functional Decomposition

(1) Personal Computer Applications. This is the portion of the software which will operate only on the personal computers. It will accept data in files from the mainframe. It will accept inputs from the user as data entries and commands entered from the keyboard. It will perform routine database functions mainly concerned with the management reports analysis, verification, and production and storage. This includes arithmetic operations, searches and sorts of data files to facilitate analysts' routine tasks. Custom spreadsheet applications would also be required.

The math programming model required for the forecast of the overhead accounts will be mostly a mainframe application. However, as much post-processing as possible will be done using the personal computers to increase responsiveness and avoid mainframe operations costs. Estimates for this portion of the software reflect this assumption.

(2) Interfaces. This represents the interface modules between the users and the system, the system and its host machine operating environment, and the MPBS and any other software systems with which it will share data. This also includes interfaces between the major functional modules of the system such as personal computer-based portions and mainframe based portions.

(3) Mainframe Model. This is the math programming model to forecast the T2P2 man year averages and dollar costs based on the parameters given by the user. It is expected to be developed to allow user inquiries of the effects of changes in the model parameters on the level and composition of the overhead accounts. A clear possibility for this function is the direct use or adaptation of

existing manpower models. The extent to which existing code can be modified or a functioning model's output may be used will have a significant impact on the cost of providing this function.[5]

(4) Mainframe Database. This will extract from the JUMPS/MMS system the required data elements and transactions in order to build a table of Transient and Trainee related characteristics. It must have the capability to be updated based on current actual Transient and Trainee reporting transactions of the JUMPS/MMS system, such as a marine's origin, destination, schools information, years of service, grade, military occupational specialty, sex, delay and travel time, etc. The model will use this data to forecast future T2P2 numbers based on present and planned manpower structure, manning policies and constraints.

(5) Reports. This is the summarization and presentation of the results of analysts' queries to the system. It includes such items as mainframe or personal computer generated reports and presentation graphics in hardcopy or magnetic media. It should have the capability to produce routine reports, and allow users to easily produce custom report formats for presentation of results of ad hoc queries and analyses.

e. Mainframe Development Charges

Boehm's estimates for computer use during system development were used as the basis for this estimate [Ref. 12: p. 256]. Computer hours are estimated based on the amount of development effort and the type of computer to be used. Results of calculations are shown at Table 11.

---

[5]The possible impact of the use of existing models or code is addressed in the Conclusions section of this chapter.

Rates are based on the resource accounting system of a large time sharing system which is not a candidate for implementation. A complete discussion of this issue follows below under Mainframe Operations Costs.

3. Recurring Costs

These are costs which will be incurred on a periodic basis throughout the life of the project. Only those recurring costs which will differ materially from the status quo or among each other will be addressed. Cost of materials and supplies under all alternatives are considered to be roughly equal.

a. Software Maintenance and Modernization

This covers the personnel costs of maintaining the system software once it has been developed, installed and tested. It does not take into consideration major modifications. It allows for routine, minor modifications in response to changes in the environment in order keep the system running in a useful condition. A major consideration under this aspect is the estimate of the magnitude of change that the software will experience during the year. This was estimated with a quantity called the Annual Change Traffic (ACT) of the components of the software. All components are estimated to incur a 10 per cent rate of change except those portions which will interface directly with the JUMPS/MMS system. These are projected to experience a 15 per cent rate of change. The COCOMO model results for maintenance appear in Table 10.

b. Mainframe Operations Costs

Mainframe operating costs are based on two factors. First, on estimates of computer resource charges for similar software systems running at CDC Rockville, Md in a mix of batch and real time modes. Second, they are based

TABLE 11

COCOMO Estimate for Mainframe Computer Development Charges

	Alternative 1 Distributed		Alternative 2 Centralized		Alternative 3 Distributed Network	
Mainframe Development Costs	Usage	Cost	Usage	Cost	Usage	Cost
Connect Time $9/hr.	440	$ 3,960	580	$ 5,220	440	$ 3,960
Input/Output $40/hr.	8.8	352	11.6	464	8.8	352
CPU Charge $600/hr.	4.4	2,640	5.8	3,480	4.4	2,640
Processor Storage $54/M/hr	4.4	238	5.8	313	4.4	238
On line File Storage $20/connect hr	440	8,800	580	11,600	440	8,800
Total Monthly Charges		$ 15,990		$ 21,077		$ 15,990

on resource charges of another large computing operation [Ref. 13], specifically an IBM computer system at the Naval Postgraduate School, Monterey, CA., operating under VM/CMS and [6] These cost estimates are summarized for each alternative in Table 12.

There are complications in estimating the costs of mainframe operations. First, it is not known at this time where the mainframe portion of the system will be installed. There are two likely sites. Control Data Corporation's Rockville, Maryland time sharing service is used by the Marine Corps for several other manpower models. And the CDPA, Quantico also has the capacity to support the proposed system. Second, it is difficult to estimate costs for timesharing when only a general notion of the size and type of software required can be known at this stage. Finally, the CDPA, Quantico does not have a billing algorithm with which to charge back users for computer resources they use.

To consider the cost of the resources used, a judgement was made to assign an opportunity cost to the use of the Marine Corps computer based on estimates of charges for commercially available time sharing services. No assumption is made to locate the system at particular site. The intent is to assign a cost for resources consumed, whether it is a Marine Corps owned computer or a time sharing service. Resource consumption was extrapolated based on estimates of computer resource usage developed for other related manpower systems developed by Decision Systems Associates, Inc., of Rockville, Maryland [Ref. 11: p. 32]. The usage rates and estimated charges for all three alternatives are summarized in Table 12.

---

[6] VM/CMS and MVS are IBM trademarks for conversational and batch mode operating systems.

TABLE 12

Estimated Monthly Mainframe Operations Costs

	Alternative 1 Distributed Usage	Alternative 1 Distributed Cost	Alternative 2 Centralized Usage	Alternative 2 Centralized Cost	Alternative 3 Distributed Network Usage	Alternative 3 Distributed Network Cost
Mainframe Monthly Costs						
Connect Time $9/hr.	25	$ 225	40	360	25	$ 225
Input/Output $40/hr.	0.5	20	0.8	32	0.5	20
CPU Charge $600/hr.	0.25	150	0.40	240	0.25	150
Processor Storage $54/M/hr	1M/.25	14	1M/.4	22	1M/.25	14
On line File Storage $20/connect hr.	25	500	40	800	25	500
Total Monthly Charges		$ 909		$ 1,454		$ 909

c. Recurring Costs Summary

(1) Alternative 1. The recurring costs for this alternative are grounded on the assumption that the use of personal computers will allow costs of mainframe processing to be lower. Therefore, costs of operation for this alternative are lower than for Alternative 2. Rates applied are for civilian contractor charges generally charged in the local data processing environment [Ref. 11].

(2) Alternative 2. Under this alternative all significant processing is done on a mainframe. Estimates of computer usage are based on estimates for similar systems running at the Control Data Corporation Eastern Computer Center, in Rockville Maryland.

(3) Alternative 3. The charges for this system are the same as under Alternative 1. Network software is not expected add any significant costs to system maintenance or operation.

F. BENEFIT ANALYSIS

1. General

We now will discuss the possible benefits to be realized from the implementation of the system. The alternatives do not provide the same level of benefits. Additionally, the benefits are not equally important to the user.

To gain more understanding of the relative level of benefits provided by the system, we will use a weighted benefits analysis approach. Each of the benefits that the system will provide will be weighted based on its relative importance. Each alternative will then be judged on the degree to which it can provide a benefit. The product of the benefit weight and the benefit rating yields the alternative's weighted rating for a given benefit.

2. Discussion of Benefits

a. Increase In Data Reliability

Increased reliability of data used in the preparation of management reports. Data will be extracted, verified and edited electronically.

All alternatives offer a significant increase over the present system. Use of personal computers will increase the ability to share data among analysts. Alternative 3 provides the highest level of this reliability since it will be easier to have access to data possessed by others. This means that changes or updates to reports or statistics can be made available to all analysts. Inconsistency in data may be reduced.

b. Increase In Data Handling Efficiency

Increased efficiency in the handling and storage of data for management reports, budgets, Program Objective Memoranda (POM), Five Year Defense Plans (FYDP). Data and reports will be easily stored and retrieved electronically. Hardcopy reports are reduced to a minimum. Analysts and supervisors may share, review work and have access to stored files.

Alternative 3 provides the means to achieve the highest efficiency in data handling and storage. Alternative 2 does not provide a significant improvement in the means to handle, store and organize the data and reports used by MPP-40.

c. Enhanced Physical Security

Data and reports can be archived on magnetic media. There will less chance for accidental destruction,

deterioration or physical damage. Back-up copies may be stored elsewhere. This will reduce the vulnerability to loss from physical damage.

d. Increased Productivity

Reduction in the time required to analyze data and understand the impact of various courses of action on the Manpower budget through "what if" capabilities in electronic spreadsheets and model parameters. Historical data may be searched, retrieved and organized in less time than in a manual file system.

Personal computing will allow a larger increase in personal productivity than a mainframe approach. The ability to access common data, reports, and prepare correspondence with less manual intervention can be gained with a network approach. Mainframe processing alone does not provide as great a benefit.

e. Enhanced T2P2 Estimates

Increase in the reliability of the estimates for the T2P2 accounts for the FYDP and budgets. Present methods for estimating and costing T2P2 manyear averages are time consuming and are less rigorous than desired. T2P2 rates and averages may be determined from actual elapsed time reporting in the Manpower Management System.

All alternatives will use a mathematic programming approach to improve the present methods of forecasting and budgeting for T2P2 numbers.

f. Increased Analysis Flexibility

Enhanced flexibility will be provided through an analysis feature for the forecast of T2P2 in the math projection model which will allow a rigorous approach to the impact of such changes in force structure, manning, schools,

and assignment policies. Electronic spreadsheets will allow many different approaches to be taken in data analysis.

Personal computing will allow analysts to use custom written programs to aide in preparing reports and budgets. In addition, the use of electronic spreadsheet and database applications written by users themselves will allow an increase in analysis flexibility not available in a mainframe environment.

g. Decreased Inquiry Response Time

Decrease in the response time for preparing reclamas or responses to hoc inquiries from senior Headquarters officials. Wordprocessing, electronic filing, presentation graphics capabilities will speed the preparation of briefs and reports.

Personal computing will allow analysts to have access to data and the ability to prepare reports needed to answer inquiries and prepare responses to other agencies requests. This decrease in response time will not be as significant in a generally less responsive mainframe environment. Only personal computing offers the office automation capabilities required to speed the production of reports through access to computing power.

h. Increase In Morale and Job Satisfaction

Increase in morale and effectiveness of analysts will be gained from the reduction of repetitive clerical processing and increases in personal productivity. Analysts will have time to do more worthwhile tasks.

Improving the quality of data used by analysts and lessening the burden of repetitious manual editing and calculation will have a positive impact on the working conditions and personal satisfaction enjoyed by users. In general, all alternatives will provide at least a perceived increase in productivity and efficiency.

3. Benefit Ratings

The benefits discussed above were quantified with ratings reflecting their relative merit and desirability. A rating of twenty indicates the highest desirability or importance and a rating of five reflects the lowest relative importance. The alternatives were then judged on how well each satisfied the benefit. A weighted score was then calculated for each benefit by multiplying the weight of each benefit and its benefit score. The weighted scores were then summed over all benefits for each alternative to arrive at a Total Weighted Score. The results of these computations are shown in Table 13.

The results of this analysis yield the following scores:

Alternative 1	1055
Alternative 2	840
Alternative 3	1200

G. COMPARISON OF ALTERNATIVES

The alternatives have been found to have unequal benefits and unequal costs. Because of this, a benefit/cost ratio was computed for each alternative based on the results of the costs and benefit calculations [Ref. 8].

TABLE 13

Benefit Analysis Summary

Benefit	Relative Weight	Score Alt 1	Score Alt 2	Score Alt 3	Weighted Alt 1	Weighted Alt 2	Weighted Alt 3
INCREASE IN DATA RELIABILITY	20	8	7	10	160	140	200
INCREASE IN DATA HANDLING EFFICIENCY	20	7	5	10	140	100	200
ENHANCED PHYSCIAL SECURITY	10	10	10	10	100	100	100
INCREASED PRODUCTIVITY	15	7	5	10	105	75	150
ENHANCED T2P2 ESTIMATES	20	10	10	10	200	200	200
INCREASED ANALYSIS FLEXIBILITY	15	10	5	10	150	75	150
DECREASED INQUIRY RESPONSE TIME	10	10	7	10	100	70	100
INCREASE IN MORALE, JOB SATISFACTION	10	10	10	10	100	100	100
TOTAL					1055	860	1200

The present values of the estimated life cycle costs for the three alternatives are presented in Table 15. Alternative 2 has the lowest costs on a present value basis of the alternatives. The difference between the high and low costs is $28,969, a variance of approximately 7 per cent.

To provide a consistent method of comparing costs for the alternatives, a quantity known as Uniform Annual Costs was computed [Ref. 8: p. 11-1]. First, the present value of the life cycle costs is discounted at 10% over a five year economic life. See Table 15. Next, the present value cost is divided by the cumulative series present value factor used to calculate the discounted life cycle cost. The resulting Uniform Average Cost is an average annual cost which takes into consideration the time value of the stream of costs associated with the alternative. Finally, the quantified benefits of each alternative are divided by the Uniform Annual Cost for each. The result is a discounted benefit to cost ratio. For the base case these calculations are shown in Table 14.

Alternative 3 was found to have the highest benefit to cost ratio using discounted costs over a five year life. The variance between the high and low ratios was a differential of 19 per cent.

H. SENSITIVITY ANALYSIS

The purpose of sensitivity analysis is to determine the affect of changes in underlying assumptions on the results which were obtained above. It indicates the resistance of our analysis against errors in estimation, bias, defects in our modelling techniques, and unexpected changes in the economic and technical environment in which the system will be developed and maintained.

TABLE 14

Benefit Cost Ratio Calculations

Alternative	UAC	BCR
Alternative 1	99,969	1.06
Alternative 2	89,876	0.96
Alternative 3	100,790	1.19

$$\text{Uniform Annual Cost} = \frac{\text{Present Value Cost}}{\text{Cumulative Discount Factor}}$$

$$\text{Benefit Cost Ratio} = \frac{\text{Weighted Benefits}}{\text{Uniform Annual Cost}} \times 100$$

A sensitivity analysis was conducted to determine the affect of certain changes on the results obtained above. The following changes were introduced into the analysis:

1. Reduction in the number of workstations from four total to two.
2. An decrease in the size of the software product required of 15, 25 and 50 per cent.

1. Reduction of Hardware Costs

The number of workstations purchased for all alternatives was reduced by 50%. Accordingly, a 50% reduction in hardware and software purchase costs is realized. This shows the sensitivity of the results to changes in hardware costs and configurations. See Table 16 for the results of these calculations. The lowest cost alternative here remains Alternative 2. However, the costs begin to converge slightly in real terms. The difference between the high and low costs is now $22,288 (down from $29,000), a spread of 6%. On a cost/benefit basis, Alternative 3 still provides the highest level of benefits

per discounted dollar cost. Here the differential between high and low BCR is 26%. This is not significantly different than the base case.

2. Reduction of Software Costs

The size of the software product required was reduced for all alternatives by 15, 25 and 50%. This also reduced the maintenance costs by the same amounts. The results of these changes are shown in Tables 17 through 19. Alternative 3 always had the highest level of benefits per discounted dollar of cost. Alternative 2 was the lowest cost for all cases.

I. CONCLUSIONS

Under all cases of sensitivity analysis, Alternative 3 produces the highest level of benefits, and the highest benefit to cost ratio. Alternative 3 is also the most expensive to implement. Figure 5.1 illustrates the relative levels of costs and benefit to cost ratios for all alternatives from the base case through a 50% reduction in software development costs. We note that as project costs decrease, the benefit to cost ratics increase.

As project costs decrease, there is a tendency for costs of the alternatives to ccnverge. Put another way, as the project gets smaller and cheaper there is less of a difference in cost. This is illustrated in Figure 5.1 by the data points grouping around a cost level as the benefit to cost ratios increase.

In our original estimates, the costs associated with building the model to predict the T2P2 rates were based on a separate, complete development effcrt for a large, complex math programming model.

TABLE 15

Total Present Value Costs

Present Value Analysis

DISCOUNTED ANNUAL COSTS

COST CATEGORY	FY 0	FY 1	FY 2	FY 3	FY 4	FY 5	TOTAL DISCOUNTED COST
Undiscounted Costs							
Alternative 1	259,392	34,408	34,408	34,408	34,408	34,408	431,432
Alternative 2	216,427	35,448	35,448	35,448	35,448	35,448	393,667
Alternative 3	263,967	34,408	34,408	34,408	34,408	34,408	436,007
Present Value Factor	1.0	.954	.867	.788	.717	.652	.592
Discounted Costs							
Alternative 1	259,392	32,825	29,832	27,114	24,671	22,434	396,268
Alternative 2	216,427	33,817	30,733	27,933	25,416	23,112	357,438
Alternative 3	263,967	32,825	29,832	27,114	24,671	22,434	400,843

TABLE 16

Sensitivity Analysis
Case 1

REDUCE HARDWARE/SOFTWARE PURCHASE BY 50%

COST ELEMENT	FY 0	FY 1	FY 2	FY 3	FY 4	FY 5	TOTAL COST
Undiscounted Costs							
Alternative 1	246,691	34,408	34,408	34,408	34,408	34,408	418,731
Alternative 2	212,752	35,448	35,448	35,448	35,448	35,448	389,992
Alternative 3	248,979	34,408	34,408	34,408	34,408	34,408	421,019
Discount Factor	1.0	.954	.867	.788	.717	.652	
Discounted Costs							
Alternative 1	246,691	32,825	29,832	27,114	24,671	22,435	383,566
Alternative 2	212,752	33,817	30,733	27,933	25,416	23,112	353,764
Alternative 3	248,979	33,825	29,832	27,114	24,671	22,435	385,857
Benefit Cost Ratio							
Alternative 1		1.09					
Alternative 2		0.97					
Alternative 3		1.24					

TABLE 17

Sensitivity Analysis
Case 2

15% REDUCTION IN SOFTWARE DEVELOPMENT COSTS

	FY 0	FY 1	FY 2	FY 3	FY 4	FY 5
Discount Factor	1	0.954	0.867	0.788	0.717	0.652
Alternative 1						
Annual Cost	226,692	30,883	30,883	30,883	30,883	30,883
Cumulative Cost	226,692	257,575	288,458	319,341	350,224	381,107
Discounted Cost	226,692	29,462	26,776	24,336	22,143	20,136
Cumulative Discount	226,692	256,154	282,930	307,266	329,409	349,545
Alternative 2						
Annual Cost	188,227	32,748	32,748	32,748	32,748	32,748
Cumulative Cost	188,227	220,975	253,723	286,470	319,219	351,967
Discounted Cost	188,227	31,242	28,393	25,800	23,480	21,352
Cumulative Discount	188,227	219,469	247,861	273,667	297,147	318,499
Alternative 3						
Annual Cost	231,267	30,883	30,883	30,883	30,883	30,883
Cumulative Cost	231,267	262,150	293,033	323,916	354,799	385,682
Discounted Cost	231,267	29,462	26,776	24,336	22,143	20,136
Cumulative Discount	231,267	260,729	287,505	311,841	333,984	354,120

Benefit Cost Ratio

Alternative 1	1.19
Alternative 2	1.07
Alternative 3	1.35

TABLE 18

Sensitivity Analysis
Case 3

25 % REDUCTION OF SOFTWARE DEVELOPMENT COSTS

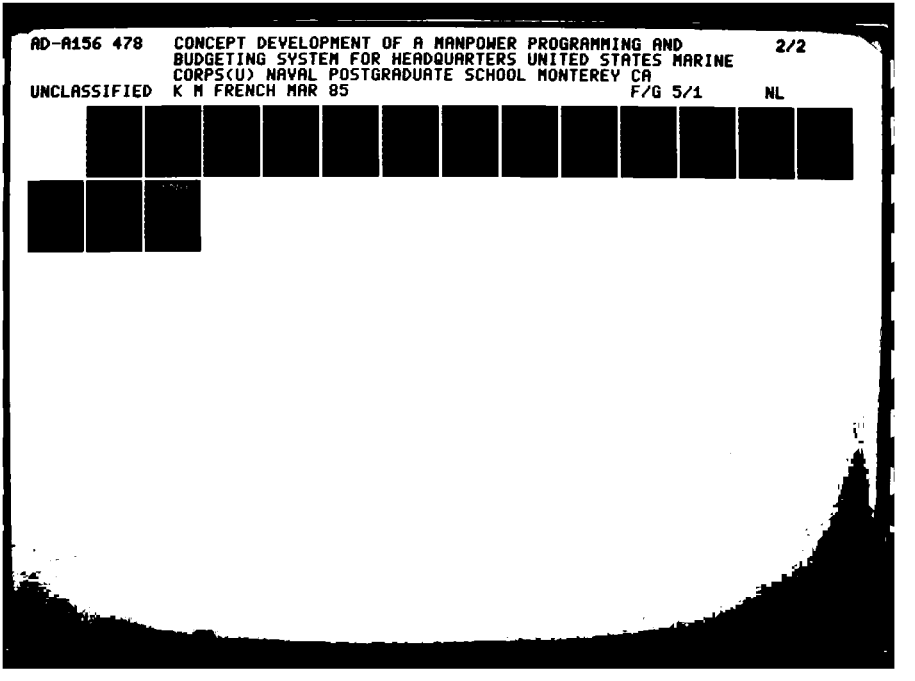
	FY 0	FY 2	FY 3	FY 4	FY 4	FY 5
Discount Factor	1	0.954	0.867	0.788	0.717	0.652
Alternative 1						
ANNUAL COST	204,892	28,533	28,533	28,533	28,533	28,533
CUMULATIVE COST	204,892	233,425	261,958	290,491	319,024	347,557
DISCOUNTED COST	204,892	27,220	24,738	22,484	20,458	18,604
CUMULATIVE DISCOUNT	204,892	232,112	256,851	279,335	299,793	318,396
Alternative 2						
ANNUAL COST	169,427	30,408	30,403	30,408	30,408	30,408
CUMULATIVE COST	169,427	199,835	230,243	260,651	291,059	321,467
DISCOUNTED COST	169,427	29,009	26,364	23,962	21,803	19,826
CUMULATIVE DISCOUNT	169,427	198,436	224,800	248,761	270,564	290,390
Alternative 3						
ANNUAL COST	209,467	28,533	28,533	28,533	28,533	28,533
CUMULATIVE COST	209,467	238,000	266,533	295,066	323,599	352,132
DISCOUNTED COST	209,467	27,220	24,738	22,484	20,458	18,604
CUMULATIVE DISCOUNT	209,467	236,687	261,426	283,910	304,368	322,971

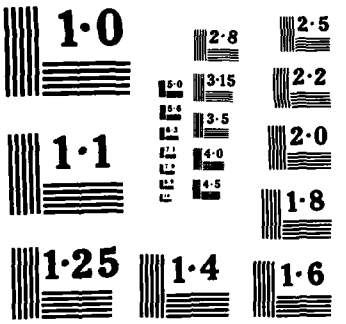
Benefit Cost Ratio

ALTERNATIVE 1	1.31
ALTERNATIVE 2	1.18
ALTERNATIVE 3	1.48

AD-A156 478 CONCEPT DEVELOPMENT OF A MANPOWER PROGRAMMING AND BUDGETING SYSTEM FOR HEADQUARTERS UNITED STATES MARINE CORPS(U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA 2/2

UNCLASSIFIED K M FRENCH MAR 85 F/G 5/1 NL





NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

TABLE 19

Sensitivity Analysis
Case 4

50% REDUCTION IN SOFTWARE DEVELOPMENT COSTS

	FY 0	FY 1	FY 2	FY 3	FY 4	FY 5
Discount Factor	1	0.954	0.867	0.788	0.717	0.652
Alternative 1						
ANNUAL COST	150,392	22,658	22,658	22,658	22,658	22,658
CUMULATIVE COST	150,392	173,050	195,708	218,366	241,024	263,682
DISCOUNTED COST	150,392	21,616	19,644	17,855	16,246	14,773
CUMULATIVE DISCOUNT	150,392	172,008	191,652	209,507	225,753	240,526
Alternative 2						
ANNUAL COST	122,427	26,448	26,448	26,448	26,448	26,448
CUMULATIVE COST	122,427	148,875	175,323	201,771	228,219	254,667
DISCOUNTED COST	122,427	25,231	22,930	20,841	18,963	17,244
CUMULATIVE DISCOUNT	122,427	147,658	170,589	191,430	210,393	227,637
Alternative 3						
ANNUAL COST	154,967	22,658	22,658	22,658	22,658	22,658
CUMULATIVE COST	154,967	177,625	200,283	222,941	245,599	268,257
DISCOUNTED COST	154,967	21,616	19,644	17,855	16,246	14,773
CUMULATIVE DISCOUNT	154,967	176,583	196,227	214,082	230,328	245,101

Benefit Cost Ratio

ALTERNATIVE 1	1.64
ALTERNATIVE 2	1.41
ALTERNATIVE 3	1.85

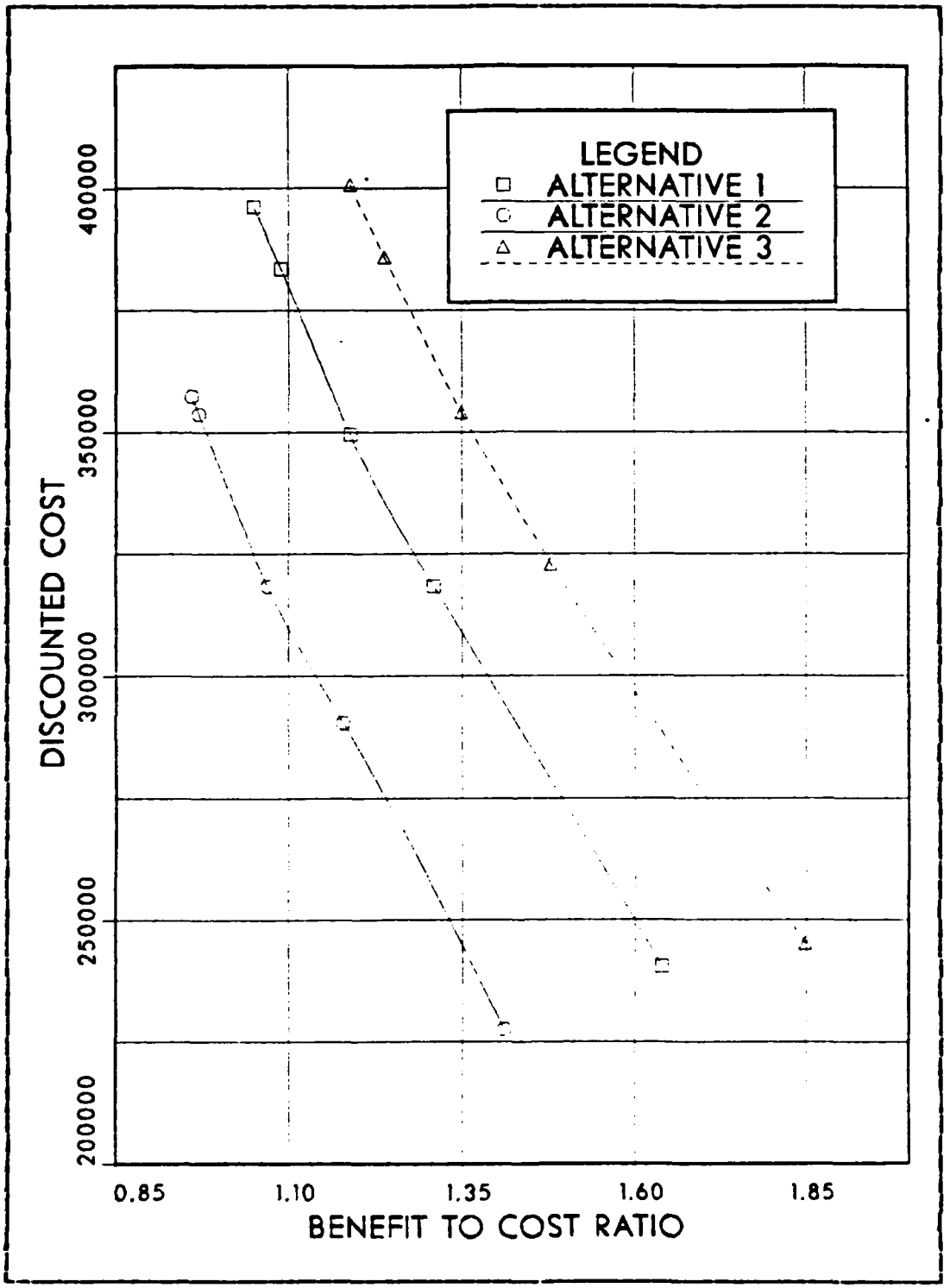


Figure 5.1 Cost Benefit Analysis

It is likely that a large part of the model's functions may be directly adapted from existing manpower systems (Transient Flow Model, Officer and Enlisted Planning Systems). If this is the case, the project will tend to look more like sensitivity case 3 or 4 (the lower end of the graph in Figure 5.1), because less custom built software will be required. This means that the cost differences between the alternatives will tend to lessen as overall project costs decrease. The actual level of benefits provided will remain the same as in the base case. So, the marginal rate of return on investment (as measured by the benefit cost ratio) grows as project size decreases.

This finding from the model of the project which we built using the COCOMO method is supported in [Ref. 16]. In it DeMarco argues that there are decreasing returns to scale in software projects in general. Simply reducing the size and scope of a project causes a significant decrease in the cost.

J. RECOMMENDATIONS

Under the conservative assumptions of the base case (large software product size) Alternative 3 presents the highest level of benefits at the greatest cost. An overriding consideration is the level of confidence which we can place in our estimate of software product cost. At this early stage, there is uncertainty in the size of the software product required. Boehm [Ref. 12: p. 310] argues that early in the life cycle cost estimation errors tend to vary by a factor of four on either the high or low side of the actual cost. As we move into the project and gather more knowledge about the requirements of the software, we begin to narrow our estimating error. He maintains that by the time the feasibility study phase is completed, there

should be approximately a factor of two error in our estimate. Figure 5.2 [Ref. 12: p. 311] illustrates the great variability of cost estimates in the early stages of project development. Clearly, we are at a point near the origin of the graph in Figure 5.2 where the variability of estimates is still comparitively high.

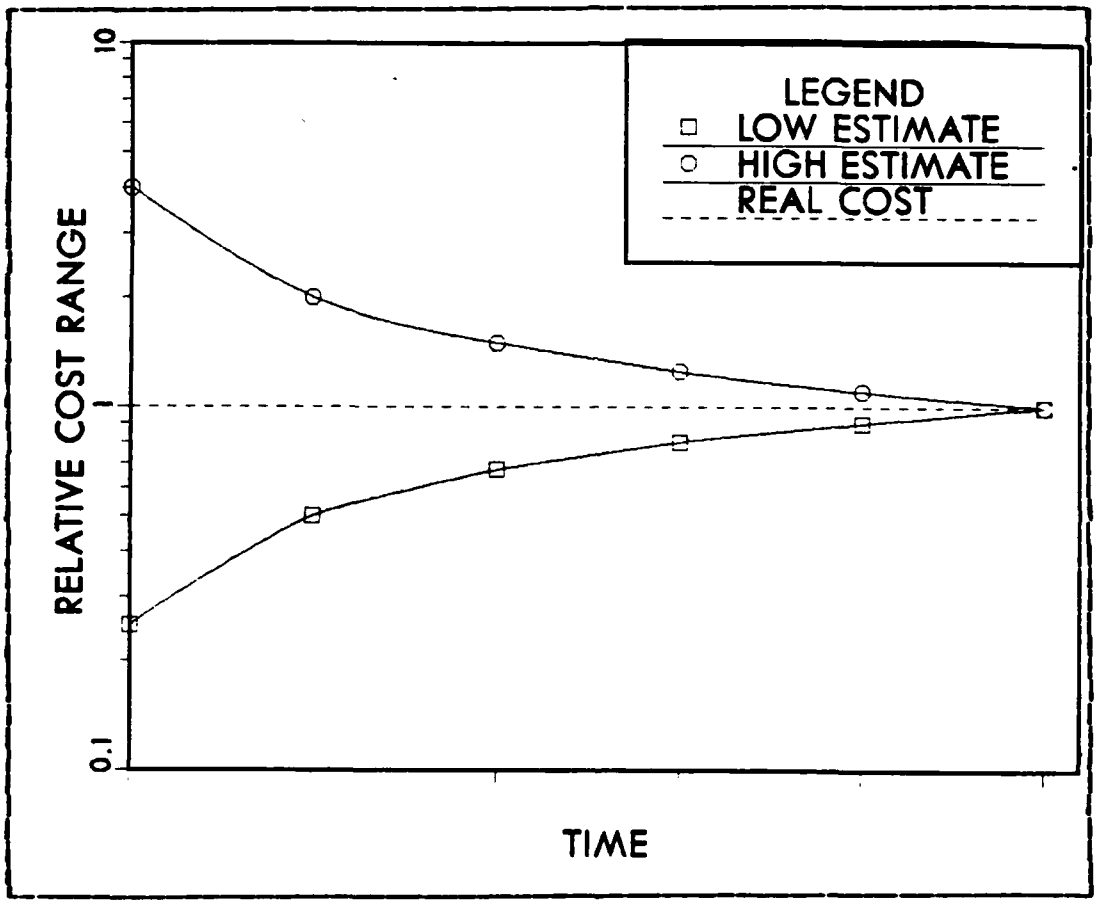


Figure 5.2 Software Cost Estimation Accuracy Versus Time

Through sensitivity analysis, we have shown software costs have a major impact on project cost. We should consider a range of possible outcomes. There is a strong possibility that the actual size of the project will be much

smaller due to the availability of existing and developing manpower systems software. If this is the case, then the recommendation is Alternative 3, based on the premise that it provides a superior level of benefits for a small increase in cost over the other alternatives.

VI. CONCLUSION

A. ANALYSIS OF METHODOLOGY

The life cycle management procedures that are prescribed by the Department of Defense have changed little in the past five years. The methods prescribed were tailored for the analysis and procurement of large systems dominated by hardware costs. The microcomputer explosion of the past three to five years has changed the way users see their information needs. As we have seen in this study, there is a need for user-responsive, flexible information processing. While a large portion of the processing is clearly adapted to mainframe processing, there are significant needs which can only be met with personal computing and office automation.

In the case where an automated solution clearly involves microcomputers, the development process is the same for a mainframe batch-oriented system. [Ref. 2] encourages the analyst to address interface issues in system design, but only since the widespread use of microcomputers has this gained importance. Users want to share data. They also want to avoid what they view as wasteful, inflexible and unresponsive centralized information processing support. As microcomputers become more and more powerful, they are playing an increasing role in the solution of information processing problems. The obvious result is the proliferation microcomputers.

However, nowhere in Department of Defense Life Cycle Management for Automated Information Systems directives are the unique problems of system design and system management and integration with microcomputers addressed. As more and

more distributed and office automation systems evolve, the Marine Corps faces challenges in attempting to fully exploit the benefits of the disparate systems which exist in various user organizations.

B. RECOMMENDATIONS

1. Strategy

The methodology prescribed by [Ref. 2] is a structured approach. It uses an iterative design technique where user needs are identified and solutions are proposed at increasing levels of detail as the project moves through the approval milestones. Clearly, such a controlled approach is well suited to the corporate culture of a military headquarters staff where clear consensus and concurrance is required. It might be argued that the staffing approach used by military organizations, in general, tends to ameliorate the tendency to produce systems of extremely narrow focus, since often those persons who will not be direct users of the system must give their concurrance as the system passes through approval milestones. This encourages the consideration of wider issues such as information sharing across organizational bounds and duplication of effort.

However, the advantage gained from having control over the development process also leads to certain disadvantages. The process generally starts with a user identifying a deficiency in the way business or processing is done. Analysis and possibly design of a system to correct the deficiency then begins. The controls within the process (the requirements of [Ref. 2]) require that interfaces, inputs and outputs be carefully defined. This does encourage a wide perspective of the problem.

The problem lies in the nature of the origin of the initial request. It is a reaction to a perceived problem. Corrective action is taken and the process begins anew when another problem is identified. A more reasoned approach would be to attempt to actively identify information processing needs before they become clear hindrances to mission performance. In effect, a proactive versus reactive approach.

A wide view needs to be taken in the design of systems. Solving individual problems can paradoxically result in being saddled with many successfully implemented solutions which are not well integrated from the perspective of the overall information needs of the organization. The result is a fragmented information system and a sense of frustration over lack of coherence and usefulness.

Dr. William Zani defines the problem succinctly:

> "Traditionally, management information systems have not really been designed at all. They have been spun off as by-products while improving existing systems within a company. No tool has proved so disappointing in use. I trace this disappointment to the fact that most management information systems have been developed in the "bottom-up" fashion--an effective system, under normal conditions, can only be born of a carefully planned, rational design that looks down from the top, the natural vantage point of the managers who use it." [Ref. 17]

One approach to address this problem is the Business Systems Planning methodology develcped by IBM [Ref. 18]. It is similar to other analysis approaches which take a wide perspective of the management of information. The key element of the approach is the involvement of top management in the development of a rational Information Resource Management Plan. This is in contrast to reactively solving problems as they arise. An information plan allows the organization to identify and prioritize problems and solutions of Information Resource Management.

Clearly, the Marine Corps is a plans oriented organization. Systematic planning is imperative in amphibious warfare. It seems reascnable to propose that the Corps begin now to plan the information systems it needs to carry out the business of administering the headquarters functions. There are several systems currently under development which attempt to address information needs of the entire Marine Corps. However, there is no information management plan for the unique and critical functions of the Headquarters organizatien itself.

2. Present Methods

Despite the inherent tendency for the presently used methodology to promote less integration, the system managers and designers all expressed the view that information sharing and integration need to be stressed as much as possible. Because of this emphasis, systems under development do attempt to address the issues of inter-departmental information sharing and responsibilities and future interface requirements. Given the acceptance of these issues, a methodology which encourages more top level planning can clearly provide even a better return of more useful systems to support the information needs of the Marine Corps.

APPENDIX A
GLOSSARY OF TERMS

Five Year Defense Plan (FYDP. A document which among other things, contains the military manpower listing displaying the gross end-strength number of authorized manpower for the Marine Corps. The FYDP is updated monthly to reflect the ongoing policy decisions made by the Marine Corps which affect manpower levels.

Headquarters Master File (HMF). A subsect of the data contained in MMS. It contains summaries and statistics about the data in MMS.

Manpower Management System (MMS). MMS is the Marine Corps personnel database. It contains all personnel records of marines and all personnel transactions.

Manpower Plan. Produced by MPP-20 and Mpp-30, the Manpower Plan details the losses and gains by month of officer and enlisted populations.

(MP,MC). Military Personnel, Marine Corps. A category of fund accounting covering military compensation.

MPP-20. Enlisted Plans Section.

MPP-40. Officer Plans Section.

MPP-40. Manpower Plans Programs and Budget Section.

Officer Planning System. An automated information system currently under development that will enable the Officer Plans Section (MPP-30) to manage the officer force structure over a seven year planning horizon.

Permanent Change of Station (PCS). The transfer of a marine or a unit from one permanent station to another. PCS moves include :

> Assignment from home or place from which ordered to active duty, to the first station upon appointment, call to active duty, enlistment, or induction; and from the last duty station to home or to the place from which the marine entered the service, placement on the temporary disability retirement list, release from active duty or retirement.

Troop List. A seven year array of the unit structure of the Marine Corps created by HQMC for planning programming, and budgeting purposes. Data includes the unit number, unit structure and totals for officer and enlisted billets, and values for the manning levels of those units.

Transient Flow Model. A model used by the Officer and Enlisted Plans Sections to forecast the amount of manyears required for the Transient category of the overhead accounts. It does not contain information about budget data and dollar costs of either transients or the other categories of T2P2.

LIST OF REFERENCES

1. Department Of Defense Standard 7935, Automated Data Systems Documentation (ADS), U. S. Government Printing Office, February 1983.

2. MCC P5231.1, Life Cycle Management for Automated Information Systems, (LCM-AIS), 9 August 1983.

3. Decision Systems Associates, Inc., Transient Flow Model Functional Description, prepared for Deputy Chief of Manpower, Headquarters, U. S. Marine Corps, October 1984.

4. Headquarters Marine Corps Order P5400.18, Headquarters Marine Corps Organization Manual, 1983.

5. Manpower Integration and Procedures Branch, Headquarters, U. S. Marine Corps, "Project Management Charter for the Development of the Manpower Programming and Budgeting System", draft dated November 1984,

6. Gane, Christopher P., and Sarson, Trish, Structured Systems Anaysis: Tools and Techniques, Prentice-Hall, 1975.

7. Requirements and Programs Department, Headquarters, U. S. Marine Corps unclassified letter RP-43-DAS/118, to Navy Comptroller, Subject: Navy Headquarters Budgeting System, 25 June 1984.

8. Zimmerman, Denise C. Economic Analysis Procedures for Automated Data Processing, Naval Data Automation Command Publication 13, Naval DAta Automation Command, 1980.

9. Verbal guidance of Project Manager, Manpower Programming and Budgeting System, 23 August 1984.

10. "IBM Price List", General Services Administration, August 1984.

11. Decision Systems Associates, Inc., Feasibility Study and Economic Analysis of the Manpower Mobilization Planning System , paper prepared for Deputy Chief of Manpower, Headquarters, U. S. Marine Corps, 24 April 1984.

12. Boehm, Barry W., Software Engineering Economics, Prentice-Hall, 1984.

13. W. R. Church Computer Center Technical Memorandum, Naval Postgraduate School, Monterey, CA., IBM-3033 Resource Accounting & Charging, July, 1983.

14. Mission Element Needs Statement for Manpower Programming and Budgeting System, paper prepared for Deputy Chief of Manpower, Headquarters, U. S. Marine Corps, November, 1984.

15. Local Area Netter, Minneapolis, MN, Nov 1984.

16. DeMarco, Tom, Controlling Software Projects, Yourdon Press, 1982.

17. Zani, William, "Blueprint for MIS", Harvard Business Review, November/December, 1970.

18. International Business Machines Corporation, Business Systems Planning Information Systems Planning Guide, 1984.

19. Requirements Statement for Table of Manpower Requirements (T/MR) System and Troop List System, Decision Systems Associates, Inc., Rockville Maryland, April 1984.

20. Functional Description for Table of Manpower Requirements (T/MR) and Troop List System, draft report, Decision Systems Associates, Inc., 14 May 1984.

INITIAL DISTRIBUTION LIST

No.		Copies
1.	Capt. Kevin M. French Central Design and Programming Activity Marine Corps Development and Education Command Quantico, Virginia 22304	1
2.	Commandant of the Marine Corps Code MPI-40 Attn: Capt. J. N. Lott Headquarters United States Marine Corps Washington, D.C. 22031	1
3.	Computer Technology Programs Code 37 Naval Postgraduate School Monterey, California, 93943	1
4.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22314	2
5.	Superintendent Attn: Library, Code 0142 Naval Postgraduate School Monterey, California 93943	2
6.	Superintendent Attn: Marine Corps Representative, Code 0309 Naval Postgraduate School Monterey, California 93943	1

END

FILMED

8-85

DTIC