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DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

MANAGEMENT INFORMATIONS SYSTEMS
AND THE COMPUTER IN THE
DEFENSE ACQUISITION PROGRAM OFFICE

STUDY PROJECT REPORT
PMC 77-2

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FORT BELVOIR, VIRGINIA 22060

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DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE: MANAGEMENT INFORMATION SYSTEMS AND THE COMPUTER IN THE DEFENSE ACQUISITION PROGRAM OFFICE

STUDY PROJECT GOALS:

To investigate the role of computerized management information systems in program management offices.

To assist program managers in exercising judgement on either acquiring an MIS or improving their present system.

STUDY REPORT ABSTRACT:

This report examines the role that computerized management information systems play in the decision making process in management organizations and in Department of Defense Program Offices for acquisitions in particular. A management information system is defined, and the need for information is discussed. The values and limitations of an MIS in the decision making process are presented. The MIS should not be considered as a decision making device, but only as an aid in helping management make the decisions. Before the MIS can be used to its maximum potential the manager must know what his specific information needs are. Information on the implimentation of an MIS, and several examples of possible applications in a program office are presented.

Subject Descriptors: Management Information
Information Systems
Program Management
Computer Fundamentals

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MANAGEMENT INFORMATION SYSTEMS AND THE COMPUTER IN THE DEFENSE ACQUISITION PROGRAM OFFICE

Individual Study Program

Study Project Report

Prepared as a Formal Report

DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE

CLASS 77-2

by

Stuart N. Goodman
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December 1977

Study Project Advisor
LCDR Susan Anderson

EXECUTIVE SUMMARY

The purpose of this study project is to investigate the role of computerized management information systems in the program management office.

The access to accurate and timely information is essential to an organization for it to make intelligent decisions in the accomplishment of its mission.

This report defines a management information system, states its values and limitations in the decision making process, and presents a brief overview of computer technology. Furthermore, information on its implementation, and examples of its applications in a program office are provided.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The decision-making process involves recognition of a problem, identification of alternative courses of action, evaluation of potential outcomes, and a choice. For an organization to make intelligent decisions, the access to accurate and timely information is essential. This information is necessary for the organization to plan, control, and direct its activities toward accomplishing its goals and objectives. To assure the availability of this information on a regular basis has lead to what are termed "Management Information Systems".

Management Information Systems (MIS) could be any formalized system that provides information to management; that is, verbal, manual or computerized. However, as the term is generally used today and is used in this paper, MIS refers to information systems that consist of advanced computer technology.

The Department of Defense has requested that its managers use computers for their management information requirements if such use will be beneficial. To quote a Secretary of Defense memorandum:

> Defense managers must educate themselves on the uses and capabilities of the computer; evaluate and clearly state requirements for management information; and exercise positive direction to assure that these requirements are met by the computer system.[6]

Statement of Purpose

The purpose of this study is to investigate the role of computerized management information systems in management organizations and in Department of Defense program management offices for acquisitions in particular. It is also the intent of this study to inform program managers of the basic fundamentals of computer technology and management information systems so that they may better exercise judgement on either acquiring an MIS or improving their present system.

Limitations of this Study

This paper is limited to the very basics of computer technology. Instructions for the writing of computer programs for specific MIS applications is beyond the scope of this project. The recommendation or design of computer hardware components for specific MIS applications is also beyond the scope of this paper.

Format of the Study

The material in the succeeding chapters of this study will be organized in the following manner:

Chapter II will provide an overview of management information systems. Chapter III will elaborate on the basic fundamentals of computer technology. Chapter IV will examine several applications of computerized management information systems that could be used in DOD program offices. Finally, Chapter V will state the conclusions resulting from this study and recommendations made for areas of further investigation.

CHAPTER II

AN OVERVIEW OF MANAGEMENT INFORMATION SYSTEMS (MIS)

What is an MIS

There is disagreement among the experts of an exact, universally acceptable definition of an MIS. Many authors have proposed definitions and each has his own "flavor" of the concept.

Definitions have run from the psychological -

> An information system consists of at least one PERSON of at a certain PSYCHOLOGICAL TYPE who faces a PROBLEM within some ORGANIZATIONAL CONTEXT for which he needs EVIDENCE to arrive at a solution (that is to select some course of action) and that the evidence is made available to him through some MODE of PRESENTATION.[23]

To one with a futuristic vision -

> Radar-like screens constantly scanning the business horizon, pushbutton consoles for instantaneous pulsetaking of every corporation artery, and immediate communications with every decision and action center of the business.[24]

A very basic way to look at this array of decisions is to consider the words in "Management Information Systems":

A system implies order, arrangement and purpose. It is not ad hoc.

Information is different from data. Data does not become information until someone uses the data in some form in order to make a decision.

An information system is a system which processes data (records, stores, calculates, retrieves) to produce information.

Management organizations that require information can be considered as performing routine operations (operational control), allocating and controlling resources (Management control), and planning for the organizations future strategy (Strategic Control).

The following definition of an MIS, by W. Kennenan, is frequently used by many people in academia and business:

> A management information system is an organized method of providing past, present and projection information relating to internal operations and external intellegence. It supports the planning, control, and operational function of an organization by furnishing uniform information in the proper time-frame to assist the decision-making process.[25]

Another definition of a MIS, by G. Davis, makes reference to the computer:

> A management information system, as the term is generally understood, is an integrated, man/machine system for providing information to support the operations, management, and decision-making functions in an organization. The system utilizes computer models, and a data base.[19]

Management Needs

The various stratas of needs for a management information system by management can be described as a pyramid structure (Figure 1). The lowest level consist of the information for transaction processing, that is status equiries, etc. The next level consists of information requirements for day-to-day operations management planning and control. The third layer consists of information resources to aid in management control of tactical planning and decision making. Finally the top level consists of information resources needed for long range planning and policy making by top management.

The pyramid illustrates that the quantity of information required by management is least for top management, and is greatest at the lower levels of management. The pyramid also illustrates that information requirements at the lower levels of management act as a baseline for the higher levels of management.

Figure 1 also indicates that the base part of the pyramid applies to structured, well-defined procedures that require more programmed decisions, while the top part involves more ad hoc, unstructured processes that require more nonprogrammed decisions. The information generated by the lower levels of the pyramid are of more use to lower-level managers, while the information generated by the higher levels applies primarily to top management.

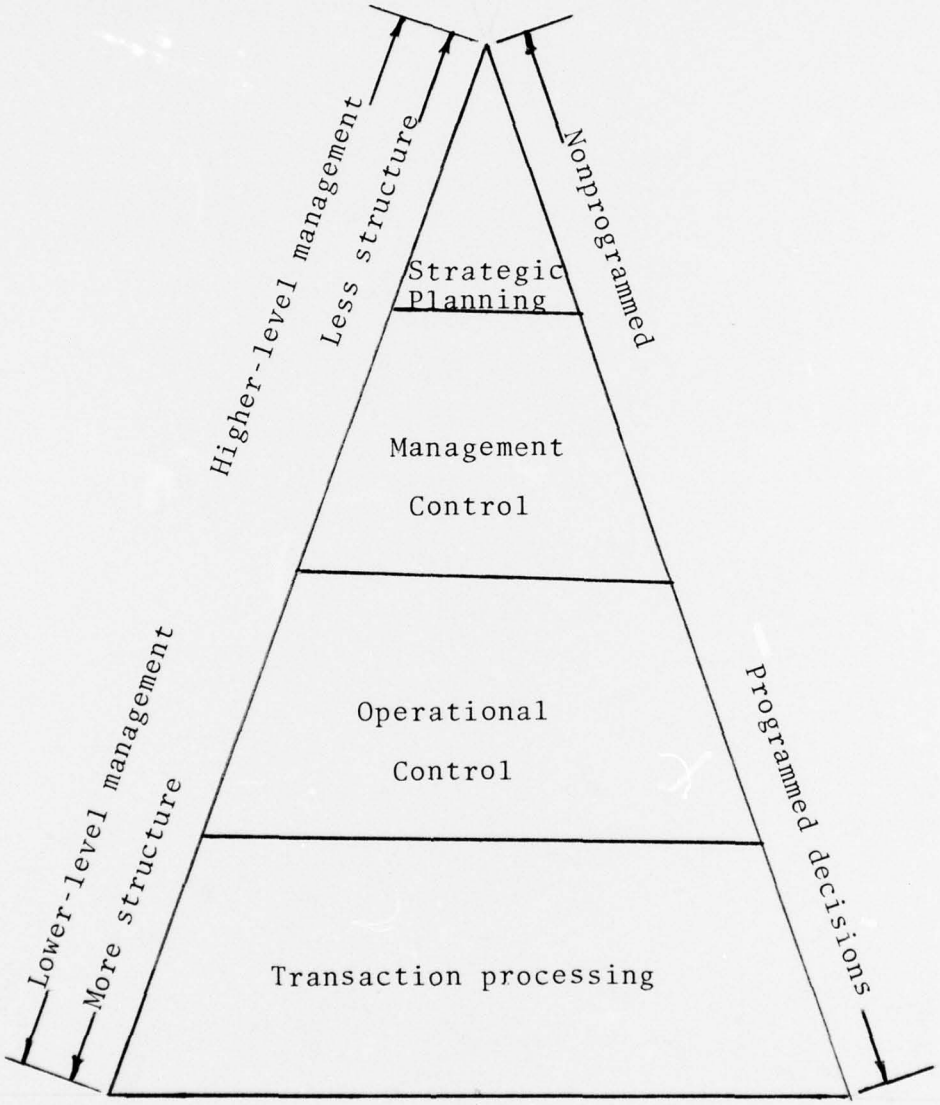


Figure 1

Management Information System as a Pyramid

Models & Simulation

An MIS frequently contains one or more models. A model is a system which is a replica or approximation of a real-world system. Mosels are used for simulation; that is, approaching a problem by constructing a model of a real situation and then manipulating one or more parameters of the model in such a way as to draw some conclusions as to how this manipulation effects the real world situation.

There are two gereral types of relationships that appear in simulation models. The first is the deterministic relationship, and the second is the probabilistic relationship. A system is deterministic when the results of a given action can be predicted with nearly complete certainty. A system is probabilistic when the outcome cannot be determined with certainty. Non-deterministec or probabilistic decision making represents decisions made under conditions of risk or uncertainty.

A more formal definition of these two types of models follows:

> Deterministic Model - an adequate and appropriate representation of phenomena, repeated observations of which warrant the assumption that the statistical fluctuations are small enough to be ignored.[17]

> Probabilistic Model - The representation of a process, event or relationship in terms of relative frequency of occurrences, degree of one's belief in logic of propositions, degree of one's belief in outcomes of events, and/or abstract characterisitics associated with groups of entities.

Computer Data Base

The term "computer data base" can be defined as:

> "...the computer-stored respository of the pertinent data from which the operations of an organization can be derived. By data is meant the facts and figures that are kept. Information then is the meaning or interpretation of these facts and figures which usually appear in computer-generated reports." [21]

DATA BASE MANAGEMENT

Data base management includes such functions as:

1. Data Collection The process of collecting the pertinent data as applicable to an organization's needs.
2. Data Coding In order to facilitate future retrieval, the input data is coded by a standard coding program.
3. Data base generation A data base generation program adds new data to the data base memory, This process includes the allocation of storage space.
4. Data base maintenance This process includes the revision and deletion of data previously added to the data base.
5. Data base retrieval The ability of the computer to perform fast and efficient retrieval. This includes direct data retrieval as requested by the user, or retrieval of required data for further processing as a parameter in a computer model even when that data cannot be uniquely identified.

The management of the data base function is performed by computer software packages known as data base management systems (DBMS).

In the early days of computer processing each application was processed by the use of a separate data file. This method lead to costly duplication, and inefficiency; also an application requiring data from many other applications necessitated the building of a new data base from parts of seperate files.

These short comings lead to the concept of the "common" data base. According to this concept data is viewed as a resource of an entire organization; that is, instead of data being available only to the originator, data should be available to anyone in the organization with a need to know. It also allows one components information system to be a function of other systems in an organization, in consonance with the "systems approach" to management.

The Decision Making Process Under Uncertainty

> If a man will begin with certainties he will end with doubts, but if he will be content to begin with doubts he shall end in certainties.[18]
>
> Francis Bacon (1561-1626)

> Doubt is not a pleasant mental state, but certainty is a ridiculous one.[18]
>
> Voltaire (1694-1778)

The primary purpose of information, and therefore the management information system, is to increase the knowledge of the user, and thus reduce the uncertainty of his decision. Although computerized management information systems, through the use of quantitative models, provide much useful information when one is dealing with uncertainty, a decision maker should be very careful in not placing total confidence in such models. Managerial decision making requires much information that cannot be accurately computerized; for example opinions, uncertainty involving future events where the probability of occurance can not be calculated using mathematical models, but must be subjectively assessed, and political and social pressures (the environment), etc.

Therefore computerized information can only increase the probability of certainity (decrease risks), or reduce the number of alternative choices. The decision maker, not the computer, must still make the choice under less then certain conditions. The overall management information decision process should include consideration of non-quantifiable inputs as well as those resulting from computerized data processing applications. The computer should be considered only as a valuable aid for human judgement, not a substitute for it.

> "... Make your decisions as much on the safe side as possible, remember that things can easily happen that should not have happened. Unless forced by necessity do not restrict yourself.
>
> Francesco Guicciardini (1483-1540)

Program Management Information Systems

Program management differs from traditional functional management in several primary respects:

1. It is structured to deal with specific complex problems or objectives using a systems approach.

2. It cuts across traditional departmental and disciplinary lines in using the expertise of personnel.

3. It deals with temporary goals or objectives. When these goals or objectives are attained or disbanded, the program management office is disbanded, its personnel are reassigned to the functional organizations, other program offices, or released.

According to Archibald, there are key differences between a functional organization MIS, and a project management organization MIS. The differences are summarized in the following figure 2.

Furthermore Archibald states that program managers must have management information systems which will enable them to:

> Plan, subdivide, estimate, integrate, forecast, evaluate and control all projects, integrating all of their life cycle phases (concept, definition, design, construction or manufacture, commissioning or commercialization, close-out).
>
> Integrate action plans, schedules, and resources (money, manpower, machines, etc), all identified by PBS-Project Breakdown Structure - element and organizational responsibilities; and including estimates, budgets, actual expenditures physical progress and forecasts of time and cost to complete and at completion. [16]

Implementing an MIS System

There are no set rules for implementing a Management Information System. Each system must be tailored to its particular organization. However, in order to obtain a system that best supports management in its decision making efforts, and also has the support of management personnel, several measures should be taken.

ORGANIZATIONAL MIS	PROJECT MIS
Purpose: To manage permanent, slow-changing organizations.	Purpose: To manage temporary, rapidly-changing projects.
Type of Information handled: Each separate MIS deals with specific information of primary interest to one part of the functional organization.	Type of information handled: Many types of information affecting several functional areas contributing to each project.
Time Horizon: Usually limited to annual budget cycle.	Time horizon: Reflects the duration of each total project and each life cycle phase therein; therefore must be flexible; usually extends beyond the annual budget cycle.
Predictive capacity: Limited to budget period, maximum usually one year.	Predictive capacity: Must have strong predictive capacity reaching to the end of each project, usually beyond one year.
Integrative capacity: Limited, since each MIS deals with one specific type of information--with the exception of general management information systems, which must have the same or even greater integrative capacity as PMIS.	Integrative capacity: High, since information dealing with action plans, time, cost, resources, logistics and business acquisition must be interrelated and summarized for each project and each affected functional organization.
Ease of implementation of new procedures: High, if a modular approach is used, since new procedures can be introduced for a limited segment within a function, and since the integrative capacity requirement is limited.	Ease of implementation: Low, since system effectiveness is directly related to the degree of integration, and since PMIS depend heavily on many organizational MIS which frequently have inherent inconsistencies in procedure and data (different numbering schemes, cut-off dates, cycle times, etc.).

Source: "Management Information Systems for Projects and for Organizations: A Comparative Overview," by Russel D. Archibald.

Figure 2

1. Top management and the MIS must be in accord, and the system must have the full support of top management. Top management itself must be involved in its implementation. The information system should support the overall goals and objectives of the organization.
2. The system must be completely user-oriented, not computer-oriented. The system that will support management decision-making processes must be able to be used by the nontechnical type of individual, avoiding a communications gap between the user and the system that is designed to aid him.
3. There must be clear agreement between top management and the MIS consultant on the quality of information that it is possible to generate and that which is to be generated by the proposed system.

The scope of management information systems for DOD acquisition program offices should be in accordance with DOD Directive No. 5000.2, Major System Acquisition Process:

> Management information systems shall be limited to program information essential to effective management control. The required information shall be provided from the same data base used by the contractor in program management. Traceability of succeeding cost estimates and costing factors including economic escalation shall be maintained. A realistic work breakdown structure shall be developed for responsibilities, control and reporting progress, and use as a data base in making future cost estimates of new Defense systems.

CHAPTER III

COMPUTERS

Introduction

Computers may be classified as analog, digital or hybrid. Hybrid computers are a combination of analog and digital computers. Analog computers are defined as follows:

> Analog refers to the representation of numerical quantities, generally by means of continuously variable physical quantities. Electronic analog computers use voltages and currents to represent continuously variable quantities, while mechanical analog computers use physical lengths and angles for these quantities.[17]

The **digital** computer may be defined as follows:

> A computer which processes information represented by combinations of discrete or discontinuous data as compared with an analog computer for continuous data. Sequences of arithmetic and logical operations are performed not only on data but on its own program which can be stored as well.[17]

A search of the literature has revealed that the digital type of computer is used almost exclusively for management information system applications. This, no doubt, is do to the much greater capacity, flexibility, and adaptibility to data processing applications of the digital type of computer. The rest of this chapter will be concerned only with digital computers.

Computer system configurations are defined as follows:

> On line - Systems characterized by the fact that input data is generated into the computer and processed on that computer at the time of its entry into that computer. This is distinguished from batch processing.
>
> Off line - Systems type in which peripheral functions are accomplished other than on the main computer. Human intervention is necessary to perform these functions.

Real time - A computer system in which data is received by the computer, processed, and the results returned sufficiently quickly so as to affect the functioning of the environment at that time.[17]

Computer Hardware System

Despite a wide variety of size and configurations, most computer systems consist of three basic elements: the input-output units, the storage or memory hierarchy and the central processing unit (CPU). The relationship of these basic functions in a computer system is shown in Figure 3.

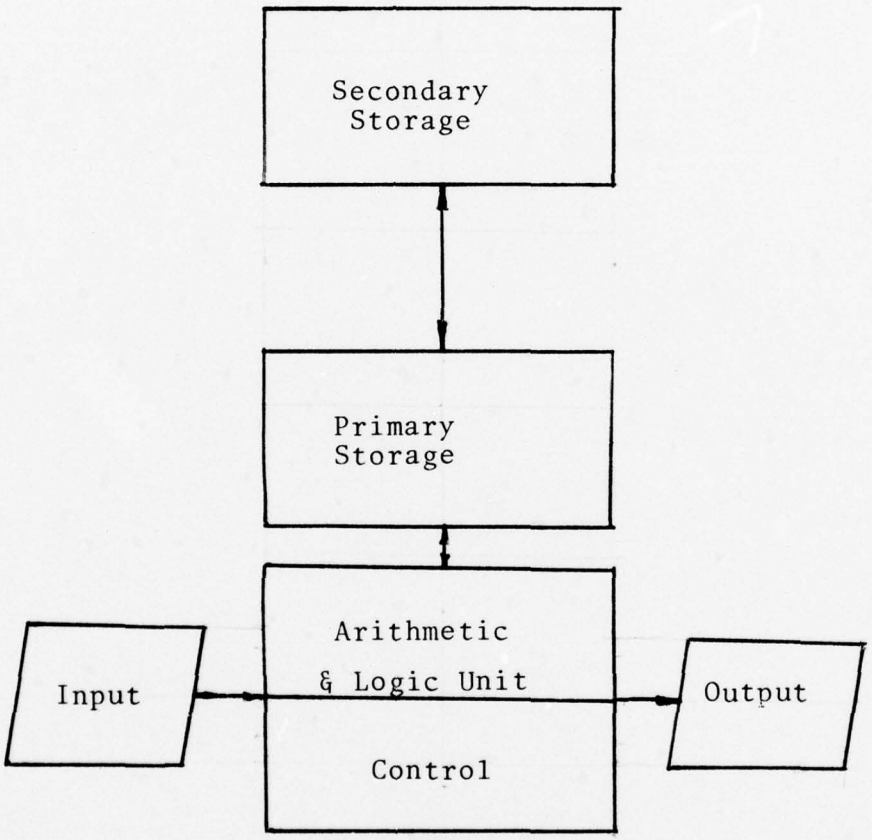
Input-Output System

Input-output (I/O) units are used to transfer external data or programming instructions into the computer, and to transfer the results of processing from the computer into the external media. Frequently used input devices consist of punched card readers, keyboards, magnetic ink, and optical readers. Among output devices are included line printers, microfilm, visual displays, and audio response units. In addition, such devices as magnetic tape and magnetic disk units are used for input, output and storage of data.

The Memory Hierarchy (or Storage System)

The purpose of the memory heirarchy is to store the program (the instructions) and the data in the system so that they can be quickly retrieved as required by the cental processing unit. There are two types of storage in most computer systems, primary or main storage and secondary or peripheral storage.

The primary storage is usually part of the CPU mainframe, although it could be located in one or more seperate cabinets.



Basic Functions of a Computer System

Figure 3

Secondary storage is always located externally to the CPU mainframe.

The primary storage contains the active program or programs, as well as the data to be processed in the central processing unit as instructed by the program. Only data contained in the main memory can be operated on by the computer. Therefore, if data is stored outside the primary memory such as on punched cards, magnetic tape or magnetic disk, it must first be "read" into the main storage before internal processing can occur.

Primary memory may consist either of a large collection of tiny magnetic cards, or of monolithic integrated circurts which are essentially large collections of transistors. Monolithic circuitry is rapidly displacing core memories because they permit faster execution speeds, and are becoming less expensive than core memories.

Primary storage transfers data into the central processing unit at high speed. Since speed is expensive, the cost of storing data in the primary memory is expensive. Therefore, secondary storage is generally used to increase the total memory capacity. The secondary or peripheral media are sometimes called mass storage devices, since they have the capacity to store vast amounts of data. They have slower speed of operation and lower cost than the devices used for the main storage.

The Central Processing Unit (CPU)

The cental procession unit performs the arithmetic and logic operations as instructed by the computer program, and controls the operation of the entire computer system by issuing commands to

other parts of the system and by acting on the responses. To perform these functions, two sub-units of the CPU are required; a control unit and an arithmetic/logic unit.

The control unit controls the operations of the computer by reading and interpreting the program instructions which are stored in the main memory. The control unit causes data also stored in the main memory to be transferred to the arithmetic/logic unit where operations are performed on the data according to the program instructions. The results are then transferred by the control unit back into the memory, and then moves information between memory levels or thru the input-output ports.

The arithmetic/logic unit of the CPU operates on the data stored in the computer's memory, under the direction of the control unit. It performs the arithmetic operations - addition, subtraction, multiplication and division. In addition, it performs logical operations such as comparing two numbers to determine whether they are equivalent, or if one number is algebraically greater or less then the second number. The results of these logic examinations are sent to the control unit where they are used to control subsequent actions of the computer.

Therefore, the control unit and the anthmetic/logic unit, acting together, may cause the computer to branch, or to take one of two different control paths at any given time depending upon the logic operations.

This decision making ability of a digital computer, that is, the ability to alter its own program in response to conditions encountered during an operation, is one of the major factors

contribution to its usefulness.

Software

The methods and techniques of communciating with the computer and instructing it in performing the tasks desired - the programs or instructions, are referred to as software. The "program", which is stored in the computer's primary memory, is a list of instructions that the user wants the computer to perform for a particular application.

The capability of varying or changing the program provide the data-processing system with unlimited flexibility. That is, one computer can be used for a great number of different applications by simply reading in, or loading, the proper program into storage.

The preparation of a set of coded machine language instructions for a computer is both difficult and time-consuming. To alleviate this problem, assemblers and compilers have been developed which enable the user to write the program for the computer in "source" language that is much more practical for the user than the actual machine instructions.

The assembler allows the user to write the program in symbolic source language, and then translates this source program into an "object" program one-for-one level language; that is, one source instruction will produce one object instruction.

The compiler was next designed to provide a higher, more powerful level of support than provided by an assembler system. In the compiler one instruction or statement in the source program can lead to the creation of many machine instructions in the object program. The distinguishing feature of a compiler is that it enables the user to prepare programming instructions about his problem in a language familiar to

the user. Each type of compiler requires the use of its own unique source language. FORTRAN, for FORmula TRANslation, is the most famous and the most widely used compiler.

Time-Sharing Systems

To reduce the cost of using a computer system, particular in applications where only part time accesseability to a computer is required, a time-sharing system may be used. A time sharing system is an on-line system in which many users, each with different programming applications, share a remote common computer. Each user has his own input/output devices which are connected to the central terminal by transmission links; for example, through the telephone circuitry. The central computer contains the central processing unit and the memory. The computer is so programmed that it appears to each user that the computer is dedicated to his program alone.

CHAPTER IV

COMPUTERIZED MANAGEMENT INFORMATION SYSTEMS (CMIS) APPLICATIONS IN A PROGRAM OFFICE

Introduction

The purpose of this chapter is to describe examples of various CMIS applications that could be used in a program office. It is hoped that this chapter, by introducing the reader to the nature, scope and potential of CMIS uses, will assist him in deciding whether to use CMIS for similar type applications or provide a framework for investigating other areas of applicability unique to his particular needs. Following are a few examples of the wide range of possible MIS applications.

PERT & CPM Networks

An important tool in the field of program management control has been the development of a network based planning/scheduling methodology. This methodology is based on two techniques; PERT (Program Evaluation and Review Techniques) and CPM (Critical Path Method) analysis.

The networks are time-phased graphical representations or models of a project plan. The first step in using these networks is the identification of all the activities and events involved in a project and the representation of these activities and events in a flow diagram or network. Events are represented by circles and activities by arrows. Events are interconnected by various activities (arrows). Activities are represented on the diagrams by the time spent on a particular activity to go from one event to the next event.

Network diagramming for project management provides the following benefits:

(1) It provides a disciplined basis for planning a project.
(2) It provides a clear picture of the scope of a project that can be easily read and understood.
(3) It provides a vehicle for evaluating alternative strategies and objectives.
(4) It tends to prevent the omission of jobs (or activities) that naturally belong to a project.
(5) In showing the interconnections among the jobs, it pinpoints the responsibilities of the various operating departments involved.
(6) It is an aid to refining the design of a project.
(7) It is an excellent vehicle for training project personnel.[32]

The key difference between CPM and PERT is that CPM uses only one time estimate for each activity, and thus no statistical treatment of uncertainty. PERT, on the other hand, involves the assigning of three separate time estimates for each event, and the calculation of probability estimates of meeting specified schedule dates.

Boths PERT and CPM networks indicate a number of different "arrow paths" between the start and finish of a project. The time to complete each path is the sum of the time for each activity or job on that path. The "critical path" is the longest path in terms of time from start to finish. It indicates the minimum time in which a project can be finished. There may be more than one critical path on a project.

Slack time is the amount of time that the completion of events on a path may be delayed without exceeding the total time of the critical path; that is, without delaying the final completion date of a project. Depending on their slack time, thradeoffs or delays may be made on the non-critical paths.

High speed computers are used to calculate such items as the expected time for the completion of each event, the identification of slack and critical paths in the project, the probability of meeting the current schedule, and the latest date by which every event must be completed in order to meet the desired project completion date.

The computer enables the manager to quickly determine the effects of delays exceeding slack times, and in allocating resources to determine the optimum scheduling of events and to determine the effects of changing the events or the timing of events as the project proceeds.

Life Cycle Costs, Naval Material Command Life Cycle Cost Guide For Major Weapon Systems[29]

Life cycle cost is defined as the total cost of acquiring the product, establishing the necessary logistics base from which to deploy and use the product, and maintaining the product in operable conditions over some prescribed period of time.

Various life cycle cost models have been developed by the Services. This section details a life cycle cost model developed by the Naval Material Command.

The Naval Material Command Life Cycle Cost (LCC) model is a computerized analysis technique. The model consists of 376 cost equations contraining approximately 1400 data items. The model is characterized by the following main features:

1. The capability to evaluate the cost associated with the entire life of the major weapon system.
2. Ability to define inflation/discount factors.
3. Simultaneous con ideration of sub-systems of the major weapons system.
4. Complete set of standard output reports.
5. Sensitivity analysis capability

The LCC cost methodology is derived from the various costs that may be attributed to designing, developing, procuring, operating, supporting and phasing out a major weapon system. The costs are separated into the

following five phases in the model:

Advanced Development

Full Scale Development

Investment

Operations and Recurring Support

New Terminal Value

These phases represent the natural chronological phases in the life cycle of a major weapons system and are in accordance with DSARC (Defense Systems Acquisition Review Council) review phases.

The Major Weapons System model calculates costs for each major sub-system within each of the five cost phases indicated above. The model considers the following ten cost categories:

Contracted Research

Management

Testing

Prime System

Training

Supply Support

Technical Data

Support Equipment

Operations

Maintenance

These cost categories are defined in Figure 4.

Each cost equation in the model is also identified with a funding type. The funding types are classified as follows:

Research and Development

Category	Definition
Contracted Research	Direct payments to the contractor for the development of the weapon system
Management	Cost of personnel in program office or field activities who manage the test, evaluation and procurement process
Testing	The cost incurred with the RDT&E for the weapon system and subsystem/component development
Prime System	The unit cost of the major weapon system
Training	Acquisition, installation, and modification costs of training devices. Cost of providing initial and recurring training facility costs incurred by the Government. Pay and allowance and travel costs of instructors and students
Supply Support	Management cost of national stock numbers introduced into the supply system by the weapon system
Technical Data	Production, distribution and updating costs of technical documentation and computer software
Support Equipment	Acquisition and maintenance cost of support and test equipment with application to the weapon system
Operation	The cost of fuel, utilities and operators required to operate the weapon system
Maintenance	Acquisition and modification costs of maintenance facilities. Cost of technical services. Labor cost of maintaining the weapon system

Figure 4

LCC Model Cost Categories

Procurement

Construction

Operations and Maintenance

Military Personnel

Other

The "other" category represents the cost benefits associated with FMS (Foreign Military Sales). The model computes these cost benefits as a negative value, rather than attempt to distribute these cost benefits as a negative value.

The sensitivity capability of the model permits one or more input data elements to be varied over a range of values to evaluate their effects on life-cycle costs. If the life cycle cost varies an appreciable amount as the input is varied over a reasonable range of possible values, then the LCC is said to be sensitive to that input.

The model has the capability for generating the following output reports to the program manager.

1. Summary Report - Total life cycle cost is broken down into the ten cost categories and five life cycle phases. Within each cost category, costs for each life cycle phase are given.

2. Funding Cost Category Report - Total LCC is broken down into the ten cost categories and six funding types. Within each cost category, costs for each funding type are given.

3. Cost Breakdown by Year Report - Annual costs are given for each element contained in the cost breakdown structure.

4. Cost Breakdown Totals Report - Life cycle costs and percent contributions to their next higher indentured cost element are identified for each element in the cost breakdown structure.

5. General Funding Report - Life cycle costs are given by cost breakdown structure element and funding type.

6. Annual Cost by Funding Type Reports - Annual costs are broken out into the six funding types.

7. Annual Cost by Cost Category Report - Annual costs are identified according to the ten cost categories.

8. Sensitivity Analysis Report - Results of the sensitivity analysis are presented. For each value of the sensitized variable, the life cycle cost is broken out into the five life cycle phases.

The input cost figures for the LCC model may originate from the Service integrated logistic support office, from the contractor or from the program office. The Cost Analysis Improvement Group (CAIG) provides cost definitions to by used by the Services for estimating purposes.

Procurement decisions and various development decisions for major acquisitions will be based on life cycle cost analyses results among other factors. The analyses should be updated at each DSARC milestone or when more accurate cost data is obtained. In addition, the LCC model should go through another iteration to evaluate the effect that any proposed change in system design will have on the LCC goal, or at any other time when the program manager must make a decisive decision during the acquisition cycle that concerns cost.

Resources Management Information System (REMIS)

The Resources Management Information System (REMIS) is a computer based automatic data processing system established within the Navy Strategic Systems Project Office (SSPO) to facilitate achievement of its program objectives through effective and efficient management of its financial resources. The ultimate objective of REMIS is the availability of funds to the project office necessary to perform on schedule the tasks essential to the successful accomplishment of its mission.

Four principles that form the basis of SSPO'S financial management structure and the REMIS system which impliments it are as follows:

1. Each objective is addressed in its entirety. Management accounts retain their identity throughout their active life rather than being arbitrarily broken into new accounts each fiscal year.

2. Funds control is exercised at a greater level of detail than any higher authority would require for reporting. Ordinarily the management account level will serve as the lowest common denominator of external requirements.

3. Every effort is made to plan, budget and execute approved projects at a common level of detail. The most important virtue of this approval is the relative certainity that future requirements will be anticipated and adequately funded.

4. Programming, budgeting, procurement, planning and execution are treated as interdependent processes. Hence, account justification used during the programming and budget formulation phases must be consistent with the task statements and contractual specifications of actual procurements.[28]

The value of the REMIS system to the SSPO has been described as follows:

> In addition to affording financial personnel a means for responding to both interval and external reporting requirements, REMIS provides to the technical staff a yardstick against which execution progress can be measured, and to the management of the system offices a powerful vehicle for decision making, policy formulation, and overall stewardship of SSPO resources.[28]

The high-speed computer at the heart of REMIS is an IBM 370/160 computer which is physically located at, and maintained by, the Naval Material Command Support Activity (NMCSA). The computer provides time-sharing operations to NMCSA customers, including SSPO. The input-output devices installed at SSPO headquarters are a Data 100 card reader and report printer, and three console typewriters (or terminals). This equipment is linked to the computer and its related peripheral devices by conventional telephone lines.

The REMIS software package is based upon the MARK IV File Management System which is a set of integrated computer programs. The MARK IV software product was developed by Informatics, Inc.

Decision Theory Analysis

Many times the program manager, based on information that he receives from his MIS, will have to make decisions under condition of uncertainty. The MIS will only assist him in his decision making process, not make the decision. To make intelligent decisions, the program manager should know how to make use of a set of quantitative techniques which is known as Decision Theory Analysis or DTA.

DTA makes use of the decision maker's judgement, experience, attitudes and values along with facts such as historical data. The executive is required to do three things as a first step in arriving at decisions made under conditions of uncertainty:

1. Stipulate what decision alternatives are to be considered in the analysis of a problem.
2. Make a probabilistic statement of his assessment of critical uncertainties.
3. Quantify some possible consequences of various actions and his attitudes toward these consequences.[30]

The best logical decision can then be obtained according to the statistical theory that underlies DTA using decision trees, utility theory, Bayesian analysis and computer programs including computer simulation.

DTA is well documented in the literature, for example, references 33 & 34 of this paper, as well as the material given out in the DSA (Decision and Statistical Analysis) course at the Defense Systems Management College.

Several examples where a program manager might want to use DTA are for "make or buy" decisions, continue or commence development/operational testing, whether to go into production or delay production in order to develop a more technological advanced product.

Commercially Available Software Products

Computer software products for project office management information systems are available from various computer manufacturers and software management consultants. Programs are available for PERT/CPM networks, resource allocating (based upon results of time analysis, activities are scheduled in accordance with resource constraints), cost evaluation and other applications. The programs are designed to assist the program manager in the planning, control and monitoring of his program.

For more information on these software products the reader is referred to IBM's "Introduction to Project Management System IV", and "System/370 Project Analysis and Control System (PROJACS)."

In addition, information on software products available from other sources can be obtained from the Project Management Institute, Technology Committee, Box 43, Drexel Hill, Pennsylvania, 19026.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This study has examined various specifics concerned with computerized management information systems, and with the possible benefits and applications of MIS to program offices. The computer's high speed, large storage capacity and computational ability offer obvious advantages for the processing of data into timely information to aid management in the decision making process.

Management information systems will be beneficial to the program manager only when it is determined that they are economically feasible. in addition to being desirable.

The economics benefits should exceed their cost. This requirement is emphasized by DOD Directive 5000.19, Policies for the Management and Control of Information Requirements as follows:

> Two major factors shall be considered prior to the establishment of a new or continuation of existing information requirements:
>
> 1. The cost of obtaining information in relation to its use.
> 2. The penalties or risks associated with not having the information.

Befor the MIS system can be used to its maximum potential the manager must know what his specific information needs are, be able to develop or be familar with analytical approaches and models, make explicit his planning, control, and decision-making processes and procedures, and be able to interpret and make use of the output information.

Several specific areas for future investigation concerning the subject of this paper are recommended. The following topics are suggested:

1. Application of computer graphics and display systems for MIS in the program office

2. What are the potential uses of mini-computers or "desk top" computers for a program office MIS

3. Can various MIS systems be interconnected

4. Building a computer data base for the program office

5. Applications of operations research methodology or management science in an MIS

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