AN EXPLORATORY STUDY FOR DESIGN
OF A PROPULSION DEPUTATE
MANAGEMENT INFORMATION SYSTEM

THESIS

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Preface

The clamor raised over the costs of aircraft
weapons systems, such as the B-1 bomber, has forced
an even closer investigation of the procedures used
to develop the systems. One result of the investigations
was the establishment of the Deputate for Propulsion
as a separate organization for propulsion unit development.
To support the organization the Deputy for Propulsion
charged personnel in his organization with the design
and implementation of a management information system.
This thesis effort is aimed at aiding the personnel
with development of the system as well as providing
some insight into the work processes of ASD organizations.

I gratefully express my thanks to Professor G.C.
Saul Young for his advice and assistance and to Professor
Edward J. Dunne for his help. I also express my thanks
to the personnel in the Deputate for Propulsion who
supported this thesis effort, particularly Mr. Jeffrey
Hoover and Lt. Col. Paul Breen. Special thanks go to
my wife for her help and understanding.

Bruce E. Wallachy

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ABSTRACT

The primary objective of this thesis effort is the development of a plan for the design and implementation of a management information system (MIS) in the Deputate for Propulsion. To accomplish the task the MIS development ideas and concepts presented by MIS experts in the literature sources are examined and applied to the organization and its work. Specific actions and agents are then identified for the MIS development. Since the development process for the Deputate is in its initial stages at the time of this thesis effort, special attention is paid to identifying actions which initially help orient the development toward a successful system.

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I.   INTRODUCTION AND OVERVIEW

Introduction

Management information systems (MISs) are of great

concern in the present-day world of business. The ever-

increasing complexities of the business world have forced

the use of information gathered from many sources in the

process of arriving at important decisions. The age has

passed where top management executives can run their

organizations by intuition. Even organizations which

have long been established as successful members of the

business world have realized the need to continually

expand the information and data they use in arriving at

the correct decisions at the appropriate time. The MISs

have provided organizations with the means of gathering

the data and extracting meaningful information.

The use of MISs has not been limited to the world of

business and industry alone. All types of organizations

have employed their uses, including the government and the

military. The use of MISs in the military has proven to be

vital in maintaining our country's military response to

potential and real threats. Particularly important in the

military case is the application of MISs to weapons systems

development and acquisition. By providing basic information

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about technical, financial, and schedule alternatives,
the MISs have provided the military decision-makers
with a firm basis to assess the risks and costs of
major weapons systems.

The application of MISs in the military sector is
not limited to the development and acquisition of weapons
systems. The uses extend into almost every conceivable
area where management needs information to operate.
In fact, the command and control networks of military
leaders are good examples of applications of MISs. Yet,
the development and acquistion of weapons systems have
proven to be so expensive that MISs have become critically
important in that area. Without MISs the funds authorized
and appropriated by Congress cannot be efficiently and
effectively applied to maintain our country's security
and safety.

Organizations within the Aeronautical Systems
Division (ASD) at Wright-Patterson Air Force Base, Ohio,
have been intensely aware of the importance of MIS devel-
opment and updating. The Deputate for Propulsion is one
of these organizations. Since the Deputate's establishment
as a separate organization in ASD in 1976, great emphasis
has been placed on developing an MIS that will support the
unique work accomplished by the Deputate. In general, the
Deputate has total management responsibility for cost,
schedule, and performance of all Air Force Systems Command
(AFSC) gas turbine engine programs. The organization

manages and directs the life cycle acquisition activities for AFSC gas turbine engines including appropriate engine deployment efforts, in association with Air Force Logistics Command (AFLC) and the users.

The Nature of MIS

Initially it is helpful to understand the general relationships between MISs and other organizational systems and the place of MIS in the organization. In Figure 1 these relationships are depicted. The MIS holds a unique place in the organization which is separate from but closely linked to the management systems. The MIS collects data and organizes the data in order to supply the management personnel, who control the management systems, with information concerning the organization's work and progress. The data received by the MIS usually concerns internal processes, but external data from the business world is also an important input. Once the data is inputted, then the MIS operates on the data transforming the facts into something by which management personnel can review the progress of the organization. When the management personnel receive the output of the MIS, they consider its content and perform their jobs based on the information. In many cases, the actions involve internal controls and directions, but the personnel also interface with the external environment. In their use or neglect of the products of the MIS the management personnel provide feedback

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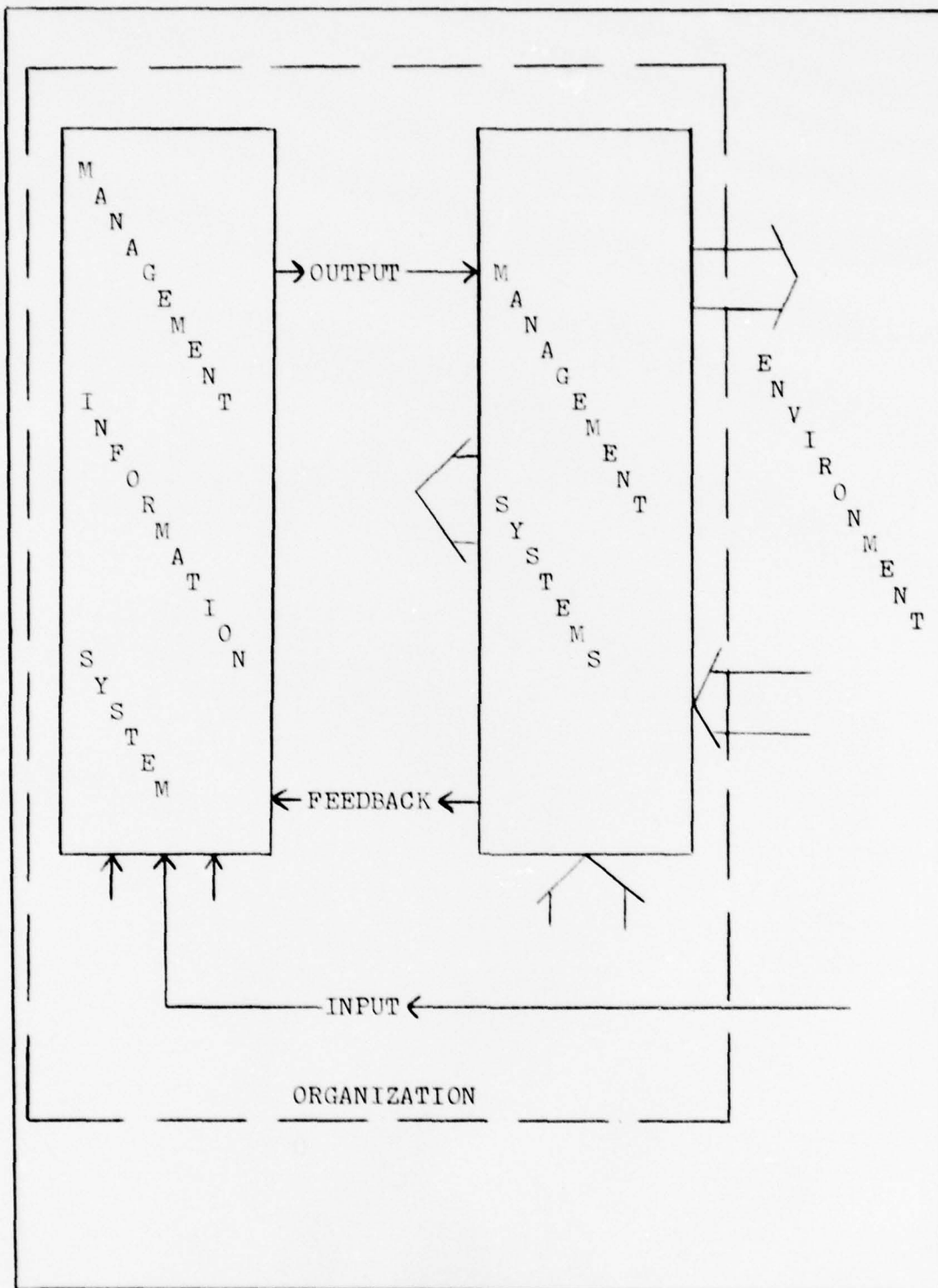
Figure 1. MIS Relationship Within Business World

to the MIS. This feedback guides the MIS in future

transformations of data.

Together the MIS and management systems give the

management personnel the tools to control the organization

and insure their success in the business world. The

information presented by the MIS gives the management

personnel a good indication concerning the success of

management decisions. Often the MIS can give the manage-

ment personnel an indication of the possible effects

of their actions before the actions are implemented.

Each system has its own methods of providing information,

and yet there are some common grounds between all the

MISs so that key decisions can be made about the devel-

opment of an MIS.

Within the fields of management and information

systems, experts have attempted to very explicitly

define the MIS. However, even with all the attention

given to MIS, no single common definition has evolved.

The views of the experts have differed greatly. Some

define the MIS as an on-line computer system that provides

information only on request while others suggest that the

MIS is nothing more complicated than the notes that

an owner of a small business might carry in his hat

(Orlinky, 1969, p. 54). Such confusion about MIS seems

to stem from the experts' attempts to be too specific

about the MIS. While one definition may apply well

to computer systems, other definitions may totally

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disregard them. This confusion over what MIS entails
forces this writer to provide a clear description of
the topic on which this study focuses.

For this study, MIS is defined as any organized
method of collecting data, extracting information, and
presenting the information to organizational personnel
(Forkner, 1973, p. 386). The methods which can be used
by the MIS are not restricted. Instead, any method,
whether it be a sophisticated computer system or a
personally kept, manual system, is considered an MIS
as long as it provides management with information
about the organization and its work.

The three essential parts of the MIS are the input,
the processing, and the output. The input data consists
primarily of data generated within the organization,
from management personnel themselves, and from external
sources outside the organization. Anything that has
a potential impact on the organization is a viable input
to the MIS. The MIS processing involves the methods
used to take the input data, organize it, analyze it,
and summarize it. In short, any method which extracts
from the data some knowledge which is valuable to the
organization can be considered an appropriate processing
method. The output of the MIS can be any method which
provides the processed information to the management
personnel on a regular basis or at the time the management
desires the information. In many cases this output

means a written report that is structured and formatted according to the desires of management personnel.

The definition of MIS to be used in this study does not include the personal contacts and informal ways that management personnel obtain and use information. While in the objective sense these contacts and informal ways may be considered as part of the MIS, they cannot be easily described or applied as part of the MIS for the whole organization. These contacts depend strictly on the individual styles of the managers themselves. Since this study is oriented to the design of an MIS for use by the whole organization, such personal and informal MISs have to be ignored. However, when the data or information gathered through the personal contacts are incorporated or inputted into the organization's MIS, then the products of the informal actions are considered as part of the MIS.

Statement of Problem

The purpose of this thesis is to advance the development of an MIS for the Deputate for Propulsion. This purpose is accomplished by aiding the organization in its initial efforts to design and implement its own MIS. This thesis describes the procedures to use in developing the MIS and identifies the critical factors involved in insuring its successful assimilation into the work processes of the organization. The approach that is outlined here is specifically tailored to meeting

the requirements of the development and acquisition of gas turbine engines in the ASD environment.

Since the Deputate is a relatively new organization in ASD, the critical factors of the MIS involve defining the basics of the Deputate's work. This work definition includes defining the objectives of the organization, identifying the major components, coordinating the information requirements of the offices within the Deputate, and establishing criteria for the successful design and implementation of an MIS tailored to the specific needs of the Deputate.

It is not the purpose of this study to completely detail all the elements within the Deputate's MIS. That is is work of those personnel who will be designated to take the guidelines developed from this study and apply them to the detailed work of developing the Deputate's MIS. Instead, this study identifies the approach to use in the development which, it is hoped, will start the work off in the right direction.

The guidelines presented in this study provide the framework of the MIS as it applies to the process of gas turbine engine development and acquisition. This study recognizes that unless a person has been working for many years in the field of weapons systems development and acquisition and in particular in the specific area of gas turbine engines, that person cannot hope to know all the details and techniques to apply to the

work processes. However, this limitation does not preclude the MIS development from benefiting from a study which objectively reviews both MIS theory and describes the most appropriate approach for the development of an MIS for the organization.

Objectives

The primary objective of this exploratory study is the development of a plan for the design and implementation of an efficient and effective MIS for the Propulsion Deputate. This plan outlines the initial steps to take in some detail and describes critical parts and stages of the development process. Not only does the plan specify the initial efforts to take, but it also gives the development process an overall framework within which to operate.

Secondary objectives of this study are the review of MIS theory and application, and the gaining of insight into the development and acquisition processes of Air Force weapons systems. Also, this study provides an understanding of the type of operational work performed in the ASD organizations.

Scope and Limitations

In fashioning a plan for the development of the MIS within the Deputate, this study concentrates on the major and critical items. Limiting the study to these items is both necessary and desirable. The time limitations

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for full development of an MIS prohibit consideration
of all the factors and details involved in a fully
operational MIS. In addition, by identifying the major
and critical items, the personnel assigned to develop
the MIS detail and management personnel have more freedom
to design the detail to meet their own needs, individually
adapting the MIS and incorporating it into their jobs.

The research material for this study is restricted
to that which was published since 1965 and is available
in the Dayton, Ohio, area. The information gathered
for this study relies heavily on the documents and
reports concerning gas turbine engine development and
the interviews with organizational personnel concerning
their views about an MIS. Extensive work was accomplished
in coordination with the Program Control directorate,
since they are the personnel who have been designated
to support this effort.

Assumptions

As with any study there are underlying assumptions
upon which the study rests. These assumptions do not
necessarily limit the study or its usefulness, but they
do direct the process and play an important part in
the final product.

The major assumptions underlying this research
effort are: 1. There is some commonality in the acqui-
sition of different engines. This commonality applies
in varying degrees throughout the life cycle of the

engines and provides the basis and reason for the Deputate's
MIS. This assumption underlies the decision by the ASD
to create the Deputate for Propulsion as a separate
organization within ASD.

2. The organizational structure and mission of the
Deputate will essentially remain as described in this
study. This includes the separation of the Deputate
for Propulsion from the other ASD organizations and
the matrix management structure used in the Deputate.

3. The information gained from personal contacts
and interviews with organizational personnel is sufficient
to gain enough information about the objectives of the
organization. Also, the interviews and contacts identify
the major elements of the operation within the Deputate.
In this regard, the personnel must recognize their need
to be involved in the design of the MIS and clearly
describe their needs for management information to
accomplish their jobs.

Plan of Presentation

Chapter II presents the methods by which this
study was conducted. The chapter identifies the sources
of information and how the information was collected.
Some particular studies and reports which are of significant
importance are also identified.

Chapter III describes the general approach of the
MIS development process as found in current literature.

The chapter describes the phases which are generally thought to be appropriate in developing an MIS.

Chapter IV describes the organization and its role and mission in the process of weapons systems development and acquisition. Both the general items and unique actions of the Deputate are reviewed so that the design of the MIS can support the organization. At the end of the chapter the plan for the development of the Deputate's MIS is specifically identified along with the rationale for the particular steps to be taken.

Finally in chapter V, the study is summarized and the plan for the design and implementation is briefly outlined. Additional topics for further study and investigation are also identified.

II. RESEARCH METHODOLOGY

As previously defined, the objective of this study is the development of a plan for the design and implementation of an efficient and effective MIS for the Deputate for Propulsion. This study outlines the steps and procedures to use in developing the MIS. Since the MIS development effort within the Deputate at the time of this study was in its early stages, particular attention and emphasis have been placed on outlining the actions that can be taken at the outset of the development process that can aid in securing the success of the Deputate's MIS.

The study primarily concerns the information needs of upper level management personnel. These upper level management personnel consist of the Deputy for Propulsion, the functional directors, and the heads of the engine program offices. The orientation of the study to the needs of these upper level management personnel emphasizes the purpose of reorganizing the Deputate as a separate organization in ASD. Also, the upper level management are those in the Deputate who benefit most from an MIS, for the program managers who work daily with the programs tend not to need or use the outputs from such a system. However, the program managers' inputs are usually critical to the success of the MIS to higher levels of management. For those who are one or two steps away from the program manager-contracter interaction, an MIS provides very

useful and needed information about the status and health
of the programs.

Data Collection

With the problem and objectives of this study stated,
the next step is the description of the sources of infor-
mation and data used in the study. The general information
about MIS theory and the design processes were obtained
from library literature and government-sponsored reports
about MISs. The MIS information also included investigating
the nature of MISs and their roles within the management
framework. The information concerning the organization
and its work processes was gathered from two primary
sources: materials and reports generated from within the
Deputate and other ASD organizations, and the interviews
and personal contacts with upper level management personnel
and Program Control personnel in the Deputate. In all
cases, the emphasis was placed on gaining an understanding
of how the MIS theory and design processes can be most
effectively applied to the development and acquisition
of gas turbine engines.

Materials from the Deputate and other ASD Organizations.
When ASD reorganized to separate the Deputate for Propulsion
from other ASD organizations, both very specific and
quite general objectives were identified for the organi-
zation. Job descriptions for personnel were also written
and the organizational structure was established. All
of these actions, materials, and information support

the purpose of crossfeeding information and experience across the engine programs. To continue in this trend set for the Deputate, specific attention is given to the objectives and job descriptions.

In the period between the establishment of the Deputate until the time of this study, a system for passing information within the Deputate was established. This system consists of loosely formatted but very detailed, periodic reviews of each engine program as well as in-depth reviews of the functional directorates. These reviews are dedicated to crossfeeding the experience and information among the engine programs and the management personnel in the Deputate. The information gathered from these reviews provided a great amount of help in determining the proper approach for the organizational MIS.

Other organizations in ASD have also experienced problems with the development of MIS. Since these organizations have very similar objectives and problems as the Deputate, the information gathered from these organizations was helpful in directing this study.

Interviews and Personal Contacts. The materials generated by the Deputate did not identify all the factors that were significant in developing the Deputate's MIS. Therefore, interviews were conducted with the management personnel for whom the MIS was primarily being developed. The interviews centered on defining the work performed by

each manager in his particular job position. The information sources and needs of each manager were also discussed, including special items or procedures which were unique to their jobs. A formal interview questionnaire, which is presented in Appendix A, was used to conduct the interviews and provide some direction to the interview process.

In addition to the interviews conducted within the Deputate, other interviews were conducted with personnel in other ASD organizations. These personnel had knowledge or insights useful to the development of MIS or to the work performed by the Deputate for Propulsion. The list of personnel interviewed for this study is also presented in Appendix A. The major purpose of the interviews outside of the Deputate was the identification of any work already completed concerning MIS development for ASD organizations and identification of studies completed concerning life cycle engine development costing methods. Of particular interest were computer programs readily available for use by the Deputate.

The personal contacts mentioned here referred to the discussions among personnel in the Program Control directorate. The Program Control directorate has been tasked with the job of developing and then controlling the Deputate's MIS. These discussions were usually informal but aided greatly in the completion of this study.

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Literature. Much has been written about MISs and
information systems in general. This interest about
MISs has generated many articles and books describing
applications of MISs and describing procedures to be
used in developing MISs. From the literature, this
study identified the significant factors which can
contribute to the successful development of an MIS for
the Deputate. These factors provided the basis from
which the plan for the design and implementation of
the Deputate's MIS evolved.

The literature also included many articles about
the failures of MISs. MIS experts have analyzed the
reasons for the failures and have provided documentation
on factors, items, and actions to avoid in developing
an MIS. Although these articles are not specifically
important to the development of the MIS for the Deputate,
they did provide valuable information concerning the
pitfalls that the development of the MIS should avoid.

The literature surveyed for this study was limited to
that published or written after 1965. The sources were
primarily the Air Force Institute of Technology (AFIT)
library and the Wright State University library. However,
some important reports and publications from the Defense
Documentation Center and the personal libraries of AFIT
professors were also used. Special attention was given
to a study of the critical factors of Air Force MISs

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completed by Colorado State University (CSU) faculty members (Carter, 1975). An AFIT thesis completed by Captain Jere Retzer (1977) which addressed some questions raised by the CSU study was also given special attention. These reports concentrated on elements critical to MISs for Air Force organizations and were significant in identifying the areas of emphasis needed for this study.

Data Analysis

The analysis of the problem to be addressed by this study initially began with informal meetings with personnel in the Deputate. These initial contacts established the reasons for this study, showing the importance and value of a plan to aid the personnel in developing their own MIS.

The next step consisted of conducting formal interviews with the management personnel in the Deputate in order to gain an understanding of the work that is accomplished and the overall performance of the organization. These interviews did not delve into the minute details of the personnel's jobs, but instead tried to identify common processes and procedures performed by these personnel. The specific details involved with the jobs will be left for investigation by those who proceed into the actual detail work involved in developing the Deputate's MIS.

With some knowledge of the work accomplished in the Deputate, the study proceeded to review the literature

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and articles written about the procedures for developing

and implementing MISs within organizations. With as many

different approaches as authors, this part of the analysis

consisted primarily of summarizing the development

procedures and identifying the critical factors involved

in the development process. During the literature review

the ideas and procedures were continually being reviewed

against the goal of outlining a plan for MIS development

within the Deputate. Emphasis was given to details

of MIS development which seemed to best apply to the

Deputate's MIS.

The final result of the analysis was the plan for

the design and implementation of the MIS. This plan

was specifically detailed for the application to the

Deputate. The plan explicitly outlines the steps and

phases of the development to help insure the successful

development of the MIS. In particular, the plan emphasizes

steps to follow to begin the process.

Presentation

The presentation of the remainder of this study

is broken into three major parts. In Chapter III the

MIS procedures and the basis for the procedures are

described in detail from the literature research. The

critical components of the development process are

related to the work of the Deputate as well as to organi-

zations in general. The role that MISs play in the work

of organizations is also explained.

The second part of the study consists in detailing the organization. The organizational structure, its mission and the tasks it performs are detailed in Chapter IV. At the end of the chapter the plan for development of the MIS within the Deputate is spelled out. As stated earlier, this plan details steps to be used by the personnel who are assigned the task of developing the MIS.

Chapter V summarizes the work accomplished in this study and the plan spelled out in Chapter IV. Also the chapter suggests other areas which can support additional study and work.

III. <u>THEORY</u>

Management Information System

The MIS, as referred to by its name, is a managerial tool used by management personnel to aid in planning actions, organizing work, directing workers, and controlling the operations in an organization (Terry, 1977, p.34). The MIS reduces the work of the managers by collecting data, sorting out and summarizing pertinent information, and displaying the results. At the same time it gives managers the ability to manage larger areas of operation.

Because the purpose of the MIS is to aid the management personnel of a particular organization, the MIS must be tailored for the data items with which the management personnel work. These data items may encompass any or all of the basic resources: men, materials, markets, machines, money, and methods (Terry, 1977, p.56). The desired end result of the MIS is the presentation of all information that is needed by the management personnel to accurately assess the operations of the organization and make correct decisions about actions to be taken.

Background

The MIS evolved during the Industrial Revolution out of the need to coordinate specialized tasks into one total product/process. In the early stages, the MIS consisted of very informal, unstructured methods and notes, which the managers themselves maintained.

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As the organizations and the coordination work of the managers grew, these personal systems of information were quickly outgrown. These personal MISs became more structured and oriented to the organization rather than to the managers. Personnel other than the managers were tasked with collecting data, using the MIS to process the data, and displaying the information needed by the managers. The size of the MIS and the number of personnel required to operate it were determined by the amount of information required and the number of management personnel supported by it. Also, the manual processing work of the early MIS restricted the size of the MIS.

With the invention of the computer, the MIS received a great boost. Now instead of the personnel laboriously processing the data, computers could be used. The speed of the computers not only reduced the time required for processing the data, but also increased the amount of data that could be processed. The computer also allowed the MIS outputs to be oriented for each manager, tailoring the MIS products according to the special or unique needs and desires of the managers.

At the time of this study many industrial and government organizations were benefiting substantially from their MISs, particularly the computerized ones. However, not all the systems were successful. The process of developing an MIS is a difficult task which must be executed with care and planning. The remainder of

this chapter summarizes the important and theoretical

findings relevant to a successful MIS development effort.

Role

The role played by the MIS in the management of the

organizations consists of reducing the uncertainties

involved with management decisions. The process of reducing

the uncertainties can be represented by the system depicted

in Figure 2. The information processing block represents

the MIS and its place in the managerial decision-making

process. Also emphasized in the figure is the separation

between the MIS and the decision. The MIS supports the

management personnel in their decision-making. It does not

usurp any authority from them. The feedback loop insures

that the MIS continually readjusts to the needs of manage-

ment. An MIS quickly loses its value if it does not respond

to the ever-changing environment and needs of managerial

personnel.
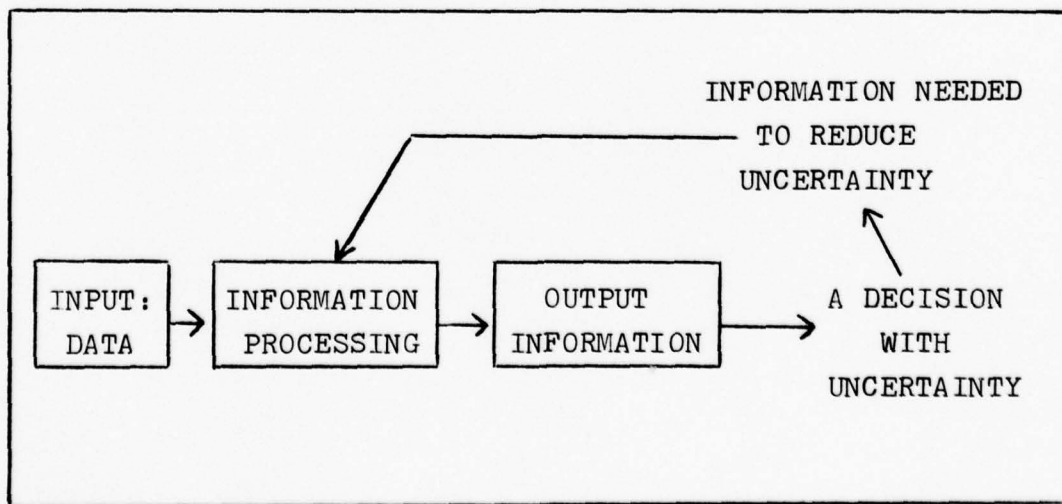
Figure 2. Information Processing Model (Voich, 1975, p.6)

While Figure 2 relates the position of the MIS in management decision-making, Figure 3 depicts the position of the MIS in the total organization. The central position underscores the fact that the MIS is involved in past, present, and future operations of the organization. The past, present, and future operations are more commonly referred to as managerial/ financial control, operational control, and planning.
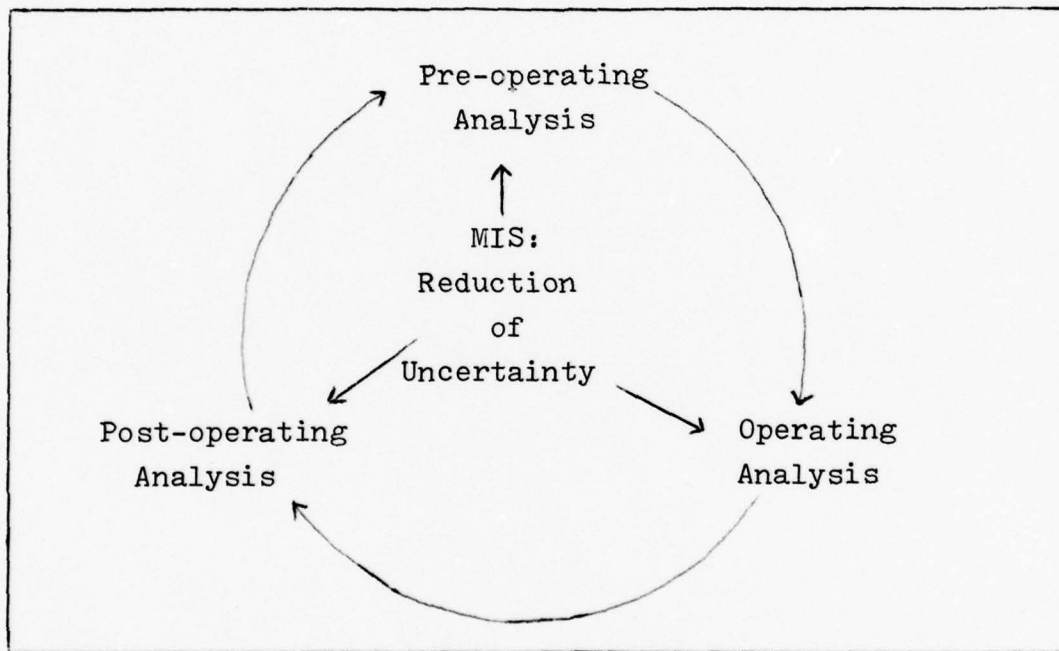
Figure 3. MIS Role Within the Organization (Voich, 1975, p.11)

Because the MIS is involved in all phases of management analysis, the MIS can also be used to predict outcomes of alternate proposals of action. Then, the management personnel can evaluate the effects of their proposals before the final decisions are made.

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Systems Approach

The many different plans for development of an MIS
from the literature sources confirm that the process
closely parallels the management decision-making process
as shown in Figure 2. The goal of all these plans is
the establishment of the MIS in the organization. To
reach this goal the developers collect data, design
the MIS, and present the MIS output to the management
personnel. The management personnel's reaction is then
fed back to the design stage to cause the MIS to be
modified. During this process, the input remains open
so that new data can enter the system and cause changes
as well. The development process continues in this
manner until the feedback from management personnel and
their input do not make any changes to the MIS.

This approach to development requires repeated
interactions with the organization's operations personnel
as well as with management personnel. The data which
is used in the development can only be gathered through
this involvment. Also, management's reaction to the
MIS can only be collected by allowing the developers
to closely interact with management personnel so that
specific comments and suggestions can be collected.

Although this approach to development seems straight
forward, there is one facet which is easily overlooked.
By leaving the input open ended, the development of the
MIS is never really completed. While the MIS may reach

a stage of development which seems fairly stable, new inputs can cause drastic changes. The developers have to be aware of these possibilities and remain receptive to new inputs. Through this awareness the MIS can keep current with the requirements of the management personnel in their support of the organization's goals.

Practical Approach

At the beginning of the MIS development process, many visions of the final MIS are entertained. Often these visions include a very complex, intricate system where all the interactions between the different operations of the organization are reflected in the MIS output. While such a system is desirable, the developers of the MIS have a difficult time designing it. Also, this vision is based on the idea that the operations within the organization are coordinated in one overall, consistent pattern. This is rarely the case.

An approach that is more realistic for MIS development separates the development work into manageable sections much in the same way that management personnel approach their jobs. These sections correspond to the different types of actions and information with which the management personnel work. The point of concern with this approach rests in the development of the sections so that they are in agreement with the overall objectives (van Gigch, 1978, p.367-369). Development of the MIS

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in this manner is futher supported by data about successful
MIS developments. The most successful systems have
generally begun small and progressively developed from
that point (Hershman, 1968, p.86).

The involvement of management personnel in the
development work is another practical step to take.
The management personnel are not only to be the recipients
of the MIS products but they are also the individuals
who are most experienced in the operations of the organi-
zation. The development effort gains by drawing from
their experience and expertise. Development of the MIS
in small sections also encourages the management personnel
to become involved in the development. When the sections
of the MIS are put into operation in support of the
management personnel, the personnel will often indicate
errors in the MIS and explain what the correct results
should be. Then, the developers can redesign the MIS
with management personnel's comments in mind.

Desirable Characteristics of MIS

The MIS development process includes more than
just designing the details of the system. It also
includes developing the character of the MIS. This
character is manifested through the composite arrangement
of its characteristics. Since each MIS application
normally requires a slightly different character, an
understanding of the characteristics of MISs is part
of the task of developing an MIS.

The use of the word "desirable" is deliberate when referring to characteristics of the MIS. The "desirable" characteristics differ from the "necessary" or "ideal" characteristics. The MIS does not have any "necessary" or "ideal" characteristics, because while some of the characteristics might be appropriate for one application, those same characteristics might not be appropriate for another application. The "desirable" characteristics refer to the traits which are regarded as most appropriate for the MIS when considered as a group.

These desirable characteristics are extremely difficult to assess and almost impossible to measure. They relate to the indicators of quality, which are subject to the judgements of those using the system. Each person's experiences affect his judgement of these characteristics. To provide some insight into the MIS characteristics, a brief review of six MIS characteristics is presented below.

Effectiveness. This is a composite or overall characteristic. The MIS is considered effective when the objectives are attained. Effectiveness is oriented to the results sought rather than to those which are not sought (Robinson, 1969, p.90).

To evaluate effectiveness a number of other characteristics which are needed to achieve the objectives of the MIS are evaluated. The degree to which other characteristics

reach their appropriate levels indicates the overall
effectiveness of the MIS.

Efficiency. Efficiency is also related to the
results of the MIS. However, in this case efficiency
refers to the unsought results. If they are not important
to the work of the management personnel, then the MIS
is said to be efficient. Efficiency indicates whether
any resources are wasted on unimportant results or
whether important results are ommitted.

Like effectiveness, efficiency is evaluated by
a number of other characteristics. "Efficiency and
effectiveness are in a sense the sum of all specific
characteristics which presents a balance of desirable
and undesirable consequences." (Robinson, 1969, p.91)

Timeliness. To be evaluated as timely, the MIS
must produce outputs at the times that management personnel
need them or earlier. Lateness is fairly easy to determine,
for late outputs delay actions from taking place or
cause personnel to make decisions without reference
to the current output. This lateness is measured in
terms of time units or operational cycles. The time-
liness of the MIS is particularly tested when there
is an unexpected, early requirement for the output.

Sufficiency. This characteristic concerns the
judgement of adequacy of the MIS and its products.
The measure of this characteristic involves the judgement

of whether the MIS and its products satisfy the management personnel's information need in the performance of their jobs.

Two other characteristics, conciseness and completeness, are related to sufficiency and indicate something about the degree of sufficiency. Completeness concerns the presentation of the MIS products so that all the consequences and interactions between the information elements are provided. Conciseness involves the presentation of important elements in as brief a form as possible.

Accuracy. Accuracy refers to the correctness and precision of the information presented by the MIS. While accuracy may seem to be easy to assess, it is not. The degree of accuracy needed plays an important part in determining performance. For example, the payment of a creditor requires more accuracy than does the prediction of costs.

Reliability is another characteristic. It is closely linked with accuracy. Reliability pertains to the consistency of the accuracy which the MIS maintains.

Economy. This characteristic concerns the costs of the MIS. These costs generally oppose the improvement of the characteristics previously described. The characteristic of economy imposes limiting constraints, forcing trade-offs to be made between the characteristics which are desired and the costs of increasing those chracteristics.

Operational Design

Five phases are identified in this study for the
MIS development process. These phases are depicted
in Figure 4. The names associated with the phases
are not intended to describe all actions to be taken.
Instead, the names were chosen to indicate the more
significant actions performed within each phase.

While a development plan tends to indicate a start
and end to a process, the plan for MIS development
does not. Figure 4 emphasizes this fact again. There
is a continual review and reexamination of the ideas
and work accomplished throughout the development process.

Definition of System Objectives (Phase 1). While
the definition of system objectives is the most signif-
icant action at the beginning of the development, there
are some important steps that precede it. These steps
involve such things as recognition of a need for the
MIS and the appointment of personnel to develop it.

The first step toward the development consists
of the recognition that the MIS is needed. Generally
this recognition is a spontaneous thing. It can develop
from ideas of personnel within the organization or from
exposure to benefits derived from the application of
an MIS in other organizations.

Two critical factors for successful Air Force systems
are the attitude and support of management personnel toward
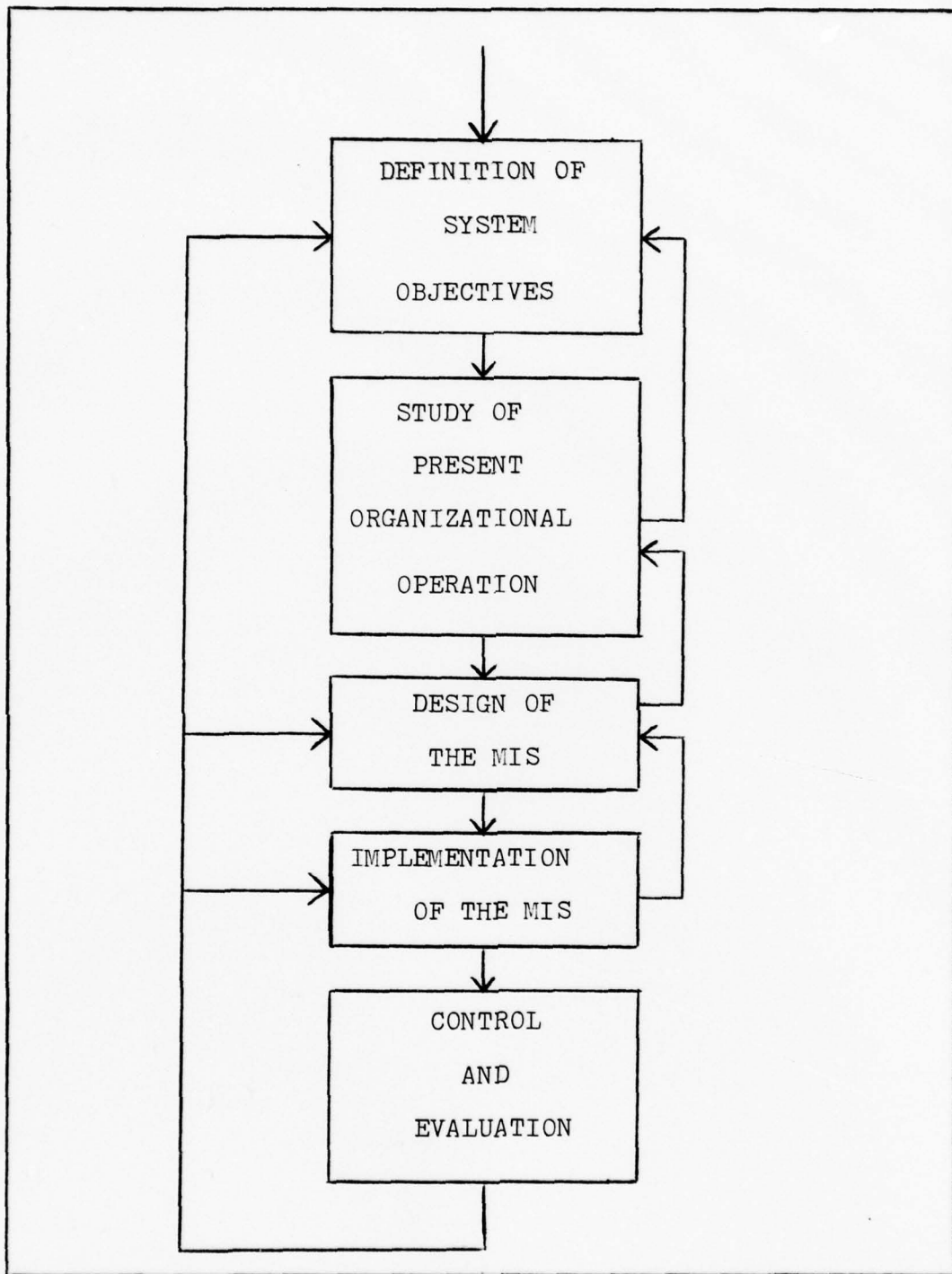the MIS (Retzer, 1978, p.84 & Carter, 1975, p. 24-30).

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Figure 4. System Methodology for MIS Development

The possibility for success is directly related to the attitude and support given by management personnel not only at this phase of the development but throughout the process. Generally a favorable attitude to the MIS development accompanies the recognition of the need for an MIS. However, the support, which involves an active participation by management personnel, does not always correspond to the favorable attitude of the management personnel.

The support of top management is vital for the success of the development. Without top management's approval and commitment to the MIS, resources can not be applied to the development process. Also, top management's support keys other management personnel's support by setting an example.

With top management's commitment to the MIS, the next step consists of designating an individual as the MIS Director. This individual should be familiar with MIS theory and have some knowledge about the operations within the organization. His appointment also involves the conferral of authority and status which allows the Director to cross divisional boundaries within the organization. This authority and status are necessary if all parts of the organization are to be supported and coordinated by the MIS.

The first action that the MIS Director takes is to identify and negotiate for individuals to serve on

the MIS Staff. The Director is interested in securing

personnel who are both capable and dedicated, for the

use of this type of personnel is another critical factor

for successful development (Retzer, 1978, p.84-86).

The identification of personnel who also have experience

and knowledge of managerial and financial accounting

concepts, behavioral science, industrial engineering,

computer programming, and quantitative concepts can

also benefit the MIS development well (Voich, 1975, p.56-58).

If the Director cannot negotiate for some particular

individuals on a full-time basis, the Director might be

able to secure the individuals as part-time augmentees

to the MIS Staff.

With the assembling of the MIS Staff completed, the

definition of system objectives for the MIS can begin.

The MIS Director and MIS Staff work together to identify

to what areas of the organization the MIS development will

be oriented and what the MIS development expects to

accomplish. Of course, these objectives reflect the views

of the management personnel along with those of the MIS

Director and MIS Staff. Once the objectives have been

defined, the MIS Director sends a written list of the

objectives to top management for approval before the

development work continues.

Next, the Director and MIS Staff outline a master plan

for the development. The plan includes a schedule of events

and actions to be performed by the MIS Staff as well as

actions to be performed by organizational personnel to develop the MIS. The schedule of events is arranged so that there are minimal conflicts with the schedule of normal operations in the organization.

Once the plan is developed, it is published and distributed to the personnel in the organization. Particular care is taken to insure that the personnel who are tasked with some actions receive a copy of the plan. In this way all personnel can review the schedule and identify conflicts as well as use the plan as a calendar to prepare for their involvement in the development process.

Study of the Present Organizational Operation (Phase 2). After the objectives of the development have been identified, the MIS Staff turns to the study of the operations of the organization. The scope of the study is limited to those areas which were identified in the objectives. The objectives also determine the amount of detail needed and the personnel who will be contacted.

The study focuses on identifying the key information elements which support the decisions made in that area of operation. The MIS Staff critically evaluates the information elements in terms of quality, quantity, cost and time (Voich, 1975, p.33). Yet, while they focus on what information is currently being used, the MIS Staff is also alert for any information items which are not being used but seem to have some definite value.

The methods that the MIS Staff uses in studying the operations can include field study, case study, and controlled experiments. Each method has its own advantages and disadvantages. The MIS Staff determines what method is most appropriate to use for each area under study and with which they are most comfortable.

The study of operations does not complete the work accomplished in this phase. The MIS Staff also contacts the management personnel to be affected by the MIS and who work within the areas studied. Through interviews, informal discussions, or questionnaires the MIS Staff determines what information these management personnel use in their decision-making processes. Since these particular management personnel will use the MIS products, their needs provide the basis for the MIS. Of course, the management personnel have to accurately describe their information needs and provide the MIS Staff with indications about the value of the information. This interaction between the MIS Staff and management personnel should be free and open, as it is critical to a successful MIS development.

Through the interactions with management personnel, the MIS Staff may help identify measures of effectiveness for each manager. The measures have great value in providing the managers with objective feedback about the work under their control. Through these measures they can determine if progress is being made and maintained.

Criteria to use in developing these measures are enumerated later in this chapter.

Design of the MIS (Phase 3). This phase consists of developing the MIS output formats, and the procedures required to produce the output. The design also includes reviewing input data to insure that the data items necessary to support the MIS are present. In fact, one good way to design the MIS is to accomplish the design in reverse order to normal MIS computer processing: design the output formats, develop the procedures, and then review the input data.

The design starts with the MIS Staff outlining the format for the MIS. The MIS Staff considers many factors in the process of developing the formats. The needs of management personnel, the amount of detail required, and the key information elements identified by the study of the organization and from management personnel are all carefully weighed in the design of the output. If the management personnel have indicated some specific formats which suit them well, the MIS Staff should give special attention to those formats in their development of the MIS formats.

After the formats are preliminarily outlined by the MIS Staff, they are presented to the management personnel for whom they were designed. The management personnel then make improvements to the formats and tailor the specific details to their jobs. A major

revision of the formats is not desirable at this time, for in designing the MIS formats the MIS Staff also considered common trends or needs of other management personnel who are performing similar tasks.

In the next step all the details and procedures used to take the input data and produce the output are described. Since the MIS is meant to support the management personnel, the MIS Staff can benefit greatly from using the same procedures the management personnel use when they process the data. If computers are to be used for the MIS, it is the MIS Staff's responsibility to either develop the computer programs themselves or engage a programmer to develop the programs for them.

The final step in the design consists of reviewing the input data which is currently being obtained. The purpose of the review is to insure that all the input data needed to support the MIS is available. Where the data is not available the MIS Staff determines how and where the data can be obtained.

Planning and control of the design process throughout the design phase has been determined as another critical factor for successful Air Force systems (Retzer, 1978, p.80-86). The design plan, which includes a schedule for the MIS Staff, and the control exercised over the design, help to keep the development process on schedule and coordinated with the overall MIS development.

Interest in the MIS is maintained by keeping the development on schedule and short.

Implementation of the MIS (Phase 4). With the design of the MIS now completed, the next phase involves putting the system to work in the organization. There are two important actions which are necessary for the implementation of the MIS.

The first action is actually a series of steps to help gain acceptance of the MIS from management personnel who will use it. These actions are not limited to this phase of the development. Actions taken throughout the development process can help gain this acceptance.

Since acceptance is a personal feeling, the method to use in gaining MIS acceptance is to build the management personnel's confidence in the MIS and to address the changes that the MIS will have on the organization and the personnel. The perceptions about the changes is a significant force behind the resistance to the MIS. Therefore, the MIS Staff should address these areas of change and clearly spell out what changes will actually occur. These areas of change are the following:

1. Changes that are perceived to lower status or prestige.
2. Changes that cause fear.
3. Changes that affect job content and/or pay.
4. Changes that reduce authority or freedom of acting.
5. Changes that disrupt established work routines.
6. Changes that rearrange formal and informal group relationships.

7. Changes that are found without
   explanation or employee partici-
   pation.
8. Changes that are resisted because
   of mental and/or physical lethargy.
                    (Hodge, 1970, p.432-433)

Erroneous perceptions about changes which will be caused

by the MIS are eliminated through full documentation

of the work of the MIS Staff and distribution of the

documentation throughout the organization. If management

personnel still resist the MIS because of the changes

that it will effect, they will be given advance notice

so that they can take appropriate steps to prepare for

the MIS.

The second action in this phase is incorporating

the MIS into the operations of the organization. There

are many methods to use to accomplish this action. Some

of the methods include the parallel approach, sequential

transition, pilot programs, and total, immediate conversion.

The important point in incorporation is that there exists

a general consensus among the management personnel about

what method to use.

If the incorporation involves a Processing Staff,

which is responsible for the handling of data and operating

the MIS, the MIS Staff has the obligation to explain

fully the work that the Processing Staff has to perform.

Operational tests with the Processing Staff are also

advisable so that errors in the MIS itself and in the

actions of the Processing Staff can be identified and

corrected.

Another issue which is important is the timing of the incorporation. The incorporation will always evoke questions and problems, so the time most appropriate for incorporation is during slack periods in the work of the management personnel and the organization. The timing for incorporation should allow management personnel to become familiar with the MIS and start to use it in their work.

Control and Evaluation (Phase 5). This phase is broken into two portions because of the nature of the work. The control portion corresponds to what some call systems improvement (van Gigch, 1978, p.40). The control actions consist of maintaining the MIS so that it supports the objectives established for it in the first phase of development. The evaluation portion corresponds to systems design (van Gigch, 1978, p.11). The evaluation actions question all facets of the MIS: its purpose, its objectives, its interface with the organization, and the methods it uses. Through this evaluation the MIS is adjusted to meet the needs of the organization as it interfaces with other organizations and systems. Both portions in this phase are necessary and vital to insure the validity of the MIS and its products (Voich, 1975, p.99).

The MIS Staff conducts the control actions. They monitor the performance of the MIS and evaluate the accomplishment and progress toward the objectives.

When the performance indicates undesirable results or
trends the MIS Staff performs those actions which correct
the situation. The use of measures of effectiveness (MOEs)
to monitor and assess the performance reduces subjective
evaluations and reduces the work of the MIS Staff.

The MOEs are indicators which assess the MIS perfor-
mance in objective terms. Through their objectivity
accurate assessments of performance are obtained without
any judgmental evaluations. While the MOEs are valuable,
they are sometimes difficult to establish. The criteria
to use for developing the MOEs are the following:

1. The MOEs should be as few as possible, while
   indicating the desired attributes.

2. The MOEs should be applicable to the present
   as well as to the future operations.

3. The MOEs should permit comparisons with different
   parts of the MIS and with its past.

4. The MOEs should promote the worth of the MIS
   by keeping it on track towards its goals.

5. The MOEs should be computed as orderly as possible
   from the data with a minimum amount of interfaces
   that could be used to "game" the indicators
   (Smith, 1973, p.81).

To decrease the possibility of prejudice toward
the MIS, the evaluation actions can be accomplished
by personnel in different sections of the organization.
One effective way is to form a small rotating team which

is tasked with performing the evaluation. The personnel
serving as members of the team can be assigned on a
part-time or full-time basis depending on the size
of the MIS and the time allotted for evaluation. The
rotation of the team members with other personnel in
the organization increase the value of the evaluation
by broadening exposure to the MIS (Robinson, 1969, p.61).
Each member brings a different view to the evaluation.

To maintain continuity in the evaluation, not
all the members of the team are replaced at each cycle.
A nucleus of about one quarter of the members are
assigned to the team for a second time. These reassigned
personnel maintain continuity without imposing too
many preestablished methods or norms. However, because
they do not compose a majority of the team, there is
less chance that their views will dominate the evaluation.

At the beginning of the new evaluation period,
which is spelled out in the MIS development plan, the
team establishes its written charter identifying what
areas of the MIS will be evaluated. When the evaluation
is completed, and just prior to the end of the time period,
the team prepares a written report to the MIS Staff
concerning the recommendations for changes to the current
system. These recommendations are positive steps to
improve the overall goals of the organization as related
in the MIS. The recommendations are based on the supporting
evidence as documented by the team in their report.

Once the MIS Staff receives the team's report, they respond to the recommendations. In some cases their response involves evaluating the objectives of the MIS or redesigning a section of the MIS. The important point is that the MIS Staff is obligated to respond to the recommendations. In their response the MIS Staff also evaluates the benefits and costs of the changes that have to be made to accommodate the recommendations. These costs encompass the whole MIS and not just the area which was evaluated. When the benefits exceed the costs the MIS Staff institutes the changes according to an established schedule.

The final action accomplished by the MIS Staff is to publish the recommendations of the evaluation team verbatim and the MIS Staff's response to the recommendations. In this way all personnel are informed of the changes and the work of the team is publicly acknowledged and answered.

IV. DEPUTATE FOR PROPULSION

Basic to any process of development is a review
of the elements to which the process applies. In this
case it is the organization itself. This section of
the study concentrates on the organization and the
work processes used within it. This section also
outlines the plan that seems best to use for the
development of an MIS for the Deputate.

Background

History. Prior to October 1976, ASD was organized
so that major aircraft systems were developed and procured
through separate Systems Program Offices (SPOs), often
called super SPOs. These super SPOs were responsible
for all the parts of the aircraft systems including
the propulsion units. Figure 5 indicates the relation-
ships that developed within ASD to aid in the acquisition
of the propulsion units

The aircraft systems and the associated propulsion
units assigned to ASD continued to grow in number and
monetary value. From a $500 million total obligation
of funds for propulsion in 1971, the 1978 total reached
the $1603 million figure. This total consisted of
$1300 million for procurement, $195 million for research
and development, and $102 million for the Component
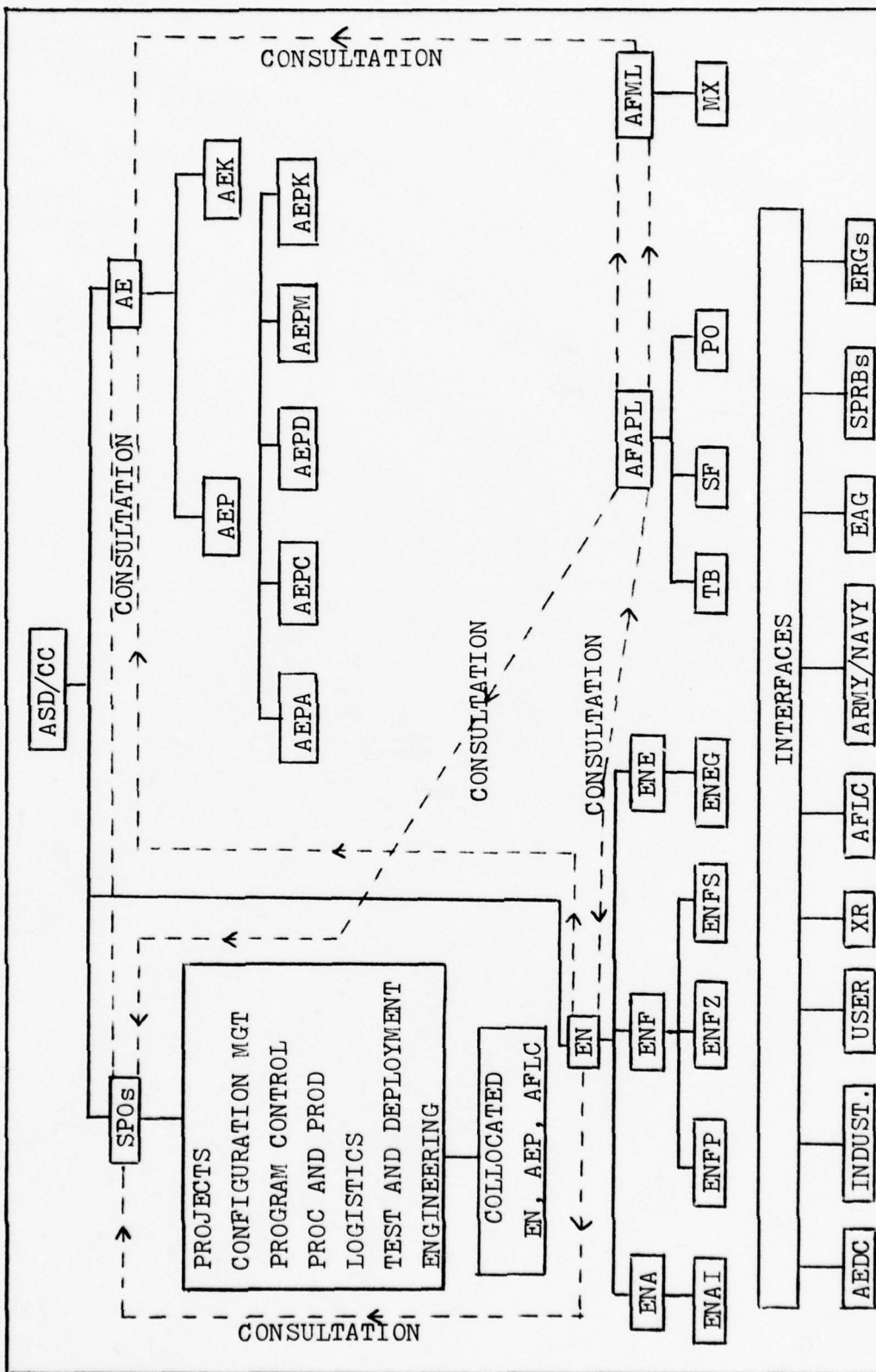Improvement Program (CIP). The rising costs of the

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Figure 5. Former AFSC Propulsion Acquisition Organizational Relationship

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propulsion units plus the magnitude of the obligations precipitated many studies and reports on the processes and methods of acquiring propulsion units. A major study by Rand Corporation was accomplished in 1973, and by 1976 six additional studies were completed.

The studies uncovered some serious flaws in the Air Force acquisition of propulsion units. Some of the more significant flaws were a lack of discipline and a lack of consistent philosphy in the engine development process. These problems occurred because of the fragmented approach taken in development and procurement of the units. This independent approach did not provide for the crossfeed of experience between the SPOs, and the same mistakes continued to occur. In effect, there was no corporate memory concerning the propulsion units. Report PMR-AF-76-35-1 (February 1976) summarized the problem well.

> The Air Force organization for engine
> management is fractionalized. Its
> stature is not commensurate with the
> importance of this subsystem. Many
> Air Force engine problems today are
> management related problems.

In response to the flaws discovered by the studies, ASD reorganized and created a new organization under the Deputy for Propulsion, Figure 6. The purpose of the reorganization was to give one organization responsibility for all ASD engine development.

In October 1976 the organization initially began operation on a limited basis. By January 1978, with

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AERONAUTICAL SYSTEMS DIVISION
JULY 1977
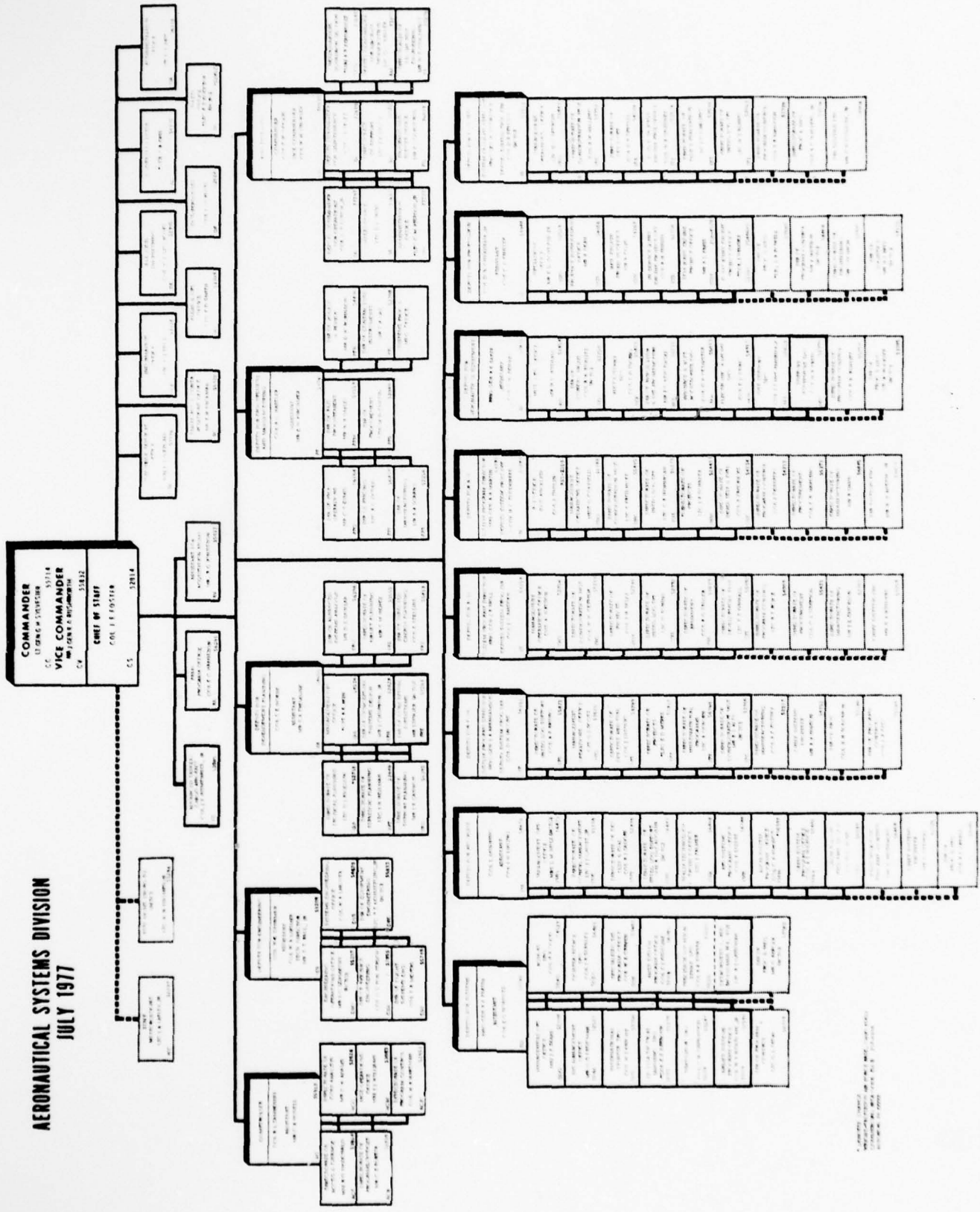
the transfer of the F101 engine program, all gas turbine engine programs were under the management of the Deputate for Propulsion.

Mission. Since the organization was established because of problems in the acquisition of propulsion units, the objectives of the organization were outlined to meet the problems. The following list contains the objectives of the organization as they were identified.

I. Establish a single Air Force Program Office with primary responsibility for engine acquisition including appropriate deployment matters in association with SPOs, AFLC, and users.

      A. AFSC and AFLC elements included for direct and continuous interaction throughout engine life cycle.

      B. Clear focus for internal Air Force engine business and advocacy.

      C. Interface for industry, inter-service, and other agencies.

II. Improve the effectiveness of engine acquisition community through matrix management.

III. Provide a vehicle for unified, disciplined business and technical management policies.

The primary advantage of the reorganization relates to the congregation of engine development personnel in one organization. The gathering of these people and their work promotes the crossfeed of information and experience.

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Common mistakes can be avoided and more accurate cost
and risk assessments can be made before resources are
committed. The one organization approach to engine
development also improves the interface between industries
and Air Force laboratories concerned with propulsion units.

Organization. Listed in the objectives of the
organization is the reference to matrix management.
This concept is displayed in Figure 7, which is the
organizational chart. The functional directorates,
which provide the matrixing concept, are listed along
the left-hand side of the chart while the various Engine
Program Offices are listed across the top. What this
chart indicates is that the directorates provide support
to all the engine offices and as such provide the major
avenue for the crossfeed of experience in the programs.

The directorates are further broken into work
specialties in Figure 8. More detailed descriptions
of the directorates' functions are presented in Appendix B.

The Joint Engine Program Offices (JEPOs) and the
Engine Program Offices (EPOs) coordinate the work performed
on the particular engines associated with their offices and
report the progress of the engine programs. The JEPOs'
and EPOs' jobs originate when the New Engine Office
turns over engine responsibility to them, as the various
engine programs enter the full-scale development phase.
Their jobs are finished when they in turn hand over
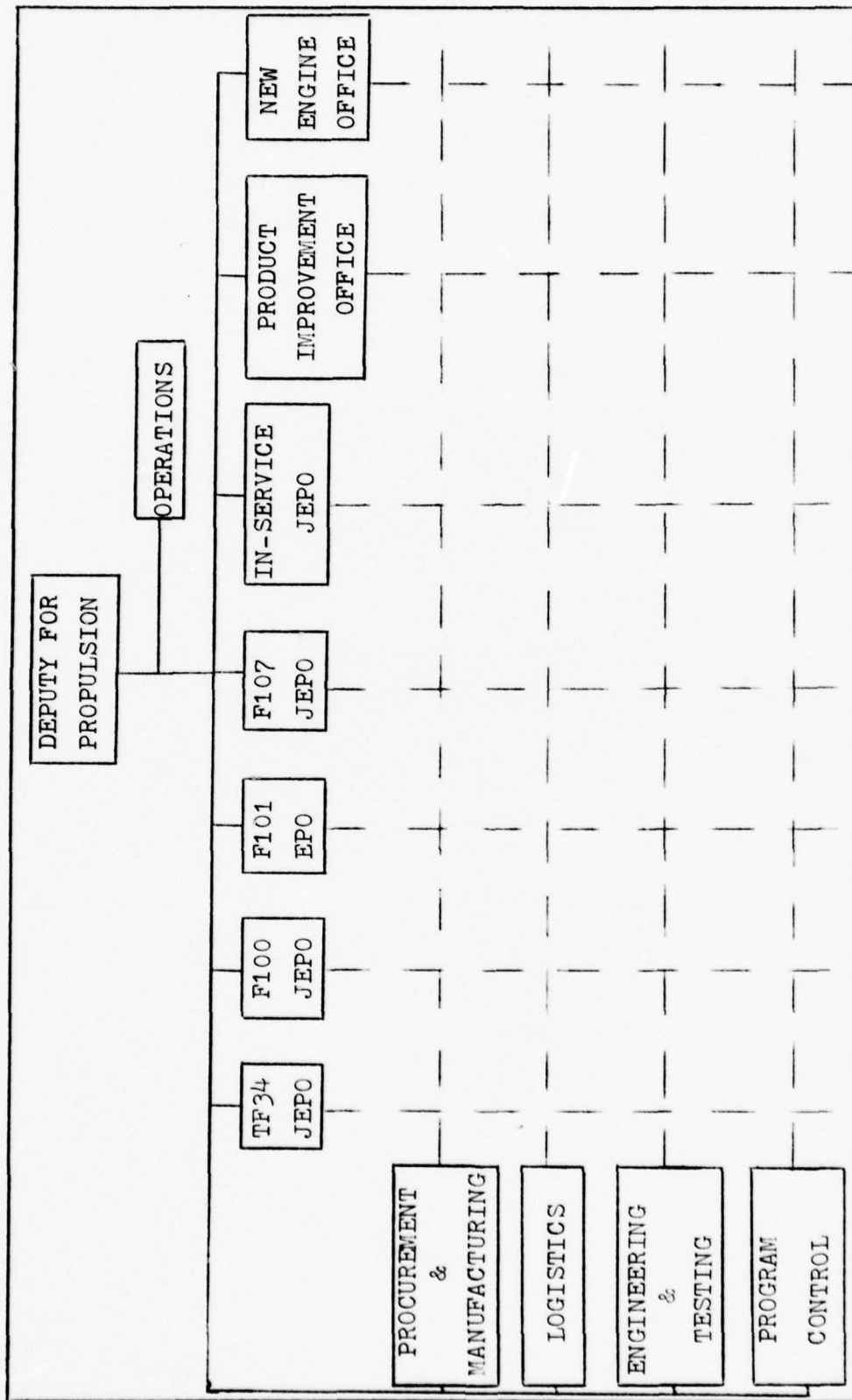responsibility to the In-Service JEPO. The In-Service
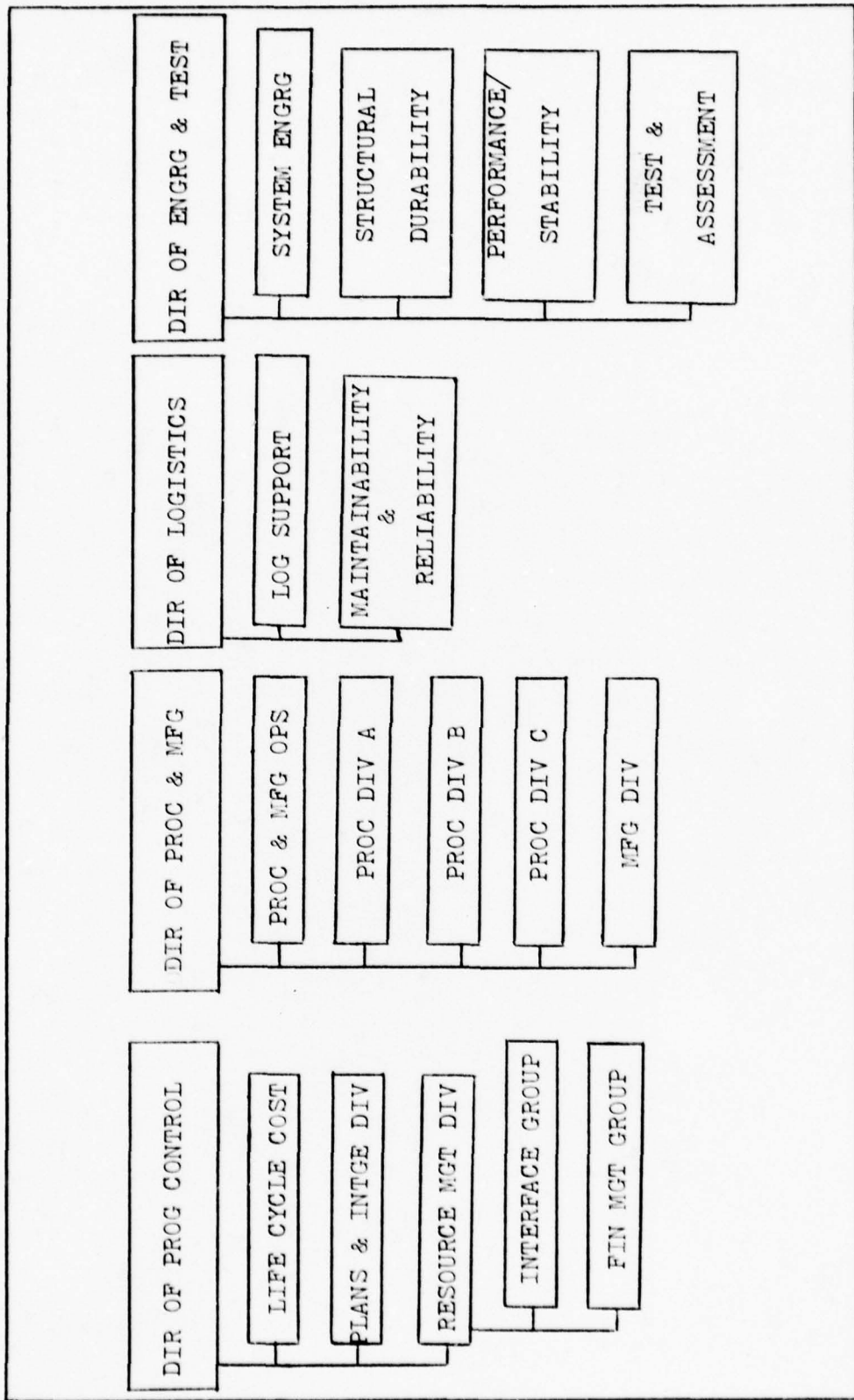
Figure 7. Organizational Chart

Figure 8. Propulsion Directorate Structure

JEPO assumes responsibility of the engine only when the production lines are well established. The In-Service JEPO monitors a number of these engine programs, evaluating the production schedules, the costs, and the performance of the engines.

The Product Improvement Office exists for the purpose of applying new ideas and technologies to the existing engines in order to increase performance or reduce life cycle costs. The office also develops guidelines for meeting new engine requirements. These goals are reached through the Componenet Improvement Programs (CIP) and the Engine Model Derivative Programs (EMDP).

Management Problems

Some unique problems result from the assignment of all engine development responsibility to one organization. The following problems, which are classified according to the management personnel they affect, were identified through personal interviews and assessments of the tasks required of the management personnel.

Deputy for Propulsion. The first and immediate problem the Deputy encounters concerns the compliance with the deadlines imposed on the Engine Program Offices by the systems programs. The Deputy must insure that the EPOs and JEPOs provide the information and support needed for the systems programs according to the systems programs' schedules. The Deputy continually reviews

the progress of the programs and settles problems about priorities among the program offices.

Another problem involves the personnel assignments within the Deputate. The Deputy monitors the workloads imposed on his organization and is forced to continually readjust personnel according to the priorities and needs of the engine programs. The difficulty in this stems from correctly assessing the workloads and then assigning the personnel who can best resolve the situation. Also, the Deputy is responsible for scheduling replacements for future vacancies and maintaining personnel proficiency through adequate training.

A third problem involves the application of experience gained from one engine to other programs. Since the engine programs currently assigned to the Deputate were designed with little commonality in mind, there is a constant struggle to apply experience across engine programs.

The discovery of commonalities in the engines and engine programs is another significant problem to be addressed by the Deputy. Coupled closely with this is the determination of the major cost drivers of the engines so that emphasis is placed on those commonalities which are important in terms of cost. The long-term life of the organization rests on the discovery and use of common elements.

Because the engine programs are in many different phases of development, there has to be some means of storing facts, ideas and techniques used in one program so that they can be applied to other programs. The solution to this problem rests in a well developed information system within the organization.

Directors. The greatest problem faced by the directors is the scheduling of personnel within the directorate to insure that sufficient aid is given to the EPOs and JEPOs in meeting their deadlines. The difficulty arises from insufficient knowledge of program schedules and changes to those schedules.

Another problem involves the discovery of commonalities among the engine programs. Since the directorate personnel work with each engine program it is primarily through their insights that commonalities among the programs can be discovered. The personnel must continually be alert for clues and then investigate possible commonalities.

The directors also have the constant problem of keeping current with new ideas and techniques which are identified in their particular fields of work. Where these ideas are appropriate for inclusion into the organization's work, it is incumbent on them to explain the new ideas and techniques, to show the benefits involved, and to incorporate the ideas or techniques into the organization.

Heads of the EPOs and JEPOs. A constant problem
faced by these individuals involves the support given
to two different channels of authority. The EPOs and
JEPOs are required to meet the deadlines imposed on
them by the systems programs of which they are a part.
Also, the EPOs and JEPOs are required to support the
Deputate's deadlines. The totally different schedules
and information requirements force the heads of the
EPOs and JEPOs to constantly adjust priorities and
resolve conflicts.

Because the engine program responsibility is
transferred to the EPOs and JEPOs at an important
stage of development, the speed at which the personnel
become familiar with the programs can critically affect
the success. It is a difficult problem for the personnel
to become quickly familiar with the programs, particularly
when a common approach to the development has not been
discovered.

A requirement imposed on all development programs
to consider life cycle costs (LCC) creates a major problem
for the EPOs and JEPOs. The engine LCC models are not
well coordinated and defined. Therefore, consideration
of LCC requires extensive work and close coordination
with directorate personnel to identify the costs of
alternate choices.

Because of cost overruns with previously developed
weapons systems, a great amount of emphasis has been

placed on avoiding the overruns. To avoid the overruns, the costs must be accurately identified at the start of the programs and must be closely monitored throughout the development life cycle. Because of design changes and new requirements which alter the original cost framework, the EPOs and JEPOs have to continually reassess the programs' development to identify possible cost overruns.

Plan for MIS Development

The plan outlined here is an MIS development plan which has been obtained from the literature sources and tailored specifically for the Deputate for Propulsion. This plan not only describes what actions are needed throughout the development process, but it also identifies actions to be taken in the initial stages of development to help insure a successful system.

System Definition. The MIS for the Deputate is defined in accordance with two levels of management and five bases of specialization.

Management Levels. The two management levels for which the MIS is oriented consist of the Deputy for Propulsion as one level, and the directors and heads of the EPOs and JEPOs as the other level. One way to briefly understand the different views of the management levels is the following.

1. The Deputy reviews whole programs, comparing progress between programs as well as comparing each program's progress with benchmarks and previous progress.

With the functional directorates, he reviews the methods used with the programs.

2. The heads of the EPOs and JEPOs review their programs by assessing the progress within each functional area. The current progress is compared with benchmarks and previous progress.

3. The directors separately review the functional work within each program according to the areas of their responsibility. The progress of one program is compared with other similar programs.

Bases of Specialization. The bases of specialization referred to here correspond to the functional directorates within the Deputate and the administration of resources to support the Deputate's work. These bases can be classified into three general groups: business management, technical management, and administrative management.

The business management group encompasses the directorates of Program Control, Procurement and Manufacturing, and Logistics. Business management consists of performing actions and making decisions using principles known from the operations normally found in commercial enterprises. The purpose of business management for the Deputate consists of controlling engine development within the established time and cost constraints.

The technical management group encompasses the directorate of Engineering and Testing. However, the directorate of Logistics has some concern for technical management as well.

Technical management involves controlling the performance of the engines to meet established performance parameters.

Administrative management encompasses the decisions and actions involving personnel and clerical resources throughout the organization. Its purpose is to help management adjust personnel according to the changing workloads within the organization. Administrative management also provides personal information about the organization's personnel which helps management personnel address individuals' needs.

Operational Design. The following presentation details a plan of actions to be taken in the development of an MIS for the Deputate. The plan results from tailoring the ideas and actions in the literature sources to the specific needs of the Deputate. The plan is separated into five phases: Definition of System Objectives, Study of Present Organizational Operation, Design of the MIS, Implementation of the MIS, and Control and Evaluation.

Definition of System Objectives (Phase 1). The first step in the development is the recognition that an MIS is needed. This recognition is primarily important for top management because it is by top management's approval that resources are committed. At the time of this study the Deputy and much of the management personnel had already recognized a need for an MIS. Their recognition was based upon the benefits of MIS use as shown in other ASD organizations and the increasing details of the engine programs.

The next step in the plan is the designation of
an MIS Director who is solely responsible for the MIS
development. The Director is appointed by the Deputy
and is released from his previous job. Because of the
current grades held by management personnel in the
organization, it seems appropriate that the Director
have a rank at least equal that of a lieutenant colonel.
The Director's rank along with the status given the MIS
effort by the Deputy are important to insure the development
work is not subordinated to the directorates or the Engine
Program Offices. The Director's job transcends the normal
boundaries within the organization.

Once the Director has been appointed, it is left to
him to justify the support required from the organization
and negotiate for MIS Staff members. It is helpful to
identify MIS Staff members from personnel within the
organization because of their familiarity with the work
of the organization. Also, personnel from within the
organization can be assembled more quickly than by
drawing personnel from outside sources.

Together the MIS Director and the MIS Staff develop
a master plan and timetable to use for the development.
While this master plan identifies only the significant
events to take place for the next two or three years,
the detail is sufficient to show what actions are to be
performed by the MIS Staff and what actions are to be
performed by organizational personnel in developing the MIS.

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The master plan fits in the organization's operational plan over the same period so that there is minimal hinderance to the organization's work. Once the plan is reviewed by top management and approval is given, the plan along with the timetable of events can be published and distributed within the organization.

Since the more successful MIS developments have started small and expanded from that base, it seems best to follow this same route. In keeping the initial development process small, it would appear best to start with something that is familiar to the personnel in the organization and to the MIS Staff. One area in the Deputate in which to begin concerns development of the MIS to support established requirements as outlined in Air Force Systems Command Pamphlet (AFSCP) 800-23. The pamphlet details the exact format for the Secretary of the Air Force Program Review (SPR), the Program Assessment Review (PAR), and the Command Assessment Review (CAR). The minimal flexibility in the formats dramatically reduces the initial work of deciding what the MIS output product is to be. Also, since the organization has already responded to these reviews, appropriate historical information is available.

For the Deputate the MIS can be developed to support two types of reviews. The first type is limited in scope to each engine program. It involves providing formatted propulsion information to support the reviews

of the systems programs of which the engine programs are a part. The second type of review involves supporting the review of the Deputate itself. This review concentrates on how well the crossfeed of information and experience is working to improve the development of engines.

A second area which the MIS development may initially address is that of administrative management. While the format of the output product is not as rigidly established as for the reviews, the management personnel usually have developed their own formats and charts to aid them. However, the personal systems and charts are often more limited in scope than the management personnel would like. The personnel systems are generally restricted to displaying only the most significant data. Yet information such as the office assignments and telephone numbers of personnel, retirement dates, and Permanent Change of Station orders can help management personnel make adjustments to meet the organization's requirements.

The two areas just discussed for the initial development of the MIS seem ideal for computer application. By using the computer for the reviews, the workload of the personnel immediately before the reviews is greatly reduced. Also, the computer gives the opportunity for quick responses concerning the reviews. When questions are asked concerning the programs, the answers can be

more easily and quickly obtained from the computer, which can keep the information shown in the reviews updated. The computer aids administrative management by keeping track of more data and information than currently is possible with the personal systems of the management personnel.

The ASD computer center has a couple of programs already designed which could be used for two types of applications. The work that needs to be accomplished is the application of the computer programs to the areas described here. The Eagle program, which is specifically designed for cost calculations, is flexible enough to be applied to the information involved in the reviews. The Venus program is specifically designed for use in the administrative management area.

The areas initially identified for MIS development were selected so that the organizational personnel and the MIS Staff can generally feel confident concerning the MIS development. By starting small and with parts familiar to all, the development of the areas can proceed quickly and results are noticed in short order. When the management personnel begin to use the MIS products, it is hoped that they will begin to sense the value of the MIS for these applications as well as for other applications. Their use of the system also tends to breed interest and involvement when they sense the future worth of the system to them.

After the MIS is developed for the reviews and administrative management, another area which seems appropriate for development pertains to the composite schedule of organizational actions. The goal of this development is a composite schedule oriented to the needs of the Deputy, the directors, and the heads of the EPOs and JEPOs. The schedule can indicate specific deadlines to be met, how many personnel in each section are needed, and the time at which personnel must begin work. The MIS can also indicate whether the schedule is feasible by calculating the number of personnel needed at any one time. The Netplot program available through the ASD computer center can provide some assistance to this area of the MIS.

The area of engineering is another very important area for MIS development. The organization was established for the purpose of providing crossfeed of information among the engine programs. The technological crossfeed is the key issue in this approach, for the solution of the technical problems with engineering actually drives the other elements of cost and schedule. At the time of this study the individual engineers assigned to the programs were given the primary responsibility of keeping the technological crossfeed working. Informal discussions among engineers and periodic reviews of problems were being used to disseminate this crossfeed. An MIS which briefly summarizes the performance problems

and engineering changes can improve the crossfeed of
experience outside of the directorate of Engineering
and Testing. The MIS increases the crossfeed not partic-
ularly by performing any engineering work but by exposing
more personnel to the engineering changes being made and
the affects that the engineering solutions will have on
performance, schedule, and cost. When everyone sees the
technical information across all the engines, they may
more quickly identify problems and solutions in their
own areas of responsibility.

Study of Present Organizational Operation (Phase 2).
This phase of the plan should be completed fairly quickly,
particularly for the initial areas to be addressed for MIS
development. The preestablished formats for the MIS output
and the limited dimensions of these areas contribute to the
quick completion of this phase. The selection of MIS Staff
members from personnel familiar with the areas being
addressed also speeds the completion of the study. However,
familiarity only reduces the time needed, it does not
substitute for the study.

By interviewing and working with the management
personnel during the study of the organization, the MIS
Staff identifies what is desired by the management personnel
and discusses with them those items which are not appro-
priate for MIS application. Through this interaction
and discussion it is hoped that the management personnel
will become interested and involved in the MIS development.

The study also helps management because it forces them to review the procedures they use and identify key items and decisions that they make. While the output format for some MIS applications allow little flexibility, such as with the SPR, PAR, and CAR formats, the MIS Staff must insure that procedures to arrive at the output for each section are clearly understood. An open and continuing dialogue between the MIS Staff and management personnel is necessary at this stage of MIS development.

In the study of the organizational operation, the identification of measures of effectiveness for the management actions can be important. Often personnel do not wish to indicate any such measures for fear of having their performance open for inspection or for fear that such indicators could be used against them. However, with top management's assurance that such indicators are to reflect on the programs rather than on the personnel, the managers can identify indicators for their own personal use. The indicators give management personnel objective feedback about the programs' progress.

Design of the MIS (Phase 3). The design approach which seems most appropriate to use starts the design in reverse order. First, the MIS output format is described. Then the processing methods are developed to support the output. Finally, the required input data is obtained.

In describing the MIS output, the MIS Staff first develops a preliminary outline which reflects both the

desires of the management personnel and, hopefully, some commonality among the different engine programs. For the SPR, PAR, and CAR formats, the output is well established and there is much commonality because of the structure of the output. However, there may be additional items desired by management personnel which can be attached to the output. For other not so well documented output formats, it is incumbent on the MIS Staff to design an output which they feel fits the situation.

The design of the MIS output consists of the MIS Staff balancing two opposing approaches: an output which displays only common information, and an output which is tailored only to the needs of each manager. The MIS Staff can hopefully marry the two approaches into one acceptable style which satisfies both approaches. The MIS Staff is aided in this problem by studies which have identified some of the major cost drivers for the engine programs. Although more work is needed in this area, the studies can be used so that only those elements of the engine programs which are major cost drivers are forced upon the MIS output. For those areas where the more significant elements have not been previously identified the MIS Staff and the management personnel decide upon what elements they want to show as common in all the outputs.

With the preliminary MIS output described, the MIS Staff again coordinates with management personnel to determine any improvements to be made and to finalize

the format before the design work proceeds. Then, the MIS

Staff turns to the work of structuring the procedures for

the MIS to use in producing the final format. The MIS

Staff relies heavily on the information processing methods

normally used by the management personnel.

Once the MIS Staff has developed the processing

procedures for the MIS, they review the inputs to determine

if all the data that is needed is currently available. In

most cases, the input data being collected greatly exceeds

the MIS requirements. The review identifies the signifi-

cant data inputs and indicates which are insignificant.

Then, future data acquisitions can concentrate on obtaining

significant data only, avoiding the costs of acquiring

insignificant data.

The design effort benefits from the positive involvement

of management personnel. However, it suffers from constant,

negative criticism. Therefore, the MIS Staff removes the

design effort from the negative reactions. The removal

allows the MIS Staff some freedom to test new ideas. If

necessary the MIS Staff may still interface with management

personnel to collect additional data, but the MIS Staff

does not allow the evaluation of the design at this stage.

If the MIS Staff decides to approach the design of

the MIS with new ideas they have to be aware that the

success of the MIS depends on how well they can satisfy

the needs of the management with the new design and how

well they can convince them to use the MIS. The use of a

new approach often delays the acceptance of the MIS products because the lack of understanding causes a lack of confidence with what is produced. Therefore, it seems best to develop the MIS using familiar procedures first and later investigate the use of new procedures.

Implementation of the MIS (Phase 4). This phase concerns two actions: gaining the acceptance of the MIS and incorporating the MIS into the organization's operations.

Throughout the discussion of MIS development, the involvement of the MIS's future users, the management personnel, has been suggested. In this study this involvement means the positive participation of management in the on-going work being done on the MIS, not just the participation in the interviews or during the study phase of the development. One of the purposes of this involvement is to expose the MIS to the management personnel so that they understand it more fully. By gaining understanding it is hoped that management increase their confidence in the MIS products and commit themselves to use them.

Another method to build confidence with the MIS was also suggested. By selecting those areas to which the MIS can be quickly applied and put into operation, the time between the start of the development and the recognition of benefit is greatly reduced. In this way management can see the actual operation of the MIS and begin to see benefits to be gained from its use in other areas. The length of time between the start of the development and the use of

the results seems to be inversely related to the amount of interest and confidence in the results.

While gaining the confidence of the management personnel is one of the issues in gaining MIS acceptance, the personnel's acceptance is also predicated on their perceptions concerning the organizational changes to be caused by the MIS. Perceptions that the personnel are losing their positions within the organization because of the MIS tends to make them reject the MIS. To counteract these perceptions the MIS Staff can keep open the channels of communication with the managers affected by the MIS. By doing this the managers can freely express their fears without threat of reprisals. Also, thorough documentation of the progress of MIS development insures that there are no surprises concerning the MIS when implementation is attempted. Personnel who continue to fear changes caused by the MIS can keep track of its progress and can make their own adjustments accordingly.

The second action in this phase involves incorporating the MIS into the organization's operations. There are a number of possible methods to use as described in the previous chapter. The concern at this point rests with obtaining a consensus from the management about which method to use. Since the personnel's degrees of acceptance may differ, the only realistic way to approach incorporation seems to let them decide.

No matter how well designed and documented the MIS is
there will be questions and problems to be addressed when
the system is put into operation. Since management per-
sonnel know their workload they can best advise the MIS
Staff about the most appropriate time for incorporation.
Generally, it is best to choose a time at which the incor-
poration does not hinder the organization's operation and
the management personnel have more time to familiarize them-
selves with the MIS as it relates to their work. Later
when the workload increases, the managers can feel confident
with the MIS and use it prudently.

Problems that occur in this phase of development are
never fully predictable and for that reason all the actions
that help to incorporate the MIS can not be fully described
beforehand. Therefore, the MIS Staff has to be ready and
able to respond to questions and problems that arise. The
staff's own managerial and human skills will be called upon
and their response means a great deal to the MIS's success.
However, it is pointed out again, that close work with the
management personnel in the earlier stages can eliminate
problems. Hopefully the involvement of management personnel
in the development process will cultivate friendly and open
relations between the personnel and the MIS Staff so that
together the MIS can be incorporated and success for the
MIS is assured.

Control and Evaluation (Phase 5). The control over
the MIS rests with the MIS Staff. The control involves

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insuring that the MIS operates as it was designed. This includes making sure that the input data is available and accurate. The quick detection and correction of problems by the MIS Staff continues to build and maintain the personnel's confidence in the MIS.

The use of internal measures of effectiveness is one good way of monitoring the performance of the MIS. The measures of effectiveness provide the MIS Staff with objective feedback. However, the identification of good measures of effectiveness is a difficult task. The criteria to use in the identification of these measures are enumerated in the previous chapter. During the design phase of the MIS development these measures can be more readily identified than after the MIS has been incorporated into the organization's operations. The main point of concern with the measures of effectiveness is the identification of measures which reflect on the MIS and not on the management personnel. For example, the timeliness is a good measure of effectiveness. It can be measured in minutes, hours, or days to indicate how late the MIS is in providing the required output to the management personnel. Accuracy of the MIS can also be measured by comparing the data within the MIS which is gathered from different sources but are derived from the same data base.

The evaluation of the MIS can be accomplished by assigning two or three individuals to a team on a part-time basis. These individuals are not necessarily the

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same management personnel who are using the MIS output, but they should be familiar with the ways in which the MIS output is used within this organization. Familiarity with the MIS procedures and processing methods can help, but it is not essential, because during the evaluation the personnel assigned to the team will become thoroughly knowledgeable about the MIS.

At the outset of the evaluation phase the team identifies the portions of the MIS which will be evaluated. Then they proceed to evaluate all the things involved in the MIS processing and the interface between the MIS and the organization. The team's primary task is the identification of areas where improvements to the MIS are desirable. Where improvements seem appropriate, the team specifies what the improvements are, how they change the previous operation of the organization, and how the management personnel are affected. The recommended improvements are then written into a report along with the justification for the improvements. The report is sent to top management directly with copies also going to the MIS Staff.

The MIS Staff responds to the report and analyzes the cost of implementing the changes recommended in the report. The MIS Staff also expands on the affects that the changes will have on other sections of the MIS not addressed by the evaluation team. Then, in written reply the MIS Staff acknowledges the recommendations and describes

the actions taken.   The MIS Staff's response is sent to top management and to the evaluation team members.

Next, a new team is designated with one member of the previous team remaining.   Another portion of the MIS is then chosen for evaluation and the evaluation process starts over again.   Since the Deputate's MIS will be developed in portions or stages, it seems appropriate that the evaluation team can limit the scope of its work to one of these portions.   For example, one team may evaluate the engineering portion of the MIS while another may evaluate the portion that reflects the reviews of the programs.

V. SUMMARY AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary

Objectives. The primary objective of this thesis
effort is the development of a plan for the design and
implementation of an MIS for the Deputate for Propulsion.
In order to accomplish the objective, Deputate personnel
were interviewed and MIS literature was surveyed. From
the literature, actions which were commonly regarded as
relevant for MIS development were identified. These actions
were then applied in appropriate manner to the task of
developing an MIS for the Deputate. Resulting from this
application is an MIS development plan which identifies
specific actions and agents to accomplish the development
tasks. Since the MIS development effort in the Deputate
at the time of this study is in the initial stages, special
attention is given to identifying actions which initially
orient the development work in the proper direction for a
successful system.

Secondary objectives of this thesis effort are the
review of MIS theory and the gaining of insight into the
work of weapons systems acquisition and development. The
study also provides some understanding of the types of
work performed in the ASD and related organizations.

Literature Survey. The research of the literature
indicated that there is a great amount of disagreement

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about the definition of MIS. However, there is much similarity between the different authors on the general phases or stages involved in the development of an MIS. The similarities are often not explicitly evident but become apparent after comparisons among the different author's plans are made and common elements extracted. A significant amount of the similarity seems to stem from the recognition that the MIS development must be accomplished in a practical manner. The MIS development process has to be planned and approached in a manner which separates the process into manageable sections or parts. While the MIS is often viewed as a totally integrated and complicated system, the authors recognize that it is not possible to develop it in one effort. Instead, the process which seems to work is a carefully planned and controlled process which concentrates on parts of the MIS. In this way each additional part or step builds on the experience gained from the previous part.

The development plans stress the cyclic nature of the MIS development. The development of an MIS is never fully completed, because its final structure is never completely stable. Instead, the MIS structure and purpose are continually reevaluated and changed as appropriate to support the changing environment and the organizations within it.

MIS Role. The MIS role in the Deputate for Propulsion is to be the information provider to management personnel

so that they can effectively and efficiently manage the
engine programs. This role differs from many other MIS
roles since for the Deputate the MIS is required to pass
information which is common among the engine programs.
This commonality is the prime reason for establishing
a separate organization for the development and acquisition
of propulsion units. The commonality in the MIS is required
at the beginning of the MIS even though the engine programs
were not initiated with that concept in mind.

To aid the MIS and the management personnel in passing
commonality and experience, the MIS is best separated into
sections. These sections are business management, technical
management, and administrative management. While it is
recognized that all sections have to fit well into an over-
all, coordinated MIS, the separation allows the information
in each section to be designed in the format most appropriate
for that type of information.

While the MIS presentation is best for passing common
information among the programs, the MIS also tailors the
information according to the individual needs of the manage-
ment personnel. The MIS can present the MIS formats accord-
ing to the amount of detail and the managers' perspective.
For the Deputate the MIS is developed for Deputy, Directors,
and heads of EPOs and JEPOs.

Development Plan. The development plan for the Deputate
encompasses five different phases in the development process.
These phases are the Definition of Systems Objectives, the

Study of the Present Organizational Operation, the Design of the MIS, the Implementation of the MIS, and the Control and Evaluation.

The first phase consists of recognizing the need for an MIS, appointing personnel to develop it, and identifying the objectives of the development process. The objectives are defined in terms of the areas of organizational operation and timetables for the development.

The second phase involves studying the operations of the organization to understand what information is gathered and what information is needed. Also, the future users of the MIS are surveyed to define the items they need and use in their decision-making processes.

The third phase consists of the actual design of the MIS. After the MIS output formats and procedures have been designed in detail, the MIS developers secure the input data needed to sustain the MIS.

In the fourth phase the MIS developers review and promote the acceptance of the MIS, and they incorporate the MIS into the organization. While the acceptance is addressed in this phase, the development plan identifies actions which can be taken throughout the development process to insure the acceptance of the MIS.

The fifth phase produces the feedback in the development process. Through control actions the developers modify and change the MIS so that it is correctly oriented to achieve its objectives. Evaluation of the MIS and its

relationships with the whole organization and the environment create feedback for the whole MIS and its role in the organization. Personnel besides the MIS developers perform the evaluation.

Deputate for Propulsion. The history, mission, objectives, and management problems of the Deputate provide the background to support specific actions for the development of the MIS. From this material it is determined that the development process is best approached by dividing the work into manageable sections, beginning small and developing from that point. The first sections to be fully developed concern the Secretary of the Air Force Program Review, the Program Assessment Review, and the Command Assessment Review plus the management of personnel and clerical resources. Since the formats of the reviews are rigidly established, the information is already available, and the personnel are familiar with the reviews, the development of the MIS in that area can be accomplished quickly and show the management personnel possible benefits for MIS development in other areas. The administrative management area (personnel and clerical resources) also can be developed quickly using charts and graphs currently in use by management personnel.

Once the MIS is established and working well in these areas, the MIS developers can turn to other more difficult and complicated areas. The application of the MIS to monitor and maintain the overall schedule of the

organization is another area which seems most appropriate for the Deputate's MIS. Also the MIS developers can design the MIS to help management personnel apply commonality between technical and engineering actions.

Recommendations for Further Research

Theory. The success of MISs depends on the effectiveness and efficiency of the systems. The effectiveness and efficiency are evaluated by the personnel who are using the systems and the developers of the systems. These subjective evaluations are often clouded by prejudice that the personnel bring to the evaluation. To alleviate the prejudicial responses to the MISs, instruments for measuring these MISs and their characteristics with more objectivity are needed. Then, the personnel are less likely to be deluded by their own feelings and inaccurately assess the MISs. The accuracy of the measurements is necessary to indicate when changes must be performed on the MISs at an early stage. In that way the changes are effected before the MISs reach the stage where they are totally rejected.

Although the Carter and Retzer studies have identified a number of critical factors for successful Air Force MISs, there is still a need to continue that type of research. Because the environment within which the MISs work is constantly changing, the development of the MISs has to adjust to the changes. Critical factors which were identified by the Carter and Retzer studies may not be the same for future MISs. Also, the study of critical factors can

be expanded to insure that no critical factors are missed.

Deputate for Propulsion. One major area for further investigation concerns the identification of the major cost drivers for the engine programs. These factors drive the cost of the engines and therefore need more thorough review and monitoring than do the other sections of the engines.

Coupled with the identification of the major cost drivers is the development of life cycle cost (LCC) models to use with the engine programs. The major cost drivers are the pivotal points in these models, but not just for research and development and acquisition costs. The increasing cost associated with operations and support of the weapons systems have been very significant. In fact, the operating and support costs of the engines have generally accounted for 59% to 72% of the total LCC of the engines. Therefore the decisions made at the outset of the engine developments should be tied together in LCC models which indicate and predict all costs accurately for management personnel.

The inclusion of the LCC models into the operations of the Deputate's MIS is another area which will require much work. This work will be important after the major cost drivers are identified and incorporated into the LCC model for the engine programs.

Another area for further research involves a study of the commercial jet engine business to find out which programs

and methods they have used for their engines. While
the Air Force is usually ahead of commercial engines,
the commercial businesses are required to keep close
track of operation and support costs which may benefit
the LCC models and engine programs.

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APPENDIX A

Interview Questionnaire and Interviewees

Interview Questionnaire

I. Objectives of Organization

   1. What are your major areas of responsibility?

   2. What are the major functions within each particular
       area?

   3. How does your job relate to the overall objectives
       of the organization and others jobs in the organ-
       ization?

   4. What events significantly affect your job? Both
       good and bad.

   5. How do you measure the effectiveness of your job
       performance?

   6. How closely does you job description match your job?

II. Identification of Information Needs

   1. What functions depend on information?

   2. From where does the data for the information come?

   3. Who/how/where is the data processed?

   4. Is the data and information adequate for normal and
       special use? (Timely, accurate, relevant, sufficient,
       concise)

   5. How is the information measured for effectiveness?

   6. What are the consequences of making decisions without
       any information or without adequate information?

   7. How is the information used in decision-making?

   8. How many pieces of information do you normally
       handle in making decisions?

   9. How are exceptions or unusual events handled?

   10. Are there any sources of data or information not
       now used, but which could or should be used to
       enhance the value of the MIS?

III. Objectives of MIS

1. What are the current MIS objectives?

2. What should the objectives be?

3. What kind of an MIS is it and what should it be?

4. What kind of an output do you have now?

5. What kind of an output should be produced for your job and for the organization?

6. What are some specific results for which you would consider the MIS successful?

7. Who/how should the MIS be developed?

8. What do you invision your role in development to be?

9. How much control over the design and operation of the system should be have?

Interviewees

Deputate for Propulsion

     Col. Cheatham-Deputy for Propulsion
     Mr. Koepnick-Vice Deputy for Propulsion
     Col. Binish-In-Service JEPO
     Mr. Deam-Component Improvement Office
     Col. Dimski-F107 JEPO
     Mr. Ellis-New Engine Office
     Mr. Etchison-Program Control
     Mr. High-Engineering and Testing
     Mr. Paris-TF34 JEPO
     Lt. Col. Powell-Procurement and Manufacturing
     Mr. Schuessler-Configuration Management
     Capt. Shelnutt-Operations

Other ASD Organizations

     Capt. Brewer-ASD MIS Working Group
     Mr. Maas-Air Force Wright Aeronautical Laboratory
     Mr. McNally-Air Force Aero Propulsion Laboratory
     Mr. Mitchell-Air Force Aero Propulsion Laboratory
     Mr. Price-A-10 Systems Program Office
     Mr. Sternberger-Air Force Flight Dynamics Laboratory

APPENDIX B

Job Descriptions for Personnel in the Deputate for Propulsion

DEPUTY FOR PROPULSION

Manages and directs life cycle acquisition activities for
Air Force Systems Command aircraft gas turbine engines
including appropriate engine deployment afforts in association
with AFLC and the users. Accepts total management responsi-
bility for cost, schedule, and performance of all AFSC
turbine engine programs. Establishes and translates propulsion
requirements into integrated hardware. Provides engineering
and procurement support for assigned Air Force engines under
the management of AFLC. Studies and evaluates potential
engine requirements as applicable to existing engines,
upgrading of existing engines, and new new engines. Budgets,
defends, and provides funding for engine modifications to
meet new or potential engine requirements. Manages directed
USAF and joint USAF, Navy, and Army Engine Component
Improvement Programs to assure the proper support of engines.

TF34 JOINT ENGINE PROGRAM OFFICE

Manages (plan, organizes, coordinates, controls, and directs)
the collective actions of participating organizations to
accomplish the total life cycle acquisition process for the
TF34 series engines in support of the A-10,S-3A and Compass
Cope Aircraft programs. Ensures that TF34 cost, schedule,
and performance are compatible with established requirements
for the A-10, S-3A, and Compass Cope programs. Ensures that
necessary functional support is provided to optimize
development, integration, and use of engine components and
parts developed under the component improvement program
(CIP). Accomplishes TF34 configuration management.

PRODUCT IMPROVEMENT OFFICE

Formulates and recommends management policy and guidance to
component improvement programs (CIP) and engine model
derivative programs (EMDP) for all Air Force aircraft gas
turbine engines. Budgets, defends, and administers the
overall Air Force funds for these programs. Conducts
independent studies of individual CIPs and EMDPs and develops
recommendations for implementation. Serves as AFSC office
of primary responsibility (OPR) for interface with other
Government agencies and industry in the areas of CIP/EMDP,
technical requirements and general management policies
and procedures for aircraft gas turbine engines. Provides
deputate interface with industry for IR&D. Conducts Tri-
Service reviews, Engine Advisory Group meetings and other
committee meetings to accomplish these objectives.

NEW ENGINE OFFICE

Manages (plans, organizes, coordinates, controls, and directs) the collective actions of participating organizations in planning and executing the acquisition of new or derivative engines and new applications of existing engines through conceptual and validation phases. Coordinates with the government laboratories, planning agencies, and industry to assure cost-effective utilization of the latest technology for engines. Coordinates the validation of engine data for aircraft and system studies, assesses contractor submittals, and establishes propulsion system requirements. Maintains cognizance of commercial and foreign engine developments. Provides initial engine support to aircraft SPO cadres. Serves as Deputy's point of contact for all new engine developmental activity being conducted by other governmental agencies and industry.

OPERATIONS OFFICE

Provides executive services and administrative support to all elements of the deputate in functions relating to: administration; personnel, training, and career development; manpower and organization; security; correspondence, publications, forms and reports management; and facility, property and supply control. Provides the secretariat for review boards. Monitors and coordinates Memoranda of Agreement with other agencies. Performs management analyses and initiates organizational development and other corrective actions to assure that management objectives are met and to accommodate changes in the status of assigned programs/projects. Manages the development and implementation of policies, procedureal techniques and training to maintain uniform configuration/data management, throughout the Deputate. Reviews program documentation, correspondence, and overall program operation to ensure that areas such as configuration, data, standardization,reliability, maintainability, safety, value engineering and environmental factors are properly addressed. Coordinates and directs information and operating policy for these specialities. Develops a corporate memory of lessons learned for life cycle engine management and plans data bank and computer utilization to effect optimum communication. Performs/manages technical and trade-off studies and special projects as directed.

IN-SERVICE JOINT ENGINE PROGRAM OFFICE

Manages (plans, organizes, coordinates, controls, and directs) the collective actions of participating organizations in planning and executing the total life cycle acquisition process for assigned "in-service" engine systems,subsystems, equipment and services. Ensures that cost, schedule, and performance of assigned engine programs meet aircraft system

requirements. Ensures that all aspects of assigned
Component Improvement Programs are properly planned,
implemented and managed. Conducts configuration and
data management and manages assigned project programming,
evaluations, and reporting. Coordinates functional
support to ensure achievement of system objectives.
Ensures that assigned engine programs satisfy the require-
ments of the weapon system.

F107 JOINT ENGINE PROGRAM OFFICE

Manages (plans, organizes, coordinates, controls, and
directs) the F107 Engine Program as an integrated service
project under an agreement with the Joint Service Cruise
Missle Program Office (Naval Air Systems Command, Washington,
DC). Provides for the consolidated development, test and
evaluation, acquisition and logistic support of the F107
turbofan engine as applied to the USAF Air Launched Cruise
Missle (ALCM), USAF Ground Launched Cruise Missle (GLCM),
and the Tmahawk Cruise Missle Programs and any associated
variants. Assures maximum program responsiveness to
the cost, schedule, and performance needs and requirements
of each missle program while achieving maximum engine
subsystem/component commonality, maximum utilization of
joint test and evaluation, and maximum advantages of
common procurement.

DIRECTORATE OF PROGRAM CONTROL

Accomplishes the planning, scheduling, analyzing, fore-
casting, estimating and budgeting for the system program
office. Provides staff assistance to the Deputy in
management of resources associated with the approved
programs. Performs engine integration and interface
with other system program offices. Develops life cycle
cost methodologies and strategies implementing same.
Chairs the Joint Air Force/Industry Engine Life Cycle
Cost Working Group. Prepares, presents, and defends
budget estimates and financial plans. Works with Deputy
elements, contractors, and other Air Force and Government
agencies in developing system cost estimates. Maintains
program schedules, and prepares the schedule sections
of system documentation. Assures compatibility between
all programming documents and directives in response
to current program requirements. Initiates and coordinates
cost change proposals and other changes required to
support the approved program. Maintains program cost
change histories which include contractor performance
in terms of actual cost incurred versus prior estimates;
prjected cost to completion of current authorized work;
projected cost of anticipated but unauthorized work;
and current adjusted target cost/price and adjusted
ceiling price. Continually reviews and monitors the
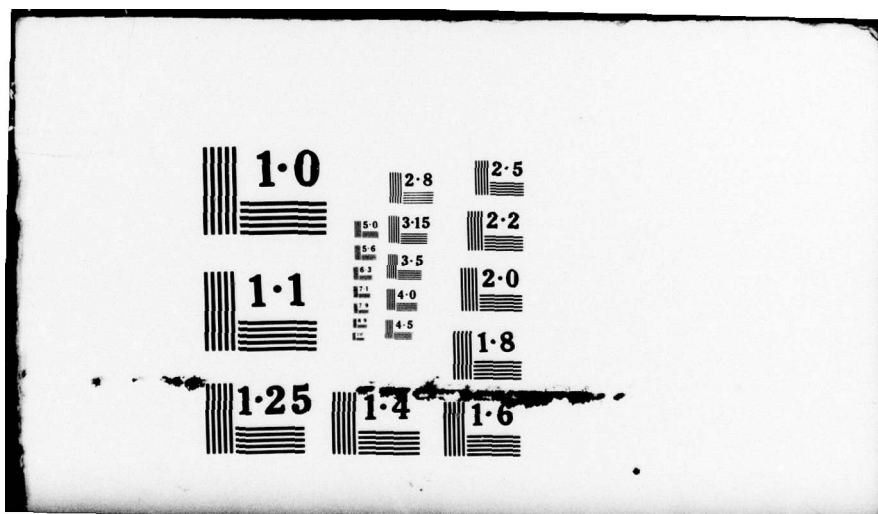
Cost Schedule Control System with emphasis on the
financial reports generated with this system. Allocates
financial resources and issues Program Authorization
(PAs) for funds control within Deputy jurisdiction to
all functional agencies participating in the programs.
Maintains current status and records of program funding,
initiations, commitments, obligations, and expenditures.
Develops and implements management information system
(MIS) to provide management visibility to Propulsion
SPO System Program Director (SPD) and to other concerned
SPOs. Prepares system presentations, program status
reports and other required periodic programs, reports
and documents. Serves as prime focal point within the
Program Office on all IG, GAO, audit and congressional
matters.

<u>VITA</u>

Bruce E. Wallachy was born in Portland, Oregon on January 11, 1946. After graduating from hig school in Troutdale, Oregon in 1964, he attended San Luis Rey College and Portland State College.

In 1969 he enlisted in the United States Air Force. He completed Technical School training and served one year in Japan as a Telecommunications Technical Controller before being assigned to the University of Wyoming under the Airman's Education and Commissioning Program. In 1973 he graduated from the University of Wyoming with a Bachelor's degree in Electrical Engineering.

After completing Officers Training School and a Technical School training course for 305X officers, he was assigned to Richards-Gebaur Air Force Base, Missouri. He worked there three years as a Traffic Control and Landing Systems Evaluation Engineer. He was selected for admission and entered the Air Force Institute of Technology beginning in June 1977.

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

The primary objective of this thesis effort is the development of a plan for the design and implementation of a management information system (MIS) in the Deputate for Propulsion. To accomplish the task the MIS development ideas and concepts presented by MIS experts in the literature sources are examined and applied to the organization and its work. Specific actions and agents are then identified for the MIS development. Since the development process for the Deputate is in its initial stages at the time of this

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thesis effort, special attention is paid to identifying actions
which initially help orient the development toward a successful
system.