TOTAL MANAGEMENT INFORMATION SYSTEM CONCEPT

by

HAROLD ROBERT ALLSOPP

B. COMM., UNIVERSITY OF SASKATCHEWAN, 1962

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF BUSINESS ADMINISTRATION

in the Faculty

of

COMMERCE AND BUSINESS ADMINISTRATION

We accept this thesis as conforming to the

required standard

THE UNIVERSITY OF BRITISH COLUMBIA

APRIL, 1969
In presenting this thesis in partial fulfillment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representative. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

April 11, 1969
Date
The objective of this thesis is to develop and define the concept of a total management information system. The term "total system" has been grossly misrepresented since its coinage, however, the misuse can be attributed to ignorance of its full meaning. The misuse is also attributed to narrow thinking on behalf of the user for its application has mainly been directed to a specific circumstance.

The study defines the term "total management information system" and it also outlines the attributes which make up the total system. As in all situations where an ideal is created, there is resistance to reaching the ideal - these barriers are enumerated and commented upon.

To test the validity of the concept, it is applied to an existing company's informational system by the methodology of a systems analysis. Conclusions are reached on the soundness of the concept and on the status of the case company toward its claim of holding the totality status.

Primary research was conducted on the theory of a total system; secondary research was conducted into the existing systems of the case company. Throughout the study, observations were made concerning the problems associated with the topic and an evaluation is made on the status of the evolution of the total information system.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>Objective of the Thesis</td>
<td>2</td>
</tr>
<tr>
<td>Scope of the Thesis</td>
<td>4</td>
</tr>
<tr>
<td>Definitions</td>
<td>6</td>
</tr>
<tr>
<td>II EVOLUTION OF THE TOTAL MANAGEMENT INFORMATION SYSTEM CONCEPT</td>
<td>9</td>
</tr>
<tr>
<td>The Role of Information Systems</td>
<td>9</td>
</tr>
<tr>
<td>Evolution of Systems</td>
<td>11</td>
</tr>
<tr>
<td>Interpretation of the Concept</td>
<td>14</td>
</tr>
<tr>
<td>Total Information System Concept Defined</td>
<td>20</td>
</tr>
<tr>
<td>Barriers which Prohibit Achievement</td>
<td>23</td>
</tr>
<tr>
<td>III THE SYSTEMS ANALYSIS</td>
<td>29</td>
</tr>
<tr>
<td>Objectives of the Systems Analysis</td>
<td>29</td>
</tr>
<tr>
<td>Methodology of the Systems Analysis</td>
<td>36</td>
</tr>
<tr>
<td>Method of Analysis to be Used for the Case Study</td>
<td>42</td>
</tr>
<tr>
<td>IV ANALYSIS OF CASE COMPANY</td>
<td>48</td>
</tr>
<tr>
<td>General Information on the Company and its Operations</td>
<td>48</td>
</tr>
<tr>
<td>Identification of the Key Variables</td>
<td>50</td>
</tr>
<tr>
<td>Description of Key Operating Systems</td>
<td>54</td>
</tr>
<tr>
<td>Current Systems Design</td>
<td>72</td>
</tr>
<tr>
<td>V SYSTEMS ANALYSIS FINDINGS</td>
<td>82</td>
</tr>
<tr>
<td>Interpretations of Case Company's Reporting System</td>
<td>82</td>
</tr>
<tr>
<td>Application of Totality Concept to Case Company</td>
<td>99</td>
</tr>
<tr>
<td>VI CONCLUSIONS AND GENERAL OBSERVATIONS</td>
<td>107</td>
</tr>
<tr>
<td>Disclosures of the Study</td>
<td>107</td>
</tr>
<tr>
<td>Conclusions of the Study</td>
<td>112</td>
</tr>
<tr>
<td>Observations of the Study Which Could Provide Other Topics for Research</td>
<td>116</td>
</tr>
<tr>
<td>General Observations on Current Problems of Information Systems</td>
<td>118</td>
</tr>
<tr>
<td>Total Systems - A Present Evaluation</td>
<td>122</td>
</tr>
<tr>
<td>BIBLIOGRAPHY</td>
<td>125</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Monthly Marketing Reports</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td>62</td>
</tr>
</tbody>
</table>
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>Description</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Analytical Problem Solving</td>
<td>38</td>
</tr>
<tr>
<td>II</td>
<td>Logical Systems Analysis</td>
<td>44</td>
</tr>
<tr>
<td>III</td>
<td>Production Planning System</td>
<td>65</td>
</tr>
<tr>
<td>IV</td>
<td>Production Scheduling Procedure</td>
<td>67</td>
</tr>
<tr>
<td>V</td>
<td>Distribution and Marketing Subsystem</td>
<td>75</td>
</tr>
<tr>
<td>VI</td>
<td>Cost Control and Manufacturing Information Subsystem</td>
<td>79</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

I. INTRODUCTION

The phrase "total management information system" is among the most used — and abused — in business today. It has been applied to virtually every kind of information processing system that a company may possess. As a result, it is frequently misunderstood and often unjustly criticized by those who have little patience in searching for its true meaning.

The confusion has arisen in part from differences in terminology and in part from the variety of opinions on how management information systems can or should be applied to management problems. But the main source of controversy lies in the lack of consensus on what management information systems are supposed to be and how they should be designed to meet the growing needs of management today.

The movement toward more fully integrated systems has been underway for several years and does not appear to be retarded by problems in terminology. This movement is evidenced by the growing number of major companies that have installed centralized management information systems or are planning to do so. Moreover, as management is subjected to increasing pressure for faster, more complete and more fully coordinated information, it is only reasonable to assume that the trend will continue.
What has begun to be realized is that as information processing systems become more complex, a need develops to have basic terminology clearly defined and in a manner which will be universally understandable. The basic criteria for discussing systems of this type must be known to all parties before an intelligent exchange of opinions can be made.

Despite differences in nomenclature, it may be easier to define a total management information systems in terms of what it should do rather than in terms of what it is. Once this point is established, the relationship of modifiers or factors effecting attainment can be introduced.

In its broadest sense, a "total" system is one in which all information - external and internal - affecting a company's operations is made known to management. The information can then be used in the decision making process. Using this generalized definition, it can be seen that a total system is only a concept and must be further defined to facilitate implementation into a business organization. It is this process of refining the broad definition, and implementation of principles expressed by the definition, that will be discussed through this thesis.

II. OBJECTIVE OF THE THESIS

Statement of the Problem

It is the purpose of this thesis to develop a universal definition of the concept "a total management information
system." The derived definition will constitute a model total management information system which will then be applied against an actual company as a means of assessing whether or not the existing information system of the company attains the status of totality. The application to a case company will also demonstrate the feasibility of the definition as being universally adaptable to a practical situation.

Importance of the Study

"The ultimate goal of an effective management information system is to keep management completely informed on all developments of the business that affect them".¹ The system will make information available to management to facilitate an efficient decision making process. The prime concern of the system is to provide timely, relevant and accurate information at minimum cost. The biggest obstacle to developing such a system is to have general agreement on exactly what the totality concept should be. It will be the object of this thesis to investigate current literature on the subject of totality and from these writings and personal observations to produce a definition of the concept which will contribute toward understanding information systems.

As a secondary objective, the definition of a total management information system will be applied to a case situation to test the concept's validity and a company's claim to achievement of the totality status. The method of application will be a beneficial exercise for anyone in a systems analysis situation. The attempt in this thesis will be to set out an overall technique of analyses which could be applied to any company in making a systems analysis. The review will avoid making detailed quantitative valuations and will not be directed specifically to a computer application because these types of approaches are very much identified with an individual company situation.

III. SCOPE OF THE THESIS

In dealing with the topic of total information systems, the scope of study will be narrowed by limiting the amount of reference to specific information processing equipment. For example, it was not felt that the consideration of computers is an essential element in a model information system, therefore, the study will not be directed primarily to a computer application. In areas where a computer would facilitate a better information flow than experienced otherwise, mention will be made of its use and advantages.

The contents of Chapter II represents considerations which are very basic to a broad understanding of the role of information systems and introduces concepts which are germane to
the development of the entire thesis. The concepts of the total information system which are reviewed in the chapter are useful in orienting one's thinking regarding the objectives of information systems.

The purpose of this chapter is to develop the concept of a model total information system by integrating the significant contributions of individual definitions.

Construction of a model is a common technique used to study the characteristics of systems under varying conditions. The model is an abstraction of the essential elements that characterize the system or the previously unstructured situation which one wishes to view as a system. Once constructed, a model serves as the guidelines for further analysis.

Often companies will perform what is known as a systems analysis. However, the purposes and methods of the analysis are usually not fully understood. It will be the purpose of Chapter III to set out the recognized objectives of a systems analysis in order that guidelines can be established for the review process followed in the remainder of the thesis. Once the analyst becomes acquainted with concrete objectives, he can design his review to suit his own individual needs.

Having set out the objectives and methodology of an acceptable systems analysis, the framework will then be drawn up
for the specific analysis to be used in reviewing the case company (to be known as ABC Company).

Chapters IV and V will involve the investigation of ABC Company in its current operating form. The approach will be to identify the key success areas of company operations and to relate these variables to the common goal. Once the key success areas are known, the subsystems for each of these functions can be studied. Analytical procedures will be used for the review so as to provide a systematic outline of each subsystem's relationships. Having examined the subsystems, the totality concept will come into focus by viewing the interactions of these subsystems and how they are orientated toward the common goal.

Once the findings have been presented, Chapter V will attempt to interpret the data in light of how each procedure contributes toward the total information system.

IV. DEFINITIONS

Explanations of the key terms used throughout the study are as follows:

Information - It should be emphasized that there is a distinction between the terms "data" and "information". Data are simply unrelated and uninterpreted facts or statistics. Information is knowledge derived from the collection, organization and analysis of data.
Business information is not homogeneous. Therefore, varying kinds of information must be treated differently. Consequently, it may be useful to divide information into its several classifications. These classifications will be expressed as follows:

- Information may result in action or non-action; i.e. the information may require the recipient to initiate some kind of action or merely to be of interest requiring no immediate follow-up. For purposes of this thesis, information will be taken to mean only written or documented details. Non-documentary information is information that is transmitted through word of mouth or personal observations. This form is very difficult to trace and identify, therefore hard to substantiate in cases of argument.

- Information may be generated internally or externally in relation to the firm.

- Information may also be historical or projective.

A System - A general definition would describe a system as set of objects with a given set of relationships between objects and their attributes. In a more specific form, the foregoing system elements would be defined as follows:  

- Objects are the parameters of systems. The parameters or constraints are input, process, output, feedback-control and a restriction.

---

- Attributes are the properties of object parameters. Attributes characterize the parameters of systems, making possible the assignment of a value and a dimensional description.

- Relationships are the bonds that link objects and attributes in the system process. Relationships are postulated among all system elements; i.e. among systems and subsystems and between two or more subsystems.
CHAPTER II

EVOLUTION OF THE TOTAL MANAGEMENT INFORMATION SYSTEM CONCEPT

Much has been written in regard to the development of improved management information systems, but most authors have generally differed in defining the term "information systems". A brief review of current literature on the subject of total information systems will be given in an effort to disclose the reasons for the vagueness surrounding the term. An attempt will also be made to derive from the various views a generalized definition of the total information concept, while in later chapters the definition will be tested for its validity by applying it to an existing company.

I. THE ROLE OF INFORMATION SYSTEMS

The objective of all decision making in organizations has one general effect - the promotion of the ends of participants to their satisfaction.¹ The pursuit of this one general effect requires that there shall be a means or a process by which co-ordination of the decisions and acts of the employees of an organization is secured. Coordination entails that:

(a) all employees shall know the effective elements of the environment of the organization;

(b) all employees shall know the common goal of the organization at any time;

¹Chambers, R.J., "The Role of Information Systems in Decision Making, Management Technology, Volume 4, Number 1, June, 1964, p. 15.
(c) all employees shall react to the environmental facts insofar as the facts affect the pursuit of the common goal;
(d) all employees shall have the same interpretation of facts.

As organizations increase in size, each of these requirements becomes more difficult to fulfill.

Every organization has its own technical vocabulary. For different aspects of its operations it may use different technical languages. Each of those languages consists of a set of signs and a set of rules by which they may be formed into other signs. If effective communication is to take place, the language used must be such that signs employed evoke in others the same response as if those others were to see the objects represented instead of the signs. The information system is designed to employ the technical languages of events and produce a common understanding.

The role of an information processing system with respect to decision making is to produce and supply statements which, in conjunction with their interpretations, will evoke persons to make decisions. The information system may not, in itself, make the decision, but will alert the decision maker to environmental facts allowing him to perform the actual decision process.

An information system is an abstracting system; its justification lies in the reduction of information available to the information that is relevant to action. But abstraction may
not be carried to the point where differences isignificance are obscured. The ability to make intelligent decisions on vague information becomes one of chance rather than judgement.

II. EVOLUTION OF SYSTEMS

The time is not far removed from when total systems, although not referred to as such, was the operating method of every business enterprise. Each entrepreneur either conducted all his own affairs or intimately knew each employee. Each decision was based upon complete knowledge of the situation from the environment, market, economic condition and state of production. Obviously each of these conditions entered into every decision in varying degrees as an automatic reflex of the principal's thinking. As business enterprises became larger, they began to fragment functionally simply because anyone possessing the generalized capabilities of the principal would likely to be engaged as an entrepreneur in his own enterprise. In order to make use of people who had limited ability, the functions of the enterprise were fragmented.

As time passed and business enterprises became even larger and more complex, communication lines grew longer, slower and more difficult to maintain. Those in the seat of direction of the enterprise themselves became specialists. With each specialty developed a provincial attitude and a specialized jargon, which further complicated the semantics of communication. This finally
led to the recognition by many managements that communication and direction of all segments of their enterprise was impossible with the existing tools and intelligence. This realization produced the development of a scheme of semi-autonomous divisions. This process was called decentralization and reflected recognition of a lack of the two of the essentials that maintain a business, communications and intelligence.

With the decentralization process came the recognition that the entire information system of a company was just too large and all-encompassing to be a meaningful and useful classification. Some began to think of systems as being activities of horizontal and vertical dimensions. One such person was John Dearden who said, "horizontally, the system's activities can be classified by the type of work performed; vertically, the system's activities can be classified by the kind of information handled".²

Others believed the overall system to be made up of various subactivities with an integrating common objective. Each subactivity of the system came to be referred to as a sub-system.³ Any degree of subdivision could now be possible as each activity could be further broken out.


This gave the real beginning to the study of the systems as now management could look at the complete enterprise as fragments rather than as a whole entity. The infinite number of events happening every day could be arranged and surveyed without the cumbersome dynamics of a changing enterprise constantly taking them out of view.

The next phase in systems development was to take the newly identified system and subsystems and through individual analysis create new system designs, evaluate existing systems, or improve their function. There could be a determination of the need, propriety and effectiveness of the existing systems in terms of established objectives.

In the future the phase of total systems and integration of subsystems will become increasingly highlighted. The high level of interest in information systems may be directly related to a new concentration on the dynamics of change and advances in technology. As stated by E. Tomeski:

"Top management is interested in those significant tools, techniques and ideas that can provide control over complexity and time spans. The drives of top management to seek assistance from their managerial burdens by advantageously using total information systems are not based on the need to supplement the shortcomings of human beings - but because of the intense competitive economy. The pressures are from many sides: federal government's active role in constraining businesses, wages and salary spirals and bidding for scarce manpower talent, international competition, new products, new market demands."  

---

There is a greater awareness of the need for constantly updating systems concepts to meet the needs of business. A need has developed for far more penetrating and orderly studies of the business in its entirety to discover what are the specific information requirements.

III. INTERPRETATION OF THE CONCEPT

The first principle of the total information systems concept is that the entire business enterprise itself is a system of the highest order. It is a purposeful organization of resources. Objectives are pursued. Choices are made. Responsibility for choices is divided among two or more individuals or groups and the choosers are aware of each other's choice. One individual or group has a control function, comparing outcomes with objectives and adjusting the system to reduce differences.

What is significant in any organized system is the overall performance rather than efficiency of some individual part. Further information systems are characterized by the interdependence of their parts. According to Dr. H.N. Laden, a business organization is essentially an extremely complicated system of cooperation in which effectiveness is dependent less and less on the quality of individual efforts and more and more on the logic of the total design and upon the precision with which each individual's

---

Various definitions have been offered on how a business organization can be represented as a total system. However, each opinion takes a very narrow approach to the subject.

A view expressed by R.W. Christian states the total management information system concept as an integrated corporate intelligence system designed to permit management by exception, based on timely information, randomly available, and guided by rigorously determined relationships and decision rules.\(^7\)

His total information systems concept would provide a reservoir of information available to any manager in the company, any time it is needed. Significant relationships between trends or data, the probable impact on the entire company of contemplated action, the comparative return on investment of totally unlike possibilities could be developed on command. The system would go beyond gathering and processing data to include, among other things, records management and information retrieval.

Much more planning information could be available - information that focuses on the future and on external factors such as population, plans and activities of competitors, new laws,


import trends. The company could ultimately isolate and study the controllable, or at least predictable facts that affect its growth and prosperity. There would be far more effective use of economics, decision rules, probability theory and statistical analysis. The company could gather and make persuasive use of much more non-financial information.

Christian, however, did not recognize the total system to be a single all pervading system. He viewed each company needing a coordinated interlocking set of systems. For example, he viewed a planning system not being identical with a control system nor dependent on identical information. Reporting systems represent something else again. The crux of his concept was that these types of information systems must support each other for maximum efficiency. It was the concept of integration of subsystems rather than a total system.

Another view on the total information system is expressed by E.R. Dickey who does not attempt a concrete definition of the concept, but gives his interpretations of the objectives and scope of a total management information system.

Basic objectives of an effective total information system, as identified by Dickey, are to provide the right information to the right people at the right time at the lowest possible cost. 8

---

Right information consisting of three primary types; i.e. succinct action information, historical information and current status information. The right people will include those individuals charged with the responsibility for initiating action, for maintaining conformance to policy and operating personnel. The right time is a variable according to specific information, but will also be a time which provides for an effective interpretation of the information.

The approach and score of such a total information system, as viewed by Dickey, is mainly one of utilizing electronic data processing equipment. The scope would then be defined as:

"The collection of all clerical data at the point of origin in machine language, validation of the data, and assimilation into a single corporate memory; for retention, rearrangement and timely, capsulized dispersal to users with authoritative need".  

To be of general value, this interpretation need only omit the words, "in machine language", because these apply specifically to those companies serviced by a computer or other electronic data processing equipment.

In this definition, the collection of clerical data at the point of origin represents a twofold problem. First, the data must be captured only once (at its inception) and shall not be processed manually from one activity to another, thus avoiding the duplication of clerical efforts and possibilities of transcription.

9Ibid., p. 339.
error. Second, having captured data once, it should be possible to make it available for re-use as an economical by-product of the initial transaction.

It is the assimilation of all clerical data into a single corporate memory that is a key element in the scope of the total information systems program. The corporate memory of any company can be taken to mean the grouping of all the clerical files and manuals of policy or procedures needed to provide valid basic data.

A more general view of the totality concept is held by R.W. Graham, Jr., who takes the position of dealing with both management and operating personnel. He feels that the total information system is a system which provides the maximum pertinent information that management or operations require to effectively discharge their assigned responsibilities. Most definitions look upon the information system as dealing only with management or those in a position to make decisions rather than operating personnel.

Graham continues his observations by saying that management has three main responsibilities; operations, planning and control. The superior total management information system should assist in all these areas.

---

Other approaches to the problem of a definition use the method incorporating automatic data processing equipment. For instance, Asa T. Spaulding, Jr., in an address to the 1964 International Systems Meeting defined the total information system as an approach that considers the business enterprise to be an entity composed of interdependent systems and subsystems which, with the use of automatic data processing systems, attempts to provide timely and accurate information which will permit optimum management decision making. The definition implies the combination of three components which in this context are inherent to a total system - an automatic data processing system, a management information system and a feedback system. The idea is to provide those who have a "need-to-know" with information which is in a meaningful form, timely, and that it be provided at the lowest possible cost.

Several other views on the concept have been expressed, but each continues to be an individual interpretation. Among these include:

(a) "...a truly comprehensive system concept that will encompass the whole range of an organization's data processing requirements, in both variety and volume."

---


(b) "All data processing applications are functionally grouped according to their inter-related element and purposes, thus permitting development of a broad concept of a comprehensive system that encompasses all data processing. This concept is expressed in broad blocks of information, each an integral part of what will be the total information system."\(^{13}\)

(c) "...a total information system is made up of many systems; i.e. accounting system, production control system, inventory management system, etc. But the design objective is to build toward a system that will facilitate the decision making process. The decisions should be aimed toward improving the company as a whole rather than the operation of one particular part."\(^ {14}\)

IV. TOTAL INFORMATION SYSTEM CONCEPT DEFINED

During the review of various interpretations of the total information concept, certain common characteristics appear which point towards unanimity in the development of a definition. A brief summarization of these identifying characteristics follows:

(a) Information should be generated for those who require it to fulfill their decision making role. Thus, the system will

\(^{13}\)Ibid., p. 1.

need to produce internal as well as external information. The key, though, is to produce information for those who need it. The inference being that any information produced purely for interesting reading by others is a waste both in dollar cost and time value.

(b) The total information system will have a unity of purpose which it will accomplish in as simple, clear and as understandable a manner as possible. The system must provide information that is related to the company's objectives and in an understandable form. To accomplish this, there must be a uniform interpretation of the objectives and how the objectives relate to information the system provides.

(c) A superior total information system must provide a required service at the lowest possible cost. The rule being that no function or portion of a function be performed when it does not contribute more than its cost to the enterprise.  

(d) The information system must be all encompassing; i.e. the company will be viewed as an integrated entity in its information requirements. The information generated for one user can also be made available for other users if they so desire. Duplication of information production is to be avoided.

---

(e) Integrated data processing techniques must be employed in designing information systems. Data is to be captured or created in a uniform language as near to the source of origin as possible and to flow through the system automatically from that point on. Whether or not the system is automated (implying the use of a computer) is a matter of individual preference, depending on requirements in any given information system. The computer is not considered necessary in a total information system, but in some situations would be highly desirable.

Having reviewed some of the main characteristics of a total information system, an attempt can be made at combining them into a workable definition of the concept – one that will be used throughout the remainder of the thesis.

A total management information system is defined as a system involving the acquisition, processing, communication, storage and retrieval of all types of information products and services required by either users or generators of information using the best combination of available concepts and equipment combined in an optimum fashion with constraints to be factors of cost, efficiency and growth.

This definition deals with the complete cycle of information. It follows a "cradle to grave" path. The definition also deals with only that information which is required, whether it is required by the originator or other users. It will be generally understood that information will only be dealt with at a managerial level or those in a position to carry out a decision making process.

The definition will fit either a manual or an automated system, or any combination of both. The only parameters to the system is that consideration be given to cost, efficiency and growth. A careful eye has to be kept on all three of these factors as each one may cancel out any advantage gained by the other.

It is believed the definition given is a workable one for any analyst to consider in his look for the overall system. It attempts to project through the use of systems an appreciation of the information requirements under the totality concept.

V. BARRIERS WHICH PROHIBIT ACHIEVEMENT

The concept of a total information system is even more difficult to attain than it is to define. The reality and practicality of applying the concept to a given situation gives rise to many problems. These problems are not universal but taken as a frequency distribution will provide a basis for understanding

---

17 This term was used by R.M. Skinner and R.J. Anderson in describing the analytical audit procedure of tracing each type of transaction throughout a system - from the point of inception to either permanent storage or destruction. *Analytical Auditing*, Toronto, Sir Isaac Pitman (Canada) Ltd., 1966.
the limitations of the concept itself. Some of the problem areas are defined as follows:

(a) The main factor which inhibits the building of a total information system is the cost. The personnel cost, the equipment cost, the physical facility cost and the time value cost are all costs which contribute toward the total cost barrier. In theory, if each enterprise could install all the latest electronic reporting equipment and educate employees to the most advanced information processes with no concern as to the cost, achievement of a total system would be made much more simple.

(b) Related to the cost element in the information process is the problem of report strangulation. In the search for better reporting, information is often duplicated, made redundant, routine, etc., which all add up to a higher cost for the useful information which is eventually received. Closely associated with this characteristic of excessive reports is the desire for protection against possible blame should some part of the information system fail. This takes the form of extra copies, time stamps, initialing of memos, various checks and logs. But the cost of these protective measures can far exceed the delays or errors which they protect against, and often they provide little or no help in determining the source of such delays or errors.
(c) The problem of centralization versus decentralization for service and planning functions has inhibited the totality concept. The trend toward larger enterprises has often necessitated the need for decentralization. Reasons of flexibility, responsibility, product specialization and control are given for these moves. However, under a decentralized organization there becomes a duplication of functions resulting in a duplication of information generated.

(d) The information system must contain a high degree of flexibility, thus maintaining the ability to withstand change and to adapt itself to the changing demands of business. This condition is sometimes called "management myopia". The modern manager not only cannot afford to be looking backward, he can't even safely constrain his vision to the present. He must not be saddled exclusively with the programs dealing only with today's priorities because "today" too soon becomes "yesterday".

(e) Rigidity is often built into a system by failing to provide an adequate procedure for changing the system to meet new conditions. A ready awareness is needed to keep up with the times. The ideal information system will function automatically and will bring attention to any situation which requires investigation or corrective action.

(f) The human element has been a significant barrier to the attainment of a total information system. People tend to cling to those things which they are accustomed to. The information systems in many concerns have been established over long periods of time, tailored to the requirements of various supervisors, department heads and top management. These people are often very selfish or self-centred in their approach to the overall objectives of the company. They are concerned with their immediate objective only. The total information system concept does not cater to the special personalities and abilities of persons in the organization.

(g) The total information system program must obtain the general acceptance of management. It must have their understanding. This prerequisite has blocked numerous programs for when management does not understand why they are doing a procedure, they tend to avoid it and follow another procedure which they do understand.

(h) The scope of a total information system encourages numerous areas for specialization. The tendency is not to advocate the overall perspective, but to emphasize and practice in those areas about which one knows the most, either by training or experience. As a result, specialization creeps in and the broad balanced viewpoint falls by the wayside.

---

Communication difficulties arise among the specialists. The total information systems concept is evolved on what meanings are believed to be as well as what they really are.

(i) One of the most serious barriers is the temptation to cling to narrow approaches. The complete and full benefit of a total system can never be won by adhering to limited areas.\(^\text{20}\) This is apparently related to a persisting tendency to orientate systems efforts to specific problems as they arise. Often, systems are changed to bring about a solution to an immediate problem. The initial thinking is focused on patching up or repairing systems already in existence — called the fire fighting approach.\(^\text{21}\)

(j) The barrier of speed in reporting has and always will be a strong factor. Reference is made to automated systems as well as those of humans. The problem is the time lag between the occurrence of an event and the reporting or feedback of the desired information.\(^\text{22}\) The objective is to keep the lag at a minimum, but men and machines have yet to have a perfect coordination of efforts.

\(^{20}\)Ibid., p. 49.

\(^{21}\)A term used to describe a method of correcting a problem. It has a lure of being service-oriented, and usually amounts to little more than an expedient patching up of weak spots in the routines of business.

(k) As stated in the basic definition of a total information system, there must be clearly stated objectives. The system will have a unity of purpose which it will accomplish in as simple, clear and as understandable a manner as possible. All management should be made aware of and be able to recognize the common goal, but as often happens they fail to keep it in mind at all times. A complete information system with an undefined set of objectives is seldom a total system because of the tendency to follow an individualistic set of goals which often differ from other members of the management team.

(1) For effective results, an information system must be based on verified facts and not on opinions, guesses or false information. As often happens, the informal system comes into play during communication relays with the result of accuracy being sacrificed. The scientific method requires the use of established and verifiable facts as the basis for hypothesis and decision. If the significance of the information is lost during translation, the system breaks down and the totality notion is lost.

---

II. OBJECTIVES OF THE SYSTEMS ANALYSIS

Traditionally, "systems analysis" has served the needs of the analyst in dealing with the improvement of a specific clerical operation. It encompassed only such matters as the measurement of work flow, costs and paperwork volumes. This limited function is not adequate for the requirements of an organization in terms of a comprehensive total systems program. Considering only the operations analysis requirements, the systems analyst is usually concerned with three aspects of analysis for a total system review: (1) the analyst is as concerned with qualitative analysis as he is with quantitative analysis, (2) when designing a company wide system, the analyst gives less attention to document flow within a single department and more attention to interdepartmental or interfunctional data and information flow, (3) the limits for detailed analysis will be determined by the specific needs of the information processing program itself. The factual data and flow charts developed will be directly related to and influenced by the definitive outline of the logic of the new system.

There are two schools of thought on the basic role of a systems analysis. The proponents of one of these theories maintain that a detailed analysis is concerned with virtually every aspect of the project under study and is necessary as a preliminary to developing the design specifications for the information processing system. This position is defended on the basis that a complete understanding of the existing system is required in order to determine the impact that a change in the system will have upon certain functions.

The supporters of the second theory hold that, except for those factors which clearly have company wide management implications, detailed analysis of the existing system at the operations level is wasteful, unnecessary and will result in a mass of detail that can be of only historical interest because the system will likely be substantially changed. The design of the new system will certainly not be predicated on the requirements or restraints of the old one. Under this concept, the focal point of concentration is on the formulation of the new system rather than the point by point improvement of the old, and all resources should be diverted to systems design and development.

It will be a modification of this second approach that is more of interest in dealing with total information systems.

---

2Ibid., p. 127.
analysis. Concern is not over the minutely detailed procedural aspects of the analysis, but is directed towards the company wide management implications in the system. The perspective is the totality concept and cannot be clouded over by looking at every detailed operation.

Within this boundary there can be two additional alternatives. One alternative is where the proposed or model information system is known to be the objective, with a subsequent review to be a routine of examining the existing system, analyzing and recommending alterations to fit this model. This method assumes a prior detailed knowledge of the systems in use. The second approach is to acquire a working knowledge of operations by very briefly studying the existing procedures and systems, examine for inter-relationships and commonness of efforts and classify into functional groupings. The functional areas can normally be thought of as individual segments of a total system; i.e. subsystems. Establishing functional areas permits classifying the relationships between activities and the natural flow of information from one system to another. This plan would serve in establishing a recommended total information system.

Again, the second approach lends itself to greater acceptance in that it assumes no prior detailed knowledge of the

---

3This approach was recommended and used by C.C. Wandler in a paper entitled "An Approach to Developing a Total System", Ideas for Management, Cleveland, Ohio, Systems and Procedures Association, 1964, p.p. 205-220.
systems and may allow for a more objective review. No prior opinions have been formed. A generalized definition of a total information system must be held beforehand so as to form guidelines during the review. However, the model will be moulded to the particular circumstances. Thus, in one situation the system is structured to fit a model or ideal, while in the other situation both the model and the system may be altered to have compatibility.

In practice, this second view is more accepted because the analyst has often had experience in or has been exposed to similar systems under other circumstances.

The initial step of the analysis should be to examine the existing systems with the objective of gaining an understanding of the operations and to search for information that may be required in an overall system. This means a brief review of the input, processing and output operations. Each processing system is intended to serve a certain purpose. These purposes should be examined to determine their current validity and worth in terms of contributing to the objectives of the overall program. The established processing goals should dictate the specific information output required to meet these goals. What types of output are required? In what form? How frequently? What should they contain? These questions should all be incorporated in the objective. Often, the input or raw data will in turn be governed by the output requirements.
Another objective will be to determine in what organizational units the work is performed. The procedure will be to classify the information processing operations by organizational unit and by objective; also determine which information may be best performed centrally and which on a decentralized basis and by which unit.

The analyst should become familiar with company policies, especially with those which have a direct bearing on the system. The present policies could serve as the guidelines in any future mouldings of the system. The system must serve the needs of the company, but shall not go against an established policy. However, as systems may be revised, so may company policies. If the occasion arises where a challenge to an existing policy is made, the analyst should be fully aware of the implications so as to prepare his defence to gain management acceptance.

The systems analysis serves to study the origin of data and the processing steps involved. The purpose is for the analyst to determine the sources of information and to be able to capture this input data as close to the source as possible. The data would flow through the system automatically from that point on. The need for accuracy and reliability in data collected dictates the source be known and controlled to the point of

---

producing satisfactory input. The processing steps involved usually fall along the lines of clerical routine once the input has been collected, but the systems analyst must be positive of exactly what processing is done, times taken to process, personnel used, equipment used, costs, etc. Once these are established, the possibility of integration of process steps may be studied.

Another objective of the systems analysis, although somewhat detailed, is to assemble forms used in processing and to evaluate reports prepared. The analyst should make his evaluation on the basis of firsthand observation rather than accept a verbal description that may omit numerous details. This process is often called "forms analysis and evaluation". The purpose of the form is reviewed in conjunction with the details required on form, distribution and filing of forms. It gives a valuable insight into what exactly is being produced by the recording process and where information is being duplicated or made redundant. The transformation of information into report form may point out numerous areas where data is never being used past the initial input stage. This information is often rendered completely useless and could be eliminated altogether. Possibly, through this procedure, other uses for information may be displayed resulting in a revision of report structure.

Volume statistics for forms and reports often produce some surprises in terms of sheer quality and number of
duplications actually performed. Volume reduction by way of multiple uses of single reports rather than multiple reproduction for different uses may result. Complete elimination of some forms may be a suggestion.

A review of the number of people and costs involved in specific operations may be one objective of a systems analysis. The amount of work involved in each task in terms of man hours can be roughly converted to dollar values. The analyst should have developed an attitude that a system is to be designed to facilitate the attainment of objectives only at a reasonable cost.

A sometimes overlooked objective of the systems analysis is the determination of the type and frequency of exceptions to basic procedures; i.e. diversion from routine. This area cannot be stressed too lightly because it is the emergency situations which give the real test of the information system. The method that the system will use to handle non-routine information is often a crucial feature of a dynamic business. The systems analyst must have the imagination and foresight to allow for the unexpected and to build enough flexibility into the total system to be able to cope with these unusual situations. The trend today is to place a greater emphasis on the "management by exception" method as it is often far easier to look at a few exceptions than it is to review a complete normal operation.
II. METHODOLOGY OF THE SYSTEMS ANALYSIS

Successful analysis requires an evaluation of the present business system as documented in the fact finding phase of a survey. After an analysis is made, there is an application of human intellect to a set of data. It is, therefore, appropriate to discuss the importance of the proper mental attitude to every step of the study. The most efficient plan can be completely negated by unsatisfactory attitudes. It is essential that the systems analyst adjust his mental approach before starting analysis activities.

The proper attitude is described as being analytical in your thought processes and being able to define the logic of a system. An objective viewpoint must be held. The maintenance of an objective viewpoint is not as easy as it sounds, as soon discovered in practice. It has not been stated, and it is not implied, that maintaining the proper attitude is easy, but simply that it is necessary.

A systems study is conducted in a logical sequence of activities. The "engineering approach" or "scientific approach" are terms used to describe any approach to a problem that is thought out and planned in a logical sequence.

To begin with, a traditional systems analysis is usually conducted to solve a specific problem. The sequence of activities which will be given in this study will not cover all situations, but can be used effectively as a guide for steps to be followed. If each step is followed implicitly, no major revisions should be needed for any specific situation. These steps are diagrammed as in Figure I.

The problem, itself, must be recognized. The problem often goes unrecognized or discounted because the scope of the problem is not known.

Problem identification often reveals that the apparent problems are only symptoms; the basic cause of the difficulty is yet to be determined. The true problem is identified by one or more of the following techniques whose operations precede or follow the system in question:  

(a) Up- and down-stream studies - A study is made of the system whose operations precede or follow the system in question.
(b) Responsibility analysis - A study is made of the responsibilities of the group initiating, performing or receiving an operation within the system.
(c) Supporting or related operations - A study should be made of any operations or systems supporting the particular system involved.

---

FIGURE 1

ANALYTICAL PROBLEM SOLVING

PROBLEM RECOGNITION

PROBLEM IDENTIFICATION

PROBLEM DEFINITION

DETERMINATION OF OBJECTIVES

ENVIRONMENT

ATTITUDES

RESOURCES

SYSTEMS PLANNING

SYSTEMS TOOLS

SYSTEMS TECHNIQUES

SYSTEMS INFORMATION

ANALYSIS

RECOMMENDATIONS
Each problem will vary in the amount of detail required in the study. Normally, the time spent in isolating and defining the real problem reduces the lost effort at other stages of the analysis.

The mere identification of the problem; i.e. the segregation of the basic difficulty in the system, is not enough information upon which to base the solution. The problem must be defined in detail. "Definition", the halfway point to solution, forms one of the keystones of systems work. Definition allows the problem to be broken down into smaller segments. It allows for the logical grouping of objectives into related functional areas (or other groupings) to promote the most efficient use of the facilities available.

There is usually a recognition of the need for specific objectives directed at the solution of specific problems. However, every enterprise or function within an enterprise needs a rather clear statement of its immediate objective to use as a basis for all its planning. This objective influences the planning used to guide overall operations. The basic objective of the analysis in the study is to attain the status of a total management information system.

To permit a logical analysis, facts must be organized in a manner which relates to the objective of the system. This kind

---

Ibid., p.p. 5 - 6.
of an analysis often discloses why the existing system is good or bad.

The purpose and scope of the study will have an important bearing on the organization of facts. The general rule is to group the facts according to the external factors that may affect the achievement of the objective and the major steps in the system.

There are a number of ways in which facts can be recorded. Since the ultimate goal is not merely to record the facts but to analyze them, it is better if the facts are recorded in a manner which parallels the analytical steps. For this reason, it is advisable for the analyst to determine major analytical steps or process prior to the recording process or, if not practical, to recategorize the facts during the process of analyses.

One of the most important aspects of recording facts is to put them in a form that will be understood by individuals who are working with the analysis. This means that they should be simple, concise and in terms understood by people not familiar with technical systems terminology. One of the most common and most acceptable techniques is that of charting.

Charts with their representative symbols can eliminate pages of written description, and therefore become one of the most effective and efficient means of communication. Flow charts show
the relationship between components and the logical structure of activities, both important tasks in accurate specification of an existing or proposed system.\(^8\)

When charts form the basic tool for recording, they should meet the criteria of simplicity and clarity. They must be simple and cogent enough for utilization at all organizational levels. Standardization of symbols is the vehicle for communication.

Having established the tools and techniques of system analysis, the review itself may get underway. The approach should cover the following aspects or areas:\(^9\)

(a) Personnel and organization - All of the qualities, attributes and peculiarities of the organization should be detected.

(b) Processing cycle - The charts, as plotted, should be compared with actual process operations to check on validity of information.

(c) Inter-relationships - No system stands alone. The output of one may form the input of another.

(d) Work flow - As an essential part of the analysis, it should cover the size and peak load conditions of the work flow through a department or operation.


(e) Procedural structure - The vital question is whether or not procedures are adequate and are being followed.

(f) Physical environment - Physical environment may be said to include everything, except the people themselves.

(g) Forms and reports - Forms analysis deals with the what, why, how and when of records.

(h) Management directives - A management directive is an all inclusive term covering written and unwritten policy, management planning and forecasts, and management preferences and prejudices.

(i) Goals or objectives - At this point the systems analyst can evaluate the general objective of his project.

Check lists are a useful tool in performing an analysis. They are not the answer to a complete or perfect review, but they assist in reducing the possibility of overlooking some of the more important aspects of the study. The check list need not be an endless complex listing of every conceivable event that the systems man might encounter. The prime factors governing a system should dictate the type of check list needed.

III. METHOD OF ANALYSIS TO BE USED FOR THE CASE STUDY

As can be seen by the previous section, in the past the general approach to the conduct of a systems analysis has been directed in one area - the solution to a specific problem within a system. The procedural approach to analyzing a total information
system will be somewhat similar, but with a change in objective. The approach will have to be altered by noting that all individual subsystems are to be looked at with the view of inter-relationships rather than specific problem solving.

The diagrammatic presentation of analytical problem solving can be altered to reflect the required approach. The main adjustment is the change of wording from "problem" to "system". It will not be assumed that an individual problem exists within a system. Therefore, the review will be focused on whole subsystems. See Figure II.

The beginning steps will involve starting at the lowest managerial level of the organization, working up through the organization, briefly studying the flow of information in the existing systems. A review of the inadequacies of the present systems and control reports will be made at each level of the existing management reports. Discussions on determining the requirements of a total information system will be given.

The case company to be studied is typical of the majority of national companies today, in that its decentralized nature requires that a working knowledge of the existing operation be obtained prior to working with top management in defining their information needs. In this way, the current systems may be discussed in more concrete terms and it will allow for a discussion with top management on a more informed basis.
LOGICAL SYSTEMS ANALYSIS

SYSTEM RECOGNITION

SYSTEM IDENTIFICATION

SYSTEM DEFINITION

DETERMINATION OF OBJECTIVES

ENVIRONMENT

ATTITUDES

RESOURCES

ANALYSIS

SYSTEMS TOOLS

SYSTEMS TECHNIQUES

SYSTEMS INFORMATION

INTERPRETATION OF ANALYSIS

PLANNING

FACT FINDING

ANALYSIS OF DATA

CONCLUSIONS
The study will be divided into four review phases. The first phase will entail the initial planning of the study. The second phase will include the "fact finding" of the existing information system with the company. Using the data collected about the existing system and its workings, the functions subsystems can be viewed as collectively forming a total management information system (or failing to reach totality, as the case may be). This third phase comparison of gathered data to a preconceived outline of a total information system is mainly an analysis of the facts - no opinions on the status of the system will be formed during this phase. Phase four will assess whether or not the totality status for the system is attained. A more detailed explanation of each phase follows:

(a) Phase One - Planning

Thorough planning is required before beginning the overall study in order to keep the designated objective in view at all times. The end result of preparatory planning is often a minimization of time required to carry out a study mainly due to avoidance of detail and foreseeing potential problems. In this phase, all key variables\(^{10}\) will be identified along with their various activities. Advance material will be prepared to guide the analyst in gathering necessary additional information. For example,

---

\(^{10}\)Key variables refer to those operations of a company which are considered essential to its success. For example, in a retail organization the sales or marketing function is critical, therefore will be considered a key variable.
check lists may be prepared to help ensure that complete information is known or gathered for all areas. The planning phase also is important in preparing senior management for the study, itself, as complete acceptance of the study by them is critical to its success. It will involve informing all members of the objectives of the study and requesting their cooperation so that the proper atmosphere is created for the project.

(b) Phase Two - Fact Finding and Systems

This phase will be considered basically one of familiarization and fact finding in order to obtain a greater understanding of all activities of the company. It will involve interviewing personnel representing all levels of company activities which can be considered of managerial significance.

In addition to analyzing the functions and responsibilities of various members of the company, it will be necessary to obtain an understanding of the approaches used in all regional offices plus that of the head office. This will relate to such general subjects as sales reporting, inventory control, production scheduling, costing, traffic, warehousing, etc. The current organizational structure of all sections will be studied and all management information reports prepared in the company will be reviewed. Information collected during this type of a phase should be organized so as to make it accessible during later phases of a study.
(c) Phase Three - Analysis of Data

The objective of Phase Three would be to consolidate and analyze the data collected in the previous phase and relate the data to the concept of a model total management information system. In analyzing the various subsystems, consideration will be given to the advantages and disadvantages of a higher degree of organizational centralization than currently exists in the case study. Due to the company having national operations, regional differences may need to be maintained purely to be more aware of special geographic situations. Organizational outlines would be considered where necessary as part of the ability of the various activities of the company to provide and to make use of management information.

(d) Phase Four - Interpretation of Findings

This phase will incorporate the results of both Phases Two and Three and attempt the real assessment of whether or not the status of a total management information system was attained. If totality was not attained, then some comments or observations will be made on how the particular information system of the case company could be altered to better reach the goal of totality. If sophistication of information processing equipment or changes in basic information flow are required, these can be best observed and commented upon during this phase.
CHAPTER IV

ANALYSIS OF CASE COMPANY

As indicated in the previous chapter, the systems analysis is primarily an information or fact finding segment of an overall review. The identification of operations, the determining of systems and the recognition of inter-relationships of subsystems all form part of the total review. This chapter will look mainly at the case company that was chosen for review and will involve identifying the various aspects of its operations which make it unique and worth investigating.

I. GENERAL INFORMATION ON THE COMPANY AND ITS OPERATIONS

Due to the nature of this investigation, it is the wish of the company involved to remain anonymous. Most of the information concerning company matters has been disguised and will bear no identifying marks of its actual operations or products. The information that was gathered could be considered very confidential and, for that reason, the company will simply be identified as ABC Company.

ABC Company is a Canadian company with operations on a national basis. It is a manufacturing concern dealing in the production and distribution of sugar and sugar products. The company's plant facilities are situated in all the principal marketing areas across Canada, with the head office in Toronto and the sales branches in major Canadian cities, plus some secondary
branches in smaller communities. The main product which the company sells is sugar, which accounts for roughly 90% of total sales. Sugar products account for the remaining 10% of total sales.

The company purchases, in substantial lot amounts, inputs which it requires as raw materials. Purchasing is decentralized for lesser items, but controlled by head office for major materials and supplies.

The company sells sugar and sugar products via specialized salesmen with distribution being varied as a result of special circumstances. For example, sugar may be sold directly to other manufacturing concerns, to a wholesale outlet or to retail dealers, depending upon the market volume for a specific area and the transportation costs involved.

The company employs over 1,000 persons, with the majority being hourly rated employees involved in the production and distribution phases of its operations. These hourly workers are represented by a union.

The company is involved in an industry which is universal in importance and, as such, has international ties in marketing and purchasing of raw materials. Within the industry, the company ranks high in terms of quality of product, developments in product research and maintaining a share of the total national market.
As part of its systems, ABC Company has a medium size computer with the capability of providing limited information in the form of "on-line" communication. This enquiry facility is part of the marketing and production information systems.

In the following portion of this chapter, operating detail will be outlined for the company as a whole. The detail must be given to provide an understanding of the existing systems and their implications. The method used for gathering the detailed information was mainly direct interviews with various management people. An informal check list of possible questions to cover was used as a guide to attain full information gathering.

II. IDENTIFICATION OF THE KEY VARIABLES

As part of the planning phase for the overall study, the examination of a specific company should begin with a broad over-view. This is the role of key variables.

The identification of key variables is simply a method for breaking the complexities of a whole enterprise down into something that is more manageable. The use of the term "key variables" has been used by many, including Robert Anthony, to describe those operations of a company which are considered crucial to its success.\(^1\) The strategy of setting out the key

variables of a company, as opposed to listing the more traditional functional breakdowns, is that it eliminates a possible concentration of effort on areas that may or may not be crucial to a company's success. For example, there is often an accentuation put on personnel as being a critical area in a company. However, this, in most companies, would not be considered a key variable. The feeling is that although personnel (excluding top level management) is an essential item in a company's operations, it is not often crucial to its success. The shift of importance in managerial effort should then be able to be directed to areas of operations other than personnel, resulting in a more efficient and effective channelling of resources.

The key variables in ABC Company will be expressed as production, marketing, distribution and packing, and maintenance. The production of sugar and sugar products is considered to be crucial both in terms of quality of product and in costs of the production. The marketing variable can be shown to be of vital importance due to the company operating in a highly competitive market. The distribution, packing and maintenance may be considered somewhat secondary, but in recent years the rising costs of all these functions have brought to light the need for identification and institution of integrated approaches towards these activities. ABC Company is mainly capital intensive. Therefore, maintenance costs become a very critical portion of total operating costs. The variables are easily tied together, in that if you have an attractive product available to a customer when he
demands it and at a competitive price, he is just as apt to buy your product as he is to buy a competitor's product. The buyer is said to be indifferent as to brand preference among like competitive products.²

With these variables in mind, the information system must be tailored to fit the industry in which the company operates. Also, the system should receive careful and continuous management attention if the company is to be successful. To do this, it must highlight these variables and report results to all levels of management.

The production variable will have related sub-activities. The function of purchasing is very crucial to production, in that materials must be purchased with a view to minimizing costs, handling times and quantities. The actual production scheduling is an activity that must try to optimize the available physical facilities, raw material and manpower resources.

The distribution variable is becoming more and more of a critical function. Therefore, it has been designated a separate cost centre. Costs of distribution continue to rise more rapidly than any other type of cost in the production phase.³


The marketing variable will obviously have related subactivities which help make it up. The sales results form a complete activity when dealing with sales by geographic area, product lines, customer or sales by day, week, month and year. Salesmen and their performance are a major part of marketing. Advertising and promotion form another activity. Customers, customer relations and the total environmental market all have to be viewed as subactivities.

The mere identification of the key variables does not complete the planning phase, but basically it gives a point with which to begin. It must be remembered that the overall objective in this case study is to determine whether or not the information system of ABC Company attains the status of a total management information system as defined earlier in the study. It must now be a task of breaking down each system of the key variables into their component subsystems. With smaller subsystems defined, an analysis of the integration and relationships of the various subsystems can be performed.

The subsystems of each key variable will be identified more in detail terms rather than a point-by-point listing of each subsystem. A brief identification of each subsystem and its products is required to bring each section into focus and provide more meaning to the reader. The data indicated here can be used later when doing the interpretations.
III. DESCRIPTION OF KEY OPERATING SYSTEMS

As noted in the previous chapter, the first stage in an overall management information system is the development of plans. ABC Company has a definite planning activity. The planning function was developed in conjunction with the overall view of the management information system. Priority is given to short term planning; the preparation of a comprehensive annual plan each year and the use of the plan to coordinate all company activities through the year.

Annual planning is coordinated by the finance division which is responsible for the final assembly of plan information into an annual plan form for approval by the management committee. Long-range planning is the responsibility of the planning department.

The annual plan contains a summary profit plan with detailed supporting schedules, a cash forecast, a capital expenditure forecast and a balance sheet forecast.

The starting point for preparing the annual plan is the setting of annual corporate profit goals by the management committee. These goals are consistent with the long term policies of the company, expressed in quantitative terms such as return on investment and market share.

Actual preparation of the plan involves considerable
managerial and supervisory time. Detailed involvement by persons in the middle and lower management levels of each division and functional area permits them an opportunity to contribute detailed plans and schedules for their areas of responsibility and to budget expenses for their own sections. Their involvement at an early planning stage permits better follow-up procedures during the course of realizing the plan and better assessment of responsibilities for deviations from the plan.

In attempting to quantify the cost of production, distribution and administration, the management information system of ABC Company allows for a systematic accumulation of appropriate historical data for use in the planning activities.

In up-dating annual plans, sales forecasts are reviewed throughout the year in the light of changing market conditions. Because these changes affect not only the sales volume in dollars, but also production and distribution costs and total profitability, the revised forecasts are incorporated into annual plan revisions. Changes in other operating factors also affect profitability and they, too, are built into revised plans during the course of the year. In actual practice, the updating is usually carried out on a quarterly basis.

The management information system also includes a budgetary control system with reporting designed along the same organizational lines as for the preparation of the annual plan. The reports inform management of actual performance compared to
the plan throughout the year and the extent to which planned activities were reached. Deviations from the plan are also highlighted. This control report is a key management report produced by the management information system.

Of note here is the fact that the company adopts the technique of "responsibility accounting" for the design of all reports in the management information system. Information is presented to the persons who can directly influence revenue and costs and who are, therefore, responsible for obtaining favorable results.

Reporting under budgetary control has allowances for a flexible report structure. However, a report of overall results contains a monthly profit and loss statement showing actual versus planned sales, variable costs and profit contribution information. Period manufacturing costs are shown separately as well as selling and administrative expenses and net trading profit. Subsidiary schedules are prepared showing the major variances from plan with explanations. Distribution of reports of company overall trading results are limited to the management committee and to managers designated by the management committee. Marketing and sales management also receive reports covering product and divisional

---

*The primary objective of any responsibility reporting system is to relate actual results to the various levels of management responsible for producing such results. See *Responsibility Reporting*, Peat, Marwick, Mitchell & Co., New York, 1961, p. 23.*
profitability which include sales and variable cost figures, together with direct or controllable selling and administrative expenses and details. Monthly reports on expenditures to date for capital asset projects are being prepared by the finance division for operating personnel.

The company also adopts the concept of "marginal costing" which facilitates the estimating of manufacturing costs for any level of sales by product and for sales in total by separating variable from fixed (period) costs. With this information management can predict the effect of sales volume in profits.

(a) Marketing

ABC Company has marketing reports which are prepared both manually and by data processing. The computer system has a high speed tape storage device, therefore giving the sales reporting system flexibility and speed. It also gives it a complete data base from which to develop a wide range of marketing reports. The marketing reporting system places as much emphasis on reporting and measuring profitability as it has historically on reporting sales volume figures.

A fundamental part of the management information system is the annual market plan. This plan outlines the objectives

---

5The "marginal" or "incremental" approach separates all costs which tend to vary directly with output (production or sales) from those which do not. The income statement then builds up the net income figure by computing the contribution which the volume of sales makes toward the recovery of non-variable costs and profits. W.C. Haseman, Management Uses of Accounting, Allan and Bacon, Inc., 1963, p. 576.
set by the marketing group for the upcoming year and the strategy to achieve these objectives. It includes product forecasts and estimated product margins. Where the forecast product volume assumes a shift in either product mix or customer mix, plans are included as to how the changes are to be effected.

The marketing plan, for purposes of the management information system, has two basic objectives. First, it establishes volume estimates on which the product plan, operating budgets, profit forecasts, etc., can be prepared. Second, it establishes targets on total market share, profitability, product mix, volume, etc., for the various sections of a marketing department against which the information provided by the management information system can be compared. The purpose of the comparison is to highlight where there are diversions from the plan so that corrective action can be taken as soon as possible.

The sales reporting system has flexibility, in that it had the capability of retaining sales statistics on a customer basis by product item; i.e. the lowest level of detail. While it is unlikely that this amount of detail would ever be required on one report, nevertheless, through the retention of this detail, complete flexibility is achieved for the production of virtually any volume data which the marketing department may require. The retention of information on a customer level makes it possible to establish easily the demands by geographical area which could be used in reviewing periodically the allocation of production to refineries.
There are a number of factors which marketing can influence which, in turn, affect company profitability. It is, therefore, essential that the management information system can report back to marketing on the current status of the various factors.

Profitability is affected by changes in product mix and, therefore, the constant feedback of actual product mix versus planned product mix establishes where a divergence in total profit is being caused by a shift in product mix.

Secondly, the comparison is automatically made by the data processing system of the planned and actual margin on each product, reporting to marketing on a divisional basis the cumulative price discounts.

Thirdly, a feedback of freight absorption also is built into the management information system.

Fourthly, budgets are established for the sales division and the central marketing staff to report on costs under their control against planned selling and marketing administrative costs. These budgets are organized along responsibility lines and are consistent with the budgetary control system which is introduced on a company-wide basis in conjunction with the management information system.

The product cost information provided by the management information system segregates costs into fixed and variable components.
components so that marketing has added perspective on the contribution of each product to fixed costs and to company profit.

Market share is an important part of the marketing reporting system. The management information system indicates the market share for the fiscal year to date, also the rolling twelve month market share figure.

Market share information is not produced by the data processing system, but is produced on an annual basis in the form of graphs.

As part of sales coverage information, all sales personnel are responsible for reporting on the details of customer calls.

In addition to sales coverage data, the management information system also contains a sales contract file which is used to price contract orders and to report to marketing on the current status of all contracts.

The use of marginal costing provides added perspective for the marketing department on product profitability. The information system is also designed to provide added perspective on customer profitability.

The use of the computer makes it a practical technique to retain sales information on a customer level. Delivery costs to
each customer are established on a basis of standard delivery rates. A sales coverage cost for each customer is also calculated on salesmen's call reports. In calculating customer profitability, actual selling and delivery costs for the customer would be used.

The nature and distribution of the various marketing reports provided by the management information system is shown by Table I. One of the objectives of the basic management information system is to provide only the information which is required on a regular basis. It excludes information which may be required for special analysis from time to time because of the flexibility of the system to provide the special reports on demand. While it would appear that there would be a large number of sales reports, in fact each one is quite brief because of the limited details on each report. None includes produce and size shipments on package products, for example. However, a general purpose computer program is maintained which is able to develop the detail to be provided upon request of marketing.

The management information system provides for the reporting of customer service information. This is a feedback of information so that the customer service level can be measured and the safety inventory stocks adjusted to obtain the level of customer service desired by the company. The company currently provides a high level of service to their customers and are rarely in a position where orders must be delayed or short-shipped. A record
### TABLE I

#### MONTHLY MARKETING REPORTS

<table>
<thead>
<tr>
<th>VALUE - $</th>
<th>Management Committee</th>
<th>Vice-President Sales</th>
<th>Division Managers</th>
<th>Territorial Managers</th>
<th>Salesmen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit Contribution</td>
<td>Company</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>- Division</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>- Territory</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Marketing Expense</td>
<td>Company</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>- Division</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>- Territory</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

#### VOLUME POUNDS

| Market Share | Company | X | X | X | X |
| - Division | X | X | X | X | X |
| - Territory | X | X | X | X | X |
| By Brand | Company | X | X | X | X |
| - Division | X | X | X | X | X |
| - Territory | X | X | X | X | X |
| By Division | All Divisions | X | X | X | X |
| - Individual Divisions | X | X | X | X | X |
| By Territory | - | X | X | X | X |
| By Industry | Company | X | X | X | X |
| - Division | X | X | X | X | X |
| - Territory | X | X | X | X | X |
| Bulk, Liquid and Granulated | Company | X | X | X | X |
| - Division | X | X | X | X | X |
| - Territory | X | X | X | X | X |
| By Central Purchasing Groups | Division | X | X | X | X |
| Major Accounts | Company | X | X | X | X |
| - Division | X | X | X | X | X |
| By Dealer | Division | X | X | X | X |
| Sales to Other Divisions | - | X | X | X | X |
| By Salesmen by Customer | - | X | X | X | X |
is maintained manually on the number of items and pounds short-shipped per month, the number of orders and pounds not shipped on time, orders cancelled because of inability to ship on time, a record of customer complaints, etc., so as to provide a sound basis on which to review periodically the level of service provided to customers by the company.

(b) Production

The system for the key variable, "production", is somewhat less detailed, but, nevertheless, complicated. In specifying the management information system on production, two natural headings occur - sugar plant production control and production control of sugar blends. In the sugar plant production control area, the main subsystems are annual planning of production, weekly monitoring of forecasts and the method of ordering by regional warehouse. In the production control of sugar blends, the principal subsystems are optimal raw sugar distribution, control of plant performance and selection of optimal sugar blends.

The production information system has recognized the need not only for operating control over production, but also the provision of adequate planning tools and information for the production activities. These they have achieved through the use of a variety of computer and mathematical techniques which provide management with better and complete information for production planning and control.
The mathematical techniques consist principally of linear programming models. A package program for solving linear programming problems, called LP-MOSS, is used on the company's computer. Another technique used is regression analysis, for which a packaged computer program is also being utilized.

Within the sugar plant, production control subsystems exist which allow for an identification of the total production picture. These subsystems will be described only in those details relevant to a general description:

(i) Annual planning subsystem

The major feature of the demand faced by the sugar plant is its seasonality. The method used for determining the best production plan for any year is to derive a mathematical model of production levels.

This model may include such items as total expected costs, maximum number of production days available, minimum number of production days that may be used, maximum number of days that any work crew taken from another production location will be available. The planning program then establishes the optimal production plan for the twelve months which meets all the expected demands each month and obeys the various capacity constraints. See Figure III.

(ii) Monthly scheduling subsystem

The production planning phase indicates for any given month the number of production hours allocated and how they
are arranged into shifts. The purposes of the monthly scheduling subsystem is then to determine the best way to distribute the available plant capacity among the various grades and types of sugar products. It does so in two stages: first, the scheduling program calculates the minimum quantity required for each product in the next month in order to meet the expected demands with a predetermined probability of success, example, at a 95% confidence level; second, the system manually converts the minimum requirements into production quantities. If the plant capacity allows no build-ahead, then the production quantities would remain the same as the minimum requirements.

Thus, at the end of the phase, a production schedule for the month in question is produced in which the basic structure of the schedule is specified and the exact production quantity for each sugar product is specified, indicating what part of that quantity represents working stock, build-ahead stock and safety stock. The aggregate safety stock for all sugar products is available monthly and can be used in the annual planning phase where the overall inventory needs are being evaluated. See Figure IV.

(iii) Weekly sequencing subsystem

The purpose of the weekly sequencing is to respond to those deviations of actual demands from forecast that are likely to result in an out-of-stock situation. This is done by
PRODUCTION SCHEDULING PROCEDURE

1) Current Month Number
2) Production In Hand or on Order for each product this month
3) Sales Dept. Forecast of Shipments for each product next month

SCHEDULING RUN 2.
Second last Monday of each production month

1) Safety Stock allowance
2) Minimum requirement

MACHINE GROUP REQUIREMENTS REPORT
FORECAST COMPARISON REPORT
PRODUCTION PLANNING SPECIFICATION OF CAPACITY

MANUAL DETERMINATION OF PRODUCTION QUANTITIES
calculating an index, called the critical ratio, for each product. This index indicates to production management whether the product has to be made earlier than scheduled because of a low forecast, or whether it can be delayed without risk because of a high forecast. The weekly scheduling program produces a critical ratio report which lists each grade of sugar in ascending order of their relevant critical ratio. This report is the basis for deciding on appropriate action in response to short term differences between forecasted and actual demand.

The three subsystems of production control described so far—annual planning, monthly scheduling, weekly sequencing—are all aimed at centralizing control over sugar production. They do not distinguish between orders on home office and those from regional warehouses. This makes no difference when all orders can be met. However, when shortages arise as a result of orders from regional warehouses, the management information system has a provision to indicate to head office the disposition of field stocks so that a rational choice can be made between short-shipping (which is a possibility if the item was ordered mainly to obtain a carload order) and changing the production schedule to produce the out-of-stock item. This decision is made with reference to a national inventory status report and is negotiated between the regional sales department and the production scheduler.
The management information system has been extended to generate recommended orders for all grades of sugar for each region. This involves maintaining accurate inventory records centrally and opposes a fixed pattern of ordering on regional warehouses.

(c) Distribution and packing

The management information system is designed to provide control reports on delivery and freight costs. Variable storage costs are included in delivery charges. It is considered important not only to know when delivery costs are other than estimated, but to know the basic reason for any discrepancy. As a result, the amount of freight billed to the customer is compared and accumulated against the freight and delivery costs from the normal point of delivery. A further control report is provided which measures the difference between the freight from the normal supply point to the customer, and the freight from the actual supply point to the customer.

Electronic data processing mechanizes the finished goods inventory records. A natural by-product of this system and its management information system is the daily exception report of items outside the minimum and maximum inventory levels, and a periodic review and recalculation of minimum and maximum levels.

The management information system does not actually control the total finished goods inventory or the split between packed and unpacked finished goods inventory, but merely records
the changes in levels. The information system does, however, report on the mix of the packed finished goods inventory. Target inventory levels for the various individual packaged products are developed on an informal basis by marketing and distribution. While in the context of this system the product mix of the packed inventory is not critical, provision is made in the management information system for a more sophisticated method of establishing target inventory levels. This is before the method of scheduling the packaging operation can be changed, thereby increasing the efficiency of personnel and equipment utilization within the packing operation.

The management information system develops the necessary data to establish target inventory levels for each packaged product. Using inventory movement figures from the management information system, safety stock is the calculated for each product based on the variability of demand over the desired packing department lead-time. With this technique for setting the target inventories, the overall packed inventories are better balanced and efficiencies are obtained in personnel utilization within the existing overall company finished goods inventory system.

In the packing department, system job cards are prepared for all packing labour indicating the various cost centres, cost stations and elements which are to be charged. Data processing produces a weekly tabulation of the packing labour by cost centre, based on the job cards. There is not always a direct relationship
between labour requirements and total tonnage output. This problem is normally solved through the scheduling of production over a period of two or three weeks during which labour requirements are levelled. This technique eliminates the necessity to have excess staff to cope with the peaks which occur from time to time under a daily scheduling operation.

The lengthening of the production schedule in packing has the added advantage of decreasing the effect which distribution can have on the packaging operation, and therefore increases the ability to isolate the performance of the packing activity.

The packaging section of the management information system produces a weekly performance report which compares actual production to attainable standards for both machine controlled operations and manually controlled operations. Machine utilization records are kept and a coding system is established so that the reason for down time can be indicated in the reporting system. All machines have recorders to accurately measure machine utilization.

A daily analysis of packing performance is done by the computer system, highlighting on an exception basis to packaging management those items which did not fall within an acceptable performance range.

(d) Maintenance

Job cards are prepared for all maintenance personnel indicating for each repair assignment the cost centre, station and
element code, the regular, overtime or double-time hours, the employee number and the machine number. Requisition cards are required for all maintenance material and include the cost code and dollar amount of the material which has been priced by purchasing. As a by-product of the costing system, reports are provided to maintenance management each period covering the maintenance, labour and material by cost centre.

ABC Company has an on-going preventative maintenance system in which a history is retained for each machine on a Kardex file of all maintenance work done. As maintenance represents a significant percentage of total variable production costs, the management information system plays an important part in reporting all maintenance costs. Maintenance information is maintained by data processing, therefore an up-to-the-minute report on maintenance cost is readily available.

Various maintenance reports are available. Cost detail is provided to various operating departments showing not only total maintenance, but also a breakdown into the various types of maintenance. Information is also available by machine number and can be provided to maintenance management.

IV. CURRENT SYSTEMS DESIGN

In ABC Company there are two basic concepts relating to systems design. The first concept is the emphasis on the design
for input and proper storage of data in order to form a comprehensive data base. It is this data base which provides unlimited flexibility as to the format of the various output reports, the frequency with which the information is provided (i.e. instantaneously or periodically) and the basis on which the information is provided (i.e. exception or complete reporting).

It is felt that the processing of input and the construction of the data base will have lasting value as the company increases its degree of sophistication of the management information system over future years. It will remain relatively unchanged until the need arises in the future for a change in computer equipment to provide faster response to the systems.

The other basic principal used in the design of the management information system is that of integration. This means that the input data is used for multiple purposes. For example, job cards prepared by the packing department are only to be used for cost accounting purposes, but are also stored in a packing data file to provide management reports on the performance of packing activities. Similarly, the data needed to prepare an invoice is also used to up-date the marketing data file and the finished goods inventory file.

As stated previously, the overall management information system is made up of a number of operating systems (e.g.
billings, payroll, etc.), and a number of information reporting systems (e.g. marketing information systems, maintenance information systems, etc.).

For purposes of documentation, the design of the overall management systems can be combined into two major subsystems which are relatively independent of one another.

The first combines the order processing, billing, accounts receivable, credit and finished goods inventory operating systems with the marketing and distribution information systems. The second system combines the operational functions of maintaining labour, payroll, material and other cost records with the budgetary control, product profitability, packing and maintenance management reporting systems. Within each of the subsystems there is a high degree of integration; i.e. a multiple use of common input data and a common use of the basic files of the system. Both subsystems provide data for the company's financial reports.

(a) Distribution and Marketing Subsystems

Figure V indicates the general outline of a distribution and marketing subsystem. It identifies the key types of input data, files and output documents and reports.

A sales contract file is maintained and is up-dated daily with new contracts, altered contracts and cancelled contracts. The file serves two basic purposes:
(i) to report periodically on the status of the contract,
(ii) to allow orders which indicate a contract number to be automatically priced by the system.

A sales coverage and statistics file is maintained to retain data on each customer pertaining to sales coverage. It includes the number of calls during the period, the number of orders, the time spent in covering the accounts, the estimated total purchase for the year, etc. This file is up-dated on the basis of the salesmen's call reports. The basic purpose of this file is to provide statistical information on customers (other than shipment data) and to provide data used in the periodical analysis of customer profitability.

A product master file is maintained which includes the cost of information on products, such as product description, packed price differentials, etc. This file is maintained only when new products are added or changes are made to the existing product prices, etc. Similarly, a customer master file is maintained containing all constant customer information, such as name and address, freight area, salesman's territories, chain store codes, etc. It improves not only accounts which are to be billed, but also "ship to" accounts. It is only up-dated where new customers are added or information on existing customers is to be changed.

By far the largest volume of input data is the daily customer's order. It is desirable to get the orders into the system
before shipment by placing them on an open order file. In processing customer orders, the product and customer file are checked to ensure the validity of the coding on the order. The advantage of maintaining an open order file is to produce, at the earliest possible time, a daily order report and to reduce the amount of keypunching which must be done after shipment so that the finished goods inventory files are more quickly up-dated.

On receipt of advice of shipment of a particular order, the advice is taken off the open order file, priced and extended and placed in the marketing data file simultaneously up­dating the finished goods inventory file for that particular plant or warehouse location, the accounts receivable file and the sales volume and revenue file. At the same time, a customer invoice, an account receivable card and an invoice register are produced.

In order that the finished goods inventory file is completely up-dated, daily production is also processed against the file as well as inter-plant or warehouse shipments. Similarly, customer payments are processed against the accounts receivable file.

Daily inventory exception reports are produced after the finished goods inventory file is up-dated and credit exception reports after the accounts receivable file is up-dated. At the end of the period (or as often as required), customer statements can be produced from the accounts receivable file as well as the ageing analysis of outstanding accounts. The finished
goods inventory file provides the necessary information to periodically analyze warehouse movements for the divisional manager and to reassess target inventory levels.

The marketing data file produces a wide variety of reports. These include the various reports by salesmen, territory, division, national, brand and industry, as well as sales information on key accounts and the summary of price discounts and freight absorption during the period. Since the marketing data file is retained on a customer detail basis, it has complete flexibility in providing virtually any combination of data which is required and forms the basis for a periodic analysis of customer profitability.

The marketing information file contains all budgets and sales objectives so that comparative marketing reports can be produced.

(b) Cost Control and Manufacturing Information Subsystems

Figure VI indicates the general outline of the cost control and manufacturing subsystems. The key file of this system would be the cost file by cost centre, station and element. Cost centres and stations are established for head office administrative and marketing departments as well as for manufacturing departments. Job cards from all hourly personnel are processed daily and at the end of the week matched against clock cards, costed and the cost centre station master file up-dated. Similarly, salary payroll cards are processed and allocated appropriately by cost centre and
station. Salaries and hourly employee master files include the necessary information to produce payroll cheques, registers and supplementary payroll reports.

Job cards for maintenance personnel would include the additional information which was outlined previously and go not only into a cost centre file, but also into a special maintenance data file. Similarly, job cards on packing labour go into a cost centre station file as well as into a special packing data file. This file is also up-dated daily with finished goods production. Such data is one of the examples of input that is common to both the major subsystems. The production data is also used in the order subsystem to up-date finished goods inventory.

Maintenance stores requisitions are priced by purchasing and processed daily, up-dating the cost centre master file.

Maintenance labour, direct labour, stored material, etc., is chargeable to factory authorizations or engineering work orders and charged directly into a special work order file. Maintenance labour on factory authorizations and engineering work orders are also added to the maintenance data file so that a complete distribution of maintenance labour is available.

A fixed asset file is maintained both to do the year-end calculation of depreciation and to distribute depreciation to the appropriate cost centre.
At the month end, a number of retroactive entries are keypunched to complete the cost records. This includes operating supplies, packing material usage, accounts payable distribution and miscellaneous journal entries.

A budget file is maintained containing the budget for all cost centres and stations as well as the fiscal year-to-date figures. Using the cost centre master file and the budget file, budget reports are produced at the end of each period. The packing data file is used to produce weekly packing performance reports and the maintenance data file is used to produce a number of maintenance reports by cost stations, type of maintenance, machine number and ratio of direct labour and ratio of over-time against the total maintenance.

The salary employee payroll master file and the hourly employee master payroll file are used to maintain statistics on employees which personnel requires for analytical purposes.

In ABC Company's management information system, one of the prime considerations is the degree of response required from the systems; i.e. speed of access to the information. Compared to some companies, very little data is printed out in the form of routine reports, but rather data is requested of the system when needed and it is provided instantly on the basis of a specific inquiry.
CHAPTER V
SYSTEMS ANALYSIS FINDINGS

After all pertinent facts have been gathered concerning an information system, the real purpose of the systems analysis can be undertaken; i.e. the interpretation of the facts into meaningful information.

In analyzing the facts gathered in the previous chapter, the interpretations will relate to the stated objective of determining the totality status of ABC Company's information system. In areas where the reporting system significantly contributes towards a total information system, elaboration of the elements of the system will be outlined. In areas where particular parts of the reporting system prohibit or hinder the achievement of totality, mention will also be made of this fact and possible solutions toward correction of the system's deficiency will be given.

I. INTERPRETATIONS OF CASE COMPANY'S REPORTING SYSTEMS

In analyzing the facts gathered pertaining to ABC Company's management information system, several items were mentioned which help make the system somewhat unique.

The first item of note is that the reporting system has as its nucleus a computer with limited "on-line" capabilities. The addition of the computer made it possible to store and manipulate large volumes of data and to provide information on a current basis
in a manageable form. It also provided for the integration of the various informational and reporting systems of the company. The computing capability of the computer, along with this ability to handle large volumes of data, has made it possible to use a number of mathematical techniques to assist in the decision making function. It also possessed the capability of providing, within the computer systems, a feedback of information with which to measure and control actual performance against predetermined standards and plans.

A second item of note was that ABC Company was placing a very heavy emphasis on the planning function. This was evidenced by the development of a detailed marketing plan, a budgetary control system and the large amount of work spent on creating the production plans. The total planning program appears to have the following main features:

(a) The probable effect on net profit of following each of several alternative marketing plans is studied prior to the beginning of the fiscal year. A plant is then selected which would produce the best results in line with company goals.

(b) As part of the planning process, all managers appear to have the opportunity of making an objective appraisal of the activities under his supervision. The manager can then request the system to review any proposals he may make.
(c) Properly prepared plans are coupled with well designed management reports which compare actual results to those planned on a "responsibility accounting" basis.

Planning and improved informational reporting is possible through the use of good plan development, together with the use of marginal cost information from major components of ABC Company's management information system.

A third overall feature of ABC Company's information system was the flow of information to the individual members of management. It followed the company's organizational structure wherever possible. This was a result of the fact that the organization structure of the company was clearly established and the responsibilities clearly defined.

A fourth component of the management information system was the use of "marginal costing".\(^1\) This technique had several advantages to management in planning and control activities, among which include:

(a) the planning of product mix for sales and production is speeded up and made more accurate;
(b) there is more accurate accounting for contribution to profits by product groups, sales divisions and regions;
(c) better information is available for the setting of selling prices;

\(^1\)Marginal costing facilitates the estimating of manufacturing costs for any level of sales by product and for sales in total, by separating variable from fixed (period) costs.
(d) Unit variable production costs are available by cost stations;
(e) A comparison of actual with plan for all activities of the organization becomes more meaningful.

Along with the more general interpretations of the facts connected with ABC Company's management information system, there are several features of the subsystems, themselves, which should be noted. By interpreting the facts, relationships can be drawn between how each attribute of the system contributes or deters from a total management information system.

(a) Marketing

Within the marketing subsystem there is a situation whereby the reporting system places as much emphasis on reporting and measuring profitability as it has historically on reporting sales volume statistics. This is due to the company's attempts to maximize profitability within the given market share, resulting in a need for more complete product profitability information. The rapid feedback of this type of information greatly increases the accumulated total of knowledge on a particular product's marketability.

Also, the design of the marketing section of the management information system assumes the availability of large storage in its computer configuration. The system is then able to retain sales statistics on a computer basis and by-product item; i.e. the lowest level of detail. This allows for complete flexibility
on report preparation of virtually any volume data which the marketing
department may require. Further, the retention of information on a
customer level makes it possible to establish easily the demand by
geographical area which could be used in reviewing periodically the
allocation of production to refineries. It is also possible to
develop new reports which may be needed in the future because of
shifts in emphasis in marketing activity. The facility exists to
prepare reports on a regular or periodic basis or completely on an
exception basis.

As a by-product of order processing, a daily summary
of orders is prepared by division, in addition to the regular sales
volumes produced at the end of each period. Production personnel
often make use of this information in their production scheduling
techniques.

Sales personnel state details of their sales calls
which, in turn, are injected into the company's sales reporting
system. This contributes to the total management information system
in three ways:

(i) the inclusion of coverage information permits a periodic
    automatic analysis of sales coverage. In order for it
to be complete, information or inactive customers, as
well as customers who are regularly placing orders,
is included;
(ii) the central collection of customer coverage information allows for high speed processing of numerous records maintained by the various levels of sales management;

(iii) the inclusion of sales coverage information facilitates the periodic calculation of customer profitability, since it is possible to establish a basis on which to allocate sales coverage costs to particular customers.

The act of forecasting involves making projections on a five year and a one year volume basis. This is easily performed by using a mathematical approach involving exponentially weighted moving averages adjusted for seasonal and trend effects. By using the computer, trends and moving averages are easily calculated, increasing the usefulness of this information as background data on which to estimate the future. Again, this multiple usage of original data is one facet of total information systems.

One further advantage of the flexibility built into ABC Company's marketing system is that it does not rely on only one method of reporting. For instance, it can very quickly generate "exceptional" sales results to the marketing manager. If this were the only capabilities of the system, the manager would very likely be faced with more problems than ever before because it would be difficult (and dangerous), however, for the manager to act on this information alone. Before he can take intelligent action, he must also know whether the deviations from plan are the result of
deviations in sales efforts of unusual competitive activities or of other factors. To be a total informant, therefore, the system must also include a diagnostic procedure. This ABC Company's system can do because of its high data storage powers - the format of the report is simply altered to inform on the variances within specific areas.

There is one drawback in the area of product profitability, however, and it involves the limited amount of statistics that are available on unit product costs and product mix. If efforts are to be made to increase profitability, much more must be known about product costs, product mix and customer profitability. This may not be considered a systems fault, but it is a limitation towards achieving the totality concept in the marketing area. If management is to be versed in how to utilize the data that is given to them, then full information should be put into the system and not partial details. Correction of this fault would include the reassessment of the costing system, recognizing not only the need to develop accurate cost data, but also the requirement to present the cost information to management in a meaningful way.

The annual market plan developed by ABC Company is fundamentally good and appears to meet its objectives. Production is able to key its plans to estimated sales volumes and the targets

---

for market share, profitability, volumes, etc., are clearly defined. The objectives are said to be ideal. One problem exists, however, and that is what to do when there are diversions from the plan. Management has expressed the feeling that they are not being made aware of deviations from the plan soon enough. They feel they are not able to take corrective action fast enough. Therefore, they are unable to take full advantage of corrective measures. The system is not total, in that it does not allow for information when it is really required the most.

Most sales reporting systems deal mainly with the preparation of periodic sales statistics, usually on a volume basis only. The system at ABC Company, however, allows the marketing department to not only influence volume, but to effect profitability. This contributes toward the totality concept because it deals with sales performance on a volume basis, plus selling and administrative expenses incurred by the marketing department, plus product contribution to profits, plus market share, plus customer profitability.

The design of the marketing subsystem is such that it is possible to retain sales statistics on the lowest level of detail - by customer and by product item. This allows for the flexibility in report preparation which is required in a total system. One limitation to this system is the fact that some information must be summarized, therefore losing its originality. A certain amount of summarization is necessary to make it practical to store the information within the
core capacity restraints of the computer configuration. If specific information on an individual product item is required, it may not be possible, through the system, to obtain the desired information due to the summarization process. The totality of the system has not been maintained.

The marketing subsystem provides only limited information on the company's market share. This is mainly an environmental feature, but a total management information system would be able to produce such information and on an immediate basis. To date, ABC Company deals only in historical estimates of its market share stated in terms of market share at the end of each month. To be a total system, it would have to be "on-line" to the various environmental factors and be able to report immediately anytime management queried the company's position in the market place.

A significant feature toward a total system is the company's practice whereby all sales personnel are responsible for reporting on the details of their customer calls. In other companies this type of information is rarely included in its sales reporting system. This type of reporting should belong in a management information for three reasons. First, the inclusion of coverage information in the management information system will permit a periodic automatic analysis of sales coverage. In order that the analysis be complete, information on inactive customers as well as customers who are regularly placing orders would be included. Second,
the central collection of customer coverage information, including estimates of their annual usage, etc., would eliminate the necessity for manual records to be maintained covering this data by various levels of sales management. Third, the inclusion of sales coverage information in the management information system could facilitate the periodic calculation of customer profitability since it would be possible to estimate a basis to allocate sales coverage costs to particular customers.

One of the objectives of a total management information system is to provide only that information which is required. This includes information which may be required for special analysis from time to time. As indicated in the Summary of Market Reports, only certain levels of management receive certain reports. For example, the management committee would receive only profit contribution, market share and total brand information on a company basis. Therefore, the objective of providing information to only those who need it is being met.

Most management information systems provide for the reporting of customer service information. ABC Company, however, has an exceptional system for reporting customer service and appears to be totally aware of their service levels.

(b) Production

The production subsystem of ABC Company is relatively sophisticated in its approach to information processing and handling.
It relies very heavily on planning and forecasting. It also relies on the use of mathematical models for determining the optimal operating control over production. The use of planning tools and information producing techniques contribute significantly to management's total awareness of the overall production phase.

The mathematical techniques have been used very effectively over a reasonable period of time. Therefore, it may be assumed that the management has gained better information on their production activities compared to previous reporting methods.

Planning is emphasized very heavily for the various production demands. For example, in annual production planning, environmental factors affecting a changing market situation are brought into calculations. In a total system, complete knowledge must be coordinated between the subsystems of marketing and production to give only one right decision on the level of production expected to be optimal. ABC Company's system determines from various plan levels of operation the production capacity allocated to product groups in such a way as to meet expected demands at the lowest production, plus holding cost.

One shortcoming of the company's production planning program is the method of determining the various capacity constraints. The constraints are too rigid and narrow, not allowing for total information. For example, there is no allowance or recognition given to hiring and firing costs associated with changing from single to
double shift operations or vice versa. The model should be designed so that the total cost of a particular plan can be established.

The production planning does have a fair degree of flexibility and can be re-run as often as the information system dictates in the light of changing circumstances. It does not re-run automatically, however, but must be reintroduced upon inspection and made to include the revised data.

Once the annual production plan is established, a monthly scheduling system is used to determine the best way to distribute the available capacity among the various products. Once the distribution has been established, it is relatively stable unless target requirements are changed. To change the plan, the whole planning system has to become operative again for each plan is set to an optimal solution and if any constraints are altered, the end solution is altered. For this reason, management tends to ignore anything but a major change because the nuisance and time value of a production plan alteration is prohibitive. The totality concept would allow for any alterations to be made automatically because the system would be programmed to interpret plan changes.

ABC Company attempts to lessen the effects of fluctuating demands by creating over-production in the form of build ahead stocks. The system attempts to project what products to over-produce by forecasting what is likely to result in an out-of-stock situation. This is done by calculating an index, called the critical
ratio, for each product. The logic behind the critical ratio simply indicates what production can be delayed without risk of reprisal from your customers due to an out-of-stock situation. The principle is very sound and helps contribute greatly toward a totally informed management. It forces them to appraise their production situation each week, thus keeping them fully aware of the total production environment.

The management information system is, in theory, used to generate recommended production for all products for each region. If this were happening in practice, it would be a large step forward to having a total information system. Practical considerations, however, dictate this procedure to be limited. The cost involved in putting centralized systems of ordering and inventory record-keeping are prohibitive.

(c) Distribution and Packing

The management information system for this section is designed to provide control reports on delivery and freight costs, finished goods inventory levels and packaging information.

Delivery and freight costs are controlled adequately for the present purposes of ABC Company. However, the system does not have the flexibility to control the costs involved in an abnormal shipment; i.e. a shipment originating from a plant or warehouse other than the nearest one to the customer. It is the incremental cost incurred to supply goods from some other supply point that would
be meaningful to management. It would indicate the added costs that had to be incurred because of an out-of-stock situation. If these stock shortages were causing excessive distribution costs, a totally informed management would be able to take corrective action.

Also, the system uses standard freight costs in calculating the normal delivery expenses to a customer. The standard rate is built up from historical shipping information. The use of an historical standard imposes rigidity into the costing, for it does not allow for rapidly changing costs of delivery rates. The reviews made of the standard rate are not frequent enough to keep current on distribution costs.

The finished goods inventory is mechanically controlled for all refineries and warehouses. This information system provides an excellent check on daily finished goods inventory levels. It also gives a daily exception report to management of items outside the minimum and maximum inventory levels and a periodic review and weight calculation of minimum and maximum inventory levels. The complex controls in this area of finished goods inventory appears to be a waste, however, because, under current production facilities and planning, there is very little opportunity to change the total finished goods inventory at any point in time. Total finished goods inventory is currently a function of the total forecast of sales for the year.
While there is limited opportunity for a management information system to improve the control of the total finished products inventory, additional management information is required on the mix of the packed finished goods inventory. Under the present system, the product mix of the packed inventory is not critical. However, provision should be made for a more sophisticated method of establishing packed target inventory in order that the method of scheduling the packed operation can be changed, thus increasing the efficiency of personnel and equipment utilized within the packaging operation. It is this provision or ability to change which makes the system a total information system.

Within the packing department, itself, the information provided management is adequate to control both labour and machine efficiency. Reports are produced daily for all controllable operations. There are some inconsistencies, however, and these are mainly reporting practices among the various branches. For instance, one branch does not prepare an equipment performance report, while a second branch does not report on packing operations which are manually controlled. Another practice which tends to detract from the totality concept is the fact that production rates against which day-to-day production is compared tends to be historical production averages rather than an attainable standard rate of production. Also, the feedback of information to one branch is in the form of the monthly budget which covers far too long a period in order for the recipient to properly relate the cause and effect of a particular problem in the packing operating during that
period. Because packing must react quickly to the current order and inventory position, there is little advantage to preparing a long term packing schedule which would require more information on actual historical packing rates.

It is also recognized that the packing schedule can be affected by the production of certain bulk products and the capacity of storage bins. While it is unlikely that a packing schedule can be established for two weeks and not require amendment at all during that period, nevertheless, it is believed that significant opportunity for improvement exists in the packing scheduling operation. If production levels are to be smoothed, much more information would be required on the labour content of packed products so that these factors could be used to establish the total labour requirements for the production schedule. These could then be used to establish the individual daily schedules based on level labour requirements, recognizing the various operating speeds of the equipment. The management information system should be designed to produce this historical data. A further degree of sophistication which could be introduced would be a daily analysis of packing performance by the computer system and highlighting on an exception basis to packing management those items which do not fall within an acceptable performance range.

(d) Maintenance

ABC Company has a preventative maintenance system in operation. However, the system does not appear to contribute to a total information system concept. There are a number of practices of
the system which do not keep management fully informed of maintenance operations.

First, maintenance reports provided are produced on a period basis and tend to be received in the second or third week after the end of a period. Second, if there is a large variance on the budget report, it is difficult to establish the reason for the variance since maintenance time is not segregated into various categories; i.e. regular preventative maintenance, emergency repair, plan repair, etc. Third, the information provided to maintenance tends to be a by-product of the costing system rather than a special purpose maintenance report which reflects the consolidation of maintenance work done throughout the refinery. Fourth, the factory authorization job report which reflects actual expenditures to date against the various projects is also produced two to three weeks after the end of the period and does not include an estimate of the percentage of the project completed, and, therefore, it is difficult to establish whether the work in any particular project is on target until the work is completed. Finally, there is no specific follow-up on factory authorization and engineering work orders to establish whether the savings on which the cost was justified has been achieved.

Maintenance costs represent a significant percentage of total variable production costs (excluding raw materials). Although it tends to be one of the most difficult areas in which to measure performance, nevertheless, maintenance reporting should be an important part of the overall management information system.
A number of consolidated reports should be prepared each period for maintenance management so that they can see the total distribution of maintenance time into the various categories of plan preventative maintenance, emergency repair, capital projects, etc. This report would be in addition to the normal report of labour by cost centre. The reports should be prepared immediately after the end of a period so that corrective action can be taken by management if required.

The practice of preventative maintenance is based upon an assumption that minor repairs performed on a continuing basis will avoid major breakdowns and contribute toward longer machine life. Under a total system, information would be made available to management on exactly how effective the preventative maintenance procedures are. There should be a measure of how capital investment is being deferred due to longer machine life or how the frequency of machine breakdowns is decreasing, thus lowering the level of "costs" associated with machine downtime. ABC Company has neither of these effectiveness reports.

II. APPLICATION OF TOTALITY CONCEPT TO CASE COMPANY

The Total Information System Concept defined previously sets out the ideal, the model, or the perfect system for management use in the decision making process. To attain such a system status is considered a real feat of managerial designing. To say the information system of ABC Company was a total system
would be a gross exaggeration. It is a very acceptable system, however, but it is far from attaining the status of totality. It is a system with which ABC Company is very pleased with because it is a system which is designed to serve their immediate needs and informational requirements.

The biggest barrier that ABC Company faces in attaining the total system is the time element. The time it takes to report the occurrence of an event can take up to two or three weeks from the date it happened. Some other responses only take minutes. However, the time lag that occurs is often excessive, resulting in an ineffective decision making process. If the management decision could have been made immediately after an event occurred, the corrective action would be considerably more effective. For example, the majority of the marketing reports are prepared only monthly and are available for management use anywhere from the 8th to the 15th working day of the following month. This time lag does not keep management totally informed. In the area of customer profitability; the company could have made a large sale to an unprofitable customer during the first part of the month before receiving a report that the customer has proven to be unprofitable and no further sales to him should be contemplated. If management was totally informed of this condition, then the unprofitable sale would never have been made.

In most cases, the time lag of reporting is directly related to the accessibility of the information itself. If the
source of information is environmental, the system has the task of trying to monitor something that is beyond the control of the company. This often accounts for some of the time lag as the right to procure data is a major initial question. If the total system is active, environmental information would be gathered from all sources as quickly as possible, but within the bound of good business ethics. The concept is to get as much relevant information as is possible within as short a time as possible to be effective.

The cost factor has also held ABC Company back from being able to achieve a total system. Each time a segment of the system needs to be improved upon, the cost of such a change must be considered - the cost of the physical equipment and facilities, the personne cost involved in the change and the managerial time spent on planning a change. When the total cost involved is evaluated, the project is often not feasible. For instance, ABC Company wanted to acquire "on-line", "real-time" computer equipment for use at the various plant branch offices. It would have greatly increased their information handling capabilities, but the cost of instituting such a system did not exceed marginal benefits that would be forthcoming. The cost factor has become increasingly significant in recent years.

ABC Company is having problems with report strangulation, especially at the level of division managers. The division manager is burdened down with an extreme amount of reports - many of which
he is not really concerned with. It has developed to the state whereby the division manager almost automatically receives a copy of every report produced by his division or produced by head office with some application to a particular division. The division manager now tends to disregard most of the information for he doesn't have the time to read and absorb each report coming to him. What is really required is a further delegation of authority, rechannelling of reports to other persons responsible, or greater use of reporting by exception.

Another barrier to the totality concept for ABC Company is the spread of functional responsibilities between the head office and branches. Some functions are handled centrally, others are decentralized. The reasons for having some services decentralized are many. However, the main criteria is that specific branches have specific demands imposed upon them by environmental factors. This is especially true in the area of marketing. By creating the situation of decentralization, duplication of effort and systems procedures imposes an added cost against the overall company profitability. The total system does not ascribe to duplication effort for it tends to be a waste of personnel and tends to "tie up" the system which could be used for other more productive functions.

One area of the information system that has been very difficult to assess is the human element connected with the system itself. The information of ABC Company is new and it was
developed with the full cooperation of all personnel involved. Therefore, there is still a high amount of human enthusiasm to make the system work. If, in future, this enthusiasm begins to wain, the system will likely begin to show signs of breakdown. To date, however, this appears not to have happened and personalities are playing a very little role in the information flow.

Some specialization has crept into the system which tends to detract from the totality concept. An air of mystery surrounds the function of the computer in the system and management tends to let those personalities directly involved with the computer take their own courses of action. This creation of a computer specialist has tended to put up a communications barrier between management and the specialist. It is not known how much of an affect this barrier has on the flow of information, but it is known that there is a hesitancy for management to analyze the effectiveness of a computer, mainly because management does not understand fully its implications.

Another approach taken by ABC Company which does not allow it to qualify for a total management information system is the practice of dealing with segments of the system instead of the system as a whole. Management tends to correct or build each subsystem at one time rather than taking the full view of the impact that a change of one system has on all other systems. The reasons for this are mainly the cost and time factors. ABC Company, as well as other companies, is governed by budget and other cost
limitations. Therefore, the amount of spending done is limited and the limit is often for one specific project or system. The time taken to build up a system is usually limited as well, hence the segment is often looked at alone. In most cases, there are only a few personnel assigned to review a system, and to have an effective review you need all management personnel for it will take everyone to give their impressions of how the system will affect the whole company rather than have a few persons give their views. To put everyone on their review committee is obviously impracticable as there are other managerial duties to be performed as well.

One major element that ABC Company does not have full information on is the environmental factors affecting the company. The exposure to the environment is still by way of managerial contacts, news media and governmental edicts. If the system was to be a total system, there should be some provisions for the monitoring of all environmental factors, including population trends, competition, new product developments, laws, import and export trends, raw material pricing fluctuations, etc. To do this, the system would almost have to be on an "on-line, real-time" basis which would give the immediate interaction and information feedback required. Of course, this type of information is the most difficult to monitor, but it is an increasingly important one, in view of rapidly changing environmental conditions. For example, ABC Company will need to begin to develop systems to
accept input to improve market forecasting and achieve faster response to a changing market environment.

Information retrieval is an important aspect of a total system. ABC Company has information retrieval facilities, but they are on a limited basis. In some instances, information can only be retrieved from the system by calling for a special study or report. This request for information indicates somewhat of a limitation in the system because those who require the information must first ask someone else who has access to this type of information. Time is wasted as well as the increased probability for a "communication loss" as a result of information being transmitted several times.

The information system of ABC Company also fails to be a total system due to its lack of fully utilizing the capabilities of the system. For example, ABC Company does not use the system to maintain detailed information on its personnel. It does not record details of its extensive research and development program. It is not fully used to control production, nor is it used to feed back information of return on various investments. All these duties are performed by manual, archaic and rather costly methods. As of yet, however, management has not fully integrated them into the overall system so they cannot be classed as part of a total system.

In summary, the information system of ABC Company is
a definite attempt at reaching a total system, but it still lacks some of the characteristics which make up the totality concept. It lacks capabilities of fully acquiring, processing, communicating, storing and retrieving all types of information products.
CHAPTER VI

CONCLUSIONS AND GENERAL OBSERVATIONS

Throughout the study, the emphasis has been on one goal - total management information system concept. To illustrate this objective, an information system from an existing company was analyzed. Several observations have been made and conclusions reached. An impression of the present status of total systems may also serve to indicate how far industry has advanced towards the totality concept.

I. DISCLOSURES OF THE STUDY

In all types of analysis there exists an ultimate objective. Throughout this study, the objective has been to develop a concept which best describes the term "total management information system".

A workable definition has been proposed in a manner which is general enough to be applicable to all reasonable situations. To demonstrate how the developed definition can be applied to any situation, it was put into a practical framework - it was used as the main criteria in determining whether or not an existing company had a total management information system. The company had expressed the feeling that a very extensive and comprehensive information system existed within their operations and management was claiming the status of a total system. By applying the proposed definition of a total information system, it
was found that the case company did not measure up to the totality status even though it did contain some of the attributes common to a total system. The approach taken to reach this conclusion was to systematically analyze each facet of the company's information complex and to assess the inter-relationships between each component of the overall system.

It was earlier assessed that the information system of ABC Company was not a total system. However, a brief review of the key subsystems of the company will disclose some of the underlying causes and effects. In ABC Company, it was disclosed that within the subsystem of marketing, several operations took a leading role in the flow of information. It was a flexible system designed to emphasize planning and profitability. Planning in the sense that targets are being set for all levels of management and the deviations are automatically known via various control features. Planning is also carried out in terms of forecasting of immediate demands and trends in demands.

Profitability analysis forms a very integral part of ABC Company's management information process, in that success of the marketing function was often measured by various yardsticks of profit contributions. The profitability standard was noted from the lowest base level of individual customers up through to total company profits.
Limitations, in the area of marketing, towards the totality concept included the limited data base and the inability of the system to monitor the environment factors governing that company's competitive position in a total market place. Relating to the data base, it has been shown that at the heart of every successful information system is a disaggregated data file... the disaggregated data file provides the flexibility which is a prerequisite of an intelligent system evolution.¹ In designing the data bank, it is important to provide for common denominators in different sets of data so that correlation and analysis potential of the management information system can be realized. This means that such elements as geography, time and responsibility boundaries of different types of data must be compatible to permit meaningful comparisons.² ABC Company does not have this very extensive data bank.

The failure to develop the use of external or environmental information is mainly due to the problems involved in monitoring such information. Data is often not in a readily useable form and must first be digested to scan for relevant details. It is surprising that more firms have not allowed for this function for such environmental data is being recognized at a rapid rate as


a key management tool. All that is needed is for firms to develop systems which will accept such input.

Interacting with marketing, the subsystem or production is built heavily around planning. The success of a business often depends in a large part on its ability to control both its current operations and rejuvenate itself through innovation. ABC Company has developed this type of philosophy, and mainly through the enthusiasm and its successful use of various operations research techniques has kept its objectives up-dated to meet future demands. This same attitude of constantly up-dating planning is helped by proponents of participative goal setting. If the productive planning atmosphere of ABC Company can maintain its progressiveness, the capabilities of management will have to be regarded as being a highly informed group within the overall company system.

The main limitation to the production subsystem of ABC Company is that it lacks flexibility both in day-to-day operating control and for future growth. The flexibility of the system is limited in that it cannot be altered frequently as day-

---


5Anthony, R.N., Planning and Control Systems - A frame Work for Analysis, Division of Research, Graduate School of Business, Harvard University, Boston, Mass., 1965.
to-day situations often demand without considerable costs involved in rescheduling. The limited flexibility also applies to the various constraints needed in developing the mathematical model for production scheduling.

The production system also fails to allow significant room for expansion of total physical facilities. It does not assume that any of the refineries could have major changes in efficiency, capacity or even the ability to close down. For practical reasons, it has assumed only limited ranges of production capabilities.

In the area of distribution and packing, an important disclosure has been made with regard to finished goods inventory and distribution methods. In context, the finished goods inventory is currently a function of the total forecast of sales for the year. Distribution basically follows the premise that the goods will be shipped from the warehouse which is closest to the customer. Use is not being made of numerous management science techniques which can easily and with very little cost be incorporated to provide tighter control over this entire subsystem. It is estimated that by not controlling this area, significant extra "dollar" costs are being incurred. It is suspected that as competition becomes more intense, companies of this sort will be placing greater emphasis on customer service; i.e. satisfy the customer at all costs.  

---

The subsystem of maintenance employs a basic concept; i.e. preventative maintenance, but it does not employ it to a total systems advantage. The key to preventative maintenance is the work "systematic". Effective preventative maintenance for a total system must provide systematic inspections, systematic repair procedures, systematic servicing procedures and systematic follow-up. Systematic means "according to a standard". Therefore, the system must be able to correct a deviation automatically, not two or three weeks later when the financial reports are prepared.

These have been the major disclosures of the information system of ABC Company and they are mainly disclosures which tend to detract from having a total system.

II. CONCLUSIONS OF THE STUDY

Several conclusions of the study can be made, but the conclusions reached can, in retrospect, be applicable to numerous companies who usually have a similar basic organizational structure. These conclusions are as follows:

(a) ABC Company does not have a total management information system. However, it does not really need a total system. The concept of totality is the ideal and the ABC Company philosophy or goal is not specifically stated as obtaining this ideal. They only want to work towards it, not attain

---

it. The company is not in that critical a competitive position that it must have a total system to survive. The total system concept is a motivation that exists only in the minds of the corporate management - it is a drive that is felt personally by each manager, but it is a drive that represents a challenge rather than the matter of survival.

(b) The total information system concept covers so vast a spectrum of conditions that it is doubtful that a company would recognize achievement even if totality had been attained. What would management measure it against? How could it be demonstrated to show achievement? By simply saying that the system appears to qualify for all criteria mentioned in the definition does not necessarily say that all the attributes are related in an optimum fashion. A total system is not to be measured - it is too encompassing.

(c) A total system, itself, is too large to be envisioned or studied. Therefore, it is broken into subsystems. As management thinks in terms of subsystems, it tends to build up individual subsystems and never seems to really grasp the concept of one system again. Even the managerial efforts will be channelled at first to one subsystem, then another, trying to perfect each individual segment. The total system is never really reached by this process.

(d) Traditionally, the information that has bound the various subsystems together has been financial. Management has come to regard the accounting information as "the" information
system of the business and the other information systems to be merely tools of the department involved. The days of information strictly in the form of numbers has past. Information modes and technology have advanced to the stage where numbers tend to be meaningless in a lot of situations. More use must be made of other forms of communication. The system must be imaginative.

(e) The concept of a total system implies a central control of the systems effort. Centralization of control means that most planning, operating decisions and executive directives are made by top management and that the duties of the lower levels of management are primarily "acts of doing" instead of "acts of planning or deciding". This is clearly not what the total system was meant to be as it was to be an information producer and distributor for all levels of management. However, with the economics gained by having centralization of control, a trend may develop and decentralized management become less common.

(f) The most difficult barrier to a total system is the cost involved for instituting such a system. Companies just cannot afford all the required tools, personnel and knowledge that must go into making up a total system. In recent years,

---

8Hein, Dr. L.W., "The Management Accountant and the Integrated Information System", Management Accounting, National Association of Accountants, June, 1968.

information is being produced in such quantities that the physical task of sorting through great amounts of data to find meaningful information is enormous.\textsuperscript{10} If a dollar figure is attached to the search for information, the total cost would be astronomical. Half the cost of running our economy is the cost of information.\textsuperscript{11} For individual firms, the same principle applies, in that a benefit-cost analysis performed for information gathering makes most ideas of innovations prohibitive. The high price tag of information processing equipment also places a cost barrier to the purchasing of improved information handling techniques.

(g) The dynamic society within which a total information system must work almost destroys the totality notion as quickly as it can be said to be attained. By the time the system has been instituted to the degree necessary for totality, a changed environment requires a changed system. It is doubtful that a total information system could ever be designed to take account of a current situation.

(h) The use of electronic data processing equipment is almost essential for a company to build a total management information system. This applies to medium and large size companies specifically and to some small companies which are heavily


dependent on environmental conditions. The manual processing of information is just too slow to be of real value. Online capabilities from management to the system are required for quick and easy access. Computers also allow for greater capabilities such as the use of management science techniques in information gathering and handling.

(i) With the increased emphasis on more information, the controls instituted to ensure accurate information have been reduced somewhat. The cost of detailed controls have now risen to levels which exceed any amounts of losses that could be expected if no controls existed.

III. OBSERVATIONS OF THE STUDY WHICH COULD PROVIDE OTHER TOPICS FOR RESEARCH

Several observations made throughout the study pointed toward a new trend in management policy and information procedures. These interesting features would require greater in-depth review before commenting on and, as such, could be topics for further research.

One observation was that major revisions in organizational structure appear to result from the development of a total information system. Organizational changes caused by the information systems revision can be classified into three forms: (1) general organization revisions, (2) realignment of functions, and (3) use of controls. The first centres on trends toward broadening the scope of a manager's authority and increasing
centralized control. The second deals with changes in functional arrangements of duties, usually made possible or necessitated by developments in data systems. The third emphasizes changes in specific departments in which needed modifications in the assignment of responsibilities are now possible due to improved information services.

Another observation is that the design of a total information system implies greater managerial accessibility to supporting detail, which obviously increases the problems of security for confidential information. All management clearly cannot have access to all information, but yet management must have a freedom to tap the system for their individual information requirements. If the system is made extremely easy to obtain information from, competitors or even third parties could inquire - the problem is how to create the security necessary.

A third observation is that the cost of handling a unit of information has been reduced. However, total costs generally cannot be reduced significantly in a total system. An interesting research study would be to investigate ways to reduce this total cost, especially in view of the fact that original data is being used to initiate information in several subsystems within the total system.

These are only some of the topics introduced, but they could provide for further research in the total information systems area.
IV. GENERAL OBSERVATIONS ON CURRENT PROBLEMS
OF INFORMATION SYSTEMS

The term "total management information system" is a relatively new concept. However, much has been tried and achieved during recent years. Several problems have been appearing recently which influence the drive toward the totality concept. Some of these are briefly outlined as follows:

(a) Industry appears to be preoccupied with developing and installing new electronic data processing equipment. It has become an obsession with some companies to always have the most modern equipment available. Large amounts of time and money are spent on this desire, whereas the real resource should be effective utilization of the equipment already owned.

(b) Few firms have the resources, either financial or personnel, to afford to implement all modules of the management information system simultaneously. A phasing approach is the most often used. Unfortunately, priority designations among systems are often inconsistent with the criticality of the system to the firm's operations. For example, accounting systems are often given higher priority than systems which provide a higher return on investment.

(c) In many companies, unsophisticated techniques are used with sophisticated equipment. The equipment and the managerial

12 Couger, op. cit., p. 18.

13 Ibid., p. 18.
talent are just not being fully utilized. They are, in effect, being wasted. If the resources are available - use them. The long run benefits will usually far outweigh the costs involved.

(d) Company power politics has proven to be a potential disruptive factor for a management information system project.\textsuperscript{14} Instituting a total management information system frequently results in the realignment of the company's traditional authority lines. Whenever authority is questioned or changed, the company politicians become active, often damaging any chance for success.

(e) The total information system concept is partially interpreted to mean providing the right information at the right time - this is often mistaken for providing any information on an immediate basis. In reality, management does not need "all" information on an immediate basis.\textsuperscript{15} For example, fixed costs will not change minute by minute. Using sophisticated systems techniques to provide this information on a real-time basis is a waste of time and money. However, systems designers today are still trying to do this.

(f) In the rapid advance toward attaining a total system, all companies find they have omitted a critical procedure which

\textsuperscript{14}\textit{Gale, J.R., "Why Management Information Systems Fail", Financial Executive, August, 1968, p. 47.}

\textsuperscript{15}\textit{Byer, R., \textit{op. cit.}, p. 52.}
could have significant cost implications in the future. They all admit to having poor documentation. Management knows it must have documentation on what actually has been done - the remainder is assumed to not have been done.\textsuperscript{16}

Some companies have been set back as much as six months in their systems reviews just by not having proper documentation. The duplication of effort that results by not keeping proper records is really inexcusable.

\textit{(g)} Management involvement in developing a total system has been generally very limited. Management has a tendency to avoid becoming involved in the design of a total system.\textsuperscript{17} They feel they are not capable of understanding the technicalities, the jargon, etc., that naturally accompanies a total system development. This has proven to be a major barrier in the eventual success of a total system. The concept has to have managerial acceptance and managerial participation before it will succeed.

\textit{(h)} Perhaps one of the most essential elements in creating a total system is a bank or file based on disaggregated or "micro" data.\textsuperscript{18} There are limits to the size of the data bank from which the manager should be able to draw. In

\begin{itemize}
\item \textsuperscript{16}Elwell, H.H., Jr., "Data and Information Management Systems", \textit{Management Services}, November-December, 1967.
\item \textsuperscript{17}Martino, Dr. R.L., "Management Information Systems", \textit{Data Processing Perspectives for Management}, American Data Processing, Inc., February, 1965.
\item \textsuperscript{18}Cox, D.F., Good, R.E., \textit{op. cit.}, p. 152.
\end{itemize}
any firm, it is not now possible, nor will it likely ever be possible for the manager to be able to get all the information he feels he wants. As a result, the manager will choose to ignore the system and continue to make decisions by his own intuition. A practical balance will have to be reached as to the amount of information to store as opposed to the amount available. However, it will always be short of complete information.¹⁹

(i) Management, in general, has not acquired the level of sophisticated knowledge necessary to step into a total management information system. Often, they have not mastered the basic concepts on information processes before they want to incorporate high level systems.²⁰

(j) For companies that use electronic data processing equipment in their systems, the data processing manager is often the individual held responsible for deciding what kind of information should be generated by the system. This is a wrong attitude that the person responsible for data processing should restrict the systems requirements only as a result of the data processing capabilities - it should be an overall management responsibility for information output.²¹


There are obviously other problems being experienced in the development of total systems, but they are more apt to be a specific problem related to a specific company situation. The attempt in this study is to relate the basic underlying problems surrounding a total management information system.

V. TOTAL SYSTEMS - A PRESENT EVALUATION

A short time ago, the term "total systems", meaning totally integrated systems, was the rage. This was the utopia for information handling. Today, much of the initial enthusiasm has been dispelled. However, this does not mean that the total systems concept is not valid. It would seem to suggest that the work involved in developing total systems for a commercial enterprise poses greater hurdles and is far more difficult and elusive than first suspected. Also, the complexity of the enterprise's operations, the competitive environment under which it operates, the urgency for a total system, the calibre of systems made available, the attitude of top managers and a host of additional factors are contributory. In the case of several large corporations manufacturing in different locations and distributing nationally and internationally encompassing relationships with the multitude of vendors, customers, employees, communities, shareholders and governments, the thought has been advanced that the total systems concept is too broad and too large to use effectively. It is planned that satisfactory results, at least for the present, are possible with something less than total systems.
The most practical solution to some of the major problems is to base philosophies on grounds of reasonableness. Present management thinking has been trending towards this policy. That is, if a total system cannot be achieved because of constraints, such as cost, then we should attempt to build an efficient system based on reasonableness of cost. If the system requires a combination of computerized and non-computerized methods, it may be more efficient than older methods and come closer to the totality concept. The costs will be within the guidelines of being reasonable rather than being wholly dependent on an expensive system as the only means of a total system.

The present status is one of degree more than of kind. If total systems cannot be used, some degree of it can. There is unanimity of opinion that within an enterprise, a partial total system is superior to several large but uncoordinated systems. It is wise to specify the extensiveness of the coordination by the statement of the objectives. Literally, we say that to accomplish these objectives we will use integrated systems. Hence, what is a partial total system may provide the needed results. Our problem may resolve into that of determining precisely and completely the total objectives of the enterprise. This sets the stage for the total systems concept.

The day of total systems may not have arrived as yet, but it is surely on its way. As experience, greater skill and better techniques are developed for systems along with continued
progress in processing equipment, the present hurdles to the far reaching and inclusive total management information systems will be surmounted.


_______, *Planning and Control Systems - A Framework for Analysis*, Division of Research, Graduate School of Business, Harvard University, Boston, Massachusetts, 1965.


Haseman, W.C., Management Uses of Accounting, Allan and Bacon, Inc., Boston, Massachusetts, 1963.


