1967

The Role of Accounting in Management Information Systems.

Gerald Edgar Nichols
Louisiana State University and Agricultural & Mechanical College

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THE ROLE OF ACCOUNTING IN MANAGEMENT INFORMATION SYSTEMS.  

Louisiana State University and Agricultural and Mechanical College, Ph.D., 1967  
Accounting  

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1968
THE ROLE OF ACCOUNTING IN MANAGEMENT
INFORMATION SYSTEMS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Accounting

by
Gerald Edgar Nichols
B.S., Alabama Polytechnic Institute, 1958
M.B.A., Louisiana State University, 1963
August, 1967
To my mother
Eleanor Blair Nichols
and my wife
Dorothy Smith Nichols
ACKNOWLEDGMENT

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The primary goal of this thesis is to reveal the role of accounting in management information systems. The attainment of this goal requires that the exact relationship between information and the business organization also be determined and outlined. The tools of analysis chosen center around the notion of a system. Investigation revealed that information is of sufficient importance to the organization to merit explicit recognition as a function of management—the knowledge maintenance function. This function is concerned with matching the decision-maker and the information supplied the decision-maker to the requirements of each decision point within the organization.

The "total information" system thus includes all of the information useful or necessary for management to perform its decision-making functions. The total information system is divided into the formal and informal...
subsystems, but the informal information system is not considered further. The formal information system is further subdivided into the documentary information and non-documentary information subsystems. Non-documentary information is given no further consideration. The documentary information system is labeled the "management information" system, and includes both quantified and non-quantified information. This terminology does not conform with present usage, which generally equates the terms "management information" and "quantified information."

This precedent was not followed because quantified information (numbers) *per se* has no value—sufficient descriptive material (non-quantified documentary information) is necessary to convey meaning.

The management information system is classified according to the inputs and the outputs to the information generating system. Outputs are oriented around the needs of management and third parties. Outputs are related to three principal categories of needs—reporting, planning, and control. Reporting is third party oriented. Planning and control are management functions. Inputs to the system relate to either intrinsic or extrinsic events.
Intrinsic information concerns the internal environment of the organization. Extrinsic information is concerned with the general aspects of the external environment (management intelligence) or with the interaction between the organization and its external environment (interaction information). The management intelligence system is concerned with evaluating the general social and economic environment and with informing management of the activities of competitors. Latent interaction information is the basis for the evaluation of alternatives. Consummated interaction information arises from the interaction resulting from a decision.

The essence of accounting is reasoned to be the broader concept of information generation, which includes the essential elements of measurement and communication. A "systems" analysis of financial and managerial accounting indicates that restricted inputs, a limited "tool bag," and user orientation are the main system features that differentiate financial accounting from managerial accounting. The differences are such that the integration of financial and managerial accounting appears to be possible only conceptually. Both are information generating
systems existing to facilitate the accomplishment of organization goals. Financial accounting is "third party" oriented, but these "outsider" needs are filled only to the extent that fulfillment furthers organization goals.

The financial accounting system is concerned primarily with consummated interaction management information. Accounting, as defined by the 1966 American Accounting Association Committee to Prepare a Statement of Basic Accounting Theory, is essentially a subsystem of the management information system dealing with intrinsic information and quantified interaction information. This comparison of the two extreme views of the scope of accounting encompasses the range within which most other definitions will fall. The comparison indicates that accounting does not include any aspect of the important area of management intelligence or the non-quantified branches of intrinsic information or interaction information.
CHAPTER I

INTRODUCTION

The current business era is marked by the advent of sophisticated problem solving techniques, complex equipment, and increased specialization. These developments and the increased complexity and increased size of business organizations have made information a competitive economic weapon. A variety of information systems and methods of information generation have evolved to meet the resulting expanded demand. The evolution of these systems has been rather haphazard and has led to some confusion and inefficiency. Confusion abounds concerning the scope and capabilities of the various systems, and inefficiencies in the form of duplicated efforts and under-utilized facilities have resulted. Efforts are currently being made to dispel the confusion surrounding these systems and to increase the efficiency of organizational information generation. The

The problem has been approached from various directions, but usually in a piece-meal fashion.

The approach followed usually differs with the background of the researcher. Those with a management orientation tend to focus their attention on either internal or external information for decision-making purposes and scant notice is given to accounting data, *per se*; accountants often ignore the total informational needs of management in their quest for external reporting principles; and those scientifically inclined tend to concentrate their attention on mathematical information theories or emphasize the informational needs of specific mathematical techniques.

These varied approaches are often fruitful, but they may also lead to conflicting conclusions. For example, some writers contend that centralized information departments are the solution to management's woes and that such centralization coupled with electronic data processing and management science techniques will eventually render the accountant, and perhaps even middle management, obsolete.² Concurrently, accountants find the demand for their services increasing and the scope of the services being

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rendered clients broadening. In addition, forecasts of the future of the accounting profession present ever brighter prospects. The ultimate effect of these conflicting beliefs and attitudes is confusion. Enlightenment will not be found in further exhortations concerning the future, but from an understanding of the merits of these and other divergent views. The determination of the relative merits of a particular situation should be based upon an awareness and understanding of the scope of the various information systems and the relationships existing between. This thesis attempts to present a basis for the intelligent evaluation of the above described and similar controversies.

I. PURPOSE OF THE STUDY

Research has revealed that financial and managerial accounting are inextricably associated with business and management information systems. These relationships were found to be extensive, ill-defined, and interesting. Thus, the present project emerged. The guiding or primary purpose of the study is the delineation of the role and scope of accounting in the business organization. Such a

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revelation should prove beneficial in the understanding, design, and coordination of business information systems. To this end, the study attempts to bring together the scattered concepts related to management and accounting information systems in order to synthesize and present a realistic view of both areas. The results of the study should:

1. Enable members of the accounting profession and other groups to understand better the present role of accounting in business,
2. Aid in the planning and operation of business information systems,
3. Facilitate the design and teaching of accounting and systems courses,
4. Enable a better assessment of the future of the accounting profession,
5. And further and facilitate research in this area.

II. SCOPE OF THE STUDY

The first section of this study is devoted to the task of familiarizing the reader with the area of systems. General systems theory, the "systems concept" and the "ideal systems" approach are presented. These three concepts provide the basis for the analysis of business organizations, management, and accounting throughout the paper. These business-oriented systems concepts are
preceded by a *general* discussion of systems and a sketch of the development of a "systems" awareness which should facilitate an understanding of the business-oriented concepts.

The systems orientation is followed by a discussion of the interrelationships of organization theory, management, and information. This discussion is intended to point out the importance of information to the business organization, to reveal the scope of the information necessary to business decision making, and to consider the role of the information generating function in the organization. Various concepts of the organization are presented, including a systems view of the organization, to illustrate and emphasize various aspects of information. The discussion concludes that information is of sufficient importance to warrant separate consideration as an explicit function of management—the knowledge maintenance function. This conclusion then forms the basis for the analysis and subdivision of the "total knowledge system" into a hierarchical ordering of subsystems terminating with the management information system, the subsystem concerned with all documentary information.

The management information system is then analyzed from a "systems" point of view. This analysis results in the detailed consideration of the users, uses, and sources
of management information. Management information is then classified according to the source of the information—external or internal to the organization. The classification scheme presented forms the basis for relating accounting to management information.

A treatment similar to that described above is accorded the area of accounting. The evolution of the areas of accounting are presented as an orientation device, and to give historical perspective to the delineation of the role of accounting in business organizations which follows. Accounting and the relationship of accountants with the process of accounting is detailed. A discussion of the various views of accounting is then presented as background for the contention that accounting should be stressed as being primarily an information generating system. Detailed consideration is then given to accounting as a system.

The last sections of the thesis review and relate management information and accounting from several vantage points—the historical perspective, the importance and scope of information, the defined and perceived role of accounting by accountants, and from other vantage points. Both the differences and similarities between both systems are discussed, but the similarities are stressed. The presentation culminates with a perspective of the role of
accounting in management information systems based upon the material and discussions presented throughout the thesis.

III. PREVIEW OF THE FINDINGS

The business organization is an adaptive system—a system which constantly attempts to adjust its activities to conform with the environmental requirements for survival. Such a system requires information regarding the states of both its internal and external environments to enable it to survive. Organizational adaptive behavior is facilitated by the decision-making process—the sum of all the goal-directed decisions made within the organization. Thus, the organization is viewed as a hierarchically ordered system of decision-making points with each point representing an information-processing unit. Management is charged with servicing the needs of these decision-making points—the management function of knowledge maintenance. Management must match the decision-maker and the information supplied the decision-maker to the requirements of each decision point.

The organization's "total information system" is concerned with all of the information supplied to the decision-makers at all decision points. The "management information system" is the subsystem of the total information system
concerned with all of the documentary information supplied to management—the decision-makers of the organization. The accounting system is a subsystem of the management information system.

The actual role of accounting in the management information system varies from organization to organization and is a function of the size of the organization, the peculiarities of the particular management group involved, and other factors. Accounting cannot be assigned a single theoretical role in management information systems because there is no agreement regarding the scope of accounting. However, the range of management information with which accounting is generally concerned is set forth. This range is bounded on one side by the narrow scope accorded the area termed "financial accounting," and on the other side by the broadly interpreted role of accounting as outlined by the American Accounting Association committee on basic accounting theory in 1966. Financial accounting is deemed to be concerned primarily with the historical transaction information required by third parties. The AAA committee contends that accounting is concerned with all quantified economic information pertinent to the business organization's operations.
Financial accounting is generally held to be too narrow a concept, and the area encompassed is considered to be a subsystem of a broader concept—such as that set forth by the AAA. The AAA definition of accounting is not intended to be a description of accounting as it exists today. The AAA statement must be viewed as a goal or limiting value. In spite of the limitations inherent in the concepts used, the resulting range of management information with which accounting might be concerned is meaningful. Most, if not all, of the theoretical and actual roles currently ascribed to accounting fall within the outlined range and will probably continue to be considered within the range for some time to come.

IV. LIMITATIONS OF THE STUDY

The study's primary concern is with business organizations. No attempt is made to correlate any of the discussions with the needs and requirements of non-business organizations. In most cases, if not all, the material presented is equally applicable to other forms of organizations.

The study does not attempt to present answers to many of the important questions confronting those concerned with the areas discussed—for example, the role and importance
of automation in information systems, or the type of information system that will best fill the needs of specific, or even general, types of organizations. These questions are important, but they are outside the intended scope of the study. Specific recommendations regarding such things as the design of information systems or courses of instruction in this area also fall outside the scope of the study. However, the study does attempt to give the reader a better understanding of, and thus some insight into, the problems that might confront him in these areas.

"In depth" discussions of certain subject areas, such as accounting and organization theory, decision-making, measurement, and communication, are not attempted. Separate volumes have been written concerning each such area. In dealing with ancillary areas of such vast scope, only the material necessary for an understanding of the primary goals of the study are presented.
CHAPTER II

BUSINESS SYSTEMS ORIENTATION

Ross W. Ashby ascribes two virtues to cybernetics (the science of control and communication in the animal and the machine). One virtue is that cybernetics offers a single vocabulary and a single set of concepts suitable for representing the most diverse types of systems. The second virtue is that cybernetics offers a method for the scientific treatment of the system in which complexity is outstanding and too important to be ignored. In the analysis of simpler systems, the methods of cybernetics sometimes show no obvious advantage over those that have long been known. It is chiefly when the system being analyzed becomes complex that the methods reveal their power.¹

The same virtues may be ascribed to the systems approach to business problems. Economic systems are infinitely complex, and difficult to comprehend. This complexity forces the typical executive to attack his problems

as if they were an endless number of special cases. The business executive needs general concepts about the nature of business operations that will help him to abstract the properties of any individual problem. The systems concept provides the necessary frame of reference in these complex areas and, in addition, serves as a powerful tool for problem identification and problem solving.

In attempting to familiarize the reader with the area of systems, the concept of the adaptive process and its evolution are presented, followed by general systems theory considerations. This material will provide the background for the presentation of business-oriented systems concepts—concepts that will be used throughout the entire paper in explaining the role of information in business organizations, and in discussing and presenting accounting as a part of the management information system.

I. INTRODUCTION TO SYSTEMS THEORY

The systems concept is so simple and inherent in our lives and thinking that we seldom notice the pattern. The concept is not new; it is just that its emphasis gives a new perspective when applied to problems. The systems

concept is a way of thinking, a line of attack. Insight into the application of the systems concept to business problems will hopefully be enhanced by the discussion which follows.

A. The Development of a Systems Awareness

Adaptive systems are processes which are governed by the flow of information. The study of such processes in both social and biological evolution is very old. The Greeks used evolutionary principles, which they called the dialectic, in their search for truth. This adaptive process was later applied to social systems during the rise of the Hegelian concept of history. Hegel replaced a concept of society in which history was simply a record of the past with a concept of society in which history was the engine of progress. In the Hegelian world, society, remembering the past triumphs and failures, adapts to the conditions of the present, and produces the decisions which may lead to future triumphs or failures. Thus, Hegel stressed the key component for adaptive decision processes, the role of history in the formulation of current decisions.

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The dialectic process, as applied by Hegel, stressed certain fundamental aspects of adaptive processes. First, there is a set of alternative views about the problems of the present. Second, there is some objective which is to be optimized by a selection of a subset of possible views. Third, a choice mechanism is necessary to determine which subset of views is optimal to society. Fourth, a police system is necessary to impose the optimal choice on the holders of other subsets of ideas. The society then experiences the consequences of the decision and formulates the dialectic process all over again. The crucial link is the choice mechanism, and an essential concept is the irreversibility of the process. These ideas are referred to again when decision-making in the organization is discussed and still again in stressing organizational adaptation as a requisite for continued existence.

The biological aspect of adaptation emerged in the study of Malthus in 1789, but it was Darwin who clearly saw the mechanism by which adaptation takes place. Volterra in 1901 and Lotha in 1924 mathematically described adaptive biological systems. Pavlov and Thorndyke applied the process to learning at the turn of the century. 4

In spite of these applications of the concept of adaptive processes, the fundamental nature of these information-feedback systems escaped notice until the last three decades. Forrester indicated that this failure was the result of the peculiar classes into which these systems fell before 1940 and he cites three reasons for this failure: First, the biological adaptive systems, such as the human body, had been so ideally perfected for their purposes, and people had at the same time so completely accepted their shortcomings, that the systems and their information-feedback character went unnoticed. Secondly, social, economic, and industrial systems have evolved in recent centuries on so large a scale that the fundamental information-feedback characteristics were most difficult to discern. Lastly, hosts of other explanations were advanced in terms of superficial specific manifestations of the particular problem rather than in the more fundamental terms of the generalized closed-loop system.

Present-day theories and concepts of information-feedback systems are the results of attempts to build simple self-regulating mechanical control systems. As control devices developed beyond such simple contrivances as early steam engine governors, greater precision was needed. The systems to be controlled became more complex.
The dynamic characteristics of systems and system difficulties became obvious on a scale small enough for study. Strong commercial and military incentives encouraged attempts to master the theory of information-feedback system design, and the solution to these initial simple problems lay within the reach of the available mathematics. The problems, the needs, and the tools have been matched for two decades of progress in the dynamics of physical systems. The simple control systems of the 1930's described by linear differential equations of two variables by the 1940's had been developed into the concepts of Laplace transforms, frequency response, and vector diagrams—the mathematics of servomechanisms had thus emerged. The actual servomechanisms used involved electrical as well as mechanical systems, and parallel developments in electronics both furthered and made use of the knowledge of information-feedback systems thus gained.

One application or field of electronics to develop was "information theory" or "communications theory."

Claude E. Shannon is recognized as the originator of the formal theory and Norbert Wiener of the Massachusetts Institute of Technology is credited for major contributions
to the development of the theory. The outline of the theory follows:

1. It treats communications as a problem in statistics.

2. It focuses attention on the large-scale, or gross, aspects of communications.

3. It provides units of measurement for the amount of information in broad classes of messages.

4. It shows how the maximum rate of transmitting error-free information over any system can be computed.

The elements of the system are the source, transmitter, channel, noise, receiver and destination.

The application of this electrical theory of communication to information flow in a human channel reporting system (management information flow) is much more difficult than applying it to, say, the design of computers. Its application does provide some insights into the process, but McDonough states that:

To my knowledge, no specific results have been achieved by direct application of the theory to management reporting. On the other hand, many experiments are attempting to find units of measurement which can be useful when the human

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being is considered as a channel for management communication.\textsuperscript{6}

One of the major difficulties in applying the theory to management information systems is that there are many channels of communications. The lack of clarity of management problems is also hindering the theory's application.

However, much knowledge has been transferred to the sphere of business as derived from the knowledge gained concerning the adaptive ability of physical and biological mechanisms, especially with regard to the extendable concepts of the generalized components of systems. Some of these benefits will be discussed later. An understanding of these benefits will be facilitated and enhanced by a listing of the common properties of adaptive systems. Paul Konkel delineates these properties stating that:\textsuperscript{7}

First, in taking an action, we see that at any point in time an adaptive system can move off in any one of the many directions.

Second, we find that a move in any of these directions will cause a change to the system and perhaps its environment. This change becomes part of a record, the historical record of the system which is unchangeable.

Third, there is in each adaptive process a choice or decision-making function. With

\textsuperscript{6}Ibid., p. 48.

\textsuperscript{7}Konkel, \textit{op. cit.} (June, 1964), p. 819.
knowledge of the historical record and an evaluation of the effect of each action on the present and future states of the system, the decision making function chooses one of the alternative actions.

Fourth, following the taking of an action, the system may or may not achieve the anticipated result. Uncertainties in the environment or the effect of the action may cause the system to move in a direction which was unintended.

Fifth, if the result was unfortunate, there is no recourse. The only corrective measure is to re-establish the above sequence of events all over again.

B. The Realm of Systems

1. Systems defined. The word "system" can be interpreted differently. Among other things, Webster defines a system as "a regular method or order," and as "an assemblage of objects united by some form of regular interaction." This study is concerned with the latter type of system. Johnson, Kost, and Rosenzweig define a system as "an organized or complex whole; an assemblage or combination of things or parts forming a complex or unitary whole." There are all kinds and types of systems—for example, the steering system of an automobile, the circulatory system of the body, and the solar system.

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There are many different means of classifying systems. The particular classification technique adopted will vary with the intended application. Some of the most frequently used classifications will now be discussed along with the general attributes of a system.

2. A general theory. The attributes of a system uniquely define the system. Two different means of classifying these attributes are shown in Figure 1. The minimum attributes of inputs, outputs, and system structure are depicted in Figure 1A. There is obviously an infinite number of alternate ways of expanding any of these three essential attributes, one of which is shown in Figure 1B. Several alternate and much more detailed breakdowns of these basic system components are used throughout this thesis. These different methods of expressing the basic system components will facilitate an emphasis upon particular points of interest. The alternate methods used will be described at the appropriate times. However, certain commonly used methods of classifying systems should be clarified immediately.

3. Open and closed systems. The terms "open" and "closed" systems may be construed to refer to either the variables involved (that is, the interaction of the
A. Minimum System Components

B. System Components Expanded

FIGURE 1

THE COMPONENTS OF A SYSTEM
A. Minimum System Components

B. System Components Expanded

FIGURE 1
THE COMPONENTS OF A SYSTEM
subsystems of any larger system on the system in question) or to the type of control exerted on the system. As shown in Figure 2A, everything affecting the "closed" system is known, it is a determinate system; while there are unknown influences acting upon the "open" system. Obviously the closed system in Figure 2A is an idealized model, and there are no real closed systems in this sense. However, this ideal is approached in the physical sciences. The "practical" closed system is one in which all of the influences significant to the purposes at hand are known. Open systems in the sense of Figure 2B are merely highly complex systems. In studying these indeterminate systems the problem lies in devising a method of "closing" the open system. Two methods of achieving this are to either discover those influences necessary to convert the system to a practical "closed" system, or to subdivide the complex open system into more manageable subsystems.

Figure 3 indicates that, in considering the control exerted on the system, an open system has only preprogrammed controls while the closed system has, in addition to programmed controls, an information feedback concerning some state of the output that adjusts the inputs to the system. This latter system is an adaptive process. The two types of systems may be likened to two furnaces, one
A. "closed" system

B. "open" system

FIGURE 2
SYSTEMS CLASSIFIED ACCORDING TO THE NATURE OF EXTERIOR INFLUENCES
A. "closed" system

B. "open" system

FIGURE 3

SYSTEMS CLASSIFIED ACCORDING TO THE TYPE OF CONTROL EXERTED ON THE SYSTEM
which adjusts its heat output according to the temperature of the room being heated as detected by a thermostat (a closed system); as compared to a furnace that is programmed to produce no heat at all in the summer, to produce heat five minutes of every fifteen minutes in the spring and fall, and produce heat ten minutes of every twenty minutes in the winter (an open system).

Thus, the information-feedback system (closed system) adapts to the environment, the room temperature, while the open system produces heat without regard to room temperature. The advantages of the information-feedback type of system in this and comparable situations are obvious. Although the open system described might generally prove adequate, it would be ineffective during unseasonable warm or cold periods. With regard to control, therefore, open systems would prove useful only for controlling invariant systems.

Somewhat similar terminology is found in business literature concerning information feedback. A "closed loop" information system is one in which the information concerning actual performance is automatically fed back to the source of energy (the manager or decision-maker). The "open loop" information system is not automatic, it requires human intervention based on information of actual
performance to adjust the supply of energy to operations. These two situations are depicted in Figure 4A and 4B. The difference between the concepts as depicted in Figures 3A and 3B and those in Figures 4A and 4B are slight but significant. The former concepts center on the presence or absence of feedback, while the latter concepts assume feedback, but distinguish between the types of feedback. Care should be used to eliminate the possibility of confusion in applying these concepts by explicitly and clearly defining any system being considered. Figure 4C depicts a hybrid form of information-feedback system that is common to the management process. This hybrid form portrays the principle known as "management by exception." Feedback systems are extremely important to management and will be considered in more detail later. However, it is appropriate to note now that some of the greatest difficulties of developing a good feedback system result from the fact that:

1. There must be some error before action is taken.

2. There may be a lag between the time action is indicated and the actual correction.

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10 Ibid., p. 184.
A. Closed Loop

B. Open Loop

C. Hybrid

FIGURE 4

INFORMATION FEEDBACK SYSTEMS
4. **System theory applications.** As previously mentioned, the concept of adaptive systems originated in the social sciences. The concept was later given general consideration in the natural sciences, as in evolution, and was finally treated with mathematical rigor with regard to biological population growth. The rigorous treatment of adaptive processes in the physical sciences is more recent and centered around deterministic physical systems, as with servo-mechanisms, and communications theory.

The resulting mathematical theories of systems have been especially beneficial to such areas as weapons guidance and computer design. However, generalized systems theory has been successfully applied in the areas of simulation and control of non-determinate systems (open with regard to outside influences). Although this study does not delve deeply into these areas, an illustration may prove interesting. It is possible, in some cases, for a simple adaptive system to produce the same output as that of a complex system with unknown internal mechanisms.\footnote{Roy E. Murphy, Jr., *Adaptive Processes in Economic Systems* (New York, N. Y.: Academic Press, 1965), pp. 6-7.} Thus, an adaptive model can be used to control a complex
system, for example a factory. Weiner states it this way in *Cybernetics*:

... we are able to construct a multiple white box which, when it is properly connected to a black box and is subjected to the same random input, will automatically form itself into an operational equivalent of the black box even though its internal structure may be vastly different.\(^\text{12}\)

The above reference to "white" and "black" boxes alludes to systems with known and unknown internal workings, respectively. "White boxes" are usually mathematical models or simulators. Simulation is accomplished by mathematically describing the significant components of the system. Any component of a system can be completely described by two complimentary variables—propensity (or potential) and result (or flow). These two variables are given different names according to the process under consideration. In hydraulic processes the propensity is pressure and the result is flow rate; in electrical processes the names given to propensity and result are voltage and current; while in mechanical processes they are velocity and force, respectively. These concepts will be used to advantage in a later analysis.

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Systems engineering developed as a formal awareness of the interactions between the parts of a system. A telephone system is not merely wire, amplifiers, relays, and telephone sets to be considered separately. The interconnections, the compatibility, the effect of one upon the other, the objectives of the whole, the relationship of the system to the users, and the economic feasibility must receive even more attention than the parts if the final result is to be successful. This is the natural sciences counterpart of the "systems concept" in business.

Ashby declares that

It has been found repeatedly in science that the discovery that two branches are related leads to each branch helping in the development of the other. The result is often a marked accelerated growth of both. The infinitesimal calculus and astronomy, the virus and the protein molecule, the chromosomes and heredity are examples that come to mind. Neither, of course, can give proofs about the laws of the other, but each can give suggestions that may be of the greatest assistance and fruitfulness.13

Hopefully, this declaration regarding scientific interrelatedness also applies to business. Evidence is presented later to support the belief that systems knowledge is transferrable and beneficial to business.

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General systems theory, along with the related innovations—the "systems concept," and the notion of "ideal" systems—is applied to the business area. These three concepts will prove to be versatile, powerful tools for solving business problems.

II. BUSINESS SYSTEMS CONCEPTS AND COMPONENTS

Business organizations are man-made systems, and each organization may simultaneously be considered a social system, an economic system, or some other type of system appropriate to a particular viewpoint or need. This section elaborates upon the elemental components of systems previously described. The elaboration is business oriented and will later be applied in considering the organization itself and in detailing physical and conceptual organization subsystems. Thus, the intent is to consider and analyze progressively smaller business information subsystems from various points of view until an understanding of the complete role of information in the business organization has been revealed.

To the extent possible, the manager at each level of the authority hierarchy should understand that the business is not a number of isolated parts, but a system. In addition he should be aware of the systems involved and
have some knowledge of the relationship between the parts and be aware of their normal and potential interactions. Such an awareness should prove beneficial to the entire organization. For example, activities beneficial to individual departments but detrimental to other departments, and therefore to the entire organization, might be lessened. The "systems concept" stresses a constant awareness of the upward and downward interrelationships of all systems. The notion of an "ideal" system incorporates the "systems concept" and in addition provides an unvarying benchmark for evaluating and designing systems.

A. A General Business-Oriented Systems Classification

Innumerable methods of general systems classification, as well as general business system classification, are possible. Several examples of rather complex business systems in actual use are presented later. The basis for these models will now be formulated. An expanded version of the simple system components previously presented will serve as this basis. The expansion is oriented towards business systems and embodies an adaptation of a scheme presented by Optner.14 Only adaptive type systems are considered.

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1. The elementary system. The classification of systems as either physical or non-physical presents a problem in working with business systems since business involves both men and machines (physical systems) and man-made institutions. If a closed system is defined as one free of variation or disturbances (a "practical" closed system), a more useful dichotomy emerges. Systems designed to operate with people will not qualify as closed systems. Thus closed or structured systems refer to physical systems other than those involving men. Incompletely structured systems then encompass man-machine systems and man-made institutions. Systems components are defined as either input, output, processor, feedback, filters or control elements.¹⁵

The interaction of these components was presented pictorially earlier. Reference to Figure 5 will refresh the reader's memory regarding this interaction. In all cases, the system under study will be the processor. The system inputs may be multiple and are the requisite ingredients for achieving the process goal or goals, the output. Special and detailed consideration must always be given to the relationships between these three components. Questions such as "Can the chosen processor produce a

¹⁵Ibid., p. 8.
FIGURE 5

FILTER ACTION IN A SYSTEM
desired output?" or "What inputs are required to produce a specific output from an existing processor?" are extremely important. The prime rule is to let the system's requirements dictate the system design. This, of course, puts the burden on investigating the facts and carefully interpreting their relative importance.

Control and feedback are related, but different. Control is the result of predetermined knowledge about how the system should operate—for example, the policies, structure and plan of operation of a factory. Feedback is after-the-fact control based on information concerning the output of the system—such as the quality and salability of factory output. Feedback can result in input and control modification. Other controls on input, such as editing (filtering) of raw data, machine verification, and so on, are possible and will be considered further. Analysis of the subsystems where editing or machine verification occur would reveal that the actual control mechanism could be considered a part of the process in some cases. However, even in these cases it often proves expositarily beneficial to consider them as separate elements. Table 1 lists the behavioral characteristics of the five system properties relative to structured and incompletely structured systems.
## Table 1

The properties of the elements of structured and incompletely structured business systems

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>STRUCTURED</th>
<th>INCOMPETELY STRUCTURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Invariant, no disturbances.</td>
<td>Variant, many disturbances</td>
</tr>
<tr>
<td>Processor</td>
<td>Machine-like.</td>
<td>Man or man-machine.</td>
</tr>
<tr>
<td>Control</td>
<td>Reliability approaches 100%.</td>
<td>Wide range of reliability.</td>
</tr>
<tr>
<td>Feedback</td>
<td>Self-organizing.</td>
<td>Outputs are not automatically reintroduced to improve performance.</td>
</tr>
</tbody>
</table>

2. **System filters.** The filter is a useful concept and is defined as a man, man-made, or environmental factor which consciously or by its state of being, acts to admit certain system elements to the system process, while keeping others out.\(^\text{16}\) It would be desirable if these filters excluded only invalid or valueless data, but this is not the case. A method of portraying the filter in the systems model is shown in Figure 5. The existence of a filter in a system actually infers certain subsystems which cut across input, output, or feedback. The system processor itself also acts as a filtering mechanism. It produces only those outputs which can be created from specified inputs. Certain other activities are filter-type operations. Manual systems generally require more filter-type operations than mechanical systems. The ability to recognize the existence or absence of filters is essential if system boundaries are to be determined accurately.

3. **Boundary definition.** Any system may be viewed in a variety of ways and the boundaries will change accordingly. Thus it is entirely proper that the system under study be described in terms of the role the processor plays in a specific instance. The idea of a system

\(^{16}\text{Ibid.}, \text{ p. 27.}\)
processor is deceptive in its simplicity. It is clear that a man or a machine can be called a processor for the purpose of analyzing a problem, their boundaries are static, easily discerned, and understood by all. However, when the processor is a production control system or an information system the delineation of the boundaries of the system is much more difficult because the system is conceptual. Such non-static processes as these latter systems are defined by stating their boundaries. In the sense used here, the boundary concept restricts the scope of a problem to a size commensurate with the cost or time available for solution, and the amount of detail necessary to understand the process. Boundary delineation enables the analyst to look at the problem as a whole, and sets up the framework for a later analysis of the subsystems in something close to their correct relationship.

A statement of system boundaries is dependent upon the ability to define the system under study, which in turn requires a knowledge of the system requirements. These requirements will follow from an understanding of the following:17

17Ibid., p. 21.
1. The activities which are associated with the on-going process

2. The inputs which are processed in the system activity

3. The outputs which are obtained as a result of system processing

4. The way in which the on-going process is controlled

5. The errors, deviations, and exceptions which have been marked as system malfunctions

Included in the fifth category are the following:

(a) System malfunctions in time: that is, the time necessary to introduce input or to obtain output, feedback, or controls inhibits the function of the system or its next-in-line subsystem.

(b) Cost malfunctions: that is, the cost to introduce input or obtain output, feedback, or control are greater than they were in the past; or the costs to sustain the system are intuitively determined to be higher than the value of the system operation itself.

These requirements, or the contents of the system, set forth the limits or boundaries of the system to be studied. The determination of the contents of a system indirectly requires the determination of what lies outside the system. Thus, boundary definition provides additional value by shedding light on the adjacent areas of a system, and thus immediately emphasizes the integration problem to be faced later, and in turn facilitates its solution.
Boundary definition also requires that a system be distinguished from the methods of deriving input, the uses of output, and from the person or persons operating the system or performing the function. These distinctions are important and, unfortunately, are often extremely subtle and difficult to discern. Failure to recognize these distinctions, or boundaries, has led to confusion in many areas of endeavor.

Boundary delineation appears to be most difficult when dealing with conceptual systems. Confusion is most often evidenced in distinguishing the individual's performance of a process from the conceptual system itself. This confusion arises because of the many facets of an individual's activities and the names attached to each of these facets. A given person may be at once a father, a manager, a driver, an accountant, and so forth in title, because at some time in the past he performed a given function or is capable of performing, or trained to perform a function. System boundary definition will normally require that people per se be separated from the process. People are considered only in the sense of filters as described earlier. Therefore, a given person, regardless of his formal title, will be associated in name with a given system only while performing the process or function in
question. For example, an employee with the formal title of Plant Manager will be considered to be an accountant if and while he performs the accounting function. He will be considered to be a manager only while performing management functions. The use of this device will allow for the consideration of only purely conceptual business systems and will eliminate personal considerations where necessary. For example, the management process will later be considered to be epitomized by, or as, the decision-making process. In this instance, decision-making is considered to be an organizational process consisting of all the organizationally pertinent decisions made by organization members, but excluding personalized decision-making.

As previously mentioned systems may be viewed in many different ways, they are amorphous. The ability to find the correct subsystem pertinent to a specific problem, or to identify the proper system elements is often a difficult task. Knowledge of, or experience in, the system under study will speed the analysis and identification of a system's elements, but even in the absence of such advantages, an analyst can rely upon a knowledge of the general properties of systems to aid in this difficult task. Systems knowledge will provide an objective frame of
reference in which investigation and hypotheses can logically occur.

It should now be clear that systems can follow no stereotype but are at best isomorphic, that is, similar only in outward appearance. A host of environmental factors work against uniformity in even the simplest business systems. Differences in management needs and objectives are reflected in organization and operations. The design of a business system is the solution to a problem of a specific management. The solution arises out of the existing process and a knowledge of the system's requirements.

4. Systems diagrams. Systems diagrams have already been used in illustrating several points in a general way. These analytic devices are equally suitable for looking at the details of a process when the problem is to analyze the existence or non-existence of important system elements and for analyzing, relating or synthesizing complex systems. Systems diagrams are different from other types of flow charting techniques in that they accent systems elements as the tools of analysis. Systems diagrams are not
intended as replacements for other special-purpose flow charts. Systems diagrams serve graphically:⑴

1. To identify the system under study (processor).

2. To identify the purpose for which the system exists (output).

3. To identify the ingredients (input) whose functional relationships can be arranged to produce the required end results.

4. To show the existence or nonexistence of mechanisms whose purpose is to maintain reliability, accuracy and other desirable operational attributes (controls).

5. To show the existence or nonexistence of mechanisms to correct malfunctioning output (feedback).

B. The Systems Concept and Ideal Systems

Every system is part of a larger system and, in turn, every system is composed of sub-systems. Thus, a given system is the result of the interactions of its sub-systems, and it interacts with and influences the larger system of which it is a part. In studying systems a knowledge of both the sub-parts and their interactions are important. As previously mentioned, the "fluidity" of systems makes their study most difficult and requires that the system's boundaries be rather rigidly defined prior to study. Boundary definition was also said to aid in

⑴Ibid., p. 28
defining and pointing out interaction with exterior systems.

1. The systems concept defined. The overt recognition of the existence of internal and external systems, the systems means-end chain, along with the holistic idea that a given system must be viewed as a functioning entity and not as just a collection of parts, is the gist of the "systems concept." The holistic view does not minimize the importance of the parts; but it does point out that their interaction must be considered, and in fact may be more important than the parts themselves. The holistic view states that the whole may not be equal to the sum of the parts.

   Johnson, Kast and Rosenzweig have concisely set forth the idea as follows:

   The systems concept views a business firm as an integrated whole, where each system, subsystem, and supporting subsystem is associated with the total operation. Its structure, therefore, is created by hundreds of systems arranged in hierarchical order. The output of the smallest system becomes input of the next level of systems, which in turn furnishes input for higher levels.\(^{19}\)

   This is the means-end chain of the systems world.

\(^{19}\)Johnson, Kast, and Rosenzweig, op. cit., p. 307.
The adoption of this point of view facilitates problem-solving by allowing the problems of a particular system to be solved by and through the recognition of the particular problem area as a system and by considering the interaction or means-end chain of the particular system involved in delineating the inputs, outputs, and structure of the system.

Johnson, Kast, and Rosenzweig expand the concept as follows:

The systems concept is primarily a way of thinking about the job of managing. It provides a framework for visualizing internal and external environmental factors as an integrated whole. It allows recognition of the proper place and function of subsystems. The systems within which businessmen operate are necessarily complex. However, management via the systems concept fosters a way of thinking which, on the one hand, helps the manager recognize the nature of the complex problems and thereby operate within the perceived environment. It is important to recognize the integrated nature of specific systems, including the fact that each system has both inputs and outputs and can be viewed as a self-contained unit. But it is also important to recognize that business systems are a part of larger systems possibly industry wide, or including several, maybe many, companies and/or industries, or even society as a whole.20

20_Ibid., p. 3.
2. The "Ideal" systems approach. There are five ways of judging the efficiency of a new or proposed operation or system. The system can be compared with:21

1. Some arbitrary standard,

2. The old system,

3. Other systems that are comparable,

4. That achievable with existing technology,

5. An ideal.

Gerald Nadler contends that the traditional approach to the design of a new system or the improvement of an old system usually involves the application of the "scientific method" of investigation in conjunction with one of the first three gauges listed above.22 Nadler indicates that the use of the scientific method for systems design or improvement automatically insures less than an optimum solution, and has stated that this conclusion has been independently proved through the use of symbolic logic. Using the scientific method involves subdividing a problem into its parts or components, and analyzing the parts to


determine whether a change can be made or a component eliminated. The parts are then changed, eliminated, or manipulated, and re-combined in an attempt to achieve something approaching an optimum arrangement better than that started with. Nadler indicates that this approach starts at the wrong end of the spectrum. Consider for example, the application of the above process to the improvement of a system or the adaptation of an existing system to another use. If the system started with is an inherently inferior system for performing the given function, the application of the scientific method would result in a highly efficient, inferior system.

The proper approach to system design is to consider the specific system in the light of its function and its relationships in the systems means-end chain—that is through the application of the "systems concept." This analysis will help in defining the system and its functions—it is possible that the system serves no purpose in the overall scheme of things and could be eliminated. This phase of the analysis can also benefit from the "ideal" systems approach, yet to be explained.

The system proper should now be considered. Nadler contends that every business system can be considered a hopper which has common characteristics regardless of the
level of the system in the hierarchy. He stresses combining as nearly as possible the ideal states of all seven of these variables to achieve effective, not efficient, systems. These characteristics are:

1. Function—objectives or purposes of the system
2. Input—raw material of the system
3. Output—how the objective or function is attained
4. Sequence—order of changing input into output
5. Environment—heat, light, noise, operating controls, rules and attitudinal and sociological environment
6. Equipment—tools for changing input
7. Method—the way people perform their work within that particular system.

The "ideal" system concept is an approach that can be used in the solution of many problems. The approach suggests that four states of a given system are significant. These states are the Theoretically Ideal, the Ultimate, the Technically Workable, and the Recommended systems as portrayed in Figure 6A. The horizontal

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Ibid. Nadler's ideas are much more comprehensive than is indicated by the discussion above. Among other things, he also emphasizes productivity, not production, and the fulfillment of people in their work. Those desiring further information concerning Nadler's work should consult his recent book Work Design (Homewood, Illinois: Richard D. Irwin, Inc., 1963).
A. The Four Significant System States

B. Results of Ideal Approach vs. Traditional


FIGURE 6

THE IDEAL SYSTEMS APPROACH
distance between the sides of the pyramids in Figure 6 are proportionate to the unit cost of the system's output. Cost may be stated in any desired units. Thus, the theoretical Ideal is no cost solution, or system, represented by the point of the pyramids. The Ideal is a limiting value and will probably never be achieved. The Ultimate system is the long-range goal. It is not now achievable but can be foreseen; further research or development is required. The Technically Workable system could be installed today, and may be operating somewhere. Thus, the Recommended system could conceivably be identical with the Technically Workable system but may not, and probably will not, be identical because of capital costs, hazards, control factors or for various other reasons. However, the Technically Workable system provides a guide or model to be used in developing a Recommended system. Where possible the Technically Workable components are incorporated as designed, or they are modified to fit the Recommended system. Figure 6B diagrammatically presents Nadler's conception of the current state of affairs regarding the improvement of a given design or system. The geometric figures within the pyramid indicate that some parts of the present, and other system levels, will be nearer the ideal state than others. The perpendicular distance from the
base of the pyramid indicates the relative stage of sub-system advancement. The reader should notice also that there are existing subsystems (represented by the suspended geometric figures) superior to those used or recommended that cannot yet be integrated into the lower level systems. The two great benefits of using the "ideal" systems approach are that:

First: A better Recommended system will always be arrived at than would have been achieved using the conventional approach because the Recommended system is as close to the Theoretically Ideal system as is possible.

Second: When the reason for not including a Technologically Workable component is eliminated, the system is capable of receiving the component because it is designed to take that component.

The approach is change- and future-oriented and explicitly requires that the Recommended system be compared with the Ideal system periodically.

3. The tools of analysis. The business organization is viewed as an adaptive process throughout this thesis. As mentioned earlier, Hegel first stressed the role of history in formulating current decisions and outlined the fundamental aspects of adaptive processes. These same fundamentals apply to organizations viewed as adaptive processes. As related to business organizations these
fundamentals are: alternate views about problems (planning), some objective to be optimized (organization goals), a choice mechanism (managerial decision-making), and a police system (control). Chambers recognizes the business organization as an adaptive process and states that adaptation requires a knowledge of the states of affairs (potential) and their rates of change (flows), and that continuous adaptation requires a continuous record.24

Konkel elaborates upon the above concepts by listing the fundamental notions he believes are required to formulate adaptive processes:

(1) A model of an adaptive process must be a sequential time process since uncertainties in the environment make success difficult to obtain and hold.

(2) We must find a way of treating the information contained in the historical record. Thus, a concept of information will be an important notion.

(3) We must have a stochastic representation of the effects of the system's environment which plays a vital role.

(4) The role of the decision-making function must be made explicit.

(5) We note that only one action is to be selected out of many possible alternatives.

How this one action is selected is a fundamental notion with which we must deal.

(6) We must specify the ways in which the structure of the system is changed by each of the possible actions and the possible effects of the environment.25

The above notions are given detailed treatment in various sections of the paper. The section that follows traces the historical role of information in organization and economic theory, and reveals the importance currently accorded information in organization theory. This revelation forms the basis for the contention that the importance of information to the organization is such that overt recognition should be accorded it. Recognition is given by emphasizing the management function of knowledge maintenance.

A recent American Accounting Association committee report pointed out the importance of organization theory as a requisite for an understanding of accounting and the study and research of its doctoral students in stating that:

In the past economic theory of the firm has provided the major theoretical foundation for the study of business administration in general and accounting in particular. The literature of economics itself can be cited to show the recognized deficiencies of this theory in explaining all business behavior. These deficiencies arise partly from the inadequate attention given to the psychological and sociological considerations in decision making in the firm. Although organization theory has not been developed to the same degree as the economic theory of the firm, it does provide a vehicle by which the doctoral student can be introduced to the behavioral aspects of decision making in the firm as well as a more general analysis of the significance of the structure of organizations. Many profitable ideas of accounting research can be developed from the study of organization theory.¹

The relationship of accounting, per se, to organization theory will be considered later. The discussion of organization theory that follows is intended to help clarify a broader business concept—information. Tracing the evolution of thought concerning business behavior will provide the vehicle for emphasizing the growing awareness of the importance of information in business organizations previously alluded to in the Introduction. Such a discussion should also make more apparent the scope of business informational needs and the place of the information generating function in the organization. A modern synthesis of organization theory stressing decision making will provide the basis for graphic "systems" views of the organization that will further emphasize the importance of information. The "systems" views presented are dynamic, that is, they recognize the importance of time to organization activities and the ever-changing nature of organizations with time.

I. THEORIES OF ORGANIZATIONS

It must be considered remarkable . . . to find that until very recently there was only one important theory of business behavior and that this theory was based essentially upon the hedonistic calculus of Jeremy Bentham, an English philosopher who died in 1832. Thus, business operations which have rapidly changed
have continued to be explained by a theory which has remained relatively static, and which, so some scholars claim, never has been founded in reality.  

The theory referred to is the traditional economic theory of the firm. The roots of many current business and accounting practices are firmly entwined in this theory.

A. The Economic Theory of the Firm

Economists are concerned with the means of allocating the limited resources of an economy so as to maximize the utility attained from their use in the face of insatiable wants. One of the tools devised by the economists to help study the economy is the "theory of the firm." This device allows the economist to investigate and explain the rationing of scarce resources without having to concern himself with the intricacies of people and organizations. There is no one economic theory of the firm, but some consensus of economic opinion does exist. This "consensus" or "traditional" theory of the firm postulates a goal, profits, and describes how this goal may be obtained through marginal analysis.

Generally, the economic model of the firm is static and the environment in which the firm operates is static and rather rigidly defined, for example perfect competition or monopoly. Comparative statics is used in analyzing the effect of changes in the system. That is, only the equilibrium positions of the firm are considered. The method and the time required to reach equilibrium are ignored.

This theory depicts the firm as an entity whose inner workings are unknown and unimportant. The firm has a known demand schedule and known costs over feasible ranges of inputs. Profit maximization involves only decisions regarding the number and mix of inputs and outputs expressed in money terms. Marginal analysis is applied so as to minimize costs and maximize revenues in such a manner as to maximize net revenues or profit. That is, production is expanded until the revenue produced by the production of one more unit just equals the cost of producing that unit. Similarly, on the input side of the firm, resources are purchased up to the point where resource cost equals resource value. The mix of particular inputs is determined in a manner similar to that described above for outputs to insure that the costs of production are minimized.
The notion of a "black box" with predictable actions but irrelevant mechanisms led some economists to consider the firm as if it were a person—the entrepreneur. Viewing the firm as a single person gave rise to the concept of "economic man"—a perfectly rational or efficient person with the single goal of profit maximization. Perfect rationality requires a knowledge of all possible alternatives and their consequences. Thus, the economic theory of the firm assumes perfect, costless information and instantaneous, automatic decision making with immediate effect.

Prior to the industrial revolution, the determinants of human behavior were dictated by physical force or custom. The social changes that inspired and furthered the industrial revolution also eliminated the use and effectiveness of these traditional behavior determinants. The entrepreneurs that emerged in the eighteenth century needed a social philosophy to rationalize their actions and some business philosophy to apply to the practical problems of running industrial organizations.

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3Ibid., p. 4.

The social philosophy, or "apologetic" that emerged centered on profits. This was the heyday of free enterprise, of capitalism. The organizational philosophy that emerged, explicitly or implicitly, centered on "economic man." Management efforts to coordinate, control and motivate organization members were based on this philosophy. There were no competing theories; and the almost complete orientation towards production evidenced by industry eased acceptance of the existing theory.

B. Organization Theories

With time, management became increasingly aware of the inapplicability of the assumptions of the economic model of the firm to many specific situations and people began to question its general validity. The theory did work in many situations, but it was apparent that man was not rational at all times, let alone perfectly rational, and that man strives to fulfill multiple and sometimes conflicting goals. Less concern was initially given to the assumption of perfect information in spite of the obviously different efficiencies of information systems and the fact that some costs were involved. Increased competition, rapid technological changes, and de-emphasis of production caused management to show increasing concern
with the internal workings of economic's "black box" and the concept of "economic man." The reality of different factor and product market costs, and different production transformation processes induced a search for alternate theories upon which to base industrial operations. These alternate theories are generally regarded as "organization theories."

There are many "organization theories." For expositional purposes these theories will be divided into three categories--Traditional, Behavioral, and Modern. The term "Traditional" organization theory will be used to refer to those theories that are more or less based on the tenets of "economic man." That is, they assume that "organization members, and particularly employees, are primarily passive instruments capable of performing work and accepting directions, but not of initiating action or exerting influence in any significant way." The Scientific Management movement initiated by Frederick W. Taylor and the Functional Management movement, typified by the works of Fayol, are included in "Traditional" organization theory. Behavioral organization theory, as used here, had its beginnings with Mayo and Rothlisburger and their empirical Hawthorne

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experiments; and include the theoretical additions of psychologists, sociologists, and anthropologists since that time. The Behavioralists added people with their faults and inefficiencies to organization theory. People became active, important organizational ingredients.

The "Traditional-Behavioral" dichotomy used here somewhat parallels McGregor's "Theory X-Theory Y" dichotomy of management attitudes regarding the nature of employees. Theory X assumes that man is basically lazy and therefore, must be coerced into working; that he has relatively little ambition and desires security above all. Theory X is related to the economic theory of the firm and the concept of "economic man." Theory Y is the other extreme of management's possible choices of philosophy concerning employees. Its assumptions concerning man's nature are almost exactly opposite to those of Theory X and are based on Maslow's theory that man has ordered multiple needs. Theory Y postulates that work can be satisfying; that man can be enticed, instead of forced, to work; and that man is ambitious and will seek responsibility.\(^6\)

Traditional organization theory did concern itself with the internal workings of the "black box" of economic theory, but it was normative in nature, that is, it attempted to establish standards or norms. The scientific movement of Traditional theory concerned itself with prescriptive methods for achieving organizational efficiency by emphasizing employee efficiency and economic incentives. The functional movement of Traditional theory had as its primary objective "the efficient assignment of organization activities to individual jobs and the grouping of these jobs by departments in such a way as to minimize the total costs of carrying on the activities of the firm." Traditional theorists also concerned themselves with the principles of management—such as span of control and the scalar principle. These principles

... are actually a group of a priori rules prescribing how the practical businessman should construct the formal structure of his organization. To a large extent these principles were distilled from historical studies of large organizations such as armies, churches and states as well as from the experience of practicing businessmen.

These were the first steps towards a realistic theory of the firm. These initial theories have had a lasting influence; one still evident in many current business practices.

The study of the interrelationship of individuals and groups with their environments and with each other, which economic theory ignores and which traditional organization theory obscures, is the substance of such disciplines as sociology, psychology, and anthropology. Behavioral organization theory is eclectic in nature. It utilizes the applicable insights and theories of the social sciences along with those of economics and traditional organization theory. Behavioral organization theory is concerned with how people do act, rather than how they should act. Behavioral theory is predictive in nature, not normative. The various individual behavioral schools will not be discussed, but certain concepts necessary in relating information to organization theory will be mentioned.

Both the traditionalists and the behavioralists tend to view the organization as a pattern or system of relationships. For example, Bernard defines the formal organization as "a system of consciously coordinated activities or forces of two or more persons," while Mooney defines organization as "the form of human association for the attainment of a common purpose." However, the traditionalist views the individual as an essentially passive

\[9\text{Ibid., p. 57.}\]
instrument acting only in accordance with his formal role in the organization. Research in the behavioral sciences refutes the machine model of human organizations. Beginning with the Hawthorne studies, human behavior and relationships in organizations have been emphasized.

Profit maximization as the goal of the firm has been replaced by ordered goals or has been qualified, as by Joel Dean, to apply only to the long run. Maslow has posited a hierarchy of goals for individuals; and Herbert Simon contends that firms will attempt to "satisfice" rather than maximize organization goals.\(^\text{10}\)

In the economic theory of the firm the process of decision-making is insignificant. In traditional organization theory the subject is dealt with in a prescriptive manner, concerning itself only with the steps to be followed in choosing between alternatives when the facts are known. Behavioral theories focus their attention on the internal process of decision-making and decision-making under uncertainty. March and Simon outline their concept of the relationship of organizations and decision-making in the following manner:

\(^\text{10}\)Ibid., p. 59.
The basic features of organization structure and function derive from the characteristics of human problem-solving processes and rational human choice. Because of the limits of human intellective capacities in comparison with the complexities of the problems that individuals and organizations face, rational behavior calls for simplified models that capture all its complexities.

The simplifications have a number of characteristic features; (1) Optimizing is replaced by satisficing—the requirement that satisfactory levels of the criterion variables be attained. (2) Alternatives of action and consequences of action are discovered sequentially through search processes. (3) Repertoires of action programs are developed by organizations and individuals, and these serve as the alternatives of choice in recurrent situations. (4) Each specific action program deals with a restricted range of situations and a restricted range of consequences. (5) Each action is capable of being executed in semi-independence of others.11

Decision making in the organization is considered to be a process rather than the act of a single individual. The final responsibility for action may rest with a particular person, but the contribution of this person may be negligible.

The behavioral theorists have not defined the relationship of the business organization to its environment. These theorists have pointed out that the environment

11March and Simon, op. cit., p. 169.
influences the decision premises of the firm, but theories attempting to explain this phenomenon have been spasmodic and rather inadequate. However, organization theory is currently characterized by attempts to synthesize a comprehensive theory well founded in reality.

C. Information and Organization Theories

The economic theory of the firm effectively ignores the importance of information by assuming instantaneous decision making with immediate effect. This assumption requires that the decision maker be perfectly rational and have perfect, costless information.

Traditional organization theories focus upon the internal workings of the "black box" of economic theory and thus show some concern for formal information internal to the organization. This formal information is concerned primarily with quantified data concerning efficiency (scientific management) and financial condition (financial accounting). Traditional theories also stressed formal organization structure and hence formal internal communications channels (principles of management), but little was said regarding the type or form of information or the

\[12\] McGuire, op. cit., p. 65.
effectiveness of communication. That is, the need for and use of internal information was recognized, but the function of generating and disseminating this formal internal information was definitely not emphasized. External and internal, informal information was given scant, if any, notice.

Behavioral theories added people to the organization. This addition of people gave rise to the concepts of informal organization, informal information systems (the grapevine), decision-making, group dynamics, role playing, and the like. Thus, still further recognition was given to the role of information. Decision-making emphasized information, but the scope of information was still not given complete and explicit recognition, nor was the important role of information generation and dissemination overtly recognized.

As previously stated, modern theorists are attempting to synthesize a comprehensive theory. Herbert Hicks has explicitly recognized the importance and scope of information. He emphasizes the necessity for organizations to deal with both their internal and external environments, and thus with the formal and informal information concerning both.\(^{13}\) The synthesized modern theory that

\(^{13}\)Hicks, _op. cit._, pp. 70-74 and p. 311.
follows attempts to present a framework that emphasizes the importance of all external and internal information (total information) and the information generating function.

II. A MODERN VIEW OF THE ORGANIZATION

STRESSING INFORMATION

This presentation is not an attempt to formulate a new theory. It is merely an attempt to set forth an explicit statement regarding the relationships existing between information, management, and organization theory. The relationships to be presented are based on selected modern organization theory concepts, but no attempt is made to integrate these concepts—such labors must fall upon the shoulders of the organization theorist. The presentation emphasizes a view of organizations that highlights the importance and scope of information, and the dynamic nature of organizations. Organization theory is applicable, of course, to all organizations whatever their size or purpose. However, as is customary, the discussion which follows is couched in terms of the business organization.
A. The Organization as an Adaptive System

Peter Drucker has listed nine specific objectives of a business organization which determine its survival: profitability, market position, innovation, productivity, the supply of material and financial resources, the supply of managers adequate for tomorrow's job, worker performance and attitude, public responsibility, and the balance between short-range and long-range perspective. These objectives obviously require that the organization be compatible with its external environment—creditors, investors, the government, and the social system in general—and foster a productive internal atmosphere—employee relations, motivation, physical surroundings and the like.

Viewing the organization as an adaptive system emphasizes the frequently neglected area of external information. This view stresses survival, the primary goal of all adaptive systems. Darwin's concept of survival of the fittest was deduced from two empirical propositions: all organisms tend to increase in a geometrical ratio, and the number of any species remain more or less constant. Thus, a struggle for existence must take place. David Li has

14 James W. Giese, Classification of Economic Data in Accounting, a dissertation written at the University of Illinois, Urbana, Illinois, 1962, p. 152.
presented empirical financial data for organizations that correspond to the above propositions, thus indicating that organizations are indeed adaptive systems. Using his findings as his basis, Li contends that survival is the main objective of business organizations, and, as a corollary, that survival in an expanding economy necessitates growth. Logic is also on Professor Li's side, for although subgoals must be met if the organization is to survive, the accomplishment of any subgoal depends upon the existence of the organization, the means of subgoal accomplishment. However, survival may be an implicit goal and may never be recognized as a goal, per se, by the organization. In this case, survival becomes the primary goal by default, for it becomes primary only after an organization is formed to accomplish another goal or other goals; and it may be a short-lived primary goal since survival is necessary only for the time required to achieve the original goal or goals which themselves may be short-term, as for example with an ad hoc committee or a charity drive. Hicks has stressed that continued existence, or survival, must be explicitly recognized by the

organization as a goal if continued existence is to be achieved.\textsuperscript{16} Thus, business organizations must recognize survival as an explicit goal to be considered adaptive processes.

Explicitly adopting survival as a goal does not insure continued existence. However, continued existence will be more likely because the adoption of survival as a goal will require the recognition of those factors affecting survival, primarily the external environment. Like biological organisms the organization must cope with its external environment. This requires that the organization adapt to environmental changes, or change the environment. Organizations can and do influence change in their external environments through such activities as lobbying, advertising, and competition.\textsuperscript{17} A systems view of the organization as an adaptive process is presented in Figure 7. All organizational activity must be geared toward the main goal of survival. Other goals are ordered in time from the immediate or short-run to the long-run. However, the only goal that must constantly be achieved (immediate, short or long-run) is the existence

\textsuperscript{16}Hicks, \textit{op. cit.}, p. 80.

\textsuperscript{17}\textit{Tbid.}, p. 73.
FIGURE 7
A SYSTEMS VIEW OF THE ORGANIZATION
or survival of the organization. Profit for example, cannot be the main objective of organizations. Profits are not always achieved in the short-run. Survival is the only organization goal that must always be achieved in the short-run. Expenditures for the purchase of safety equipment or the maintenance of safety standards may, for example, actually decrease profits, but may be justified on the basis of actual physical survival of organization elements or on the satiation of member security needs to insure continued participation.

Murphy also views the organization as an adaptive process, and in addition stresses information. He contends that the rate of generation of information in an economic system controls the rate at which correct decisions are made and thus indirectly the rate of growth of the system's resources. It follows from this hypothesis that the growth of an organization, and thus survival in an expanding economy, is a function of information generation. Murphy points out that in a static environment the information states of adaptive processes regarding their external environments would in all probability

become the same; and, other things being equal, each adaptive process would react to the environment in a like manner. However, the "other things being equal" condition would not hold for business organizations for they are composed of people possessing different skills and abilities. Thus, even in a static environment, information would still be dependent upon decision-making, and thus information, since decision-making itself, as will be discussed later, is dependent upon the information supplied the decision-maker and the skill and knowledge possessed by the decision-maker. Realism dictates that the business be viewed as operating in a competitive society and an economy that is, at best, in dynamic equilibrium. In this more realistic view of society the importance of information to the survival of the organization is much more apparent for a constantly changing environment insures that organizations will never reach the same information states regarding their external environments.

The importance of information to the organization may be further demonstrated by considering the goals of organizations themselves and the goals of organization members. Organizations are formed to overcome man's individual limitations. Organizations exist only as long as
they are useful—that is, as long as member and organization goals are being fulfilled. When the individual goals of a member are not satisfied sufficiently by membership in an organization, he will sever his relationships with the organization. When the collectively determined goals of the organization are not being achieved or satisfied, the organization will be disbanded.

It is apparent that an organization is here defined as "a structured process in which persons interact for objectives."\(^{19}\) This view centers its attention on people and involves people oriented processes. In the larger organizations goals are generally formulated by a minority of the members. Therefore, the goals of all of the organization's members may not--probably will not--coincide with those of the organization. However, the goals of members of the organization need not coincide with the organization's goals for the organization to be successful; they need only be compatible.

The members of organizations are considered to be willful agents with different degrees of rationality and

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\(^{19}\text{Hicks, op. cit., p. 16. Much of the organization theory discussed here is adapted from Part I of Hicks' book.}\)
capable of making value judgments. If people are left alone they will attempt to maximize what they perceive to be in their own best interest. Thus, ways must be found to guarantee that the behavior of these willful agents is consistent with the overall objective or objectives of the organization. To this end organization resources and activities must be consciously coordinated and controlled if the organization is to survive--members must be motivated to contribute, and controls must be established to guarantee cooperation and coordination in achieving organization goals. This coordination and control depends upon the information supplied the manager, the organization member that falls heir to this task. A manager is defined as any organization member who contributes to the management process. The management process is the holistic view of the individual management contributions to coordination and control of organization resources in striving toward the achievement of organization goals. This process will later be viewed as organizational goal-directed decision-making, an information oriented process.

B. Knowledge Maintenance: A Management Function

Elaborating upon the idea of organization resources referred to above, it is obvious that the working elements
of an organization may be classified as being either human or non-human. The usefulness of humans centers on (1) their ability to do, (2) their ability to influence, and (3) their ability to use concepts. Each member of an organization uses all of these abilities to some extent but the proportions vary. For example, a laborer is primarily a doer, a foreman functions almost exclusively as an influencer, while top management will be concerned primarily with the use of concepts. The non-human elements are either tangible assets, or intangible (knowledge and information). These resources are combined by people in achieving organization goals by the use of the people oriented organization processes.

The people oriented organization processes are management, communication, motivation, creativity, and "others." The "others" category recognizes the possibility of the existence of other processes. All organization members are involved in these organization processes to some extent. The degree of involvement varies with the member's position in the organization structure as did the use of human abilities mentioned above. Knowledge and information are obviously important.

21 Ibid., p. 27.
elements of organizations since they are the basis upon which all of the useful abilities of humans depend—doing, influencing, and using concepts. The people oriented processes just outlined also depend upon or are related to knowledge and information. Communication is necessary to provide organization members with information concerning goals and performance, to motivate members, and to permit creativity. Motivation inspires goal directed activity and the creative use of organization resources. Creativity improves the methods of choosing, combining, and converting organization assets.

Knowledge and information are involved in all of these processes and are necessary for the processes to occur. Figure 8 presents a simplified pictorial representation of the relationships between knowledge and information and the organization processes. A more realistic view would show that all the circles in Figure 8 touch, and thus that each component involves or influences all other components. Management, the last process, is the process of judiciously combining all of the organization's resources in such a manner as to strive toward the achievement of organization goals. Knowledge and information can be likened to tinder, the organization

FIGURE 8
THE RELATIONSHIPS BETWEEN PEOPLE ORIENTED ORGANIZATION CONCEPTS
elements to fuel, and the manager to the spark that sets
the fire to blazing.

The manager achieves his life-giving coordinating
ability through the application of the management processes
of creating, planning, organizing, motivating, communi-
cating, controlling, and other processes within the
organization.\footnote{Ibid., p. 157.} These processes are also referred to as
the functions of management. Information and knowledge
are obviously associated with and necessary to all of the
listed functions of management. It is time for the
implicitly recognized function of knowledge maintenance
to receive explicit recognition as an essential function
of management. The term "knowledge maintenance" involves
all aspects of knowledge and information relevant to the
accomplishment of organization goals. This functional
concern for total organization knowledge can be expressed
in terms of levels, or propensities, and flows. Further
consideration will be given these concepts at a later time.

The life-giving ability ascribed to the manager
through the application of the managerial processes is
epitomized as the decision-making process, which in the
manner of Barnard and Simon, is viewed as the basic
element of organizations. This assumption is the basis for a later description of a simulation model of the firm that depicts information as the coordinating thread upon which the success, the very existence, of the organization depends.

Forrester writes that, "Management is the process of converting information into action. The conversion process we call decision making."\(^{22}\) The discussion that follows investigates the informational aspects of decision-making. The information necessary for a particular decision may involve either the internal or external environment of the organization, or both. The previous section concentrated upon the external environment because it is often ignored, at least explicitly. More attention will be given internal information in the sections that follow.

C. The Organization as an Information-Decision-Making System

An organization is goal oriented interaction. Management is a goal facilitating organizational process. The basic features of organization structure and function

derive from the characteristics of human problem-solving processes and rational human choice. Thus, the essential feature of the management process is organizational decision-making. Organizational decision-making is the holistic view of the individual decision contributions of all decision-makers. Individual decision-makers have limited rationality; the organization and the decision-making process are instruments for increasing rationality, and thus for accomplishing what the individual cannot.24

The individual as well as the organizational aspects of decision-making are important to an understanding of the whole. Thus, decision-making is viewed simultaneously as something that results from actions in various subdivisions of the organization and as an individual thing, that is decision making in-the-large and in-the-small, respectively.

1. **Information and decision-making.** Decision-making is the process by which the alternatives available to organization members are reduced. Decision-making itself is a process that involves five steps:25

24McGuire, op. cit., p. 64.

1. Consciousness of the problem-provoking situation

2. Recognition of the problem and its definition

3. Search for and analysis of available alternatives and their probable consequences

4. Selection of the best solution

5. Implementing the decision

The outcome of the decision-making process, as thus characterized, is dependent upon:

1. The premises (both factual premises and value positions of individual participants) upon which a person or group operates

2. The penalty-reward structure that is provided in a particular organization

3. The information available to the decision-maker

John T. Dorsey claims that

Decision making may be conceived of as a communication process or a series of interrelated communication events. A decision occurs upon the receipt of some kind of communication, it consists of a complicated process of combining communications from various sources, and it results in the transmission of further communication.  

This statement emphasizes communication, and neglects that which is communicated, information. Put another way,


communication is a means of transmitting data or potential information; effective communication transmits information—that is, it reduces uncertainty. Information and communication will be discussed in detail later. Churchman visualizes the decision-making process as involving a predicting system, a value system, and decision criteria as depicted in Figure 9. The predicting system supplies a list of possible outcomes and the probability of each outcome. The value system determines the desirability of possible outcomes and courses of action to achieve these outcomes. The decision criteria are the standards established to select the one alternative action which offers the most desirable solution to the decision maker. In real situations, each alternative will have some undesirable as well as desirable aspects. The alternative with the highest composite value will be selected. This system, as shown in Figure 9, is applicable in both individual and organizational decision-making. The effectiveness of a decision depends upon the information available to the decision maker for two reasons:

1. The potential courses of action depend upon the information available to the decision maker.

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2. Information concerning past actions and outcomes is necessary in predicting outcomes resulting from courses of action and the probability of the predicted outcomes occurring.

Barnard and Simon take a similar view of decision-making. They outline the elements that go into making a decision as:2⁹

1. The premises (both factual premises and value positions of individual participants) upon which a person or group operate

2. The penalty-reward structure that is provided in a particular organization

3. The information available to the decision-maker

Forrester states his view more dynamically, "Management is the process of converting information into action, the conversion process we call decision making."3⁰ Forrester's views are the basis for the section that follows presenting the organization as a system.

2. A systems view of the organization. There are many alternate ways of viewing the organization. This thesis views business organizations from the systems perspective but there are also alternate methods of presenting the business organization as a system. For example, McDonough views the business organization as a "cycle of business systems" as portrayed in Figure 10.

2⁹Bonini, op. cit., p. 9. ³⁰Forrester, op. cit., 93.
1. A business is a collection of problems to be solved

2. Organization is the process of assigning problems to the most qualified person

3. The most qualified person is the one who will need as little information service as possible to make the best decisions

4. Information is the measure of the value (worth) of a message to a decision maker.

5. The purpose of a system is to carry information to decision makers

6. A business system is a logical configuration of the significant elements in a selected problem area

McDonough lists six management-information propositions necessary to describe a business organization. The cycle then involves the interrelatedness of the six propositions.

The emphasis is always upon information and management, people oriented organization concepts. Repeating Forrester's statement quoted above, "Management is the process of converting information into action. The conversion process we call decision making." However, this action must take place in some ordered context. What form or order is necessary? Simon feels that

The anatomy of the organization is to be found in the distribution and allocation of the decision making functions. The physiology of the organization is to be found in the processes whereby the organization influences the decisions of each of its members--supplying these decisions with their premises.31

Johnson, Kast, and Rosenzweig elaborate upon Simon's statement as follows:

If organizations are complex networks of decision processes, there must be decision points throughout, ranging from individuals at the lowest levels to board directors at the top. The primary aspects of the physiology of the organization is the communication system, which supplies premises for decisions at various points in the organization; that is, each decision point can

31Johnson, Kast and Rosenzweig, op. cit., p. 83.
be considered an information-processing unit with input, processing, and output.\textsuperscript{32}

The statement above will probably bring to the reader's mind considerations regarding the relationship between information and communication. This important relationship has been purposely ignored thus far, and will continue to be for a short while longer. A section that soon follows presents a detailed discussion of the inter-relationship of information and communication.

The concepts considered thus far may be summarized as follows: organization structure may be considered as a system of hierarchically ordered decision-making points or centers, with each point representing an information-processing unit. The information processing unit, or decision-maker, can be an individual, a group or a non-human. Forrester emphasizes the latter unit in formulating a simulation model of the business firm, along with the concepts of levels (potential) and flows previously discussed. A sketch of some of Forrester's ideas concerning business simulation will be presented to relate the above concepts to each other and to point out the importance and influence of time upon the operations of

\textsuperscript{32}\textit{Ibid.}, p. 84.
an organization.\textsuperscript{33} The example is also intended to entrench more firmly an understanding of some concepts to be used in later analyses.

Forrester considers the business organization to be primarily an information-feedback system, where such a system exists "whenever the environment leads to a decision that results in action which affects the environment and thereby influences future decisions."\textsuperscript{34} Information-feedback systems may be either mechanical, biological, or social; however the business system (a social system) will be emphasized. All information-feedback systems owe their behavior to three characteristics—structure, delays, and amplification. These three characteristics concern organizational decision-making, information, and communication. Forrester elaborates upon these elements stating that

\[ \ldots \] the structure of a system tells how the parts are related to one another. Delays always exist in the availability of information, in making decisions based on the information, and in taking action on the decisions. Amplification usually exists throughout such systems, especially in the decision policies of our industrial and social systems. Amplification

\textsuperscript{33}The example presented is an adaptation of some of the concepts presented by Jay Forrester in his book \textit{Industrial Dynamics} (Cambridge, Mass.: The M.I.T. Press, 1961).

\textsuperscript{34}Forrester, \textit{op. cit.}, p. 14.
is manifested when an action is more forceful than might at first seem to be implied by the information inputs to the governing decisions. 35

Economic and industrial activities are closed-loop information-feedback systems. The recognition and emphasis of these system characteristics are essential because such systems exhibit behavior as a whole which is not evident from examination of the parts separately. The pattern of system interconnection, the amplification caused by decisions and policy, the delays in actions, and the distortion in information flows combine to determine stability and growth. The business organization is not a simple servo-mechanism where there is a single "error function" and a single control mechanism. Instead, economic systems have "distributed error functions" represented by the individual goals of many participating persons. The control system is likewise dispersed, so that it exists in part at each decision point in the system. 36

Forrester's conception of the business organization integrates the separate functional areas of management

35Forrester, op. cit., p. 15.

(marketing, investment, research, personnel, production and accounting) by reducing the functions to a common basis. This is accomplished by recognizing that any economic or corporate activity is concerned with the levels and flows of only five elements—money, orders, material, personnel, and capital equipment—integrated by an information network. Levels are the accumulations within the system—inventory, back balances, number of employees, and so forth. The flows are the present, instantaneous flows between levels in the system. The flows correspond to activity; the levels are measures of the result of activity. Flow rates are determined by the state of the levels according to rules defined by the decision function. These rules or decisions are made on the basis of information about the levels. Thus the integrating factor is the information network concerning the states of the levels as shown in Figure 11. Figure 11 may be visualized as a system of reservoirs connected by pipes containing valves. The levels determine the potential for flow, but the valves control the actual flow. Valve operation (decision-making) is a function of information concerning the levels to be affected by a given flow and possibly by information concerning other unaffected levels.

FIGURE 11

BASIC SYSTEM STRUCTURE
Thus any economic system or subsystem can be represented by six networks—orders, material, money, personnel, and capital equipment, all interconnected by information. Any one of the several networks may appear in several systems or subsystems. However, inflows and outflows connecting to a level must transport the same kinds of items stored in that particular level. The information network is therefore in a unique and superior position relative to the other five because information is conceptual and the others are physical, and the information network can thus extend from a level in any one of the six networks to a rate in the same or any other network. Information is the connecting tissue or common denominator of the system. This should be contrasted with the superior position usually given money in economic systems and analyses.37

Figures 12 and 13 illustrate the overall concepts presented above and the detailed mechanisms or building blocks. Very complex systems may be represented by interconnecting these basic building blocks. Figure 12 illustrates the point made above regarding the pervasiveness of information and the limitations inherent in the physical flows. In System A physical levels A1 and A2 must

37Forrester, op. cit., p. 70.

FIGURE 12

INFORMATION AND PHYSICAL LEVELS AND FLOWS

FIGURE 13

THE SOURCES OF INFORMATION AFFECTING A DECISION POINT
contain the same kinds of elements because there is flow between them. The flow from level A1 to level A2 is governed by information regarding both of these levels, plus information regarding level A3 (a different physical element) within System A, plus information concerning level B (a different physical element) outside System A. Note also that, although omitted from Figure 12 in order to simplify the diagram, there may be information levels within and without System A that may also provide a source of information affecting decision point A.

Figure 13 is concerned with the relationships of information levels and flows, omitting other relationships. Thus, information level A is composed of information regarding physical levels within and without System A and by information regarding information levels within and without System A. Note also that information may be supplied decision point A directly from information Level C. Detailed consideration will be given the information system in the next section.

The behavior of information-feedback systems depends upon three characteristics: structure, delays, and amplification. Information is the input to decisions and thus decisions are affected by influences that affect information flows. Information and the sources of information
distortion are considered in detail in a following section. Forrester recognizes the possibility and effect of information distortion, and demonstrates the interesting fact that forecasting, a form of information generation, causes system fluctuations—the very thing it is designed to alleviate. Thus, fluctuations are inherent characteristics of business systems since the decision-making process implicitly contains some type of forecasting.\(^{38}\)

Forrester feels that the relationships discussed above can be meaningfully expressed mathematically so as to simulate the actions of a business firm or of business subsystems and thus to provide management with a business laboratory where alternate organization structures, policies, and the like can be tested. Forrester also contends that the management laboratory, business simulation, is more feasible and practical than is generally recognized. He argues that the decision-making process is not the subtle and intuitive process many believe it is because the intuitive judgment of even the most skilled investigator is quite unreliable in anticipating the dynamic behavior of a simple information-feedback system of

\(^{38}\)Ibid., p. 338.
perhaps five or six variables. Simulation permits the correlation of many variables, numbering in the thousands when using a computer. He further states that most managers will fall back upon formal decision-making procedures when faced with decisions that they recognize as being beyond their intuitive judgment; and that these formal decision-making procedures, or policies, lend themselves quite readily to quantification. Forrester also maintains that

... the common belief that we cannot quantify a decision rule because we do not know it with high accuracy is mixing two quite separate considerations. We can quantify regardless of accuracy. After that we deal with the question of what is sufficient accuracy.\(^{39}\)

The latter problem is readily resolved by matching the effect of inaccuracy against the cost of increased accuracy. Forrester presents various means and methods of quantification and simulation as one means of fulfilling the need for further study of the relationships between parts of a business, and between business organizations and their markets, their industry, and the national economy. Simulation as an approach to the solution of business problems has both theoretical and

\(^{39}\text{Ibid.}, \text{p. 101.}\)
practical value. However, Dearden and McFarland point out that simulation of the firm, per se, is far from operational in the typical business. They feel that the payoff of simulation is more likely in solving problems with a reasonable degree of quantification. They see the simulation approach to business problems as limited because:

1. Many problems do not lend themselves to this approach, especially "people-oriented" problems.

2. Most problems can still be solved best by present manual methods.

3. Where speed of solution is required, complex formulations are frequently not possible.

Regardless of the limitations of simulation as a practical tool, the concepts necessary for viewing the business organization as a system capable of being simulated are invaluable to the purposes of this paper. These concepts place organizational information in the proper perspective, as an element essential to the survival of the firm.

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III. AN OVERVIEW OF INFORMATION IN THE ORGANIZATION

Early organization theories evidenced little concern for information per se, but recent attempts to formulate an integrated theory have shown concern for information internal and external to the organization. Viewing the organization as an adaptive process further stresses the organization's dependence upon information, especially information regarding the external environment. Forrester's systems view of organizations shows information to be the connecting tissue or common denominator of all economic systems. The obvious dependence of the organization upon knowledge and information requires that the management function of knowledge maintenance be explicitly recognized. The next portion of the study is devoted to a detailed investigation of the knowledge maintenance function and its subsystems.
CHAPTER IV

SUBSYSTEMS OF THE KNOWLEDGE MAINTENANCE FUNCTION

Man is confronted with a wide and varied environment. Its incidents are so numerous and heterogeneous that the mind of man is unable to comprehend them all at one time, or to hold them all in the mind simultaneously, for the purpose of making comparisons of them or judgments with respect to them. To reduce the diversity of his environment to manageable order, man resorts to classification and to the formation of general ideas about groups of things, that is, man simplifies to aid comprehension.

Events and things are ordered or classified according to properties they possess in common, and which are significant for some purpose. There are no natural classes. Classification is a purposive mental action made to economize future thought. Any element of experience can be classified in many ways according to the number of properties it is seen to possess and according
to the purpose to be served by the classification. Thus, the perception of the observer and the needs of the user are significant. The effect of every classification system is to emphasize abstraction, to concentrate the attention on the specific properties recognized by the classification system, and to disregard all other properties.

Where purely personal behavior is involved, no formal representation of reality is usually necessary. Personal choice is usually based on a direct personal evaluation or preference which is incontestable by any other party, and the grounds for such choice are often not communicable to other parties. Also, for his own information, one person may use one set of properties whereas another person may, in the same context of potential behavior, use another set of properties to distinguish satisfactorily between things (for example, men and animals) or to make appropriate decisions. However, in a social context in which some persons are required to make representations in respect to certain properties of a class of objects for the information of others—as in a business organization—some measurement and quantification system is necessary, as is a communication system. However, there is no way of equating or relating properties without
formalized rules. For any given purpose, therefore, it is necessary to stipulate specifically the property on the basis of which the classification is, or will be made. The properties specified will be dictated by the use which is expected to be made of the knowledge which the classification yields.¹

Business organizations cope with their environments through the performance of their principal assets—humans—in their roles as managers. These managers cope with economic reality through the performance of the various management functions. Every management function requires that the management process—the judicious combination of all organization resources to achieve organization goals—be applied to achieve the specific goal of the particular function, be it planning, organizing, or knowledge maintenance. The accomplishment of any organization goal is dependent upon the facilities of the human members and relies particularly heavily upon motivation, communication, creativity, and other people-oriented processes.

¹This discussion draws heavily from R. J. Chambers, "Measurement in Accounting," Journal of Accounting Research, III (Spring, 1965), pp. 34-35.
Management must show explicit concern for establishing and maintaining a system capable of providing the knowledge necessary for the accomplishment of organization goals. This facet of management was previously termed the knowledge maintenance function and is the organizational counterpart of man's individual endeavors to cope with his environment.

I. THE TOTAL KNOWLEDGE SYSTEM

The management function of knowledge maintenance is concerned with all of the knowledge necessary for the organization to achieve its goals. Thus, the function is concerned with all knowledge concerning organization resources, both human and non-human.

Organization structure was previously viewed as a hierarchically ordered system of decision-making points; and the management process was viewed as the judicious combination of organization resources to achieve organization goals. In this context the total knowledge system involves the knowledge concerning organization resources necessary for decision-making at all of the decision-making points in the organization's structure. The total knowledge system thus encompasses the levels and flows of knowledge regarding the organization's human and non-human
resources. The outflows from and the inflows to the levels of knowledge regarding these two types of organization resources are controlled by the management process.

The knowledge maintenance function is concerned with the "tailoring" of the knowledge and information requirements for each decision point. The application of the "tailoring" concept requires that the manager: (a) recognize the innate difference in the abilities of individuals to perceive, assimilate, and decide; (b) be aware of the information available, and the requirements of each decision point; and (c) match these factors in attempting to achieve optimum decisions at each decision point. The concept of a tailored total knowledge system is of course an ideal; and ideally the system would be adjusted to accommodate any change in organization structure, managerial assignments, or managerial capabilities.

Basically, the concept of tailoring a system involves a compromise between several factors which should dominate system design considerations. These factors are:

1. The absolute minimum amount of information needed to plan and control operations to the degree necessary for the firm to remain in business, given the firm's management, other resources, competition, and the state of the arts.

2. The maximum amount of information the firm's management is capable of comprehending and
effectively using, limited by the firm's resources and the state of the arts.

3. That amount of information theoretically possible, limited only by the state of the arts.²

Factor one establishes the conceptual "floor" for the system, while factor three sets the "ceiling" or ideal. Factor two represents the attainable goal or standard. Note that this ideal systems approach is as applicable to the single proprietorship as it is to the giant corporation. The approach specifies no specific equipment or methods. However, as will be seen later the approach does draw upon many disciplines oriented around information, communication, and measurement—such as mathematics, statistics, accounting and others, including the previously discussed areas of economic theory and organization theory.

For the sake of clarity, future reference to the knowledge level associated with the organization's human resources, that is, the innate abilities of organization members, will be referred to as "knowledge," while the organization's level of non-human knowledge will be referred to as "information." Thus, the total knowledge

system involves the control of two distinct types of organization knowledge levels or reservoirs and the matching of the flows from these reservoirs to decision-making points. Both of the levels (knowledge and information) are people oriented but "knowledge" refers to the mental competence or potential of organization members themselves, while "information" is knowledge generated by the organization. Both are necessary to organization decision-making, but knowledge is supplied by the decision-maker, the manager, while information is supplied to the decision-maker, to enable him to make a particular decision.

A simplified representation of the above concepts is presented in Figure 14. Decisions are shown to be a function of both information and knowledge. Inflows to the knowledge level depend primarily upon personnel admission and retention policies, and are controlled by admitting only members having special skills, minimum intelligence levels, or desired educational backgrounds. Outflows from the human level, knowledge, are primarily a function of motivation, both personal and organizational. Organizational motivation involves fostering an internal environment that will motivate members to perform their various functions creatively. Inflows to the information level are a function of the measurement process and the
Internal and External Environment

Data Measurement and Manipulation

The Management Process

Information Level

Communication

Decision Points

Motivation

Knowledge Level

Personnel Section

Decision

New State of Internal and External Environment

FIGURE 14

A SIMPLE REPRESENTATION OF THE KNOWLEDGE MAINTENANCE FUNCTION
manipulation of data, and outflows result from successful communication. The organization's information generating system, which is concerned with the level and flows of information, is discussed in detail later. The information generating system does involve people (knowledge), but expositorty separating information and people permits the information generating system to be emphasized as a process primarily concerned with the methods available for generating information—statistics, accounting, operations research, and others. However, in the final analysis a holistic view prevails.

A more complex representation of the knowledge maintenance function than that presented in Figure 14 is depicted in Figure 15 to convey visually some of the complexities involved. Figure 15 shows that each of the flow control valves have bypasses, indicating that management does not have absolute control over any of the flows. Inflows to knowledge levels include undesirable elements too, for the individual brings with him such things as prejudices and individual goals. Thus, there is some waste involved in knowledge outflows, for the individual seldom achieves his potential and often has individual goals that mitigate his efforts on the organization's behalf. The information level is affected similarly. Inflows are
FIGURE 15
A COMPLEX REPRESENTATION OF THE KNOWLEDGE MAINTENANCE FUNCTION
affected by the theoretical and practical stages of development of the tools of information generation—for example, mathematical theory, accounting theory, and measurement theory. Some inflows, such as informal information (the grapevine), can be contended with but not controlled. Waste occurs due to such things as misinformation because of the grapevine or a failure to communicate the potential information contained in the level. However, the organization need not be passive regarding these undesirable or ostensibly uncontrollable elements; the organization can affect both its internal and external environments. The availability of members with desirable backgrounds can be, and often is, influenced by the organization's impact on educational institutions through research grants, political influence and the like. The knowledge levels of organization members is often directly influenced by internal training programs, seminars, and similar devices. Information levels are influenced by improved technology and theory, developed either internally or externally, relating to such things as the informal information system or communications theory. The reader will certainly be able to add to this list of ways that the organization can influence these "imponderables." However, further pursual of the subject here
would serve no purpose. The point has been made that the interactions between the environment, the levels and flows of information and knowledge, and the organization are indeed complex.

The level and flows of organization knowledge will not be discussed formally any further, for these aspects of the total knowledge system are less germane to the study than are the levels and flows of information. However, indirect reference will often be made to the influence of knowledge upon particular topics. In any case, the human influence on all aspects of organization operation should be constantly borne in mind.

II. THE TOTAL INFORMATION SYSTEM

The total information system is that portion of the total knowledge system concerned with all of the information about people and things supplied to each decision point in the organization, and thus with the total information in the system or organization. The subsystems of the total knowledge system are shown in Figure 16. The total information system could also be called the total management information system since it is concerned with the total information supplied to management at each decision point, but the term "management information system"
FIGURE 16

SUBSYSTEMS OF THE TOTAL KNOWLEDGE SYSTEM
is used in a more restricted sense in this study. Total information is subdivided into the formal (or purposive) and informal (or unconscious) information systems. The informal information system is the organ of the informal organization—that is, of the organization members as people. The informal organization is the cohesive force that permits formal organizations to exist; and it is necessary for communication and for the protection of the integrity of the individual. The informal organization has no structure. It is amorphous and dynamic, for the same people are not always the liaison agents and the system is not always active. This system is important to the members of the organization and provides them with such things as informal status, group identity, and motivation. The informal organization is also important to management and the formal organization for it provides management with a means of disseminating information, facilitates communicating from the bottom of the managerial hierarchy up, and provides organization members with an emotional safety valve. Therefore, the formal organization should be aware of and use the informal information system. However, this study is primarily concerned with the formal or purposive information system. No further consideration is given to the informal aspects of
organizations, except as ancillary information necessary to a particular discussion.

III. THE MANAGEMENT INFORMATION SYSTEM

The management information system is that portion of the total knowledge system concerned with all the formal documentary information about people and things necessary at each decision point in the organization. Formal information includes information conveyed by other than written means, such as oral commands or gestures. However, the purposes of this study are served by limiting consideration to those systems more formally structured and thus more readily controllable—namely, the system of written (or documentary) information. Thus, the documentary information system will be referred to as the "management information system" or as the "total management information system" throughout the remainder of this thesis. The information generating process to be described shortly is concerned primarily with documentary or management information.

The documentary system consists of all formal information that is to be communicated in written form. The system uses alphabetic, arithmetic and alphanumeric symbols. Non-documentary information is necessary, used
extensively, and of great value, but it is not the "official" means of communicating in most business organizations, and for good reason. The value or usefulness of non-documentary information decreases as the number of persons through whom it must pass increases. This loss of usefulness is illustrated by the game in which a story is orally passed from one person to another, by whispering, with the last person in the sequence repeating the story aloud. The distortion that results always proves amusing to the players. Such distortions are not as amusing in the business world. Other significant disadvantages of non-documentary information are concerned with storage and communication. Non-documentary information must of necessity be stored mentally. Thus, loss of the information (forgetting) is more likely, as are the chances of a failure to communicate. Successful oral communication is also often more difficult to achieve.

Documentary information involves a slower and more costly process. However, the disadvantages of non-documentary information listed above are not encountered. The general superiority of documentary information is attested to by the heading found on the memo pads of numerous organizations, "WRITE IT! DON'T SAY IT!"
Quantified information is that portion of documentary information represented by numbers, but also accompanied by sufficient identification since a number, per se, has no significance. The word "quantified" as used in this study refers to numerical representations derived using either the ratio or interval scales of measurement. These measurement scales will be considered in detail shortly.

As previously mentioned, the management information generating system involves the measurement process, data manipulation and the communications process. The term "management information" has already been assigned a special and specific meaning for the purpose of this thesis. Information, measurement, communication, and other related terms must likewise be associated with specific meanings if the management information system is to be analyzed and classified as is intended. These elements are discussed briefly in the next several pages with regard to the possible and common connotations given them.

A. The Elements of the System

The words "measurement," "information," and "communication" are closely related and at times indistinguishable. This fact confounds a reader encountering
the words, and perhaps also the writer using the words. For example, Bevis describes accounting as a measurement and communication system. Such a definition must implicitly include the concept of information within either, or both, of the concepts of measurement or communication. Three distinct meanings will be ascribed to the word information here to serve to distinguish between the inflows, levels, and outflows relating to the total management information system.

1. The meanings of information. "Data" has been defined as a collection of isolated facts, and "information" as units of knowledge developed from the skillful management of data. However, the word "fact" implies too much accuracy for use here since many approximations and forecasts are necessary in organizational decision-making, and in addition, all measurement is relative. Accuracy depends on many things, including the perception of the measurer and the sensitivity of the measuring device. The accuracy of data or information can only be expressed statistically as a probable range of values. Thus, the word "event" will prove more useful than "fact."

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An "event" is an environmental condition or happening that is to be taken into consideration. Data are representations of events.\(^5\)

Gregory and Van Horn distinguish between the meaning of "information" at three levels: the syntactic, the semantic, and the pragmatic. They state:

Considered at the \textit{syntactic} level, data consists of collections of symbols or characters arranged in some orderly way to serve as the vehicle for information. Information is the meaning derived from data and represents the \textit{semantic} level—the relationship between a symbol and the actual object or condition that is symbolized. The impact of the objects or conditions on the receiver represents the \textit{pragmatic} level of information.\(^6\)

In this thesis "data" is used to refer to perceived and symbolized events (syntactic information); "potential information" refers to meaning derived from data (semantic information); and "information" refers to the impact upon the receiver (pragmatic information).


2. Measurement and communication. Paul Kircher has divided the measurement process of business into the following elements: 7

(1) determination of the objective of the business entity,

(2) determination of the types of factors which might serve to attain the objective,

(3) selection of the key aspects of the factors—the aspects which are to be measured,

(4) choice of: (a) a measuring method, or (b) a measuring unit,

(5) application of the measuring unit to the object to be measured—the central action of measurement,

(6) analysis of measurement—relating it to other measurements (other in time or in kind),

(7) evaluating the effectiveness of the measurement by determining the extent to which it assisted in the attainment of the objective.

This description of the measurement process almost exactly parallels the former description of the management or decision-making process. The word "measurement" is assigned a more restricted meaning here, more in line with element 5 of Kircher's concepts above, but the details of the assignment will be deferred momentarily.

7James W. Giese, Classification of Economic Data in Accounting, A Dissertation, University of Illinois, 1962, p. 54.
The same aura of confusion surrounds "communication."

One author states that

The relationship between the communications system and decision-making is extremely important. If decision-making and communication processes are not identical, they are so interdependent they become inseparable in practice. As a result all studies of communication inevitably involve decision-making.®

The Dictionary of Philosophy defines communication as

A term used to refer to a certain feature of sign situations, viz., the identity, similarity, or correspondence of what is understood by the interpreter with what is or is intended to be expressed by the speaker.®

The problems of communication have been listed by Warren Weaver as: 10

1. The technical problem—How accurately can the symbols of communication be transmitted?

2. The semantic problem—How precisely do the transmitted symbols convey the desired meaning?

3. The effectiveness problem—How effectively does the received meaning affect conduct in the desired way?

Warren's analysis of the problems of communication is


®Giese, op. cit., p. 57.

10Ibid., p. 59.
comparable to that applied to the meanings of information by Gregory and Van Horn. This correspondence tends to highlight the previously mentioned fact that information, measurement, and communication are overlapping concepts which, as pointed out above, infringes also upon the concept of decision-making.

3. A holistic view of the total system. The above description of the diverse definitions and methods of viewing the same or similar phenomena is not intended to be critical, but to point out merely that different aspects of the same phenomenon or system are emphasized in different contexts in order to make specific points. This study emphasizes "information" and the information generating process. This emphasis is condoned by Drucker who has stated that

... the manager has a specific tool: information. He does not "handle" people; he motivates, guides and organizes people to do their own work. His tool--his only tool--to do all this is the spoken or written word or the language of numbers.11

The elements of the total management information system are diagramatically presented in Figure 17. The

FIGURE 17

THE ELEMENTS OF THE TOTAL INFORMATION SYSTEM
elements shown in Figure 17 are relative to a single decision point; the total system is the sum of all such systems for all decision points in the organization. The representation is in accord with Norbert Wiener's general theory that "any organism is held together by the possession of means for the acquisition, use, retention, and transmission of information."\textsuperscript{12} Figure 17 is also in accord with Churchman's more specific statement that An organization should have the ability to make observations; transform the observations into communicable data, store the data, and reflect upon or examine the contexts of the stored information for the purpose of solving new problems. Reflection upon and examination of the stored information should include the ability to select and recombine segments of past actions relevant to current problems.\textsuperscript{13}

The total system illustrated in Figure 17 involves seven activities:

1. Specification of the information necessary for a given decision,
2. Selection of the events to be observed to produce this information,
3. Observation of the selected events,
4. Measurement of some aspect of the events,
5. Symbolization of the measurements,

\textsuperscript{12}Ibid., p. 28.

\textsuperscript{13}Giese, \textit{op. cit.}, p. 121.
6. Manipulation of symbolized events (data),
7. Communication of the desired information.

Data and potential information are storable intermediary results. The representation presented is only one of many possible ways of dividing the total system into its more elemental parts, and the classifications do overlap. This rather elaborate breakdown of the total system is presented only to make the reader aware of some of the many activities in the system. A simplified and more practical version of the same system follows in the next section, along with a more detailed discussion of the requisite parts.

This discussion again emphasizes the importance of the systems concept, the interaction of systems, and the importance of a holistic view. Reference again to Figure 17 will indicate that the diagram presented is in fact just an expanded model of the business organization as an adaptive process. Reflection upon this fact will reveal that the analysis of any system into smaller and smaller subsystems will finally result in definitions that overlap, and that beyond a given point the distinction between subsystems is impossible. It should also be obvious that the smaller subsystems may be regrouped or combined into larger subsystems in different manners, and
the various possible recombination possibilities will emphasize different aspects of the larger total system. This technique is used to advantage in the next section in stressing those aspects of the total management information system relevant to the goals of this thesis.

B. The Information Generating System

Figure 18 provides a somewhat simplified version of Figure 17. This simplification serves as a vehicle for describing the elements felt to be pertinent to the goals of this paper in such a manner as to make them easily definable.

1. Specification of information needs. This element (specification of needs) of the system re-emphasizes the "tailoring" concept previously discussed. The "tailoring" concept is relevant to all knowledge subsystems. The specification of needs is necessary since information has meaning only when associated with the decision to be made. This element also implicitly includes the specification of the events to be observed and the time and place of observation.

2. Measurement. As used here measurement includes the observation and symbolization of the pertinent aspects of the above-specified events in one of the four possible measurement scales: nominal, ordinal, interval, and
FIGURE 18

THE TOTAL INFORMATION SYSTEM
ratio. The nominal scale refers essentially to classification; whereas the ordinal scale requires that things or classes of things be ranked minimally as either "less than" or "greater than," but may include the assignment of numbers or symbols as a means of ranking multiple objects or classes. The objects ranked must be comparable in terms of some relationship. The interval scale not only ranks objects or classes but also contains information on how large the interval is numerically. The rules of the real number system are applicable to an interval measure, but not all arithmetic operations can be applied because the interval scale has an arbitrary zero and thus many different scales can be applied to measure the same phenomenon. For example, temperature can be measured in either degrees centigrade or degrees Fahrenheit. The ratio scale is an interval scale whose origin is absolute zero. All arithmetic operations are applicable to measurements derived using a ratio scale. Note should be made of the fact that measurement, and thus data, is concerned only with the past, since an event must have occurred before it can be measured.

\[\text{^14} \text{ Ibid., pp. 43-51 for a detailed discussion of measurement scales.}\]
3. **Data manipulation.** Management is concerned with the past, the present, and the future. Since data is past oriented, manipulation is necessary to convert data into potential information relevant to the present and the future. In a sense, data may also be potential information, requiring only that it be communicated to management. Johnson, Kast, and Rosenzweig have stated that

The information-decision system must be designed to garner pertinent facts and screen unwanted or unusable data. Screened data may become information for managerial decision-making. However, it is more likely that additional processing is necessary before meaningful information is available.\(^\text{15}\)

Time is an essential, but relative, consideration in developing and presenting information. Therefore, manipulation is also concerned with the timeliness of data determination and presentation and thus its conversion into potential information concerning the present (as well as the past and the future). Manipulation is definitely necessary for converting data to potential information concerning decisions affecting the future. As previously discussed with regard to adaptive processes, all decisions concern the future and are based on past experience, but in the business organization records of past experience

\(^{15}\text{Johnson, Kast, and Rosenzweig, op. cit., p. 181.}\)
(data) usually require manipulation to expose significant relationships that will reduce uncertainty. These manipulations take such forms as the determination and extrapolation of trends, correlation analysis of organization data with economic indicators, or simulations. Thus, in the final analysis all business decisions are future oriented and require information with a similar bent, which in turn necessitates data manipulation.

4. Data and potential information storage. In this day of absentee ownership and the large organization, the decision-maker does not usually gather all of the information necessary for the decisions he makes. Potential information is generated throughout the organization which requires that some form of intermediary storage be used. Data covering long periods of time are necessary for some manipulations and decisions. Hence, data must be stored until needed. Data storage is also necessary where specialization within the information generating process is used. It should be observed that data refers to measures of events concerning the organization's internal and external environments, while "potential information" and "information" are internally oriented concepts. Data and potential information storage may involve such things as
written documents, punched cards, or magnetic tapes and a concomitant concern with the method and speed of retrieval.

5. Communication. Reference was previously made to the fact that communications problems could be considered from three different levels—the technical, the semantic, and the effectiveness levels. Only the effectiveness level will be considered here. "Effectiveness" implies a relationship to purpose. The effectiveness of a communication refers then to the changes it causes in the pursuit of a purpose. The effectiveness of a communication is determined by comparing the purposeful states of the decision-maker before and after receipt of the communication. The communication is considered to have been effective if it changes a purposeful state in one of three possible ways:¹⁶

1. Informs—changes the probabilities of a choice
2. Instructs—changes the efficiencies of a course of action
3. Motivates—changes the values of the outcomes.

Effective communication of documentary information may result from proper sequencing, spacing, coloring, or things of like nature that affect or result in the reduction of uncertainty in the decision-maker. Thus,

¹⁶Giese, op. cit., p. 62.
potential information must be effectively communicated and have news content pertinent to a given decision to be considered information.

C. A "Systems" View of Management Information

As previously pointed out, all of the elements of the management information system are people-oriented, but then so are all other management processes or functions. All management functions were previously described as involving motivation, creativity, communications, and "others." The unique activity or element of the management information system is data manipulation, that is, potential information generation.

Any system representation should attempt to stress its uniqueness. A "systems" view of the management information system is presented in Figure 19B which stresses the "information generating" aspects of the system. In turn, "information generation" stresses the present and future since the manipulation of data (representations of the past) is usually necessary in producing potential information capable of reducing uncertainty concerning decisions regarding the present and future. Figure 19A is an intermediary step in the compression of the representation of the system as depicted in Figure 18 to the
A. In Intermediary View

B. A "Systems" View

FIGURE 19

MANAGEMENT INFORMATION GENERATING SYSTEMS
"systems" view of Figure 19B. The presentation of the intermediary step indicates that the information generating system includes measurement, data manipulation and communication.

As previously indicated, the concept includes the gathering of data and the timing of presentations. The system processor of Figure 19A is viewed as an information generator, while measurement and communication, along with such things as mathematics and statistics, are viewed as the tools of the information generating system. These tools or concepts are included in the category of "controls" as are such other things as the specification of information needs. Other concepts or components, such as data and information storage, are a part of the processor.

The systems view of management information permits the concept of potential information to be considered internal to the system. Thus, the concept will no longer be referred to except under special circumstances, but the concept is important and should not be forgotten. Feedback involves a measure of how well the generated information represents events, and the usefulness of these representations in decision-making. The humans necessary to operate the process are incorporated as filters in the
system. Thus, the controls—mathematical techniques, measurement theory, available information needs, and others—determine the technically achievable amount, type, and quality of information generated. The system filters limit actual performance to something less than that theoretically achievable. This "systems" model is applicable to all management information systems, but is especially pertinent to documentary systems, especially the quantified system.

IV. AN OVERVIEW OF BUSINESS INFORMATION SYSTEMS

The knowledge maintenance function is concerned with matching the knowledge and information requirements of all decision points within the organization. "Knowledge" is supplied by the decision-maker responsible for a given decision. "Information" is the knowledge regarding the organization's resources supplied to the decision-maker. This total information system is subdivided into the formal information system and the informal information system, and the formal information system is further subdivided into the documentary and non-documentary information systems. The documentary system is defined as the total management information system. The unique activity
of the management information system is data manipulation—the process which converts data into information relevant to the present and future. A "systems" view of the management information system stresses the information generating aspects of the system. The management information system involves activities other than data manipulation—for example, measurement and communication—but the "systems" view of the process allows these elements to be classified as system control inputs or "tools."

Thus, the essence of the management information system is information generation. The section that follows is devoted to an investigation of the nature of management information and to devising a means of classifying management information.
The primary purpose of a management information system is to expose significant relationships that will decrease uncertainty in organizational decision-making with a corresponding increase in the utilization of organization resources. Those concerned with achieving this goal need some criteria for guiding their efforts. The necessary considerations are concerned with a knowledge of the types and qualities of information needed throughout the organization, for the fate of the business is determined by the information supplied the decision-maker. In addition, the management information system must provide information to "outsiders" in order to meet certain requirements imposed by the organization's external environment as a requisite for continued existence, the most elementary organizational goal.

The sections that follow consider the nature and requirements of management information, the users of
management information and their needs, and the types and sources of management information.

I. THE NATURE OF MANAGEMENT INFORMATION

Mention was made previously of the fact that time delays and amplifications distort information and are thus causes of system fluctuations. In addition, Forrester points out that forecasting, an implicit component of all decision making, also causes system fluctuations—the very thing it is intended to alleviate. Information is also distorted in other ways. Modification results from averaging procedures and from summarizing. Information is interpreted differently by different people and organizations. Prejudices, past history, integrity, hope, and the internal political environment of organizations all bias information flows.¹

A prior section emphasized that useful information results only when its source is clearly understood and well defined, and when its nature and the use for which it is intended is known. Quantification was held out as another means of increasing the usefulness of information,

but one must bear in mind that "Cold, hard numbers have the unusual characteristic of creating an illusion of rightness. Under this influence people are easily lured into uncritical thinking." The section that follows attempts to give the reader some insights into the elements to be considered in judging information (that is its nature); and some idea of the types of information required by the business organization in pursuing its goals. Such knowledge should facilitate both the generation and use of business information.

A. Attributes of Information

The management information system is, in general, concerned with all documentary information pertinent to the achievement of organization goals. The representations of an event require two basic types of information, quantitative and descriptive. Quantitative information tells how much or how many, but the majority of the information will be descriptive and will serve to identify that which has been quantified. Business

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information specifically requires information regarding the five basic flows of economic systems—money, orders, materials, personnel, and capital equipment—in a time, or dynamic, context. Time is explicitly mentioned in spite of the fact that the word "flow" implicitly includes the concept of time. McDonough emphasizes the dynamic aspects of information systems in stating that

... there are no instantaneous business systems. The business system is almost meaningless when pictured as a moment in time. If we think of a system as a logical configuration, it implies a logical sequence of steps, and for these logical sequence of steps there are time intervals as inherent intervals in the system. These time intervals may be quite different for various problems in the same business.  

A partial list of desirable business information attributes are: relevance, availability, timeliness, objectivity, sensitivity, comparability, conciseness, completeness, quantifiability, and quality. The meanings of most of these attributes are self-evident even though there may be some overlap in meanings. Information must possess the first three attributes—relevance, availability, and timeliness—to have value, and thus to qualify as information. Objectivity, sensitivity, comparability,

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conciseness, and completeness are desirable, but they are present and necessary only in varying degrees in documentary information. These latter attributes of information are favorably influenced when the information is derived using higher levels of measurement scales, progressing up from the nominal to the ratio. That is to say, quantifiability is desirable. The last attribute, quality, refers to the presence or absence of ambiguities in information. All information should possess "quality." Measures of quality are validity, accuracy, and precision. These measures of quality are especially important and applicable to quantified information.  

Quantified information does create the illusion of rightness, but numbers are not sacred and are subject to ambiguities. Numbers are said to be valid if they measure what they purport to measure. For example, attendance figures for a city museum indicated great public interest and resulted in a planned expansion. Prior to the materialization of these plans the following year attendance mysteriously dropped off by more than 100,000. Why? A comfort station was erected nearby that year. The

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5The discussions regarding the measures of quality are adapted from Springer, Herlihy and Briggs, op. cit., pp. 28-29.
figures upon which expansion plans were based were not a valid measure of the number of people attending the museum for cultural reasons.

Accuracy is a measure of the difference between the numbers presented and the actual or true value. Numbers need not be perfectly accurate to qualify as information, but information with a known accuracy—say sales of $100,000 plus or minus $100—is of more value than information with an unknown accuracy—such as sales of about $200,000. Perfect accuracy is of course impossible to achieve. Increased accuracy usually increases the cost of deriving information. In some cases increased or too much accuracy may decrease the value of information, as in presenting large values with accuracies to ten or more significant figures.

Precision is a measure of the repeatability of data or information. That is, would the same data result if measured on separate occasions or by different people? If the results would be the same, or very close, the results are considered precise. Information may be precise, but inaccurate—for example in carefully weighing an item on a scale which consistently indicates five pounds heavy. Precision can generally be improved by exercising more care in data collection or measurement.
B. Amount of Information

Classification was previously contended to be a necessary device for coping with reality. Business information systems also resort to this device. Classification serves to:  

1. Reduce the complexity of the material  
2. Provide a means of identification  
3. Provide a record of experience  
4. Order and relate classes of events

However, classification creates a paradox, for it at once creates and destroys information. The number of classifications regarding a particular event (that is its information potential) are infinite, while classification systems are finite. Thus, classified data loses all of the information potential it had other than the potential possessed by the category into which it is placed. To achieve its total potential (perfect information) an event would have to be classified into an infinite number of categories, which is not to classify at all. Thus, only a finite amount of information is available in a

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given system; or conversely, a certain amount of information is not available.

This situation is analogous to that of energy in the physical world. The second law of thermodynamics states that in an isolated system the probability that entropy shall decrease is zero (where entropy is the positive measure of disorder). The physical concept of entropy is expressed as follows:

Entropy is an intrinsic property of matter so defined that an increase in the unavailability of the total energy of a system is quantitatively expressed by a corresponding increase in its entropy. . . . On this basis entropy may be looked upon as a measure of the unavailability of the energy of a system of given energy content.7

In addition, the conversion of energy from one form to another in a given system is accompanied by an increase in entropy.

The application of these concepts to business information systems makes more obvious some intuitive facts:

1. Information is a function of order.

2. Order, and thus information will not spontaneously increase in an isolated system.

3. The amount of information available in a system is finite; the measure of the unavailable information is a measure of disorder, entropy.

4. Conversion of information from one form to another (communication) results in an increase in entropy (a decrease in available information)

Item 4 above reveals that any conversion of information from one form to another results in a loss of information. Thus, the most information is available to a user who generates it himself. When the functions of decision-making and information generation are separated, less than the maximum amount of information possible is available to the decision-maker. Information theory confirms this in indicating that any communication provides an opportunity for a loss of information in much the same way that static decreases the information received by a person listening to a radio. Thus, the number of levels through which information must pass should be minimized.

One method of minimizing information loss through communication is to maintain a certain level of redundancy in messages. However, redundancy is related to efficiency of coding or classification by the relationship:

\[ \text{Redundancy} = 1 - \text{efficiency} \]

This relationship reveals that a highly efficient code or message is accompanied by a low redundancy which in turn increases the possibility of loss of information. Redundancy is most desirable when:
1. Processing data from noisy sensors or sources.

2. The system is stressed by an overload of input data.

3. One of the sensors is inappropriately adjusted and so produces erroneous data.

4. Speed demands on the system exceed its capacity to handle data.\(^8\)

"Sensors" refers to a measuring device or the information generating system as a whole. Several other devices for minimizing information losses were mentioned previously.

The discussion above was concerned with the amount of information possible and the basic means of coping with reality. The amount, or quantity, of information to be provided each decision-maker was previously indicated to be a function of the state of arts and the individual decision-maker as determined by the application of the "tailoring" concept.

The amount of information supplied is also a function of the relative position of the manager in the managerial hierarchy and the environment with which the information is concerned—later subdivided into the internal environment of the organization and the environment in which the

organization exists, its external environment. It is a well known generalization that internal information should be more and more summarized as the level of management for which the information is prepared increases in the hierarchical structure, with top management receiving the most summarized reports. This contention is based upon the fact that most internal data is control oriented and the lower echelons of management are the most control oriented; while top management is more planning oriented. This situation is demonstrated in Figure 20A where management activity is viewed as being either planning or control oriented. Figure 20A is to be interpreted broadly and is not intended to portray accurately the actual percentage of times spent by the various levels of management in either planning or control. However, the representation is roughly correct according to an estimate by Terry.9

In view of the above, it seems just as plausible to generalize that information concerning the external environment of the organization should be summarized in a manner exactly opposite to that posited for information concerning the internal environment. This is to say that

A. Relation of Managerial Position Time Spent In Planning and Control.

B. Relation of Managerial Position to Summarization of Information.

FIGURE 20

MANAGEMENT LEVELS RELATED TO PLANNING, CONTROL, AND INFORMATION
since the upper levels of management are more planning oriented and since planning necessitates more information concerning the organization's external environment, information concerning the external environment should be increasingly more summarized and selective as the position of the receiver decreases in the managerial hierarchy. This situation is depicted in Figure 20B.

C. Value of Information

There are various approaches to the problem concerning the value of information. Ackoff states that the information collection problem involves the minimization of the sum of two costs: the cost attributable to decision error and the cost of assembling and analyzing the required information. An information system is restricted by economic limitations to the accumulation of useful information only, and the measurement of usefulness depends upon the ability to relate the cost of gathering information to the benefits received.\footnote{Giese, op. cit., p. 256.}

Ackoff's approach is ideally correct, but the determination of the requisite costs necessary in applying his approach is in many cases impossible. Many authorities
have termed this type of approach impractical and so general as to be useless. More rigorous approaches based upon this philosophy have recently been formulated, but they will not be discussed here.\textsuperscript{11}

A pragmatic approach is taken by Kirk who states that a value can be assigned information by simply asking, "How much does this piece of information reduce my uncertainty in this decision situation?"\textsuperscript{12} Adopting a pragmatic approach, information is seen to acquire significance (that is its value is increased) only when it is used in conjunction with or judged by comparison with:\textsuperscript{13}

1. Other current measures
2. The same measurements in previous periods
3. Standards or targets
4. Forecasts
5. Parallel activities elsewhere

The value of information is also increased when the user has confidence in the information. Confidence is


\textsuperscript{12}Kirk, op. cit., (England), (April, 1963), p. 63.

increased if the user generates the information himself. When the user and the generator of information are not the same person, confidence, and thus value, is increased by a knowledge of the method of generation and of the generator. Confidence in the person or group generating the information can be attained by either a personal acquaintance with or power over a person; or through some sort of confirmation of or attestation regarding the reliability of the generator. Confidence in the information itself will be increased when the information and the method of generation are standardized, providing the user has knowledge of the standards and their meanings and limitations. Useful standards will involve criteria regarding the previously mentioned attributes of information in addition to the factors outlined above.

II. THE USERS OF MANAGEMENT INFORMATION

The literature concerning management information systems indicates that confusion exists regarding the relationships between the internal and external environments of the organization and the users, uses, and sources of business information. Management information systems are the sole generators of business information, but management is not the only user of the information generated.
Relating the above items to the inputs and outputs of the information generating system, as depicted in Figure 19, should dispel some of this confusion.

The output from the information generating system may be dichotomized into the information required of the organization and the information required by the organization; or stated differently, system outputs are concerned with fulfilling the external requirements and the internal needs necessary for the organization to exist and strive toward goal achievement. The uses of information are a function of the requirements of the users, internal and external, that is, information is user oriented.

The inputs, or sources of information, to the information generating system involve not only the internal and external environments of the organization, but also the interactions between the two. The mix of inputs will vary with the user (internal or external) and the specific use intended for the information. The section that follows is system output oriented. It deals with users and user needs. The sources of information, inputs to the system, are dealt with in a later section.
A. Users in the External Environment

1. Government agencies. The bulk of the business done in this country is transacted by corporations. The corporate device is granted to an organization by the public to further the public good. In return, the organization is required to meet certain requirements. These requirements include the provision of certain information regarding the payment of federal, state, and local taxes (for example income, unemployment, and social security taxes). Unincorporated business organizations are also required to pay and provide information concerning certain of these taxes.

2. Stockholders. The advent of the corporate device resulted in a separation of business management from business owners, the stockholders. Under the entity concept, these stockholders are theoretically, as well as actually, "outsiders." Thus, the professional managers are required to provide the stockholders with information concerning the activities and success of the business.

3. The public. This aspect of information requirements overlaps the above considerations in some areas, but is of sufficient importance to warrant separate consideration. Information pertinent to the general welfare may be required of the business organization. For example,
potential stockholders must be informed of organization activities through the stock market, and information regarding the preservation of natural resources or air pollution may be required of the organization.

4. Uses of information by external users. The multiple and heterogeneous needs of stockholders are usually met with general, all-purpose accounting statements which are oriented toward the reporting on the stewardship of assets. Other general users, such as labor unions, must be satisfied with the published accounting statements, regardless of their needs. Only the governmental agencies have thus far gained the power to require information for specific uses. These specific uses generally relate to regulatory and taxing matters.

B. Users in the Internal Environment

Managers are, of course, the users in the internal environment. Management must have information to insure that the business organization achieves its goals. Management's uses of business information are broadly concerned with planning and control relative to the utilization of organization resources. They are related to both recurring and special uses or needs. These topics are elaborated upon in the two sections that follow.
III. SOURCES OF BUSINESS INFORMATION

As previously mentioned, the inputs to the information generating process are concerned with both the internal and external environments of the organization, and the interaction of the organization with the external environment. To avoid confusing inputs (sources) to the information generating system and outputs (user oriented) from the system, and as an expository aid, inputs to the information generating system are deemed to be either intrinsic or extrinsic. "Intrinsic" is used in the sense of "belonging to the constitution, nature or essence of a thing." That is, intrinsic events are the inputs concerning the internal environment of the organization and intrinsic information is the output. "Extrinsic" means "pertaining to, or derived from, things outside." Extrinsic events are the inputs to the information generating system regarding the external environment and the interactions of the organization with its external environment. Extrinsic information is information generated from extrinsic inputs. Management information users may desire or use either or both intrinsic or extrinsic information. A system of classification of management information is presented in Figure 21.
FIGURE 21

MANAGEMENT INFORMATION CLASSIFIED
A. Extrinsic Information

Extrinsic information is of two general types—information concerning the general external environment (management intelligence) and information regarding organizational interaction with the external environment. Management's organizational goal-seeking efforts center on the planning and control of the use of organization assets, but only planning requires information concerning the external environment. Planning involves the formulation of organization goals and requires the correlation of both intrinsic and extrinsic information. Management must have specific extrinsic information for any given decision, and in addition must be apprised of the general social, political, and economic climate in which the business is operating or may operate in the future. Extrinsic information is especially important to strategic or long-range planning, but it is also necessary for short-term or operational planning.

For example, product price levels (latent interaction information) are required for the basic decision of whether or not to produce at all, a short-term decision. Short-run planning information may be characterized as being value oriented, while strategic information is more concerned with trends and projections. Intelligence
information may be classified as either competitive or general. Competitive information deserves special recognition because it is the prime determinant of corporate profits, and in fact survival, and because competition is an extrinsic factor common to most business organizations.

Referring again to Figure 21, management information is seen to be initially divided into recurring or special information. This dichotomy refers to the type of need that the information is to fulfill. Although further elaboration regarding special information is not depicted, the same classifications shown for recurring information are applicable.

The lowest level categories of extrinsic information could be further subdivided into financial or non-financial information, or possibly into quantitative financial, quantitative non-financial, or non-quantitative information as is done with intrinsic information. Further subdivision is not necessary to convey the intended meaning of the classification system and is therefore not undertaken diagramatically. However, reference is made in the text of the paper to these more basic attributes of some subdivisions of extrinsic information.

1. **Management intelligence.** Management intelligence involves seeking out, collecting, evaluating, and
reporting information concerning the external environment which directly or indirectly affects the organization. The use of the word "indirect" should not lead the reader to believe that this type of information is also unimportant—indeed, it is often critical.

a) Competitive information. Information concerning the past actions, present activity, and future plans of competitors can have great impact upon planning. Such information could, for example, lead to accelerated research programs, a switch of product test areas, or a change in advertising policies. A recent survey indicated that competitor pricing information is considered by management to be the most desirable type of competitive intelligence. Other information desired, in order of importance, concerned: promotional strategy, research and development, sales statistics, manufacturing processes, cost data, expansion plans, competitive bids, product styling, financing, patents and infringements, and executive compensation.14

The most frequently used sources of information, in order of importance, are company salesmen, published

sources, contact with competitors, and company suppliers. Industrial espionage (undercover agents, wire tapping, and the like) does occur but is not prevalent. Few companies have formal "intelligence" departments but formalized information collection procedures and special project efforts are employed by many organizations.15

b) General intelligence information. Other intelligence requirements common to most businesses relate to management's need for a knowledge of the general social, political, and economic climate in which the business is operating or will be operating. Indicators of the general climate would include community standing, economic indicators (GNP, inventory levels, price levels), labor availability, or population growth trends and population age or geographic distribution.

In addition to these common organization intelligence needs, there are other facets of intelligence information worthy of mention but whose importance may vary from industry to industry, from business to business, and with other factors, such as the size of the firm. Examples would include an awareness of the general financial climate and developments of technical knowledge relevant to the firm's operations.

15 Ibid., p. 8.
The availability and cost of funds are important for expansion or innovation where borrowing or new stock issues are necessary, or in considering the timing and advisability of refinancing bond issues. Other factors often relevant include stock prices, margin requirements, or commodity prices.

Innovation and product development are often necessary for short-run survival as well as for long-term growth. For example, new product development is a major factor in the food processing industry, while innovation in creating new types of policies spells the difference between success and failure in the life insurance industry; and scientific competence is especially important to the electronic and aviation industries. Extrinsic technical information is necessary for innovation. Employees must remain abreast of current technical developments. Technical information thus includes such things as theory (physics, chemistry, communications, and accounting theory) and information necessary for the performance of the various management functions, and for use in updating organizational knowledge levels.

The sources of non-competitive extrinsic information are numerous. Specific sources are government reports, technical meetings, and trade publications.

2. **Interaction information.** Interaction information relates to organizational planning or decision-making that requires actual interaction or the consideration of specific potential interaction.

   a) **Latent interaction.** Latent interaction exists when the evaluation of alternatives requires the consideration of specific extrinsic factors as a part of the basis for choice. The use or consideration of this type of information gives rise to potential actual interactions and may indeed result in a consummated interaction. However, since a choice is involved, some latent interactions will never be consummated. Examples of latent interaction information would be the factors, such as opportunity costs and imputed costs, relevant to decisions regarding such things as product mix, asset purchases, or make-or-buy decisions, and would include information regarding both the product and resource markets.

   b) **Consummated interaction.** Information concerning actual or consummated interaction is especially important for it concerns the results of managerial action. Consummated interaction information concerns such things as
dollar and unit sales of product, additions to personnel, the receipt of orders, and the purchase of materials.

B. Intrinsic Information

Intrinsic information deals with the organization, per se; it is strictly internal in nature. Intrinsic information is necessary for day-to-day operations, but is also concerned with the identification and reporting of a company's own strengths and weaknesses. Intrinsic information is involved in such activities as tracing the flow of materials and costs through the organization, personnel evaluation, research and development, or production authorization. It is useful to think of intrinsic information as being of three types—quantitative financial, quantitative non-financial, and non-quantitative. However, these categories are related; for example, the difference between some financial and non-financial quantitative information may merely involve multiplication by a unit price factor. In addition, the distinction between intrinsic information and extrinsic information is often hazy at best. For example, the purchase of a piece of machinery involves interaction information; while the cost of

17 This section is partially based upon adaptations of articles by John A. Murphy, "Dynamic Management Reporting," The Federal Accountant, X (June, 1961), and Daniel op. cit.
operating the machinery is both intrinsic and extrinsic information. In spite of this difficulty, the concepts presented provide a useful basis for the classification and analysis of management information. Some of the potentially more troublesome areas will be clarified when planning and control are related to intrinsic and extrinsic information in a following section.

1. **Quantitative financial.** Quantitative, financial, intrinsic information deals primarily with the matching of costs to activities and the determination of the costs of producing. That is, it is operational in nature. Cost behavior relative to volume changes, changes in product mix, or machine assignment are important examples of intrinsic information.

2. **Quantitative non-financial.** Quantitative non-financial information is also operational in nature. It includes information regarding the efficiency of resource uses in all facets of operations—e.g., as for example in product specifications and quality control.

3. **Non-quantitative.** Non-quantitative information will often be the most important determinant of the long run success of the business. Non-quantitative information is the most difficult to deal with, the least precise, and the most difficult to communicate. Non-quantitative
information deals with the imponderables that management must weigh in mitigating the apparent preciseness of the available quantitative information.

Non-quantitative information is descriptive in nature and concerns such things as the organization's pool of talent or innovation relevant to new and better products through research and development. Management also uses non-quantitative information in evaluating personnel qualifications, determining job requirements, and matching one with the other.

IV. USES OF BUSINESS INFORMATION

Throughout this study emphasis has been placed upon matching information with the needs of the user. This section attempts to match the generalized needs of users with the sources or types of management necessary to meet those needs.

A. External Users

The external users of business information are primarily concerned with consummated interaction information as is shown in Table 2. However, as Table 2 indicates, some concern is given to general extrinsic information (the + or 0 in Table 2 indicates relative concern with the various areas of information for a particular user's needs
<table>
<thead>
<tr>
<th><strong>SOURCES OF RECURRING INFORMATION</strong></th>
<th><strong>MANAGEMENT NEEDS</strong></th>
<th><strong>EXTERNAL NEEDS</strong></th>
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<tbody>
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<td><strong>Strategic Planning</strong></td>
<td><strong>Short-Run Planning</strong></td>
<td><strong>Control</strong></td>
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<td><strong>Extrinsic</strong></td>
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<td>Management Intelligence</td>
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<td>General</td>
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<tr>
<td>Quantitative Non-Financial</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Non-Quantitative</td>
<td>+</td>
<td>0</td>
</tr>
</tbody>
</table>

Relative concern of the various types of information within a column:

0 = concern with
+
more concern with
within a single vertical column—there is no horizontal correspondence.) The concern with general extrinsic information is very small in comparison with consummated interaction information, but some indication of concern is necessary—for example, the accounting financial statements presented to external users may show inventories valued at the lower of cost or market, or prices may be indicated parenthetically for some assets.

Within the above indicated areas of concern—general and consummated extrinsic information—external users will desire primarily financial information. Some, but relatively little, non-financial information is required by external users. As previously mentioned, this information concerns such things as collusive business activities or perhaps conservation. Thus, the generalized needs of external users can be viewed as being concerned primarily with financial, consummated, extrinsic, interaction information.

B. Internal Users

Management is charged with the responsibility of making decisions to select those efforts or productive factors which, at the time the decision must be made, seem best for achieving the existing goals. This responsibility
is fulfilled through planning and control. Planning means the selecting of objectives and the means for their attainment. Control means adherence to plans through action and evaluation.\(^{18}\)

It is useful to consider planning to be of two types—strategic (or long-run) and operational (or short-run). Thus, in reality, management is concerned with three areas of responsibility; and management's information needs will correspond to these three areas of concern. In many instances the same information will serve the needs of all three areas. At other times, different information will be required in the various areas; but the information will stem from (that is, be generated from) a common data base. In still other cases, the informational needs of an area of managerial concern will be unique with relation to both the information required and the data base. As previously mentioned, these three managerial functions (strategic and operational planning, and control) will require information concerning both recurring and special environmental events. The information selected to fulfill the needs of any specific function will,

of course, be determined by equating the value of the information (or the cost of not having the information) with the cost of generating the information.

Reference to Table 2 indicates that strategic planning is concerned with all facets of management information but emphasizes management intelligence, latent interaction, and non-quantitative intrinsic information. This emphasis points out that the long run "health" of the business depends upon management's ability to evaluate external "imponderables" through management intelligence, to evaluate internal non-quantitative "imponderables" (research, development, talent pool), and to formulate and evaluate possible courses of action (latent interaction information). The other types of information used in strategic planning are necessary for the formulation of trends and in pointing out quantitative strengths and weaknesses.

Short-run planning is seen to be primarily concerned with information having a quantitative or scheduling bent. Control emphasizes two of the same categories of information, quantitative financial and non-financial information, but control deals in after-the-fact information (feedback) while short-run planning is pre-action oriented.
Short-run planning also differs from control in that some concern is given competitive and latent interaction information.

Table 3 further points out the differences between the information requirements for strategic and short-run planning, and control. As previously indicated, strategic planning involves the mapping of the future of the whole organization. Short-run planning also transcends functional lines to insure coordination, but deals with interaction and intrinsic present oriented information. Control is more structured and follows organizational lines (as does the upward flow of responsibility). It would be desirable to have control information before action has occurred, but unfortunately the best that can be accomplished is to provide for control at the point of action or as soon as possible thereafter. How soon thereafter? Chambers succinctly covers this point in stating that

For review and replanning, a statement of the results of action and of the position arising from actions is required at points of time no further apart than the interval in which material changes occur.19

### TABLE 3

**SYSTEM CHARACTERISTICS OF STRATEGIC AND SHORT RUN PLANNING, AND CONTROL INFORMATION**

<table>
<thead>
<tr>
<th></th>
<th>Strategic Planning</th>
<th>Short-run Planning</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coverage</strong></td>
<td>Transcends organization lines</td>
<td>Coordinates functional areas</td>
<td>Follows organization lines</td>
</tr>
<tr>
<td><strong>Time coverage</strong></td>
<td>Long periods</td>
<td>Shorter periods</td>
<td>Shortest possible</td>
</tr>
<tr>
<td><strong>Reporting interval</strong></td>
<td>Regular, but not frequent</td>
<td>Regular and frequent</td>
<td>Regular and very frequent</td>
</tr>
<tr>
<td><strong>Detail</strong></td>
<td>Little</td>
<td>Much</td>
<td>Much</td>
</tr>
<tr>
<td><strong>Orientation</strong></td>
<td>Future</td>
<td>Present</td>
<td>Past</td>
</tr>
</tbody>
</table>

V. SUMMARY

The users of management information are classified as being either management or third parties— that is, internal or external users, respectively. Third parties need information to help them evaluate the success of the business and for taxing or regulatory purposes. Management requires information that will enable them to strive toward the achievement of organization goals through their performance of the planning and control functions. The particular use intended for the information dictates the source from which the information will be derived.

The sources or inputs to the information generating system are also related to the organization's internal and external environments. Intrinsic information is concerned with events internal to the organization. Extrinsic information is related to the organization's external environment. Extrinsic information is subdivided into interaction and management intelligence information. Intelligence information is concerned with the general economic environment in which the organization operates and with information regarding the organization's competitors. Interaction information is either latent or consummated interaction information. Latent interaction
information is gathered to enable the decision-maker to evaluate alternatives. Consummated interaction information results from a decision.

External users are primarily concerned with consummated interaction information. Management's needs are much more varied. Strategic planning makes use of all management information but emphasizes management intelligence information, latent interaction information, and non-quantitative intrinsic information. The information needs for short-run planning center upon consummated interaction information and quantitative intrinsic information. The control function requires mostly quantitative intrinsic information.

One of the goals of this thesis is to determine how accounting fits into the management information classification scheme just presented. Before the relationships between accounting and the management information system can be investigated the meaning and scope of "accounting" must first be set forth. The section that follows reviews the field of accounting.
CHAPTER VI

AN OVERVIEW OF THE AREA OF ACCOUNTING

Accounting does not exist in nature; it is the creation of man. Therefore, it is possible to define the term as desired. However, in order to be useful, any definition must be grounded in reality. It must reasonably encompass what actually is being done under the guise of the term, and what is being planned to be done. The term "accounting" is used in many ways and the accounting function is complex. Richard Mattessich has pointed out that the difficulty involved in postulating a practical definition constitutes a compromise of three conflicting goals: accuracy, economy, and versatility.¹ Thus, the best that can be hoped for is to postulate a definition that expresses the essence of the process.

In defining accounting, the first matter to be examined is the nature of the phenomena with which the

procedures of accounting are concerned. As a starting point, the facts of accounting may be postulated as being concerned with the human and non-human resources of organizations. Louis Goldberg states that

We do not, however, account for persons or things as such... That is the field of the medic, the psychiatrist, the physicist, and the chemist. Rather, we account for certain relationships which are taken to exist between persons and between persons and things. Now relationships, in contrast to the persons and things comprising our primary objective data, are reflections of the human mind, that is, of a mental attitude which abhors and cannot understand chaos, which seeks orderliness in the objects of its comprehension and which cannot rest satisfied until it finds order in them or imposes order upon them.²

Of the many possible inter-personal relationships of the human resources of an organization, there are many which are not the subject of accounting. To be the subject of accounting these inter-personal relationships must be capable of being expressed either directly or indirectly in terms of things lying outside the self or person.

Thus, accounting is concerned with the quantifiable relationships between the organization's human and non-human resources. These quantifiable relationships constitute a

part of the informational needs of the goal directed decision-making processes of management carried on within the organization.

The total informational needs of the organization have already been outlined. This section of the study presents a comprehensive sketch of the area of accounting and the informational needs of the organization that accounting is designed to fulfill.

I. CURRENT CONDITIONS

Accounting is currently in a state of flux. This is an era of confusion and revolutionary change. Accounting is at the crossroads of many paths. The path chosen will be determined by the resultant of many forces and influences. There are several sometimes divergent, sometimes convergent, and definitely overlapping viewpoints (e.g., social vs. private, public vs. industrial accountant, theoretical vs. pragmatic, management vs. third parties, micro vs. macro) which both guide and misguide accounting. The resultant of these forces is definitely in the direction of change. The most pressing need for change is in the area of accounting principles, with an eye towards the integration of financial and managerial accounting. However, efforts in this direction are being
hindered by a lack of an understanding of what accounting is. One author suggests that "the most important challenge facing the accounting profession today is to determine the objectives of the accounting process; and to consider how they may be achieved. . . ."³

Of the many forces influencing accounting, the variant needs of the users of accounting data lie at the root of most of the problems of accounting. These users are usually classified as owners, management, creditors, governmental units, and the public (especially potential owners); these various users are frequently grouped into two categories—management and third parties. The latter classification of users corresponds to the often used managerial and financial accounting dichotomy. The informational needs of accounting data users are usually assumed, but recent concern has been expressed over the actual needs of users. One author states:

It would be useful to make a survey of the main "customers" of external accounting reports—stockholders and potential investors—to determine:

(1) How they interpret the published income statement and balance sheet presented to them each year;

(2) What they would like the accounting reports and the auditors report thereon, to tell them. The answers to these questions could aid in the establishment of objectives in external reporting.\(^4\)

Maybe the informational needs of users aren't as dissimilar as some believe. Perhaps research would disclose that the purposes of users of accounting data are radically different and that the same data, not necessarily currently available, could be used or easily converted for use by many different users. If this is not possible, then perhaps the types and amounts of data reported should be expanded. The latter course of action has been suggested by a recent American Accounting Association committee report.\(^5\) Some research has begun in these areas. One author suggests that the general needs of investors can be classified as data relevant to:\(^6\)

1. The firm's future earnings and cash flows,
2. The firm's future dividend policy,

\(^4\)Ibid., p. 11.


3. The nature of the market's interest in the future of the firm's shares.

However, research is necessary to prove or disprove the validity of these statements and, if valid, to determine how to fulfill these informational needs.

Professor Alfred Rappaport has analyzed corporate reporting needs in terms of what should be, based on a contrived standard of social values. Professor Rappaport lists several significant areas where research should be undertaken and suggests that his list could be easily expanded.

Much more is known about the informational needs of management. The loudest clamor and the greatest fervor today center around traditional accounting's ability, or inability, to meet these needs. In 1962, in a speech in Newark, the President of the American Institute of Certified Public Accountants made reference to the conflicting needs of management and third parties stating that

The data generated by the traditional accounting system cannot serve a multitude of purposes equally well. The system falters when used for unintended purposes. During recent years there has been much emphasis on the internal use of accounting data, for planning,

7Alfred Rappaport, "Establishing Objectives for Published Corporate Accounting Reports," The Accounting Review, XXXIX (October, 1964).
performance evaluation, and decision making. For these purposes, the data turned out by the system frequently produce erroneous conclusions. Future costs, imputed costs, opportunity costs, out-of-pocket costs are essential in such decisions yet they are not produced in the conventional accounting system. 8

Another facet of management's informational problem is reflected in the statement that

The presentation of information to management calls for the exercise of judgment. There can be inflation of paper-work as well as of money, and the more documents that are published the less value each document has. There is a physical limit upon the quantity of information which a manager can read and the amount he can digest and act upon is much less. Care should be taken that significant information is not buried in a mass of relatively unimportant details. 9

Professor Mattessich summarizes the criticisms of traditional accounting as: 10

1. Accounting practice does not supply an objective scale of value that may be used for selecting optimum decisions and for evaluating managerial performance.

2. Accounting theory has developed a body of knowledge which is of a dogmatic rather

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10Mattessich, op. cit., p. 4.
scientific-hypothetical character and which serves with satisfaction only purposes, of a legalistic nature.

3. The pedagogic side of academic accounting emphasizes technical aspects and does not endeavor to relate new scientific achievements to the established body of accounting knowledge.

The desire for improved reporting has recently led the AICPA to institute revolutionary undertakings. The Institute has committed itself

...to attack the problems of financial accounting at four levels, namely: (1) to state the postulates of accounting, (2) to establish a broad set of coordinated principles growing out of the postulates, (3) to establish rules or other guides for the application of the accounting principles to specific situations, and (4) to do adequate research for each of the foregoing.11

This Institute commitment is a revolutionary shift in emphasis from passing judgment upon practices to an effort to determine appropriate practices based on sound theoretical concepts.

Accounting theory can be defined as "The organized body of knowledge which deals with order, reasons, relationships, objectives, and methods involved in the practice of accounting."12 However, the accounting theory or

11Crowningshield and Battista, op. cit., p. 31.

principles thus far formulated apply only to financial accounting; they fail to explain and justify current practice in other areas, and fail to prescribe solutions or direct activity towards the solution of problems in these areas. As a result, attempts have been made to determine a separate theory of management accounting and to delineate management accounting principles. The AAA Committee on Cost Accounting Concepts and Standards formulated "A Tentative Statement of Cost Accounting Principles" in 1952. Attempts at reconciling financial and managerial concepts have also been made. In 1961 an AAA Management Accounting Committee, in investigating the applicability of financial accounting concepts (such as consistency, objectivity, and realization) to managerial accounting, concluded that:

1. The concept underlying managerial and financial accounting differ in several important respects;

2. The differences occur because the reporting objectives are not the same; and

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3. There is justification for attempting to formulate a separate body of concepts applicable to internal management reporting.\textsuperscript{14}

This internal-external information dichotomy has led many scholars and practitioners to consider divorcing the managerial area of endeavor from financial accounting completely. English schools are already seriously considering the granting of a degree in managerial accounting.\textsuperscript{15} The practice of many CPA firms of maintaining separate auditing and management services departments (with separate offices, personnel, training programs, and other facilities) points to the separableness of these areas. Contentions that financial accounting is based on precepts while managerial accounting is based on concepts also lends credence to the separableness of these areas.\textsuperscript{16} Many industrial engineers and operations analysts also contend, with regard to the managerial sphere of accounting that in the future, accounting as an academic discipline will be replaced by something entirely new. They


feel that the needs of management will be fulfilled by a
discipline oriented more toward the social and mathemati-
cal sciences.\textsuperscript{17}

These forces have instilled in accountants

\ldots an increasing awareness of the need to
develop a framework of accounting theory
against which the procedures and practices
of accountants in their everyday work may be
measured and assessed.\textsuperscript{18}

As a result, a revolution of great proportions is underway
to integrate accounting itself, and also to integrate
accounting with other areas of endeavor. Mattessich and
others claim that it is desirable, indeed necessary, that
micro and macro accounting also be integrated on a the-
oretical level.\textsuperscript{19} However, most attention is centered
upon the integration of financial and managerial account-
ing.

Most accountants would be reluctant to allow a mana-
gerial-financial split in accounting to occur. Each area
provides indispensable aid to the other that would be
difficult to maintain were such a split to occur. Profes-
sor Sidney Davidson states that

\begin{itemize}
  \item \textsuperscript{17}Mattessich, \textit{op. cit.}, p. 4.
  \item \textsuperscript{18}Goldberg, \textit{op. cit.}, p. vii.
  \item \textsuperscript{19}Mattessich, \textit{op. cit.}, p. 1.
\end{itemize}
In my view these two approaches are complementary rather than competing. A substantial infusion of managerial analysis enriches financial reporting and gives it a more realistic, meaningful look. It is also true that much of the analysis now being carried out under the names of operations research, management sciences and management services can use the sobering effect that the traditional accounting standards of audit and objectivity impose. The notion of managerial analysis and financial reporting as separated, fragmented, and even opposing activities should, and I am confident will, be soon supplanted by the view which emphasizes the basic unity of the accounting function.20

II. DEFINITIONS OF ACCOUNTING

Although accounting practice has progressed rapidly since the 1930's and especially since World War II, many of the definitions of accounting currently used and accepted have not kept pace. There are almost as many different printed definitions of accounting as there are texts and articles defining accounting. These differences center primarily around four definitional elements:

1. The type of data--transaction, financial, and economic.

2. The time period involved--past, present, and future.

3. The intended users of the data—management and third parties.

4. The unit of measure—dollars, other quantitative or qualitative units.

Bernard and Kester wrote in 1923 that

Accounting consists of gathering and presenting information concerning the money values of the things used in business, the debts owed to others and the proprietor's net worth.21

The most widely accepted definition of accounting was formulated by the AICPA's Committee on Terminology in 1941. This "official" definition of accounting differs little from that of Bernard and Kester:

Accounting is the art of recording, classifying, and summarizing in a significant manner and in terms of money, transactions and events which are, in part at least, of a financial character, and interpreting the results thereof.22

Criticisms of the AICPA definition, according to Mattesich, are

... directed mainly at (1) the vagueness that adheres to a phrase like "in a significant manner," (2) the partial overlapping of the term "transaction" with the expression "in terms of money," "events"


and "of a financial character," and of the term "interpreting" with "recording" . . . Yet, it is the wide leeway which the word "recording" affords that makes the Committee's definition acceptable (by including "valuation," "projection," etc., in the term "recording"). On the other hand, the shadow of this advantage creates a certain vagueness that is open to criticism.23

Many basic accounting text books use the "official" AICPA definition (for example Noble and Niswonger) or an adaptation of it, such as:

Accounting is the art of recording and summarizing business transactions and interpreting their effects on the affairs and activities of an economic unit.24

Other texts and authors skirt the definition problem by describing what accountants do:

The nature of accounting and its significance in the business world can be described by noting the variety of work performed by persons trained in the field of accounting.25 or by describing the functions or purposes of accounting.

As a result, many accounting graduates learn the AICPA definition, a variation thereof, or none at all.

23Mattessich, op. cit., p. 17.


The shortcomings of the "official" definition and its variations are analogous to the theoretical problems just considered. The definitions do not apply to accounting in general, just as present accounting principles are not generally applicable to all areas of accounting. These definitions are vague enough that they could be construed to include all areas of accounting, but they are not construed in this manner. They are usually narrowly interpreted so as to embrace only financial accounting. Therefore, separate definitions have been formulated for the cost and managerial areas of accounting. The definitions of these areas are also far from consistent and mutually exclusive.

Definitions of cost accounting vary greatly. Cost accounting is often quite narrowly defined as in the following:

Cost accounting may best be described as a specialized technique for obtaining, through the double entry process, the cost of a manufactured product or of a service according to some scheme of functional classification.26

In traditional cost accounting, for example, the study of quantitative production data

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in dollars is often identified as cost accounting; its study in units is frequently referred to as statistics.\textsuperscript{27}

Others contend that

The term "cost accounting" is perhaps misleading, because the subject no longer confines itself to accounting for costs. A more accurate description is provided by the term "internal managerial accounting."\textsuperscript{28}

The United States Government's \textit{Occupational Outlook Handbook} uses the terms private, cost and managerial accountant as synonyms.\textsuperscript{29} However, the most prevalent view seems to be that cost is a part of managerial accounting.

Controversy also exists over the scope of managerial accounting. Managerial accounting is often thought of as only the "use of the accounts of the business to provide information as the basis of management action,"\textsuperscript{30} or the "presentation of accounting information in such a way as to assist management in the creation of policy and in the


\textsuperscript{28}National Association of Accountants, "The Field of Management Accounting," \textit{NAA Bulletin}, XLIV (June, 1963), p. 5.

\textsuperscript{29}Jacobsen, \textit{op. cit.}, p. 64.

\textsuperscript{30}Wilson, \textit{op. cit.}, p. 252.
day-to-day operation of an undertaking"31—that is, merely an extension of financial accounting. Conversely, management accounting is thought of as being basically in conflict with or opposite to financial accounting, yet still overlapping.32 Others consider the term "management accounting" to be the broadest of accounting concepts and construe it to include financial accounting, as in "Management accounting . . . is the quantitative measurement of enterprise management's use and stewardship of assigned resources and authority."33

In a similar fashion, many authors have attempted to broaden the definition of the term "accounting" to make it truly generic. Some authors try to achieve the requisite comprehensiveness by expounding such definitions as "Accounting is what accountants do"; "accounting is the language of business"; "accounting is communication"; and "accounting is measurement." However, the usual quest for comprehensiveness is sought through the use of more


descriptive definitions. Professor Sidney Davidson broadens the term's scope by observing that

> Accounting is an information system which provides significant, meaningful financial information about the firm—both for internal management use and for external financial reporting.\(^{34}\)

Professors Anton and Firmin even more descriptively increase "accounting's" comprehensiveness with the statement that

> Accounting's purpose is to communicate information about economic events—past, present, and future—to persons who will use the information to plan and control activities, and to choose among alternative courses of action.\(^{35}\)

These current formulations have brought accounting's definition closer to accounting reality.

The most comprehensive definition of accounting set forth by any recognized spokesman for a large group of accountants was presented in *A Statement of Basic Accounting Theory* by the AAA in 1966. They defined accounting as "the process of identifying, measuring, and communicating quantifiable economic information to permit informed

\(^{34}\)Davidson, *op. cit.*, p. 91.

judgments and decisions by users of the information." The AAA stated that this definition was considerably broader than any expressed in other statements of accounting theory. The committee stressed that the statement clearly encompasses the process of identifying, measuring, and communicating economic information related to the activities of individuals, fiduciaries, governmental units, charitable enterprises, and similar entities, and that the statement covers communication of economic information to managerial as well as non-managerial users of accounting information.

III. THE SCOPE OF ACCOUNTING

As used in the AAA definition of accounting, the word "identifying" refers to the identification of the economic information concerning an entity that will permit informed judgments and decisions by users of the information. Thus, there are two elements of identification involved--identifying the needs of the users of the information and identifying the information necessary to fill

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37 Ibid., p. 2.
those needs. This is pointed out in the statement that "The information appropriate to a specific decision can be determined only after the objectives have been specified." 38

Without an entity, accounting is impossible. The entity gives the criteria for determining what information should be accumulated. The accounting entity is "an area of economic interest to a particular individual or group." The boundaries are identifiable, first by determining the interested individual or group, and secondly by determining the nature of that individual's or that group's interest. Thus, the entity concept is central to accounting for determining all of the needs of users. A previous AAA committee voiced similar sentiments:

The role of the entity concept in accounting is to provide guidance in determining what information is relevant and what information is not. 39

Succinctly then, accounting is user-oriented.

The accounting function is said to deal primarily with the measurement and communication of economic data.

38 Ibid., p. 4.

Economic data relates to resources— their source, nature, quantity, accumulation, allocation, and exhaustion. Such data can be expressed in various quantitative terms—for example, money, tons, or number of items.\textsuperscript{40} However, as previously indicated, accounting has not always been concerned with economic information. Professor A. C. Littleton has said that accounting is closely related to only a small segment of the whole of knowledge; and that if knowledge is divided into 5 segments— (1) letters and arts, (2) biological science, (3) physical science, (4) social science, and (5) abstract science (logic, mathematics, statistics, and others)— it is apparent that accounting is related to the social and abstract sciences, and closely related only to economics and statistics.\textsuperscript{41} Within this area accountants first chose to limit their concern to transaction data, later to financial data; and now to the broader area of economic information as exemplified by the latest AAA statement on basic accounting theory. The AAA statement did specify that accounting was


concerned with economic information, but made provision for the use of other than economic information and for possible further expansion of the scope of accounting with the statement that

Most applications (traditionally defined) of accounting have dealt with economic resources (traditionally defined) and the bulk of the present discussion is oriented to these applications. Nevertheless . . . accounting need not be confined to such subject matter.42

One obvious area where the limiting bounds of "economic data" are broken, as cited by the AAA study, relates to the guidelines set forth for the communication of accounting data. The study advocated the inclusion of environmental information and relationships surrounding the measurement of accounting information as essential to communication.43 Thus, accounting is currently pictured as being limited to dealing with relevant economic information and data other than economic data are ignored except where it has an impact on reported economic data. Still further qualification of the concept centers on the fact that accounting is not concerned with all economic information. An AAA committee report recently commented that

43Ibid., p. 7.
In the accounting process, the basic criterion for determining what information should be accumulated and reported is whether the information is relevant to the particular area of economic interest of the individual or group for whose information the accounting is intended. All information pertaining to the area of economic interest is eligible for inclusion; as a practical matter, some eligible information may be excluded on the grounds of remoteness, or immateriality, or because of its subjective nature, or in order to prevent it from becoming known to competitors, etc.44

James W. Giese has observed that information generation requires four steps if it is to be useful beyond the moment of observation or useful to individuals and groups other than the observer. The steps involve the:

1. Classification of data—the basic problem is relating observations to anticipated situations of all classes of economic decision makers.

2. Establishment of procedures for recording data in a manner facilitating recall, yet sufficiently simplified to enable the operation to be routinized.

3. Summarization of data classified and recorded.

4. Specification of the collection procedure of the system.

In carrying out these four steps standards for observing and measuring should be formulated and the data collection plan must be systematic, carefully planned, and controlled.

44AAA Committee Report, op. cit., p. 361.
The number and type of observations to be made and the importance of accuracy in making observations as well as the location of the observer must be specified. The usefulness of the resulting information is a function of the standards maintained in generating the information.

The 1966 AAA Statement of Basic Accounting Theory recommends four basic standards for determining whether, and also how, accounting information is to be derived and reported—relevance, verifiability, freedom from bias, and quantifiability. Relevance is the primary standard. It requires that information must bear upon or be connected usefully with the action it is designed to facilitate or the results it is desired to produce. Relevance requires a knowledge of the accounting entity characteristics and user needs. Relevance also requires that information be available in proper form and at the proper time—infor mation can be presented prematurely as well as too late.

Verifiability requires that individuals working independently be able to develop essentially similar

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45 James W. Giese, Classification of Economic Data in Accounting, A Dissertation, University of Illinois, 1962, p. 122.

information from the same data. Exact duplication of
information is not required, variations within known
limits are tolerable. Impartial determination and re-
porting of information relates to the "freedom from bias"
requirement. Biased data are often useful, but the bias
should be made known.

The AAA Committee report indicated that "... it
can be said that the primary, if not the total concern of
accountants, is with quantification and quantified data."47
Quantification is the presentation of information in
numerical form where the numbers assigned obey prescribed
arithmetic laws or procedures. Money is the quantitative
measure used most frequently by accountants since they
deal primarily with value and wealth; but there is no re-
striction against the use of other measures.

Quantification requires that events be classified
and measured. Classification reduces the complexity of
the material, provides a means of identification by group-
ing like things together, provides a record of experience,
and orders and relates classes of events. Three major
characteristics of any classification system are:48

48Giese, op. cit., p. 15.
1. Classes must not overlap— they must be mutually exclusive.

2. The classification system must be exhaustive— each item to be classified must be placed in some distinct category.

3. The basis of classification must be significant and in accordance with some predetermined pattern.

The classification system determines the "hooks" to be attached to data which makes later retrieval and use of the data possible.

The criteria for measurement are similar to the standards of information. They are: objectivity, reliability, validity, sensitivity, comparability, and utility. Measurement does not specify the many uses of the measurements; it does not specify the amount, the object measured, or the conditions under which measured. The function of accounting is to make measurements on a continuing basis for all recurring problems and to be prepared to supply measurements for special problems as they arise. Fulfillment of this function may merely require adjustments of old measurements or techniques or may require new measurements or techniques.

49 See Ibid., p. 41 for a detailed discussion of these criteria.
The nature of the problem may be visualized better . . . by recognizing the accountant as an ob-
servor of economic or related activities (past, present, or future) which he records in abstract form using descriptive words and numbers. If the accounting information is good and the accountant is properly skilled, these abstrac-
tions will present an accurate model or picture of the underlying activity. To convey an accurate picture of the activity to the user, the accountant must use abstractions, but his objective is always to convey an understanding of the activity rather than merely to transmit abstract words and numbers.\textsuperscript{50}

To convey understanding, there must be uniformity of meaning of words and numbers used in accounting, and rules or guidelines for the use of accounting abstractions are necessary to assure that the underlying activity is revealed and not obscured or distorted by the reporting process. To this end, the AAA Committee on Basic Account-
ing Theory proposed five guidelines for the communication of accounting information: \textsuperscript{51}

1. Appropriateness to expected use,
2. Disclosure of significant relationships,
3. Inclusion of environmental information,
4. Uniformity of practices within and among entities,

\textsuperscript{50}American Accounting Association, \textit{op. cit.}, p. 13.

\textsuperscript{51}For a detailed discussion of these guidelines, see \textit{Ibid.}, p. 13.
5. Consistency of practices through time.

In addition to these guidelines for the use of accounting abstractions, many practical guides for improving communication have been set down. One author writes that communication may be improved by:

1. Rounding numbers,

2. Limiting the quantity of information to the essentials,

3. Highlighting the most important figures on reports,

4. Finding out what information is desired.

However, communication is much more complicated than has thus far been indicated. Studies have shown that even when executives have all the information they need to make a decision, they do not always make the correct one. These failures are thought to occur either because the executive does not know how to translate information into effective action or because the information has not been adequately communicated to him. C. West Churchman feels that the answer is to be found in a better understanding of the manager himself and how he thinks and works. The accountant must often fit his reports to specific individuals.

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Communicating to an authoritarian executive is different from communicating to one who manages following a participative philosophy. According to Churchman, the executives' own personality, his goals, and the persons who influence him are all important factors in his behavior. Information, analysis, and communication mean nothing unless the manager pays attention, and paying attention is an obscure and little understood process of the managerial mind.53

IV. CONCEPTS OF ACCOUNTING

Volumes have been written about each of the elements of accounting. A detailed discussion of these elements is not germane to this study, but a sketch of the main elements of accounting and their interrelationships will help in determining the essence of accounting, which in turn will allow certain concepts of accounting to be clarified. As pointed out previously, classification is a generalized process by which man copes with his environment. Accounting attempts to cope with economic reality by applying this general process. The accountant classifies, determines properties (measures), symbolizes these measurements

53Ibid., III, p. 54.
quantifies), manipulates the symbols (calculates and summarizes), and transmits these symbols to others (communicates).

Most definitions and theories of accounting stress the elements, tools, or functions of accounting—principally the measurement and communication aspects. Scant notice is given to the informational aspects of accounting. Information and information generation, per se, are taken for granted.

The AAA Committee's Statement on Basic Accounting Theory emphasizes that "Accounting is a measurement and communication process. . . ." Some individuals concur in this emphasis, while others prefer to emphasize either measurement or communication. This emphasis upon accounting as a measurement and/or communications system has led to confusion regarding the nature of accounting.

For example, R. J. Chambers contends that there is no such thing as accounting for the future since accounting

54 American Accounting Association, op. cit., p. 6.

is essentially a measurement and communication system and measurement is possible only with regard to the past and present. He states that

The greatest service accounting can give in relation to future actions is knowledge of present financial positions for this is universally necessary knowledge. Calculations relating to the future involve hosts of evaluations and speculative anticipations which are not knowledge in the sense of ascertainable and verifiable facts; they are calculations purely and simply, not measurements.

However, the significance of attitudes such as Chamber's is diminished by considering William J. Vatter's admonition that

The accountant who concentrates on "fact" is likely to miss his real opportunity of service; he ought to make his data (information) understood in the broader sense, which is to make it useful and relevant for given purposes.

Accountants are not, or should not be, merely historians. The NAA research staff has appropriately stated that

The accountant's work has value only if it influences management to make better decisions than could be made without it. If management fails to see the relevance or

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56 Ibid., p. 61.

grasp the meaning of accounting data for problems at hand, the accountant has accomplished nothing useful.\textsuperscript{58}

The output of the accounting process has value as information only if it reduces uncertainty in decision-making; and decisions can only be made concerning the present and future. Uncertainty is reduced through the device of meaningful forecasts and calculations which have some form of historical data as their basis. Thus, historical data, \textit{per se}, has no value. The value of any information lies in its relevance to the future.

Chambers does mitigate his seemingly uncompromising position somewhat by the statement that "... Accounting is concerned strictly with the past and present, but so that it is always relevant to the future."\textsuperscript{59}

Most accountants and accounting groups recognize that the future is within the province of accounting. Jaedicke has pointed out that

\begin{quote}
In order for accounting to be an important tool for management, it is necessary that the system be future oriented. Information about the past is useful only if it can be used
\end{quote}

\textsuperscript{58}Ibid., p. 7.

\textsuperscript{59}Chambers, \textit{op. cit.}, III, p. 33.
as a basis for establishing future plans.60

The AAA Committee statement on theory confirms this position. Under the heading of "The Scope of Accounting," the Committee states:

Accounting contributes information regarding activities which form a continuous stream on which many distinct points may be identified. In the main they are economic activities. The associated informational needs include historical references, as in the traditional accounting statements, and to future plans and expectations, as in budgets, standard costs, and the like.61

The above concept of accounting is in accord with the entity concept and emphasizes user needs, which are future oriented. Information asserts something about existence, order in place, order in time, causation, and resemblance. Information must be asserted about something.62 In accounting, information is a quantitative assertion concerning an economic entity relative to user needs.

In seeking to discover the essence of accounting one might ask, "What is accounting?" Many accountants would


61 American Accounting Association, op. cit., p. 5.

62 Giese, op. cit., p. 27.
answer this query, as did the AAA Committee mentioned above, with a statement to the effect that "Accounting is a measurement and communication system." Accountants do measure and communicate, and certainly these functions of accounting are important but they are ancillary to the central theme. Accounting must involve more than measurement, since measurement is primarily past oriented, as was pointed out by Chambers. Accounting does involve communication, but communication is a necessary ingredient of all human activities. Thus, the essence of accounting is information generation; but what kind of information? The AAA definition indicates that "economic information" is the answer, but further qualification is necessary.

John Carey states that

. . . the measurement and communication of economic data is also involved in the work of economists, statisticians, investment analysts, and others. It might be added, therefore, that CPA's measure and communicate such data largely for control and information purposes, uniquely for an economic entity.63

This point will be pursued further in a later section.

63Carey, op. cit., CXX, p. 63.
V. SUMMARY

There are many proposed and accepted definitions of accounting and many alternate views concerning the nature and scope of accounting.

The definitions of accounting range in scope from the narrowly defined area termed "financial accounting" to the sweeping definition recently formulated by the 1966 AAA Committee to Prepare a Statement of Basic Accounting Theory.

Measurement and communication are essential elements of the accounting process, but the essence of accounting is information generation.

The section that follows analyzes the accounting information generating system using the general systems theory previously developed. Since no one definition of accounting is universally accepted, the elements of the financial accounting system, the managerial accounting system, and the general elements of the accounting system proposed by the 1966 AAA Committee are investigated. These analyses should cover the entire range of commonly accepted definitions of accounting.

The knowledge gained from the above analyses will be used to determine the role of accounting in the management information system.
The idea of accounting as an information generating system was seen to be the most reasonable concept of accounting—one that reveals the heart of the process. Since accounting is a system, it too may be analyzed according to the elements common to all systems. It should then also be possible to determine the role of accounting in management information systems by analyzing and comparing the elements of each.

I. A SYSTEMS VIEW OF ACCOUNTING

The usual concept of an accounting system refers to the flow of paperwork through an organization. The idea stressed here portrays accounting as an information creating (or generating) system in the sense previously discussed with regard to management information, that is, accounting as a dynamic process for converting data into information. Accounting is often said to be an art, as
in the AICPA definition of accounting. The word "art" has two shades of meaning. One is that of a systematic application of knowledge—a process; the other emphasizes skill in effecting a desired result. Too often the latter meaning, which is applicable to accountants, is applied to the process of accounting. This erroneous application of the meaning of "art" to accounting has led to confusion and has hampered lay and professional understanding of the accounting process. Both of the senses of "process" are applicable to accounting—a phenomenon which shows a continuous change over time, and a series of actions or operations definitely leading to an end. The accounting process changes over time for given outputs because the means (the inputs or the accountant's tool bag) for achieving given ends change. Process output requirements change due to the effect of time upon the environment, which affects the needs of users, and also due to the effect of time upon the "tools" which determine the needs that can be fulfilled by the system.

The concept of accounting as a system is not new. Anton has advanced the thesis that

Accounting does constitute a true system, and that as such, it must be studied from a systemic viewpoint. The implications for accounting research are obvious. Most important, perhaps is first being able to borrow from the
research of other disciplines in studying accounting systems, and secondly dispelling the illusion that accounting is either "an island unto itself" or already so tightly construed that alternative basic changes cannot be undertaken.¹

Not only has accounting been previously recognized as being a system, it has also been described as an information system. Norton Bedford recently described the findings of the 1965-66 AAA Committee on Basic Accounting Theory as follows: "The Committee examined the basic nature of our discipline and found it to be, essentially, an information system--a process for developing and transmitting information."²

The idea of accounting "generating" or creating information is also not novel. As mentioned previously, most raw data is not useful until the data has been processed, that is, classified, summarized, or used in computations. Anton recognized the fact that raw data is the input to the accounting information generating system and that large quantities of the data will be unusable


in its raw form. He states that this "Source data has to be combined and repatterned in a variety of ways to provide various kinds of information in answer to different kinds of management problems."  

A. The General Nature of the Accounting System

Emphasizing accounting as a quantitative economic information generating system does not deny the importance of measurement or communication; both are very important. This emphasis merely places each element of the process in proper perspective. As indicated in Figure 22A all three elements are necessary to the success of the accounting process. However, the essence of accounting—information generation—is more readily apparent when the system is visualized as in Figure 22B. In Figure 22B measurement and communication criteria are included within the concept of "controls," as are accounting theory standards. The control elements determine the quality, number, and type of the needs of users to be met; the events to be measured to fill these needs; the categories of classification; and the methods of calculation of the

3James W. Giese, Classification of Economic Data in Accounting, A Dissertation, University of Illinois, 1962.
A. A Segmented View of Accounting

B. Information Generation Stressed

FIGURE 22
ACCOUNTING SYSTEMS
necessary information. These are the tools of accounting—for example, the double-entry device. These tools are the determinants of the structure of the processor. The feedback for the general system is some measure of the usefulness or effectiveness of the output in achieving the goals of the receiving entity or the organization within which the process takes place.

Accounting as depicted in Figure 22B is intended to be general, that is, to include both financial and managerial accounting. This systems orientation to accounting appears to come as close to "integrating" the areas of accounting as is possible. All accounting falls within the concept of an information generating system existing to facilitate the accomplishment of organization goals. Financial accounting is oriented towards the needs of users outside the generating organization, but these "outsider" needs are filled only to the extent that fulfillment furthers or facilitates the accomplishment of organization or management goals or needs. Management accounting has these same goal-oriented objectives but they are more explicit. No integration of the areas of financial and managerial accounting more substantial than that outlined above seems possible, for as pointed out
previously, these two areas of accounting are vastly different in many respects.

The general discussion of the elements of accounting that follows applies to both financial and managerial accounting. However, a subsequent discussion of the specific elements of the financial accounting system, and those relevant specifically to the managerial accounting system points out the nature of the basically incompatible demands made upon each system.

The filters of the general accounting system both limit and facilitate output. Accounting theory, accountants, and the information-generating process itself perform filtering actions.

Theory is a tool of science in these ways:
(1) It defines the major orientation of a science by defining the kinds of data which are to be abstracted; (2) it offers a conceptual scheme by which the relevant data are systemized, classified, and interrelated; (3) it summarizes facts into (a) empirical generalizations and (b) systems of generalizations; (4) it predicts facts; and (5) it points to gaps in our knowledge.4

Thus, accounting theory determines what inputs to the process are acceptable, what outputs are acceptable, and the "tools" that can be used in generating output.

Data manipulation may involve either the classification or summarization of data or both; and these devices, along with calculations and analyses, are the tools of information generation. Classification does not change the true nature of that which is classified, but classification assumes that the event or item classified has no attributes other than those specified for the category or niche into which it is placed, or that the attributes not specified are unimportant. Since no two things are exactly alike, classification destroys some information potential in the process of creating information. Summarization may also result in the loss of information, but usually the results are beneficial in that they are more meaningful than the total data. In addition, summarization may eliminate redundancy and, quite often, noise.  

The accountant or group performing the activities of the process also act as system filers and limit the inputs and outputs of the system to something less than that theoretically possible— that is, the accounting function must be performed within the scope of the

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capabilities of the accountant. This idea has macro and micro aspects. As a macro concept, the idea includes the accounting groups that help shape accounting theory and set standards—the AICPA, AAA, NAA, and others. The micro concept encompasses the individual accountant as well as the accounting department of a given organization.

Thus, the statement that "accounting is what accountants do" both explains and confuses. It is somewhat true on the macro level, but definitely misleading at the micro level, especially with regard to the individual accountant. On the micro level accountants are the entities (individuals or groups) that perform the accounting process, and the term "accounting is what accountants do" applied here is a classic case of the "tail wagging the dog."

B. The Elements of Financial and Managerial Accounting Systems

The financial and managerial accounting systems are not independent or separable systems. The managerial accounting system uses many of the same tools and much of the same data used by the financial accounting system. However, for expository purposes, they will be treated separately. Considering each as a separate system should give perspective to the nature of each; and the combined
discussions will be of such a nature as to encompass the entire range of definitions generally attributed to accounting. This should enable a given individual to relate his particular view of accounting to the systems view by allowing him to choose those concepts applicable or pertinent to his particular view. To this end, "financial accounting" will be very narrowly interpreted, while "managerial accounting" will be liberally construed.

1. System controls. As stated above, the control inputs to a system are the determinants of the structure and the boundaries of the system. These controls relate primarily to the theory or philosophy underlying the processes. Interpreted narrowly, the financial accounting system is a static model whose primary outputs are the balance sheet, which has been likened to a photograph of the financial condition of a company at a point in time, and a supplementary output, the income statement, which attempts to explain some of the changes that have occurred between photographs.6 The financial accounting system is designed to measure the performance of the total firm and to report to third parties regarding management's

6 James W. Vain, "The Predictive Model in Accounting," Cost and Management (Canada), XL (February, 1966), p. 73.
stewardship of assets, the results of operations, and for
taxing, regulatory, and other social purposes.

The theory underlying financial accounting is well
developed but rather rigid in that it is based upon con­cepts of income and wealth, and tends to be prescriptive
and legalistic in nature. The theory specifies the attri­butes of economic resources to be measured and the methods
of measuring the magnitude of the attributes. The attri­butes measured deal primarily with the dollar amounts of
accomplished transactions or events. The theory is past
oriented and emphasizes fulfilling only recurring infor­mational needs. The purposes underlying the development
of financial accounting theory were primarily oriented
toward the establishment of standards for judging the
acceptability of accounting methods for reporting to third
parties. These standards or principles upon which fi­nancial accounting is based derive their authority from
their general acceptance by the profession and business
community.

Managerial accounting is based more upon economic
and management concepts. Therefore, the managerial
accounting system is more flexible than the financial
system and includes methods and practices not generally
accepted for external reporting. This flexibility and
exemption from the standards of financial accounting exists because the users of the information, internal management, have direct control over the information-generating system, and thus knowledge of the methods used in deriving the information and control over the quality of the information provided them. The flexibility and looseness of the managerial accounting system does enhance its usefulness, but this very amorphousness has made the theory underlying the system exceedingly difficult to formulate.

The managerial accounting system is concerned with information regarding the past, present, and future. The outputs from the system are numerous and are designed to fulfill the needs of all levels of management. The inputs are more varied than those entering the financial accounting system, and depend upon the outputs. These outputs are, in turn, determined by the needs of the users of the output, and are limited only by the "tool bag" available to the accountant. The tools available to the managerial accounting system are much more numerous and flexible than those available in the financial accounting system. Although there is not a cohesive theory to guide the managerial accountant, the underlying philosophy centers upon meeting the needs of the user. To this end, the
managerial accounting system fulfills both recurring and special user needs. These diverse needs are fulfilled by various quantitative measures, including dollar amounts.

2. Outputs of the systems. As stated above the primary outputs of the financial accounting system are the balance sheet and the income statement which are designed for reporting to external users. Thus, these outputs are necessarily general-purpose type statements since they must fulfill the diverse needs of several groups—stockholders, creditors, governmental agencies, and others. Management does make some use of the financial accounting system. The information that management does use differs from that provided to external users primarily with regard to the amount of detail since the information available to management is limited by the inputs to the system, the same inputs necessary to produce the primary output—general purpose financial statements.

The uses of the outputs of the financial accounting system are primarily oriented toward reporting but may, to some extent, be used by management for control. If properly collected, the information will provide some measure of the performance of the various functional sub-systems of the firm and of organization employees. Organization goal achievement is measured or reflected in the
financial accounting system only to the extent that these goals are reflected by profit considerations. The financial accounting system can be characterized as being centered around the philosophy of profit maximization and the concept of economic man.  

The managerial accounting system, as the title implies, is much more oriented to the internal needs of the organization. Fulfilling the needs of management is the central theme or goal of the system. The system is much more concerned with the previously mentioned philosophy of "tailoring" information to the needs of users and thus emphasizes the fulfillment of both recurring and special internal needs. Financial accounting does have an element of tailoring in it with regard to output for management, but "tailoring" is the forte of the managerial system. The managerial system is concerned with all of the organization's needs for quantitative information--reporting, planning, and control. The managerial system has been influenced by modern philosophies of management.

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and recognizes and applies many psychological and socio-
logical concepts in deriving information for the reporting,
planning, and control needs of managements. Developments
include such applications as costing by responsibility
centers and the use of accounting information as a device
for motivating employees.

3. Feedback. Feedback from the external users of
the multi-purpose outputs of the financial accounting
system is scant, and the effectiveness or usefulness of
the statements is unknown. Feedback from management does
occur but adjustments to fulfill management's needs are
limited, as previously stated, by the restricted input to
the system.®

Feedback is generally more voluminous and is re-
ceived quickly in the managerial accounting system since
the outputs of the system are used internally. Measures
of the usefulness or effectiveness of system outputs are
thus known and readily available. The results of opera-
tions are constantly compared with previously prepared
plans, with standards, or with organization or entity
goals.

®These points are discussed at length by Jacob Bern-
berg, "An Information Oriented Approach to the Presentation
of Common Stockholders' Equity," The Accounting Review,
XXXIX (October, 1964).
4. **Inputs to the system.** The financial accounting system is primarily concerned with the dollar values of actual transactions. Some concern is shown for non-transaction data such as market values of inventory items or investments. However, this type of data is only supplementary and is used for such things as the basis of an allocation or as a parenthetical remark on a balance sheet.

The inputs to the managerial accounting system are much more diverse and are determined by the informational needs of the user, but are limited to quantitative economic information. The managerial accounting system accepts economic inputs other than historically-oriented transaction data. For example, measures relevant to the evaluation of alternatives regarding scarce resources or data useful in adjusting historically-oriented data in planning for the future are admitted to the system.

II. THE AREAS OF ACCOUNTING COMMON TO THE MANAGEMENT INFORMATION SYSTEM

It is apparent that the accounting system is a subsystem of the management information system and that both are contained within the scope of the total information system of the business organization. All of the criteria
relating to accounting information are included within the criteria for management information, which are, in turn, included within the scope of total information. A detailed comparison of the relationships of the accounting system with the management information system is set forth in the pages that follow.

Since little agreement was found regarding the definition or scope of accounting, or even of the subsystems of accounting, some arbitrary definition must be chosen if a comparison is to be made with the management information system. The systems view of accounting just presented dealt with both a narrowly defined concept of financial accounting and a rather liberal concept of managerial accounting so that the entire range of views might be encompassed. The two concepts combined represent the author's interpretation of the view of the AAA as postulated in A Statement of Basic Accounting Theory. This rather progressive work

... defines accounting as the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information. The concept of economics referred to in the preceding sentence holds that economics is
concerned with any situation in which a choice must be made involving scarce resources.\(^9\)

This view of accounting will underlie the discussion and comparisons that follow.

A. Controls and Outputs

Accounting and the management information system are both concerned with some type of information useful to the business organization, and both concern themselves with the reliability of recurring information, the availability of information for special purposes, and the cost of timeliness of recurring and special information. The information of both systems relates to some aspect of the efficient combination of the five physical organization resources—money, orders, material, personnel, and capital equipment. However, accounting emphasizes information regarding money, materials, capital equipment, and (to some extent) orders; and shows little concern for personnel, \textit{per se}. In addition, the accounting treatment of these elements tends to follow functional or departmental lines. Special concern is usually given to the financial and production functions. Of late, some interest has been

shown in the marketing department. Both systems generate information for reporting, planning, and control purposes. Planning entails projecting the desired levels of organization resources and the flows necessary to achieve these desired levels, or vice versa. Reporting is concerned with the levels and flows achieved. Control deals primarily with feedback in the form of comparisons of results with plans or standards. Both systems provide information to internal and external users but only to the extent necessary to achieve organization goals. Accounting is the primary subsystem for reporting to outsiders.

Both systems recognize that business information must be relevant, available, and timely to have value, and thus to qualify as information. Both systems stress the same quality features of information—validity, accuracy, and precision. Accounting, however, emphasizes quantifiability which enhances such information attributes as objectivity, comparability, and conciseness, but which restricts the usefulness of the system. Each system is also geared to deal with information relevant to the past, the present, and the future.
B. Inputs

As just mentioned, both systems are concerned with fulfilling the special and recurring needs of users within the bounds of reasonableness and cost. Both systems stress the "tailoring" of information to the needs of users. Thus, inputs are a function of outputs which in turn vary with user needs. Accounting theory presently requires that only those user needs fulfilled by quantified economic information fall within the scope of accounting. As a result, inputs to the accounting system are also limited to quantitative events. Accounting system inputs include both intrinsic and interaction events but are concerned primarily with the quantitative financial and non-financial aspects of the areas.

III. THE AREAS OF MANAGEMENT INFORMATION OUTSIDE THE SCOPE OF ACCOUNTING

The management information system is a much broader concept than the concept of accounting. The chief differences between the two systems relate to the types of information generated, the scope of concern, and the principal orientation of the system. The management information system is more decision-making oriented—that is, it is more concerned with supplying all of the
information required to permit the "tailoring" of the information and knowledge requirements at each decision point. Toward this end, more "imponderables"--that is, formal non-quantified information--are supplied the decision-makers charged with matching the information and knowledge requirements of the various decision points. More concern is given all five of the organization's resources--especially the human resources. In addition, the information regarding all five resources tends to be collected without regard to functional or departmental boundaries; and the "tool bag" available for information generation tends to be somewhat larger.

The management information system is also more planning oriented and future oriented with regard to the total or overall goals of the firm. The system is thus greatly concerned with both quantified and non-quantified management intelligence information. Accounting uses, or at least recognizes, some of this type of information, but is not concerned with the generation of this type of information.

V. SUMMARY

Accounting is an information generating system entirely within the scope of the concept of management
information—that is to say, accounting is a subsystem of the management information system. The accounting and management information systems are both concerned with quantitative intrinsic and quantitative interaction information.

The management information system is much broader in scope than the accounting system. The management information system alone deals with quantified management intelligence information, and it alone is concerned with all of the formal imponderables—the documentary non-quantified information relating to intrinsic, interaction, and management intelligence events.
CHAPTER VIII

SUMMARY AND CONCLUSIONS

The primary goal of this thesis is to reveal the role of accounting in management information systems. The attainment of this goal requires that the exact relationship between information and the business organization also be determined and outlined. The tools of analysis chosen center around the notion of a system. The first section of the paper is devoted to describing general systems theory, the "systems concept," and "ideal systems."

General systems theory states that any system may be viewed as a processor which can be described in terms of five basic elements—inputs, outputs, controls, feedback, and filters. The "systems concept" recognizes that every system is part of a larger system and, in turn, that every system is composed of subsystems. Thus, the boundaries of any system that is to be studies must be scrupulously delineated. The "ideal systems" approach
provides a benchmark for evaluating a system. It is a systems-oriented, forward-looking approach to the solution of problems that insures an optimum solution. These three tools—systems theory, the "systems concept," and the "ideal systems" concept—are used in analyzing and describing business and information systems throughout the paper.

Systems theory was first applied to a social process by Hegel when he pointed out the role of history in the formulation of current decisions. Hegel's view of history as the engine of progress replaced a concept of society in which history was simply a record of the past. Hegel viewed society as an adaptive process possessing certain fundamental aspects. First, there is a set of alternative views about the problems of the present. Second, there is some objective which is to be optimized by a selection of a subset of possible views. Third, a choice mechanism is necessary to determine which subset of views is optimal to society. Fourth, a police system is necessary to impose the optimal choice on the holders of other subsets of ideas. The society then experiences the consequences of the decision and formulates the process all over again. The crucial link is the choice mechanism, and an essential concept is the irreversibility of the process.
The business organization is an adaptive system and the same fundamentals that Hegel attributed to the societal process are applicable. As related to business organizations these fundamentals are: alternate views about problems (planning), some objective to be optimized (organization goals) a choice mechanism (managerial decision-making), and a police system (control). Chambers recognized the business organization as an adaptive process and stated that adaptation requires a knowledge of the states of affairs and their rates of change and that continuous adaptation requires a continuous record. Thus, the view of the organization as an adaptive process stresses the organization's dependence upon information. David Li likens the business organization in a capitalistic society to a biological organism—an adaptive system requiring information for survival. Li presents empirical financial data for business organizations that fit the two empirical propositions that Darwin used as the basis for his concept of "survival of the fittest." The propositions are that all organisms tend to increase in a geometrical ratio and that the number of any species remains more or less

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constant. Li's contentions emphasize survival, which again emphasizes the importance of information to the organization.

The development of organization theories over the years is traced to point out the ever-increasing role information played in these theories. Three broad classes of historical philosophies underlying the operations of business organizations were considered—the economic theory of the firm, traditional organization theories, and behavioral theories. The economic theory of the firm effectively ignores the importance of information by assuming instantaneous decision-making with immediate effect. This assumption requires that the decision-maker be perfectly rational and have perfect, costless information.

Traditional organization theories focused upon the internal workings of the "black box" of economic theory and thus showed some concern for formal internal information. The formal internal information considered by traditional theories was concerned primarily with quantified data concerning efficiency (scientific management) and financial condition (financial accounting). Traditional theories also stressed formal organization structure and hence formal internal communications channels
(principles of management), but little was said regarding the type or form of information, or the effectiveness of communication. That is, the need for and use of internal information was recognized, but the function of generating and disseminating this formal internal information was definitely not emphasized. External and internal, informal information was given scant, if any, notice.

Behavioral theories added people to the organization. The addition of people gave rise to the concepts of informal organization, informal information systems (the grapevine), decision-making, group dynamics, role playing, and the like. Thus, further recognition was given to the role of information. Decision-making emphasized information, but the scope of the information required by the decision-maker was still not given complete and explicit recognition, nor was the important role of information generation and dissemination overtly recognized. Modern organization theorists are attempting to integrate the various theories, to the extent possible, and synthesize a comprehensive theory. Modern theorists have recognized that information is the prime determinant of organization success, and they emphasize the need for organizations to seek and use formal and informal
information regarding both the internal and external environments of the organization.

Modern theory views the organization as a structured process in which persons interact for objectives. However, the goals of the members of organizations will usually not coincide with the goals of large organizations. Thus, control must be exercised by a group—management—to insure that the organization's human and non-human resources are combined in such a manner that the organization progresses towards the achievement of its goals. The non-human resources of organizations are either tangible (assets) or intangible (knowledge and information). Knowledge and information are the core elements of organizations since they are the basis upon which all human abilities depend—doing things, influencing people, and using concepts—and are central to the people-oriented processes of management—communication, motivation, creativity and others. Information and knowledge is judged to be of sufficient importance to the organization to warrant explicit consideration as a function of management—the knowledge maintenance function.

Forrester's simulation view of the business organization is presented to emphasize further the importance of information and to provide a means for discussing and
analyzing the knowledge maintenance function. Forrester points out that the business organization (or any other economic system) can be represented by five physical elements—money, material, orders, personnel, and capital equipment—all integrated by an information network. The organization is simulated using quantified representations of the levels and flows of the five physical factors of the system. Levels are the accumulations within the system. The flows between the various levels correspond to activity, while the levels themselves are measures of the result of activity. Flow rates are determined by the state of the levels according to the rules defined by the decision function. Forrester's view of the organization is unique in that he does not recognize functional boundaries and he views information, rather than money, as the common denominator of economic activity.

The physiology of the organization is widely viewed as being a hierarchically ordered system of decision-making points with each point representing an information-processing unit. Thus, the organization is epitomized as a goal-directed, decision-making process. In this context, the knowledge maintenance function is defined as being concerned with the control of the flow of knowledge to all of the decision points within the organization in such a
manner as to maximize the organization's achievement of goal oriented activities. The function involves the maintenance of two levels of knowledge and control of the flows from these levels to the decision-making points throughout the organization. The two levels involved relate to the internal knowledge of humans (termed knowledge) and to knowledge regarding the resources of the organization (termed information). The management process controls the flows of both knowledge and information into the organization levels and from the levels to the decision-making points. The distinction between the two concepts is clarified by realizing that at each decision point knowledge is supplied by the decision-maker, while information is supplied to the decision-maker. The total information system is the system concerned with all of the information supplied to the decision-maker.

The knowledge maintenance function stresses "tailoring" the flows to each decision point to meet the requirements of each decision point—that is, the decision-maker and the information required by the decision are matched to the decision points. The emphasis is upon supplying each decision point with enough information, of the right quality, when it is needed. This requires that the knowledge and information levels within the organization
be constantly updated. Not only must the information supplied the decision point be current, but the skills, or knowledge level, of the decision-maker, *per se*, must also be kept current. The information to be supplied the decision point must be tailored not only to the specific requirements of the decision to be made but also to the skills, attitudes, and capabilities of the decision-maker—that is, the manager must be supplied with information he can comprehend and use effectively. Ideally then, the information flowing to any given decision point would be adjusted when changes occurred in the capabilities of the decision-maker, or in the information available and pertinent to the decision; or if the manager responsible for the decision were changed.

Inflows to the organization's knowledge level are the result of managerial decisions regarding personnel selection policies and the like, while outflows are a function of employee motivation. Information levels and flows, the total information system, are a central issue of the thesis. The detailed analysis of the information generating system recognizes three levels of information—the syntactic, the semantic, and the pragmatic.

For the purpose of explaining the concept of information generation, "data" is used to refer to perceived
and symbolized events (syntactic information); "potential information" refers to meaning derived from data (semantic information); and "information" refers to the impact upon the receiver (pragmatic information). The informational aspect of the knowledge maintenance function involves the specification of information needs; the selection, observation, and measurement of the events necessary to fulfill the needs; the symbolization of measurements; manipulation of the symbols; and communication. Thus, measurement and the events preceding it produce data which are concerned with the past and generally usable in their existing form. Data manipulation, such as summarization and calculation, converts data into potential information, the level of information available to the organizations. Potential information becomes actual information only when it has been effectively communicated. A communication is considered to be effective if it changes the purposeful state of the decision-maker by instructing, informing, or motivating. Thus, flows into the potential information level are controlled by management through the specification of needs, measurement, and manipulation; while outflows from the level result when effective communication takes place. The entire process described above
is called an information generating system, and includes within it the measurement process, data manipulation, and communication.

There are many business information generating sub-systems. The purposes of this study are served by subdividing the total information system into the formal and informal systems. The informal system relates to the members of the organization as people, *per se*. The informal information system is extremely important to management; but is not relevant to the goals of the thesis and is not dealt with extensively. The formal system is organizationally determined. The formal system is further subdivided into the documentary and non-documentary systems. Non-documentary information, such as information that is conveyed orally or by gesture, is not considered further in the study. Documentary information is the written information system, and includes both quantified and non-quantified information. This subsystem of the total information system is most important to the purposes at hand, and very important to management and the organization as a whole. This subsystem was labeled the "management information system." The terminology used here contrasts with the meanings assigned to the same and similar terms by many authors.
For example, Joplin has written that

Those involved in information theory reason that what is needed is a completely integrated system of data gathering, data storage, data retrieval, and information communication. Such a system would accept data as raw material and, almost simultaneously, would generate information as a product. Such systems are called management information systems, or total information systems.2

The terms "management information system" and "total information system" are used as synonyms by Joplin and refer to the area termed "quantified management information" in this paper. Other meanings are ascribed to these same terms by other authors. The term "total information" is defined in this paper to include all of the information useful or necessary for management to perform its function. Thus, total information includes informal, oral, quantified and non-quantified information. This formulation does in fact encompass total information. Current usage generally equates the term "management information" with "quantified information." This precedent was not followed because quantified information (numbers) per se has no

value. Sufficient descriptive material is necessary to convey meaning. Thus, the prevalent term "management information" was retained but was expanded to include all documentary information—numbers and written material.

Information must be relevant, available, and timely to have value, and thus to qualify as information. Documentary information requires varying degrees of objectivity sensitivity, comparability, conciseness, and completeness. These factors are favorably influenced by quantification; a fact which makes quantification desirable. The quality of documentary information is described in terms of its validity, accuracy, and precision.

The primary goal of the management information system is to expose significant relationships that will decrease uncertainty in organization decision-making, which results in a corresponding increase in the efficiency of utilization of organization resources. A significant portion of the study is devoted to investigating the elements of the information generating process and in considering methods of increasing the value of information and improving the measurement and communication processes. The amount of information required by a manager is a function of the general environment to which the information is related. Information regarding the internal
environment of the organization should be progressively more summarized for managers in progressively higher levels of the managerial hierarchy, while the reverse is true for information relating to the external environment. Information regarding the organization's external environment should be progressively more summarized for lower levels of management.

The management information system focuses upon the analysis of the decision to be made, the information necessary in arriving at a decision, the sources from which the information is to be derived, and the selection of particular sources and the method of generation and communication of the necessary information. The management information system is analyzed from two points of view—inputs to the system and outputs from the system. Outputs are classified as being oriented towards the users in either the external or the internal environment of the organization (management). Inputs are classified as being concerned with intrinsic or extrinsic events. Intrinsic information deals with the internal environment of the organization while extrinsic information (management intelligence and interaction information) is concerned with the general aspects of the external environment and the interaction between the two. Interaction information
relates to both the potential and actual interaction between the organization and its external environment. Intrinsic information is strictly internal and deals with such things as the tracing of costs, production scheduling, and the determination of company strengths and weaknesses. The management intelligence system is concerned with evaluating the general social and economic environment and with informing management of the activities of competitors. Latent interaction information is used as the basis for evaluating alternatives. Consummated interaction information arises from the interaction resulting from a decision.

The information generated by the management information system relates to some aspect of the five elements common to economic systems (money, orders, material, personnel, and capital equipment) and is used for reporting (which is externally oriented), and planning and control (which are management functions). The management function of planning is subdivided into strategic (long-run) and short-run (production oriented) planning. The planning function requires primarily management intelligence, latent interaction, and non-quantitative intrinsic information. Short-run planning is concerned more with consummated interaction and quantitative intrinsic information,
while the needs of the control function center primarily upon quantitative intrinsic information. The needs of external users are fulfilled by information of the narrowest scope—consummated interaction information.

Accounting is currently in a state of flux and much effort is being made to determine the objectives of accounting, to formulate principles, to integrate the subsystems of accounting, and, in fact, to define accounting. The accepted definitions of accounting vary greatly—from a narrowly construed concern primarily with the needs of third parties (financial accounting) to the rather liberal definition recently formulated by the 1966 American Accounting Association Committee to Prepare a Statement of Basic Accounting Theory which views accounting as being concerned with all of the quantified economic information relating to the business organization. The nature of the accounting process is also being debated. Many people view accounting alternatively as primarily a measurement process or as primarily a communication process. Measurement by its nature deals only with past events, and communication is common to all professions, thus accounting must be something more. **The essence of accounting is reasoned to be the broader concept of information**
generation which includes the essential elements of measurement and communication.

General systems theory is used to analyze the accounting system, in general, and the financial and managerial accounting subsystems. The analysis of the elements of the accounting system (inputs, outputs, controls, feedback, and filters) reveals that the elements are essentially the same as those of the general information system previously analyzed.

Restricted inputs, a limited "tool bag," and user-orientation are the main system features that differentiate financial accounting from managerial accounting. The output of the financial accounting system is "third party" oriented and requires that inputs be restricted so as to fulfill "third party" needs. The restricted inputs limit the usefulness of the system to management. Management does use the financial system, but requires additional inputs and the application of additional "tools" to fulfill its needs. The only other features common to both systems is the fact that they are both information systems existing to facilitate the accomplishment of organization goals. Financial accounting is "third party" oriented, but these "outsider" needs are filled only to the extent that fulfillment furthers organization goals.
The 1966 AAA definition, which encompasses both financial and managerial accounting, is compared to the previously outlined management information system to delineate the most broadly interpreted role of accounting in the system. Accounting, as defined by the AAA, is a subsystem of the management information system concerned only with quantitative intrinsic and quantitative interaction information. Even the rather liberal AAA interpretation of the sphere of accounting evidenced little concern for any aspect of the important area of management intelligence, or for the non-quantitative branches of intrinsic and interaction information.

The actual role of accounting in management information systems is a function of many things. Some small organizations do not even have formal information systems, others have only financial accounting systems, and still others have elaborate management information systems. Theoretical discussions are usually addressed to those organizations having elaborate management information systems. However, the theoretical role of accounting in this type of organization cannot be formulated because of the lack of agreement regarding the definition and scope of accounting. Thus, the range within which this theoretical role must fall—somewhere between the narrowly
construed area encompassed by financial accounting and the broadly defined area encompassed by the 1966 AAA definition—is presented.

The 1966 AAA definition was definitely not intended to be a description of accounting as it exists today. The definition must be viewed as a goal; a statement designed to focus the attention of the profession on the need for change and to elicit effort in the proper direction for future growth. The AAA definition of accounting encompasses an area with which several other existing professional groups are also concerned. These professionals—economists, statisticians, and others—deal extensively with quantitative economic information within the business organization. However, a discussion regarding the present and future roles of these groups and accounting in the management information system is beyond the scope of this study.

Much work is yet to be done in the area of management information systems. As previously shown, the general functions of information systems are to determine user needs, to select pertinent data from the infinite variety available from an organization's environments, to create information by applying the appropriate tools to the data selected, and to communicate the generated
information to the user. However, existing systems fall far short of their idealized goals. Much more research is necessary regarding the interrelationships of information and decision-making. Bonini has stated that there is no extensive body of theory extant relating informational variables to decision-making in the firm. Such a body of theory would be very useful as an aid to individual decision-making but its greater use would be in the designing of information systems for decision-making in the whole business system. Such a system would be designed so that factors such as different displays of information, different timing, different linkings of information, and so on could be analyzed in terms of their effect upon the total business decision-making systems.³

Much more work is also necessary in the area of information generation. Churchman makes evident our paucity of knowledge relating to information generation in stating that

A rather significant portion of our resources is devoted to generating and processing data. However, it is apparent that no one knows how the data should be

expressed (the decision problem of data language is unsolved), what data are needed (the decision problem of data specification is unsolved), how the data are to be used in various contexts (the decision problem of standardization is unsolved), and how the data are to be evaluated (the decision problem of accuracy and control is unsolved). 4

This presentation will have served its purpose if it provides some insights for those who attempt such presentations as those mentioned above or to others concerned with information generating systems.

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C. MISCELLANEOUS


VITA

Gerald Edgar Nichols, born July 12, 1929, the eldest of six children, in High House, Pennsylvania, received his elementary education in Nemacolin, Pennsylvania. After completing one year of work at Cumberland Township High School, he enlisted in the Army Air Corps in August, 1946, but later transferred to the Army Paratroops. A year after being discharged from the Paratroops, he re-enlisted in the Navy for four years.

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During his graduate career at the Louisiana State University he was a Graduate Teaching Assistant in the
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