NO. 156-65  CANCELLED
WORKING PAPER
ALFRED P. SLOAN SCHOOL OF MANAGEMENT

THE CONCEPT OF THE INFORMATION SYSTEM OF THE ORGANIZATION

157-65

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I. Introduction

The existing work on the information subsystem\(^1\) has been devoted to describing desired outputs from the information subsystems and to describing activities in organizations -- mainly centered around computers -- which are called information subsystems.

Anything can be described in a variety of ways depending upon the interest and purpose involved. Weight, cost, value, inputs, outputs, color, location, and size are all individual descriptions of an object. Yet for many purposes these are insufficient either separately or jointly. And this is also true of information subsystems. It is the object of this paper to describe information subsystems from yet another point of view. This will be the point of view of the information specialist, the individual who designs, operates, modifies and functions in the information subsystem.

The information specialist must know the scope and boundaries of the information system in both a theoretical and a practical sense. He must be aware of the interactions and relations between it and the other subsystems of the organization. He must know and understand what is part of the information subsystem in a theoretical sense and what elements of the organization are to be considered elements of the information subsystem for purposes of control and responsibility.

These questions will not be answered explicitly in this paper. There is no one answer because this is a task of developing a corpus for a label when there are few if any guidelines. So in place of a flat assertion, a description of the issues and of the organizational elements involved will be given, along with a discussion of these and arguments for their inclusion or exclusion from the information subsystem of the organization.

\(^1\) Occasionally the phrase "information system" is used interchangeably with "information subsystem."
The problem is that there are many elements of the organization which may be associated with the information subsystem and at the same time may be associated with other subsystems of the organization. A primary question is "to which subsystem does an element belong theoretically" and another almost equally important question is "to which subsystem should an element be identified operationally."

These questions do not have one final answer. There are many answers, each depending upon how we wish to define the term "information subsystem" of the organization. The following discussion is designed to reveal these issues and present a suggested solution.

II. Basis of Discussion

One way of determining the concept of the information system of the organization is by determining its functions. To do this it is first necessary to have a set of functions from which to select and a basis for selection. The set of functions can be developed by adopting a relevant, functional description of the organization.

The decision-making description of the organization seems best suited for this purpose. By describing the organization from the decision-making point of view all the processes involved from recognition of relevant phenomena to the crucial act of choosing among alternatives will be described. Of all the possible descriptions of the organization this one is most likely to be a description which is divisible into functions which can be related to the information subsystem and those which cannot.

This division will be difficult since no basis for selection exists, as the very existence of one would imply a definition of the information subsystem of the organization. As suggested earlier, the definition of the information subsystem (i.e. what processes to include and exclude) is
essentially arbitrary, as the name appears to have come into existence as both an idealized concept and the label for that concept. Although a definition will be suggested, this suggestion will be made only after the processes in the decision-making approach are identified, described, and their controversial aspects vis-à-vis the information subsystem discussed. Such a procedure emphasizes the arbitrariness of any definition of the information subsystem and focuses attention on the set of related activities rather than the label.

This approach is conceptual rather than operational and there are problems in moving from a conceptual to an operational definition. After the suggested conceptual definition of the information system of the organization is presented, these will be described and discussed. Then an operation definition which will be essentially a modification of the conceptual one will be offered also.

III. Elements of a Decision-Making View of the Organization

A decision-making view of an organization can be represented by a model of the organization in which each decision point is emphasized, or it can be represented by a general model of the group of processes involved in the set of activities which terminate in a decision. As the second approach seems most useful to this discussion, it will be used.

The model, called hereafter a module, starts with an environment, defined as anything outside the specific module including the remainder of the organization, which is perceived. In the process of perception the environment is monitored in a predetermined fashion. According to a given criterion, some aspects of certain events are noted. These aspects are coded, then recorded and stored. As needed, the stored data is retrieved, processed and presented to the decision unit. The decision unit performs
three separate functions. They are intelligence, model building, and choosing. The module and a simple general combination of the processes are illustrated in Figure I.

This module can be used in multiples and combinations of Figure I or in a modification of it, to represent the decision making performed in an organization. In a specific instance one or more of the processes may be omitted. The figure is not a representation of an organization; it is a general representation of a process which occurs in every organization. In this sense it represents the parts of every organization. In the sense that any organization is more than what is represented here, the figure does not represent an organization.

In any organization there is action producing an effect on the environment and there are goals and objectives. These affect and are affected by the process, but are not a part of it. The following discussion of the process and its elements will establish its characteristics and their relation to the organization and its elements.

Environment

The environment is that of the decision not the organization or organizational element. Thus, the environment relative to the decision may be the environment of the organization, the organization itself or some small element of the organization.

Perception

Data -- that which is processed in the system -- must enter the organization in some fashion. This process of initially entering the organization will be labeled perception.

This process of perception occurs in many guises in organizations. In an organization the members who deal with the environment are constantly
The Module of the Information System of the Organization

(The arrow lines indicate both channel of transmission and the act of transmission)
perceiving, to some extent, aspects of the environment which have some significance for the organization. Aggregate and individual customer satisfaction is one example. Another is perception of sources of supply and their continuing availability, and still another is the perception of competitive activity.

The process or act of perception is to a great extent instilled in the device, animate or inanimate, which perceives. The environment of any person or organization is extremely complex. Even a segment of this is complex. A comprehensive detailed description of some aspect of an environment is a mammoth task. Consider the detail necessary to describe the complete act of reading. What is being read, who is reading, clothing, posture, and location are a few of the grosser aspects which are part of the description. In addition a multitude of fine aspects are also part of the description. Much can be said of any segment of an environment no matter how small it may be.

But we do not attempt to describe in toto a segment of the environment, we seize on one aspect, one particular phenomena or set of phenomena and describe it. How do we decide what to select; what is the criterion?

There are, at least, four factors which contribute to the process of selection. They are medium of expression, culture, education, and physiology. These factors are not separable and distinct from each other. They are so closely related that it is often difficult to distinguish one from the other. All four affect in some manner how the individual perceives the environment. This artificial division serves the purpose of emphasizing major characteristics.

Medium of Expression

Except by recreating the object, event or whatever is being described (provided it is not uniquely sensed by one individual as in the case of an idea
or an emotion) the description must be couched in some medium of expression which, by its nature, must describe rather than recreate. It is at this point that the limitations of the language come into play.

What is being described originated in one medium of expression and must now be recreated, as it were, in another medium. This second medium of expression is not natural to what is being described. Consequently, in the translation (recreation) process some of the aspects of the original occurrence are altered, omitted and supplemented. This defect is often reduced by developing, within a language, a technical jargon which facilitates more complete descriptions in the specific technical area. There are limitations to this. One is the number terms which must be assimilated by an average user of the language. Another is the interpretations of the various terms by individual users.

By and large, however, the translation from the natural medium of expression to a descriptive medium of expression, or from one descriptive medium to another entails some loss of detail and some distortion. This is apparent when someone who has been exposed to something in the artificial medium of expression is exposed to the same thing in the natural medium. Invariably there are comments about unexpected aspects or degrees of characteristics which are apparent in the natural medium.

Culture

The cultural background of an individual in addition to the culture in which he operates at any one time contributes to his acceptance, rejection, and omission (not noticing) of many events in his environment. The cultural effect causes some things to be regarded as important because of the social value attributed to them and other things to be regarded as unimportant because of insignificant social value attached. For example, in our society
indebtedness is an acceptable and useful institution yet in some historical cultures it was severely condemned. Murder is deplored in our society, yet it is a way of life in some aboriginal tribes. Many of the deplorable social conditions in a society are accepted because they have existed for a long period.

Culture affects perception in a macro or background sense. It affects the perception of individual events indirectly by affecting the acceptance and hence perception of large classes of events.

Physiology

The physiology of selection to the perceiver tends to limit physically what is sensed and how it is sensed. The decimal number system is attributed to the number of fingers we possess. Certain ranges of sound and certain degrees of sight are beyond human capability. Color perception, or the lack of it, between individuals affects relative perception. Our physiology limits in another dimension our perception.

Education

Language, culture and physiology are all macro factors of perception. They determine in broad terms the boundaries and limits of perception. Specific aspects of perception, within the organization and with respect to the organization can be ascribed to education.

Education in a general sense has been included in culture. At this point education will be considered in a more specific manner with respect to vocation. Here the term education will be construed to include informal as well as formal training, experience and conclusions drawn from experience.

This education forms within the individual a framework -- a set of relations among aspects of objects and things -- which is a basis for prediction and decision making. This framework or theory emphasizes (rightly or
wrongly) certain aspects of the environment and certain characteristics of these aspects as being essential.

For example, in a sale to a customer in a department store some aspects of the transaction are perceived and recorded and others are not. The item sold and type of sale, cash or credit, is noted. The time of day and the age of the purchaser are not. This selectivity occurs because it has been established that the item purchased and the type of sale are aspects of the transaction the organization should perceive while time of day and age of customer are not.

Although education works in the framework of the other constraints to perception, it can also extend them. Education may focus the attention of the individual upon something culture tends to ignore or accept. Again education may include a technical jargon which supplements language. Finally education along or in conjunction with technology may extend the physical capabilities of the individual.

Non-human Perceivers

This discussion on perception has been implicitly related to humans but perception is not a function of humans alone. It can be performed by animals, machines and other systems. In a man-animal or a man-machine system where man's perceptive powers are augmented, the non-human element perceives a certain limited class of phenomena of the environment according to design specifications, and, also in accordance with design specifications, the non-human element transmits a signal which is in turn perceived by the human who has probably been trained in the significance of the signals. A Geiger counter and its use is an example.
Recordation

Recordation as used here means the physical capture of signs and symbols so that they can be subsequently (in time) examined. Thus, a transmission media such as air or wire is not a record media such as paper or film.

Recordation can be combined with another aspect of data processing language. A stenographer using shorthand is an example of this. The stenographer translates into another language and then records the message (dictation) in this language.

Communication includes recordation, but is not restricted to it. Messages need a transmission medium if they are unrecorded or transportation if they are. Also a message can be transmitted unrecorded and then recorded when received. Thus, recordation is related to recorded communication. The recordation can be prior to transmission, for transmission or after transmission of the message.

Storage

The storage of information presupposes some sort of recordation and a location. These can be combined such as core storage in a computer, or separate such as invoices kept in a file cabinet. Essentially anything that is recorded is stored even if for a very short time.

With respect to the information subsystem of the organization, there is no such thing as a formal and informal system. This terminology is useful to another field -- organization theory -- in discussing types of organizations, their patterns and their coincidence in an organization. This is usually denoted by a remark about the formal and informal organizations within a firm or the formal and informal communications systems within a firm.

These terms refer to two functionally different communication systems which may supplement each other. These systems are functionally different
because their reasons for existence are different. The communication system of the firm exists primarily to further the objectives of the firm while the communication system of the informal organization of the firm exists primarily to further the objectives of the members of that organization. When the formal communication system of the firm is incomplete for furthering the objectives of the firm, it is usually supplemented by the informal communication system.

The operations of the information subsystem of the organization also have a two part division from one point of view. However, this division is not the same as the informal-formal division of the communication system. These divisions of the information system of the firm can be characterized as recorded and non-recorded. This pertains primarily to the storage or non-storage media on which the messages or symbols are stored. If they are imbedded or stored in some media, then what is being communicated is recorded. For relatively fixed storage the communication is temporal while for relatively mobile storage the communication is spatial as well as temporal.

Retrieval

Retrieval is the search for recorded data. The reconstruction or redevelopment of data which has been lost or unrecorded is not included under the concept of retrieval. Recorded data which has been formally stored in a location or a system is the major retrieval problem although recorded data which has been informally stored (i.e. records which are "lying" around) is also a retrieval problem of less importance.

To facilitate retrieval some locational notation of recorded data, in the terms of search, (the characteristic on which the search is based) is essential. This locational notation can be in physical terms, or it can

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1 There can be other secondary objectives.
be relative to other recorded data.

**Data Processing**

Up to this point the original signs or symbols have been modified and even transformed according to the general needs of the information system. The signs and symbols must be transformed also according to the specific needs of the system. This specific transformation will be labeled data processing.

This processing of data for the specific needs of a firm, as a system, is necessary to produce the inputs to the decision-making models of the organization. The unit date in the information subsystem must be transformed according to some predetermined rules, rules which also dictate the form in which the data must arrive at this stage. These rules of transformation indicate which data are to be transformed and how.

The transformation may obliterate the original recorded data or it may not, the latter is preferable of course. Whatever the case, the results of the data processing are also data which makes its own initial entry into the system at this time.

**Transmission**

Transmission is another aspect of communication and deals with the means by which data -- signs and symbols -- are transmitted through time and space.

In a temporal sense recorded signs and symbols can be considered as transmitted. More generally transmission pertains to the physical movement of signs and signals. Many aspects have been studied in the field of electrical engineering where much theoretical and applied work in this area has been performed. Transmission occurs repeatedly throughout the information
system. It can be said that whenever the system is in a passive or static state there is no transmission. But whenever the system is in an operating -- dynamic -- state, which is the normal state for most information subsystems, there is transmission. Transmission is a descriptive term for the flows which occur in an information system.

Presentation

Presentation is the placement of data both at the place and time desired; it also includes the sequencing of data as in a report or display and especially the form in which data is presented. Presentation is an old problem which has many varieties of solutions.

For written reports there are synopses, summaries, and outlines in addition to underlining and italics or capitals. Accountants use headings, subheadings and underlining. In prose selected words create a mood. More recently much has been done with electronic display systems.

Decision Making

There are three major aspects to decision making according to Simon. They are intelligence, model building, and choice.¹

¹ The exact words are: "Decision making comprises three principal phases: finding occasions for making a decision; finding possible courses of action; and choosing among courses of action," and in explanation "The first phase of the decision making process -- searching the environment for conditions calling for decision -- I shall call intelligence activity (borrowing the military meaning of intelligence). The second phase -- inventory, developing, and analysing possible courses of action -- I shall call design activity. The third phase -- I shall call choice activity."

Intelligence is principally the act of monitoring the environment for trends and tendencies as well as individual phenomena which affect the organization in the present or future. This monitoring utilizes of course the activities necessary to bridge the gap between the phenomena in the environment and the judgment as to what is relevant to the organization and how.

The second stage, paraphrased as model building, is a more advanced form of intelligence activity. Not only have the phenomena affecting the organization been identified, but the manner and some degree of how they affect the organization have been determined (in some general form), and a predictive device of effect or counter action has been developed. This can either be explicit or programmed decision models or implicit or unprogrammed decision models.

The final phase of decision making -- choice -- is assumed to be well known and completely understood.

This completes the description of the processes contained in the module representing the decision viewpoint of the organization. The next step of course is to discuss the problems of including the various parts of this module in the conceptual definition of the information subsystem of the organization.

IV. A Conceptual Definition of the Information Subsystem

Conceptually, there are very few constraints on a definition of the information subsystem. The existing literature is quite consistent in implying that storing, retrieval, and data processing are processes of the information system. In what is considered data processing both a form of perception (reading) and a form of recordation (writing) occur. It is not clear from the literature whether these, as general processes, are considered as part of the information system, or indeed whether this point has arisen at all.
At the other end of the module is decision making. The relation of this process to the information system raises a problem and illustrates the element of arbitrariness in any definition. In personal discussions with students and colleagues and from a study of the literature it appears that many strongly support the position that decision making is a part of the information system. And, of course, there are many operational situations which apparently support this view. This may be only apparent, however, because an operational relationship is being advanced in support of an aspect of a conceptual definition.

Decision making within the firm can be divided into two parts (for this discussion). There are decisions which relate to the information system per se rather than to the firm directly, and all other decisions. In the first part are such things as information system personnel assignments, work loads, methods of data processing, and general techniques. In general these decisions relate to the management of the information subsystem. All other decisions include the choice of decision models for the functional activities, the selection of input data or the criterion, etc.

Thus, the information subsystem of the organization engages in decision making that pertains to itself as a subsystem of the firm. And this part of the decision making within the organization is part of the information subsystem. The remainder, and major part, of the decision making within the firm is not as closely associated with the operations of the information subsystem. But the relationship between the processes of the information subsystem and the decision making are close enough to raise the question of including decision making as part of the information subsystem. This is a major point of controversy about the nature of the information subsystem.
It is now possible to offer a definition, in terms of operations, of the information system of the organization. The following definition is suggested: The information system of the organization is that subsystem which perceives, records, stores, retrieves, processes, presents and transmits all data used for decision making in the organization.¹ This includes all processes from perception through data processing of Figure I but excludes decision making.

One reason for including only these processes is their common characteristic data handling and data transformation. Given the basic constraints, goals, decision models and decision rules of the firm as underlying conditions, the focus of attention for each of these processes is data. The sole function of each of these processes is a transformation of data. Each performs a different type of data transformation, yet it is upon data that this transformation is performed.

¹ This definition has been anticipated to some extent by postulated definitions. Some examples are:


"Information handling is the process of collecting, manipulating, and transmitting information, whatever its use is to be." Robert N. Anthony, Planning and Control Systems: A Framework for Analysis, (Boston: Harvard University, 1965), p. 94; and

Decision making, on the other hand, does not have data as the focus of attention. Instead data is a subordinate and contributing element.

The definition given above describes the information subsystem in terms of what it does. It is not a statement of the structure of the information subsystem. These processes may each appear innumerable times in any information subsystem. Each will probably not appear an equal number of times in the same subsystem since the structure of each component of the subsystem and therefore the processes it contains, are not rigid. The definition describes only what the information subsystem does, and says nothing about how.

There is a clear implication about the sequence of the processes. The sequence of the processes as given in Figure I must be observed in the general sense that no process can function unless the prior processes have been performed. Recordation cannot occur if nothing has been perceived to record. Retrieval cannot be performed if nothing has been stored.

The information subsystem is not the decision-making organ, it does not include all decision making, for the whole organization. It has the task of receiving data, perceived by others, classifying and storing this data, and generating, in conformance with given models, the information needed for decision making.

Another crucial function the information subsystem performs is that of consultant to the remainder of the organization on matters pertaining to data form, communication volume, data perception, model feasibility, and costs. As in other departments and functions of the organization, there are areas of overlap where usually no one of the elements is completely aware of all the problems, needs and constrains that are present. Thus the groups, departments, or functions must pool their resources and abilities to determine jointly what needs to be done, what is available and what can be accomplished. There
are matters, in which the information subsystem personnel are expert, that affect the other decision makers in the organization. This may be the construction of a decision subsystem, the means of achieving a result, the form of data, or data communication. In these matters the information subsystem is able and needed to perform this unique function.

Those familiar with data processing and accounting will see immediately many similarities between the processes involved in each of these and the definition of the information subsystem of the organization. This is not coincidence or change of course. Each of these, data processing and accounting, is a major element of the information subsystem of any organization. Each is composed of the processes which are defined as the information subsystem of the organization.¹ They are composed of these processes in the sense that these processes can be identified in both the total activity and in elements of the activity for each.

Accounting

The accounting process of an organization can be broadly construed to start with transactions between the organization and its environment, narrowly as the receipt of the transaction record by the accounting department, or something in between.

The existence and recurrence of the processes which are defined as the information subsystem of the organization in the accounting process will be

illustrated best by examining the accounting process broadly construed, that is by starting with the transaction between the organization and the environment, such as a sale or a purchase.

The processes of the information system are perception, recordation, storage, retrieval, data processing, presentation and transmission. All of these are present in the accounting subsystem. When a sale or purchase is made, it is perceived as such, usually by the individual involved and that individual in accordance with prior training or a set of instructions, perceives the important elements of the transaction which are usually, item, amount, cash or charge, data, department, etc., for a sale, and records this information. In this capacity the individual is acting as an element of the information subsystem. This data is stored in a cash register tape, on the retained copy of the sales slip or purchase order. This stored data is transported to the accounting department where the perception process is repeated relative to the media containing the stored data.

After perception occur recordation in journals, storage of the journals, retrieval of the data in the journals, processing, recordation again in ledgers, further processing and finally presentation in the form of financial statements.

All the processes defined as the information system have occurred. The sequence of the occurrence is different than the illustration in Figure I. This is to be expected. It is quite likely that not all of the processes will appear in some of the information subsystem components. However, they all will appear in the information subsystem.

Data Processing

Data processing is generally defined as automatic or electronic depending upon whether machines or a computer are utilized as the major unit. In each
case for our purposes, the analysis yields similar results. Since EDP is a richer example, it will be used as an example. Data is fed into the EDP system by cards, punched paper tape, or magnetic tape. The system perceives either mechanically or electrically the input media and the signs carried. This is perception even though the perceiving mechanism is quite limited in what is admitted to the system. The perceived phenomena are expressed in system media, electric impulses, and transmitted to other parts of the system. They are stored, retrieved as desired, processed according to a set of instructions, transmitted internally to other parts of the system and finally presented. Again a set of instructions controls the presentation, content, format and even recipients.

Different groupings of these processes can occur. For example, a program subroutine will probably comprise retrieval, processing and storage. Although this is interesting it is significant that all the processes of the information system are found in this subsystem also.

These two examples illustrate the all pervading nature of the set of processes described as the information system of the organization. These processes can occur jointly with many other processes not a part of the information system. A prime example of this is a human who is able and does perform all of the processes we have described but can also make decisions and execute them in addition to performing even other processes.

The most controversial aspect of this definition is the exclusion of decision making. The scope of the information system, if it included decision making, would be too large and would be in fact identical with the organization. It is evident that the information system, including decision making, would be identical with the organization since by definition the module is the building block of the organization. Hence, when we define all
the elements of the module, and, consequently, the module itself as part of
the information system, we define the organization as being identical with
the information system.

Defining the information system as the organization defeats one of
the purposes of identifying the information subsystem. That purpose is to
investigate and understand that segment of the organization identified as the
information subsystem.

It is possible to argue that identifying the information subsystem
as the organization establishes the absurdity of the notion of the information
system, and it should be dropped. This argument can be refuted on the grounds
that among the processes, except for decision making, there is such a community
of relationships, and that these are, as a group, so relatively unexplored and
underdeveloped that they can contribute greatly to any organization. And
that this area deserves, as it is getting operationally, direct attention.

Decision making calls on experience in each functional area of
decision making. Each of these alone is a large field of study. Combining
all of these and adding them to the other processes produces a field of
study (the whole organization) which is too immense to permit any of the
specific analysis and decisions necessary for the existence of the organization.

Summary

A suggested definition of the information system of the organization
is the set of processes described as perception, recordation, storage, retrieval,
data processing, presentation and transmission. These are suggested as the
information system because they have many common characteristics which foster
their treatment as a group. Decision making is omitted because it lacks
some of these common elements and is consequently not as closely identified
with the group as any of the other processes, and because the inclusion of
decision making would render the information system synonymous with the organization.

V. An Operational Definition of the Information System

So far this discussion of what constitutes an information subsystem has been developed along theoretical lines. On the theoretical level it was assumed that acts and processes performed in the organization are completely separable conceptually, but this may not be true in a physical sense. Thus, a physical element of the organization which performs two different processes was considered, with respect to the processes, separable. Divisibility was assumed, for theoretical purposes, so that any physical unit or any part of any physical unit which performs a process that is defined as that of the information subsystem can be classified as part of the information subsystem and anything not satisfying this criterion can be excluded. For example, a human may perform both as an element of the information subsystem and as an element of the decision subsystem. In the conceptual discussion he was considered divisible and the relevant division a part of each subsystem. A similar statement can be made about the computer viewed as both an element of the information subsystem and the decision subsystem.

The practical level of discussion will recognize these limitations and others and will be an attempt to formulate an operational concept of the information subsystem. By operational concept, I mean a guide to the identification of those functions and physical units of an organization which should be necessary for the existence of the information subsystem.

The major problem in the development of an operational concept of the information system are the indivisibilities mentioned above. These indivisibilities on the one hand and the diffusion of many information subsystem processes among the traditional segments of business on the other appear to be
the chief causes of the confusion which surrounds the definition of the inform-
ation system conceptually as well as operationally.

The suggested operation definitional depends upon a reconciliation of both these sources of confusion. If a physical unit of the organization as part of its make-up, contains an information subsystem process, what is the remainder of the unit? With what other segment of the organization can the remainder of the physical unit be identified? And obviously it must be identified with some other segment of the organization.

The problem devolves around the fact that in organizations it has been found to be unsatisfactory to put partial control of an indivisible physical element of an organization with two or more different organization authority points such as departments. This leads to the confusion of multiple authority and indefinite responsibility. The generally acknowledged solution of course is single authority and responsibility for every indivisible physical unit of the organization. Since these same indivisibilities are present in organizations at present with viable organizational structures, this problem has been resolved for these indivisibilities and organizational structures. This tends to be unnoticed because the solutions have been in existence for a long time, and, consequently, their general acceptance tends to render them unnoticed. Some examples may be helpful.

Accounting data is generated and to some degree processed in various parts of an organization. Sales personnel initiate sales data and production personnel initiate production data. In each case the personnel are doing something unnecessary to their primary function of sales or production even though it is essential to the welfare of the total organization. A building which houses several departments is also an example, although here the solution is different.
When an indivisible unit contributes to two different departments unequally (to one a great deal more than another), the unit is assigned to the department of primary contribution. On the other hand, when an indivisible unit contributes to many departments in the same fashion, then the unit is assigned to none of them and is usually part of another department often designated a service department.

It is these two types of indivisible units which comprise the operational information subsystem just as these two types of units comprise all other departments of an organization. A suggested method of identifying what goes where follows.

First, consider the unit that serves many departments by primarily performing the same service for each. This unit belongs in the information subsystem if the service performed for the separate departments is one of the information subsystem operations.

Second, any unit which performs an information subsystem service for the information subsystem and another type of service for some other department in a joint fashion could be placed in either department on any one of several bases. Some of these possible bases are:

1. Location of activity. If the activity or service is that of the information subsystem, but located in another department, the unit could be assigned to either department subsequently. This would probably be a function of the power structure of a given organization.

2. Percentage of activity. If the unit performs services for the information subsystem appropriate to the information subsystem and services for some other department appropriate to that department, assignment to either department could be upon the percentage of activity attributable to each.
The percentage of activity seems to be the best basis for inclusion or exclusion of organizational elements in the information subsystem and is the basis of the following definition: Operationally the information subsystem of the organization should consist of those elements of the organization which devote at least 50\% of their activity to one or more of the processes of the information subsystem.

A computer which is used solely to record, retrieve, process, present, and transmit data would be an element of the information subsystem. Another computer which controls processes primarily and handles data secondarily would be in the production department, and a computer which serves equally several departments for decision making as well as the information department would constitute, probably, another department, a practice frequently followed today.

A salesman, in addition to generating sales, often reports on customer and competitor activities which might affect the organization. Although he is part of the information subsystem his primary activity is selling and the salesman would not be considered a part of the information subsystem operationally.

VI. Implications for the Organization

The relationship between the information subsystem and the physical elements of the organization will be considered on a theoretical basis and a practical basis. These will correspond to the conceptual and operational definitions given above.

The intent is to view the organization as a system composed of subsystems which are interrelated and to discuss the interrelations between the information subsystem and the remainder of the organization, and to describe the possible effects on the total system that can be achieved via
these interrelations.

Theoretically the information subsystem is an essential element of the organization. Without it there would be no organization, merely a collection of objects. However, the information subsystem by itself is not the organization although it may be an organization. The existence of an information subsystem may be prima facie evidence of the existence of an organization which is not identical with the information subsystem.

The information subsystem is an essential element of the organization because it connects all elements of the organization by its communication channels and because it obtains, stores, and processes the data required by the system. But not only is the information subsystem an essential subsystem of the organization, it is an integral part of the total system. It is not superimposed on the organization: it is of the organization not in addition to the organization.

Many physical elements of an organization are theoretically elements of the information subsystem in addition to being elements of other subsystems. At any specific instant the element may or may not be an active element of these systems. The role of an individual or a computer as a component of the information subsystem or some other subsystem of the firm has already been discussed. This same multiple function attribute is characteristic of many other elements of the firm.

One of the interesting aspects of the information system is its relation to the remainder of the module reflecting the decision making view of an organization. The boundary dividing the information subsystem and decision making is artificial and is not a barrier even in the conceptual sense. Decision making and the information system must interact for the best interests of the organization.
This interaction will ideally occur between two domains or individuals each of whom is an authority in his own right. The decision maker develops models which require certain data. As a matter of course, the decision-maker must know something about the information subsystem; he must be familiar with it. In the light of his knowledge in his special area of decision making, needs, his knowledge of the information subsystem, and the environment, the decision maker formulates models which are predicated upon certain data.

The information specialist is responsible for supplying this data. Consequently, it remains for him to determine the possibility or feasibility of collecting the specified data. If he decides for any reason that the specified data cannot be furnished, it is incumbent upon him to utilize his special knowledge in the area of the information subsystem and his general knowledge in the area of decision making to suggest or aid the decision maker in developing alternative data and decision models which are satisfactory substitutes.

Some examples will illustrate these points. Consider a profit maximizing model which calls for marginal revenue and marginal costs which do not exist although the incremental costs and revenues do exist. In this situation the information specialist would indicate that the marginal data do not exist, but suggest as a possible substitute the incremental data. In illustration of the same point it should be noted that at present operations researchers frequently specify, in their models, data which the organization (i.e. that part charged with collecting data similar to the type needed; usually accounting) does not collect or have available. Very often in such cases the operation researchers go out and generate this data. This is clearly a case where the information subsystem fails to satisfy the needs and demands of the model builders.
It is an interaction between the information subsystem and the decision system rather than an isolation from each other which must be developed. This cannot be established by fiat, of course, but will be the direct result of individual interaction. It can be encouraged and nurtured by an early understanding and respect of the part each plays in the organization.

The "new" feature of the management information subsystem of the organization is the attention it draws to this group of basic activities of the organization. The activities are not new, but grouping them together and recognizing similarities in these activities in the various functional areas of the organization is new. While it is true that we can say only that the emphasis introduced by the concept, the management information subsystem of the organization is new, the whole topic is not to be dismissed lightly. As a result of the increased interest in data processing and data, and their perception and transmission, there are intensive investigations of all elements of the information subsystem.

Interaction of the information subsystem with the other subsystem of the Organization

As mentioned earlier, the information subsystem of the organization exists as part of the organization, not separate from it. The subsystem supplies the information needs of the organization within the framework of the constraints which exist. The information subsystem is the focus of interaction between the desired information needs which are in turn dictated by the specific models and their sophistication which the decision makers are using as a decision framework, the data available which is in turn a function of another set of theory, and the constraints imposed by such scarce resources as time and money. Thus, there is an interaction between the information subsystem and the other subsystems of the organization. This interaction is continuous and as a result of it, the specifications for data are developed.
Integration

An important potential of an information subsystem of the organization is the integration of the whole organization it can foster. A current complaint about business is the possibility of an occurrence of instances where two elements of the same organization pursue incompatible goals, to the detriment of the organization as a whole. Another complaint of the same nature, but less intense, is that the division (also known as compartmentalization) of an organization often creates invisible but impenetrable walls for every type of lateral communication and cooperation.

These situations arise for many reasons. It would be an excursion to review them, for our concern here is with how they arise. In part this occurs from the formal organizational framework. This is not sufficient, however. An additional essential element is information control which includes control of data, control of information, insufficient information about activities of other departments that conflict or compete, and incomplete communication of information. An information subsystem of the organization can be designed to overcome these, but in the absence of such design they are generally not controlled, primarily because there is no one agency responsible for the information within an organization. The need for such services is felt and expressed in many ways.

Control of data and control of information are obvious results of compartmentation of an organization. For the most part this is unintentional and is the result, in part, of individual departments collecting their own data and developing, from this data, information to satisfy their own internal needs. When this occurs, basic data is lost in the aggregation process which produces information and, in addition, the availability of both the information and the data is usually unknown to other groups. It is a very common complaint
of consultants that desired data and information is quite often available in a business, but that its existence is known to only a few or that it has been rendered inaccessible through aggregation, storage or both.

Retention of information within a department is also caused by inertia. The effort and cost of searching either for needed data and information or for prospective users of data and information on hand is definitely greater than the cost of doing nothing in the second case and may be greater than the cost of doing it yourself.

Insufficient information about activities of other departments that conflict or compete, and incomplete communication of both data and information can be considered only remotely as proper functions of a department. Communication of information by a department about its activities to other affected departments requires cognizance of the interrelations of the various departments in general and the interdependencies of their internal decisions specifically. This cannot be construed as the responsibility of each department with respect to other departments by even the broadest interpretation of departmental responsibility. Again the communication of data and information available for dissemination is, despite departmental barriers, a responsibility of the organization as a whole, but of no particular department specifically.

The information subsystem of the organization as a department or functional area concerned with an internal cross functional or cross departmental operation is a natural place for this type of integrative activity. It is also ideal because of the commodity data, which is being handled.

Integration of the components of the organization will not be a function of the information subsystem. It cannot be a function of the information subsystem because it depends primarily upon the cooperative interaction
of the components of the organization. The information subsystem can contribute to integration but it cannot cause integration by itself.

The contribution of the information system to integration is significant even though it is not causal. This is due to the unique characteristics and functions of the system which are not present generally in any other subsystem of the organization.¹

A New Functional Area

The activities, functions, operations, and components of the information system of the organization are sufficient in number, importance, and complexity that it will probably become a new functional area of the organization. This new functional area will encompass many operations each formerly performed by the other functional areas and may include at least one more.

Data collection and processing is one of the more onerous tasks faced by many decision makers. To the extent the information system performs these tasks the individual decision maker is freed for other decision making. However, the decision maker does not abdicate his control over the specifications of the information he needs. The individual decision maker will determine his information needs, hopefully in consultation with an information system representative, in view of the decisions he must make, the decision models available and the data available from the environment.² The information

¹ A notable exception is planning.

² Definitely there should be no limitation, at least theoretically, to the data presently available in the system (collected and stored).
system consultant can probably offer some help on all these aspects.

It seems obvious that the information system of the organization need not exist operationally as a department of an organization. Indeed, for years, it has been imbedded in organizational structures which take no explicit notice of the information system.

The suggested operational definition indicates that the information system can exist as a separate segment of a firm such as department. The conceptual definition has indicated a set of processes which exist apart from the existing organizational divisions and yet contribute with them to the whole organization.

These definitions support the belief, of those interested in information systems, of the existence of a set of processes, in the various parts of the firm, with sufficient common characteristics to be grouped together for study, research and operations. Yet the establishment of this essentially new field does not impair in any respect the existing fields,¹ and there is the definite possibility that through this focus of attention upon processes of the organization which have been relatively neglected until recently, there will be benefits either direct or indirect to these fields.

These benefits will develop as a result of change in the role of the processes which comprise the information subsystem. Where formerly their role was secondary, now it will be a primary one. Where formerly they were tolerated, developed, and utilized only to the extent necessary to further some subgoal of the organization, they are now recognized as a significant aspect of the organization and contribute in their unique manner to the

¹ Including the field of accounting which it encompasses.
VII. Conclusions

This paper is theoretical; even the suggested operational definition of an information subsystem is theoretical. As a theoretical paper, it is open to criticism for not contributing directly to the solution of the three major operational problems of information systems: understanding information systems; measuring the effectiveness of information systems; and devising improvements to information systems.

The planned contribution of this paper to the study of information subsystems is the delineation of the elements of the information subsystem in theory and in practice. The expected benefits are the identification of the total area of interest for those interested in information subsystems and an understanding of the relation between the information subsystem and the remainder of the organization.

In a field of study a statement of the field is theoretical but serves, to a degree, as a guide to what is contained within the field and what is not. A statement of this nature does not directly contribute to the solution of the operational problems of the field; it does contribute indirectly by identifying the field.

This is expected of the definitions suggested here. They will contribute to an understanding of information subsystems, indicate the various elements and indirectly where problems and the need for solutions may arise.

The information subsystem of the organization will not introduce anything new into an organization. If the organization exists, then so does the information subsystem. Recognition of the existence of the collection of related activities we call an information subsystem is important. Such
recognition permits study of these processes as a system and enables us to see potential efficiencies and develop the system thus contributing to the welfare of the whole organization.

This contribution to the over-all welfare of the firm will arise through the more efficient use of existing tools and the development of additional helpful devices. The information subsystem is not a panacea; it is a segment of the organization which has long been ignored and is consequently inefficient. It is by focussing attention on them and thus reducing these inefficiencies that the organization will benefit from the concept of the information subsystem of the organization.


