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ABSTRACT

This paper was prepared for distribution to the California Educational Administrators participating in the "Executive Information Systems" Unit of Instruction as part of the instructional program of Operation PEP (Prepare Educational Planners). The purpose of the course was to introduce some basic concepts of information systems technology to administrators to provide them with a broader perspective on information systems as pertaining to organizational and educational needs and to acquaint them with some of the problems associated with computer-based information systems. (AB)

OPERATION PEP/EXECUTIVE INFORMATION SYSTEMS

M68-8

INFORMATION SYSTEM OVERVIEW

J. H. Burrows

June 1970

This paper has been especially prepared for distribution to the California Educational Administrators participating in the "Executive Information Systems" Unit of Instruction as part of the instructional program of OPERATION PEP (Prepare Educational Planners).

This document has been prepared for public release.

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PREFACE

Under a (1968) contract with the San Mateo County (California) Superintendent of Schools, the Information Systems Division of The MITRE Corporation, in conjunction with the staff of Operation PEP* (Prepare Educational Planners), prepared a three-day Unit of Instruction on Executive Information Systems. The purpose of the course, presented in June 1968, was to support Operation PEP in its efforts to introduce some basic concepts of information systems technology to California Educational Administrators.

The presentations included in the Unit of Instruction were augmented by several reports. Three supplemented the discussions by providing general background material. The remainder, prepared as companion handouts for the individual presentations, contained copies of the visual aids (diagrams) used to emphasize significant concepts.

The present (1970) contract between the San Mateo County Superintendent of Schools and The MITRE Corporation calls for the documentation of the concepts illustrated in those diagrams and for the reissue of the supplementary reports. The objective is to provide, in one package, a complete set of references which can be used by Operation PEP in its over-all instructional program. The contents of the package, which consists of eight reports, are identified in the following list.

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* Operation PEP is funded by a U.S. Office of Education Grant Award under Title III of the Elementary and Secondary Education Act of 1965 (P.L. 89-10).

SUPPLEMENTARY REPORTS

Digital Computer Principles

J. D. Porter

Input-Output Trends

J. Mitchell

Digital Simulation and Modelling

G. B. Hawthorne, Jr.

UNIT OF INSTRUCTION REPORTS

Information System Overview

J. H. Burrows

The State-of-the-Art in Information Handling

J. K. Summers and J. E. Sullivan

A Framework for the Evolutionary Development of an Executive Information System (in two parts)

J. A. Evans

Persistent Problems in System Development

J. H. Burrows

An Information System for a District School Administrator

S. G. Lewis

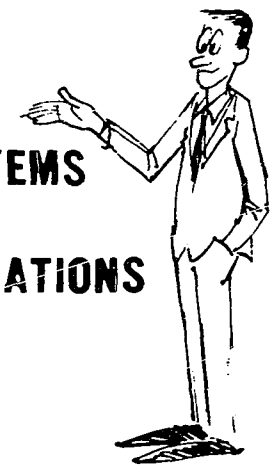
Collectively, these reports provide a basic overview of information system technology; individually, they focus on some of the specific aspects associated with the design, development, implementation, and use of information systems.

INFORMATION SYSTEM
OVERVIEW

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

OUTLINE

- INTRODUCTION
- FORMAL AND INFORMAL INFORMATION SYSTEMS
  - GENERALLY
  - SOME BASIC DISTINCTIONS
- USEFULNESS OF INFORMATION SYSTEMS
- INFORMATION SYSTEMS IN ORGANIZATIONS



During the past 15 years, the working vocabulary of the educator has been augmented — first, gradually, and recently at an accelerated rate — by terms germane to technological developments produced outside his field. During the first 10 years, daily conversations included comments about audio-visual devices, teaching machines, and programmed learning. Since 1965, new terms denoting more sophisticated advances in technology — electronic data processing, computer-aided instruction, information storage and retrieval systems, and communications networks — have been assimilated at a more frequent rate. While educators thus evidence an awareness of technological change, they may not realize either other changes generated by this trend or, more importantly, the necessity of broadening their perspective in regard to their jobs and to the educational system.

A concurrent trend, for example, in approximately the same time span has been the change in connotation for the word "system." While its basic definition, and there are many, has not changed significantly, the tremendous

growth in technological developments — particularly in the field of computers — has refined its meaning. The "aggregation of interdependent units forming a unified whole" definition usually included in some form in most glossaries of the late 50s has evolved, in step with technology, to include concepts such as teams of men and electronically controlled machines dedicated to the solution of complex and dynamic problems; integrated networks; and patterns of activity directed toward a common goal.

Today, some people link the notion of system to a unified technological approach to problem solving or to the fusing of diverse disciplines in order to achieve a goal or objective. Without realizing it, they have broadened their perspective: they are looking at their environment and the things that affect it in a different way, with increasing attention to what, how and why.

A broader perspective is a critical requirement in the selection of a computer-based management (or executive) information system, a problem many educational administrators are now or soon will be facing. In creating his electronically controlled team, the user — in this case, the educational manager

or administrator — must be able to define his job, determine the relationship of his organizational unit to others, decide what kinds of jobs (for example, process the payroll, serve as an aid in considering alternatives for future planning, and so forth) he wants his "team" to do, and identify his information needs. Without a balanced perspective, the user cannot avoid the extremes of blind specialization and useless generality.

Our purpose in conducting this Unit of Instruction particularly relates to the above paragraph. The presentations will span a variety of topics in order to offer some guidelines to selecting computer aids, a procedure that provides another perspective for viewing your organization, a comprehensive view of an information system and some of the data processing applications relevant to the needs of the educational system, and a discussion of some of the persistent problems associated with computer-based information systems.*

These discussions will be presented against the background provided by this paper: an overview of information systems.

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*See Preface.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

PART I

FORMAL AND INFORMAL INFORMATION SYSTEMS

- GENERALLY
- SOME BASIC DISTINCTIONS

All information systems — whether designed for engineering or business applications, whether their form is manual or automated — share one objective: facilitation of the processes for acquiring, assembling, storing and processing, and distributing information, not always in that sequence. They thus represent tools that can be used to coordinate the activities of an organization. But an information system does more than "glue" the organization together. Being evolutionary in nature, it cannot exist without affecting its environment. Changes to the information system have impacts on the organization itself: some slight, some drastic; some perceived, some hidden and only some intended.

The elements of such systems are resources (for example, costs) and well-defined procedures; both are exercised to achieve short- and long-term goals. Changes in one element will effect changes in the other; changes in either will affect goal attainment.

An information system may be structured formally, with the separate processes explicitly outlined and directly controlled. Or it may be evolved informally, with the processes implicit and with controls that can be adapted to, rather than preplanned for, specific situations.

Most information systems combine aspects of both extremes. When designing, using or modifying a formal* system, the informal aspects must be recognized and provisions made for the mutually supportive and organic operation of both the formal and informal systems.

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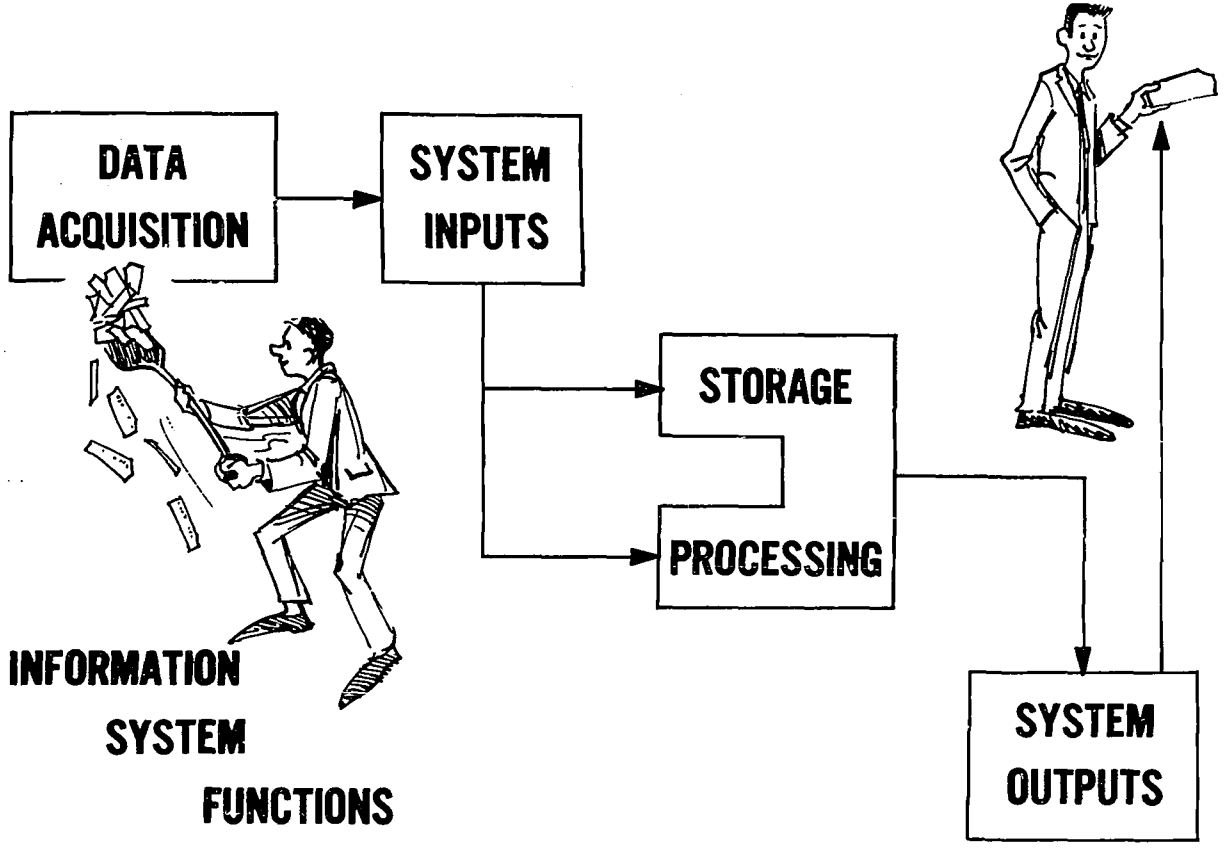
*In these reports (see Preface) the terms formal and automated or computer based will be used synonomously in regard to information system form. In a broader sense, however, manual systems can be formally structured.


DATA ACQUISITION
SYSTEM INPUTS
STORAGE
PROCESSING
SYSTEM OUTPUTS
INFORMATION SYSTEM FUNCTIONS

Because they facilitate the processing of data, information systems suggest the notion of data (information) flow. This dynamic aspect of information systems often is viewed from too narrow a perspective by the system user. A common mistake made is that he tends to define the bounds of the information flow stream as those points where data enter and leave his processing center. Both extremes of the stream, data acquisition and data use, are excluded from his context and, hence, from activities such as the development of strategies for system improvement.* Penalties for such exclusions are very costly.

Brief discussions of the over-all flow stream follow.

Data Acquisition. This activity involves collecting the data — that is, recording both quantitative and qualitative variables, as measured or observed, in either strict format or free form ("prose") — and transmitting (communicating) them to a point of entry. At this point, initial processing (for example, sorting, assembling and filing) is carried out, and those data selected for processing by the automated portion of the system (the computer) are significantly changed in form (for example, transcribed from prose to punched cards).

*This topic is discussed in greater detail by S.G. Lewis in "An Information System for a District School Administrator," (see Preface).

For many systems, despite the cost of computers and computer programs, data acquisition constitutes the most expensive portion of the information system. Paradoxically, it is also, for two reasons, the most frequently underestimated cost. First, the manpower costs, such as those for the collection, recording and correction of raw data, are often underestimated at the planning stage, and later only reflected in higher overhead rates. (Teachers reflect this underestimation of cost when they complain of the amount of time spent in reporting rather than in teaching.) Second, the costs for the data acquisition subsystem are cumulative, continuing over its active life regardless of the need for or usefulness and currency of the information. Therefore, periodic examination of both the use and costs of the data acquisition subsystem is in order.

System Inputs: Preparation and Insertion of Data. This process involves, first, conversion of raw data into a form acceptable to the automated portion of the system and, second, subsequent insertion (entry) of the prepared data into the system. Acceptable entry media include punched cards, paper tapes, specially typed forms for optical character reading (OCR), mark/sense sheets or cards and, for recent systems, magnetic tapes or disks. These forms usually are the products of a device equipped with a keyboard, similar in appearance to that of a typewriter, which accepts and transcribes the data.

A frequent data entry activity is that of verifying and editing the form in order to "clean up" the prepared data before further automated processing takes place. Since large amounts of time and money can be expended on this activity, recent developments, such as OCR and direct data entry,

have been addressed to shortening the process by omitting the middle man and allowing immediate correction of incorrect entries. The attention of the human recorder focuses almost exclusively upon preparing the raw data.

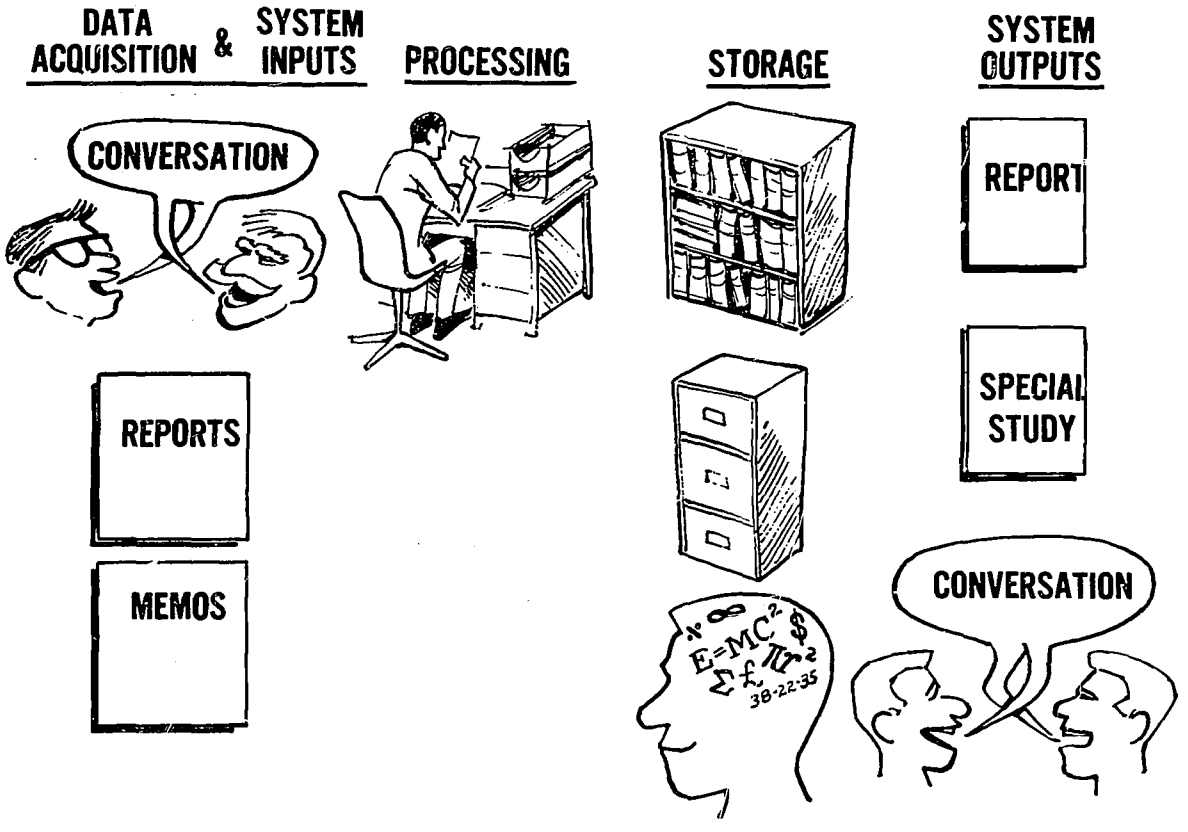
Storage and Processing. These are the more conventionally treated aspects of information systems. The only comment made here is to note that the functions associated with these processes are similar to those clerical operations of filing, summarizing, computing, retrieving, and responding to requests for information.

System Outputs: Generation and Distribution. This refers to the content and form of the information and to the media through which the system delivers the data outputs to the users. Regularly scheduled outputs may include, for example, periodic operating reports, financial statements of condition, paychecks, and grades. Other outputs generated on an irregular or demand basis, and possibly in a tentative mode, may include class lists and teacher and room assignments.

Typical media are preprinted forms. green-lined sprocketed paper printed 132 columns wide, typewriter-type outputs, and cards, tapes or disks for insertion into other automated systems. Pension deductions, tax records, and reports to other system users (for example, higher authorities) constitute examples of data usually generated on cards, tapes or disks.

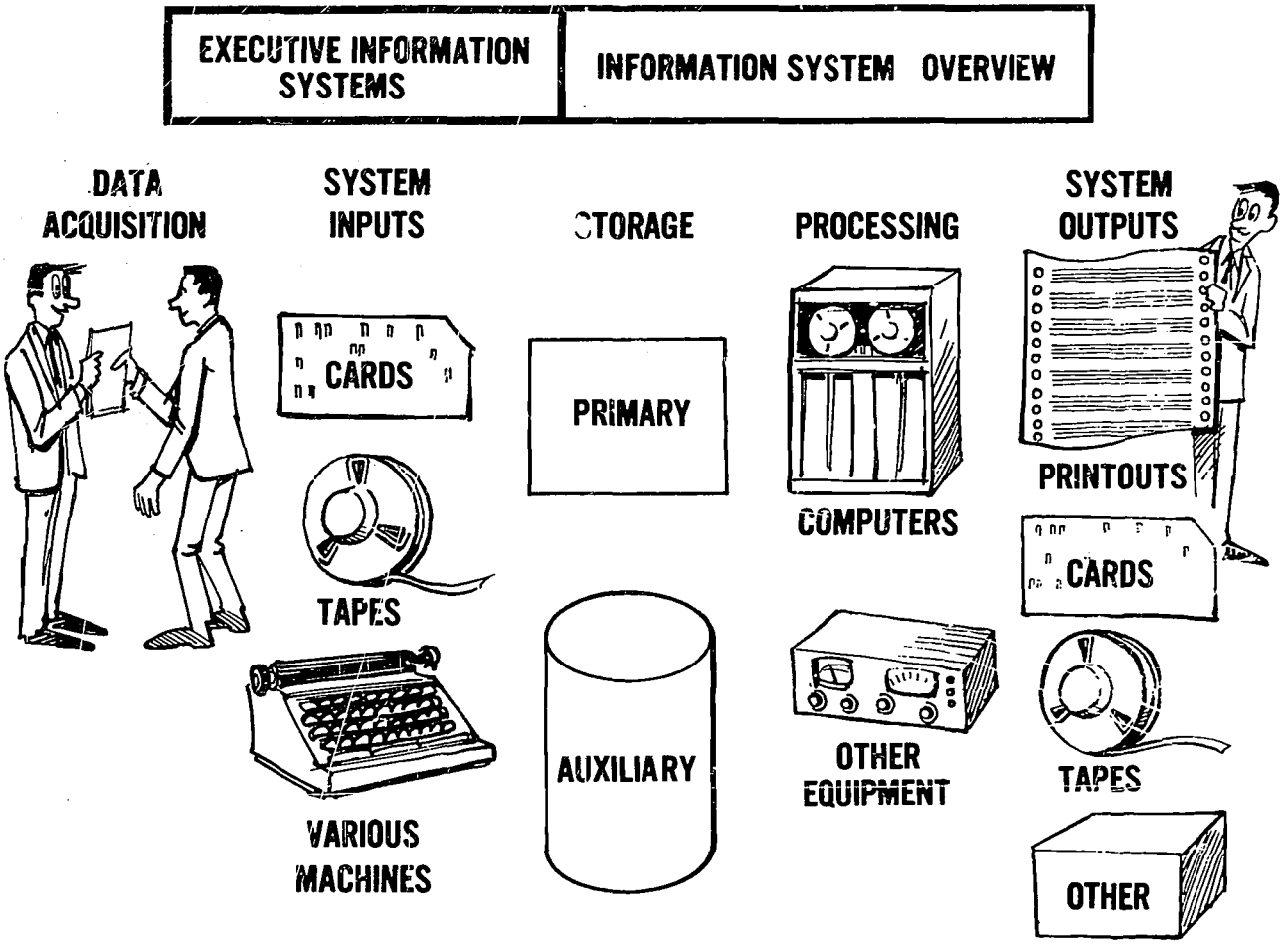
The time needed for disseminating these outputs may seriously affect their usefulness, and the costs must be balanced against the benefits. Thus alternatives for this dissemination function must be considered.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



The discussion on the preceding pages primarily has described a formal (automated) information system. Such systems were not necessarily invented by the computer systems engineer, but he has contributed to their more explicit definition. A primary difference between the informal and formal information system lies in the language invented by the engineer to describe the formal system, his way of looking at the world. The language is very clear to him; he wonders why his frame of reference and terms for his system are not clear to everyone else.

Not everyone has an automated system; however, everyone does have an informal information system. The informal system (see opposite chart), while not haphazard, does lack formal procedures and a clearly-definable structure. Its valuable attributes include self-modification or adaptation, and flexible scheduling. On the other hand, it does saturate, is more readily error-prone, consumes disproportionate amounts of time and money, and retains voluminous information in an unorganized, fragmented way. This last-named characteristic not only complicates access and retrieval but actually lessens the ability of the system to support the decision maker because he can never be sure that his information is timely, accurate, relevant and complete.


EXECUTIVE INFORMATION SYSTEMS
INFORMATION SYSTEM OVERVIEW
DATA ACQUISITION
SYSTEM INPUTS
STORAGE
PROCESSING
SYSTEM OUTPUTS
CARDS
PRIMARY
COMPUTERS
PRINTOUTS
CARDS
TAPES
AUXILIARY
OTHER EQUIPMENT
TAPES
VARIOUS MACHINES
OTHER

Advances in technology and the advent of formal information systems have eased some of the problems associated with the informal system. On the other hand, formal systems, because of their nature, have generated new demands for the user. Specifying requirements for the job the system is to do, for example, requires the user to logically and explicitly define his information needs. Once identified, these requirements become the basis for system design specifications, the structured procedures as well as the content and form of the information produced by the hardware and software selected from an ever-growing array to process it. Errors in requirements definition will inhibit the system's ability to satisfy user needs.

Explicit statements of current operations and an ability to view his job in the overall context of the organization's goals and objectives are essential to the design of a flexible and responsive (useful) system. These concepts are discussed in greater detail in Part II of this report.

PART II

USEFULNESS OF INFORMATION SYSTEMS

The usefulness of an information system, whether formal or informal, depends on its ability to serve the needs of, that is, supply the information required by, its various users. This, in turn, means that the user must be able to clearly identify his role in relation to the goals and objectives of the organization and specify the information he will need in order to carry out his assignments and/or support his decisions.

The next two charts will demonstrate a way of viewing the organization in terms of management levels and information needs. The concepts presented are, to some extent, based on R. N. Anthony's classic work, Planning and Control Systems: A Framework for Analysis.*

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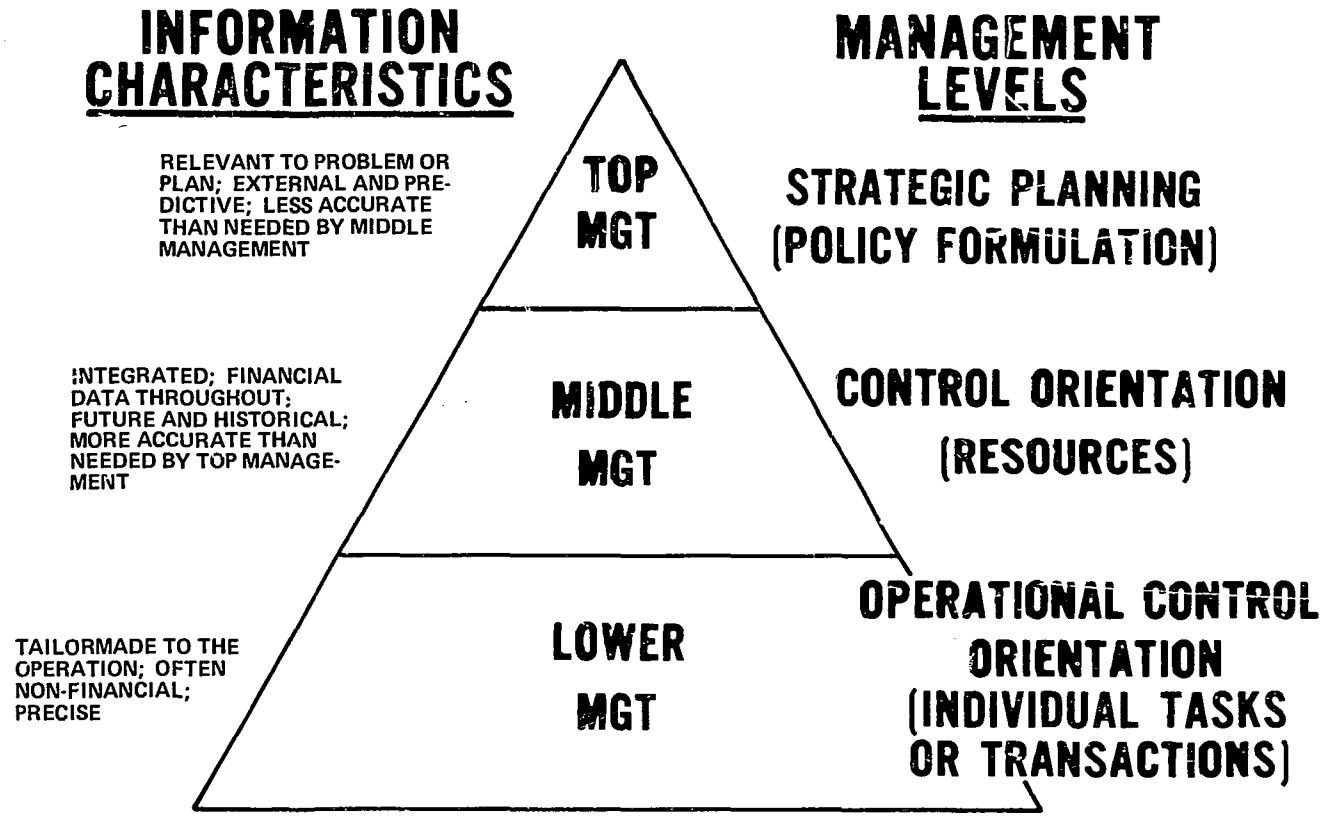
*Harvard University, Division of Research, Graduate School of Business Administration, 1965.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



As shown in the opposite chart, the organization can be veiwed as a hierarchy of management systems, each with a particular focus and all dependent on each other's decisions and actions.

At the top of the hierarchy sit the strategic planners, the men who in most organizations make decisions on the objectives of the organization, on the resources to be used to attain the objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources.* Their activities focus on structuring big plans with major consequences. At the next level are the middle managers who are assigned the responsibility of assuring that the required resources are obtained and effectively and efficiently used in the accomplishment of the organization's objectives.* Although their activities include both planning, within the framework provided by top management, and control, these functions overlap in actual operation. At the lowest level are those managers whose planning activities have the most limited scope, usually focusing an day-to-day operations. On the other hand, the control function is most prevalent here since these managers are charged with assuring that the specific tasks defined or implied by the plans developed at higher management levels are carried out effectively and efficiently.*

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*R. N. Anthony, op. cit.

The preceding, rather static description of management levels can be translated into a dynamic representation by characterizing the interdependency of the actions. Top management focuses on creating broad statements of policy and guidelines but does not detail them to the point of spelling out their cohesive application to the organization as a whole. This is left to middle management who must integrate the (sometimes) apparently conflicting statements and guidelines into a cohesive set of operating procedures and regulations that affect the organization as an entity. Lower-level management applies these procedures and regulations in the conduct of business. In effect, the middle and lower levels expand upon and add further detail to the intended operating plan formulated by the strategic planners. In terms of a specific example it can be said that top management sets personnel policies, middle management formulates specific policies governing personnel practices, and lower-level management assures that the policies are implemented.

Clearly, the activities at each level vary in complexity, decreasing with the level of management. At the highest level, the variables are harder to define and their relationships less apparent. And the information required to support the activities of each level also differs.

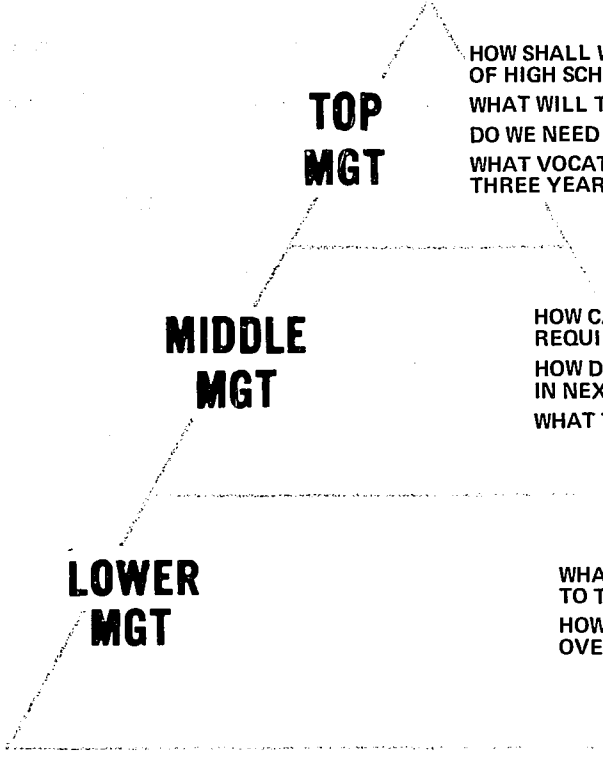
Strategic planning relies more heavily on information collected outside the organization. Much of the data required are trend data relevant to decisions about a particular plan. It is collected, assembled and used for a specific plan only. And much of it is imprecise.

Because strategic planning requires consideration of a broad time frame, the planner can only estimate what will happen — and his estimates are likely to have a high degree of uncertainty. Nor can all of the problems be foreseen. Even for those that can be predicted, data collected in a form useful for an occasional decision may not be worth the cost.

The control activities carried out at the middle-management level, because they encompass the totality of the organization, usually are based on an underlying financial structure; that is, plans and results are expressed in terms of budgetary allocations. Such information is more readily available from within the organization itself and is put together in the same way month after month.

Activities carried out at the operational control level are essentially objective in the sense that they focus on tasks for which there is quick and direct feedback of the results of a decision. Thus there is a better opportunity for correct decisions to be objectively implemented. (Decisions made at the higher levels are subjective in that they involve a greater degree of management judgment). Operational control data often are nonmonetary and may be expressed, for example, in terms of man-hours. The data are tailored for individual events, many of which are repetitive (for example, student grade reports).

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



HOW SHALL WE UPDATE OUR CURRICULUM TO MEET THE DEMANDS OF HIGH SCHOOLS AND COLLEGES?

WHAT WILL THE PROFILE OF OUR COMMUNITY BE IN FIVE YEARS?

DO WE NEED FACILITIES FOR EVENING STUDY OUTSIDE THE SCHOOLS? WHEN?

WHAT VOCATIONAL COURSES SHALL WE PREPARE FOR IMPLEMENTATION IN THREE YEARS? FIVE YEARS?

HOW CAN WE REALLOCATE OUR BUDGET TO MEET NEW COURSE REQUIREMENTS?

HOW DO WE CORRELATE OUR REGULAR AND SPECIAL PROGRAMS IN NEXT YEAR'S FINANCIAL PLAN?

WHAT TEACHERS ARE QUALIFIED TO TEACH THE NEW COURSES?

WHAT IS THE CURRENT TEACHING LOAD OF THOSE QUALIFIED TO TEACH NEW COURSES?

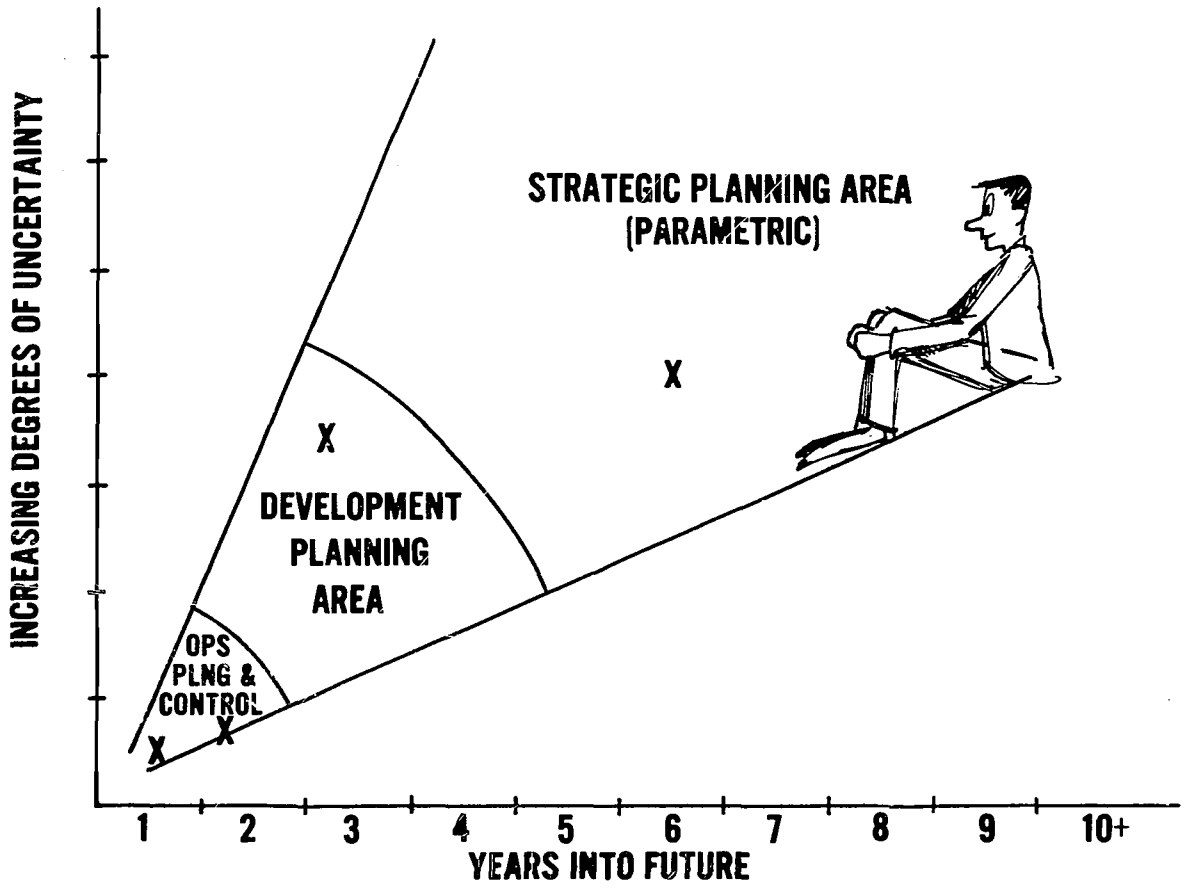
HOW HAVE OUR GRADUATES PERFORMED ON COLLEGE BOARDS OVER THE PAST FIVE YEARS?

Some of the specific questions addressed by the three types of managers are shown according to management level in the above chart. In order to support the activities of the strategic planners, the information system must be able to supply, for example, useful trend data for some future time period. If such data show that over the next five years the community will be populated by families with higher incomes, the planners may decide to increase the ratio of college preparation courses to noncollege preparation courses because they anticipate that such families will want their children to go to college. And, if they can discern from such data that the families have distinct preferences for specific (for example, Ivy League) colleges, they may alter the contents of the courses as well.

Once policy is set, middle management must translate it into operating plans within the constraints of the budget. While it, too, relies somewhat on outside information (for example, what are the salaries for teachers of new math?), many of its decisions are based on internally available information. The budget, number of teachers, and the staff levels are known.

Lower management relies on internal and often historical information to supply answers to higher management levels. Its function is objective: how many teachers carrying less than a full load are qualified to teach literature? what percentage of students over the past five years have failed math courses at or above the fifth-grade level?

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



Viewed from one final perspective, it can be said that within an organization there are three primary functional areas, each with a different time frame, that can be supported by an information system. First, operations control (and planning): from a control aspect, the system can support the individual tasks carried out in doing the day-to-day job and, from a planning aspect, it can support the work done to allow one to do tomorrow and next year what he always has done. The jobs can be well defined and the information system procedures to support them can be well structured. Second, development planning: the work associated with evaluating current and past practices, and devising and implementing new ways of doing the old job. The problems associated with this type of planning are still fairly structurable. Third, strategic planning: the work associated with changing the type of job, or the market and/or resources (or the organizational form) that can serve the new market (a new curriculum for slow learners). The problems addressed by this planning function are the hardest to structure and the most difficult for the information system to assist. Yet it is this area that probably could realize the greatest benefits from a formal information system.

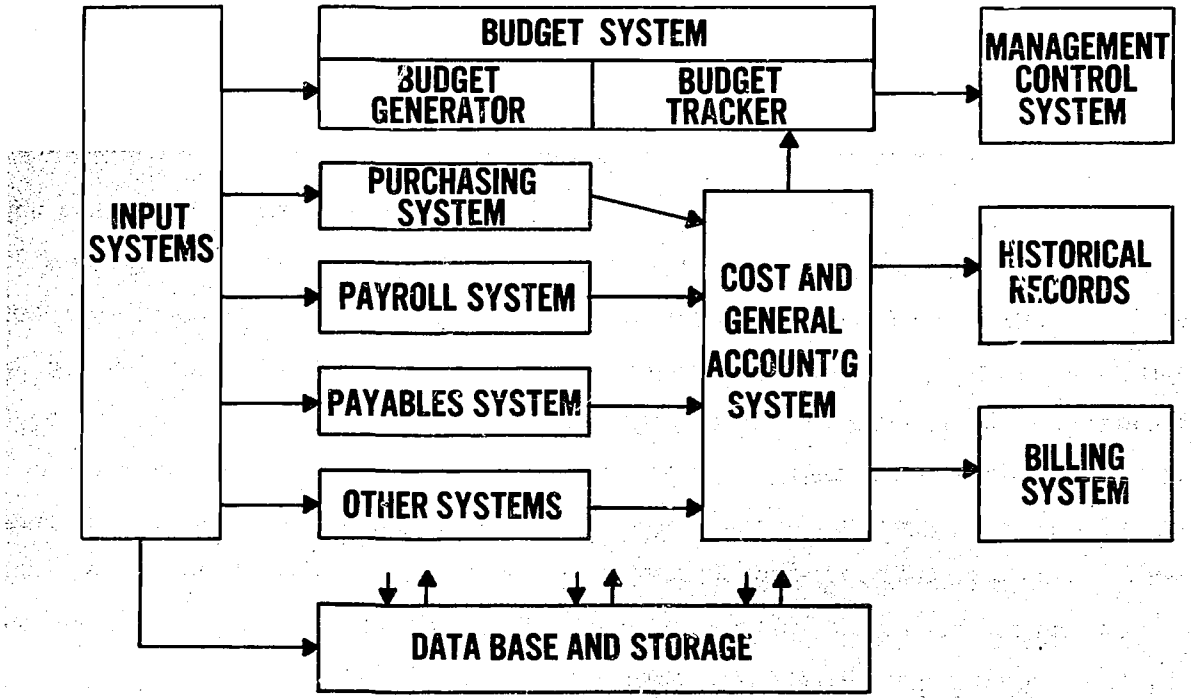
EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

DATA PROCESSING SERVICES		INFORMATION SYSTEMS
COST SAVINGS	GOALS	IMPROVED EFFECTIVENESS
AUTONOMOUS APPLICATIONS USER "OWNS" DATA CENTRAL PROCESSING	FEATURES	INTERDEPENDENT SYSTEMS COMMON USE DATA CONTROLLED INPUTS TO SYSTEM CENTRAL STORAGE AND PROCESSING
ANALYSIS OF SIMPLE PROCESSES	PREREQUISITES	ANALYSIS OF GOALS, FUNCTIONS, ACTIVITIES OF ENTIRE ORGANIZATION
1 TO 3 YEARS	TIME TO ACHIEVE	2 TO 6 YEARS (?)

From a pragmatic point of view, no matter what management function is to be supported, computers are usually introduced to save money in the face of the rising amount and cost of clerical labor. Thus most computers systems are implemented as cost-saving services, an approach referred to in the opposite chart as the Data Processing Service approach It is the simplest to introduce; the goals are apparent. Using this approach, we can take a job we are doing now and, with minor modification and possibly some new features, transfer the bulk data handling of content from people to a computer. Most of the routine jobs have been made reasonably explicit in order to get the job done, especially with a changing work force. I label such efforts "cream skimming," that is, selecting the jobs with high cost savings return or profit.

However, as time goes on, it may become clear that "cream skimming" causes problems. The new pieces of your information system that use or pass data to the other parts must conform to decisions of procedure, form, and content that were selected (and optimized) for the prior applications without thought of the new areas. Thus the costs of the new, proposed data processing applications are exceptionally high, and the "reduced cost" bonus may not be available. This ultimately leads to a stagnated system and eventually to a decision to redesign the system, usually a costly venture.

PROCESS-ORIENTED SYSTEM (FINANCIAL)



It may be that portions of your current system can and will dovetail to give more comprehensive and complete support. If this is so, someone has taken pains or you are extremely fortunate and lucky. For example, if the cost accounting system (shaded area) and budgeting system, even though built separately, are structured from a process orientation, they can be designed to work together giving a new management control tool — a single integrated subsystem designed for the business and financial aspects of the organizations operation. This is because the procedures are originated and controlled in a small area of your operation, are required by law, and are audited. This area has little impact on

day-to-day operation of the educational process, and its input and output are intelligible and useful only to a small part of your work force. It may be necessary for control or accountability but as a system, in its various forms it has little impact on major educational decisions. It is more difficult to produce such integrated management tools in the more important parts of your business, the output or product end as opposed to the input or resource/cost end.

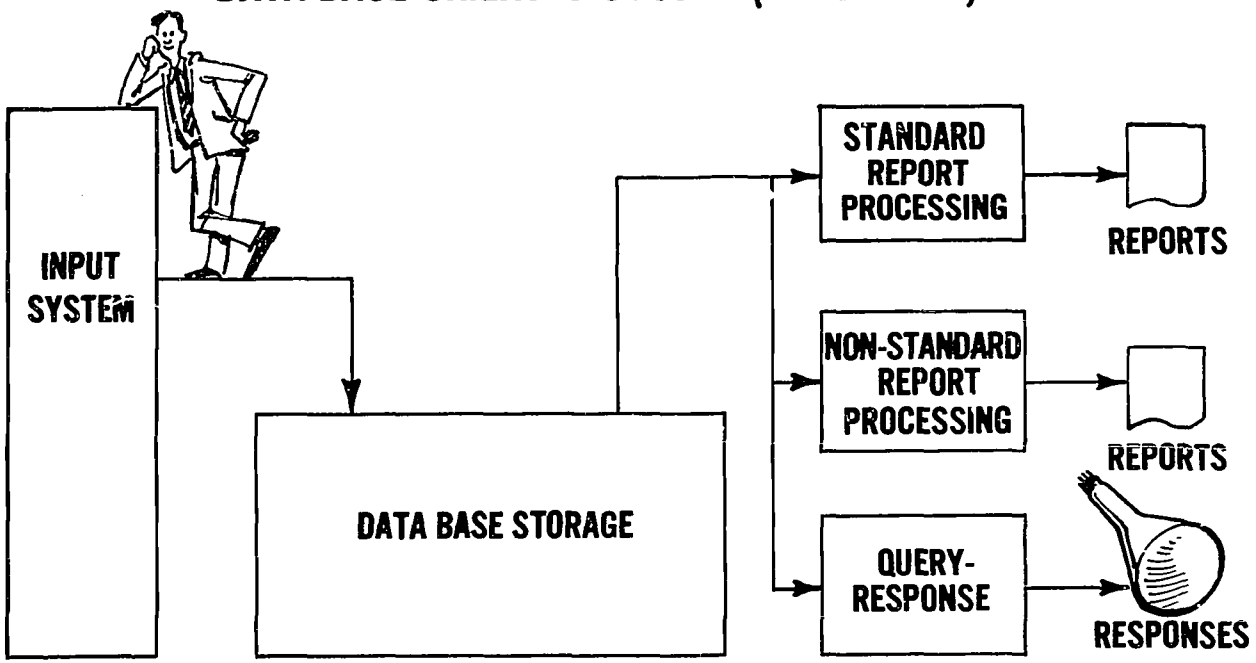
Many industries, while still conscious of cost, have changed their emphasis from cost savings to improved total effectiveness (see chart on page 26). While the change from cost savings to improved effectiveness as a decision criterion is difficult for an organization whose "tax bite" is

obvious to all, such measures must ultimately be the incentive for improved information systems.

The key difference is the scope of the prerequisite analysis, from simple isolable tasks to goal, mission, organization, and activities on an integrated overall basis. Many an organization has found value just in the re-thinking required to be more explicit about current operations.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

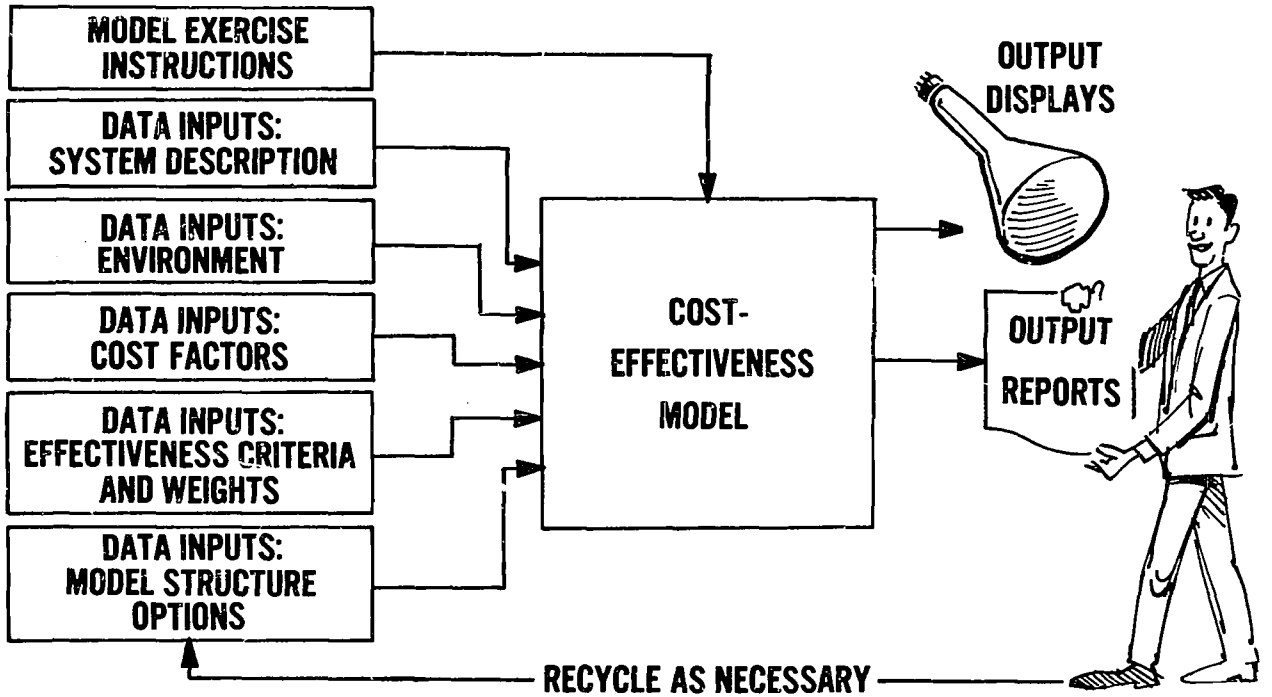
DATA BASE-ORIENTED SYSTEM (PERSONNEL)



A major function of information systems is to prepare standard resource status reports on, for example, in property, facilities, students, or personnel. Because such systems collect detailed information in one data base, the data can be accessed to produce nonstandard (that is, produce-when-needed) reports at relatively little cost. More recently these data bases have been made available in a more responsive (tailored and almost immediate) way; this has been done by introducing attached input/output devices and internal software which allow the system to answer a broad spectrum of individual requests.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

MODEL-ORIENTED SYSTEM



More recently planners about to propose significant changes in operations or to explore the future implications of current or proposed policies, and so forth, have resorted to models, gross or detailed, in order to have the computer's assistance in projecting the interlocking behavior of the various parts of the organization and its market. Simple models may be used, for example, to explore the possible impact of in- and out-migration of industry, the development of land tracts, and the expansion of the highway net, on the size and geographic distribution of the student body in the district. This type of application is one of the planning tools for the executive and his staff. Exercise of such tools will require new talents on the part of the executive's staff, talents related as much to the environment of the educational organization as to the educational process.

PART III

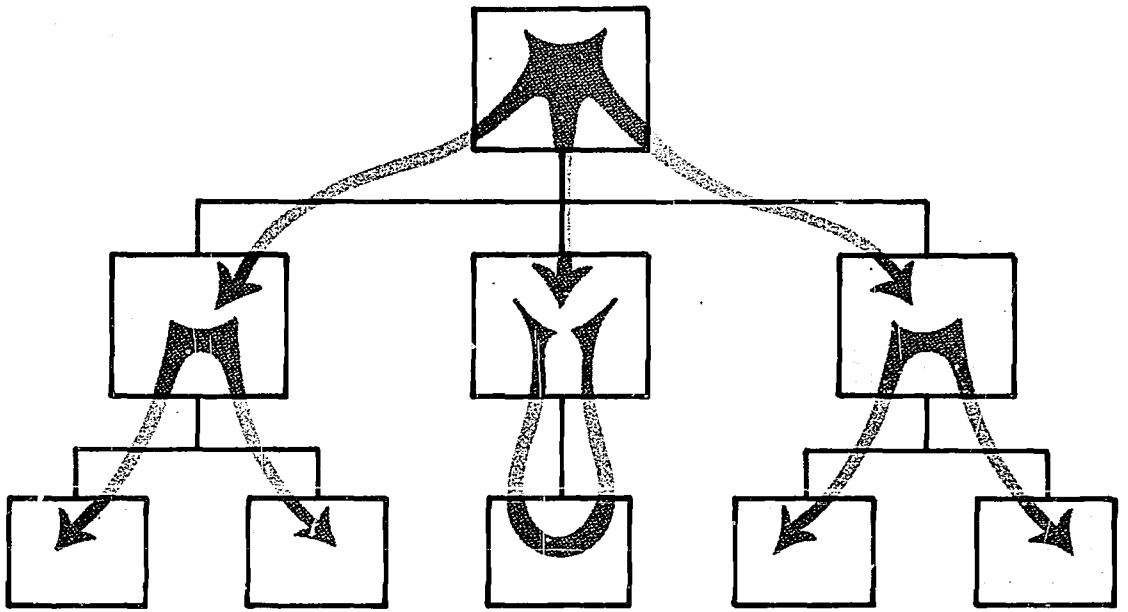
INFORMATION SYSTEMS IN ORGANIZATIONS

- CONCURRENCY OF MANY SYSTEMS
- VARIATIONS BASED ON DECISION NEEDS
  - OPERATIONS
  - PLANNING
  - ENVIRONMENT EVALUATION
- INFORMATION—POWER—RESPONSIBILITY
- "TOTAL" SYSTEMS

In Part III, I would like to discuss the integration of the information system within the organization or organism. This can be viewed as supplying the organizational glue that ties the parts together, at least in appearance, for summary reporting, or acts as the nervous system of the organism. Either way, it is clear there are, for example, the accountant's "glue," the operator's "glue", the planner's "glue," the client's "glue," and the boss's "glue."

One thing that is clear in this world to almost anyone is the power of information, its dissemination, and its use. I will be talking more about this later. In addition, I will have some comments on "total" systems.

CONCURRENCY OF MANY SYSTEMS



Most organizations, large or small, have several concurrent, almost independent information systems, usually in varying stages of development and with different primary goals. Hopefully, each system contributes to the health of the organization.

The impetus underlying the evolution of an information system within an organization is interesting to contemplate. Small companies that are activity- and product-oriented usually first develop an informal "operations control" system. Such systems usually grow from the bottom up. Concurrently, however, other informal information systems, such as financial and management, also are evolving, creating additional informal and concurrent systems.

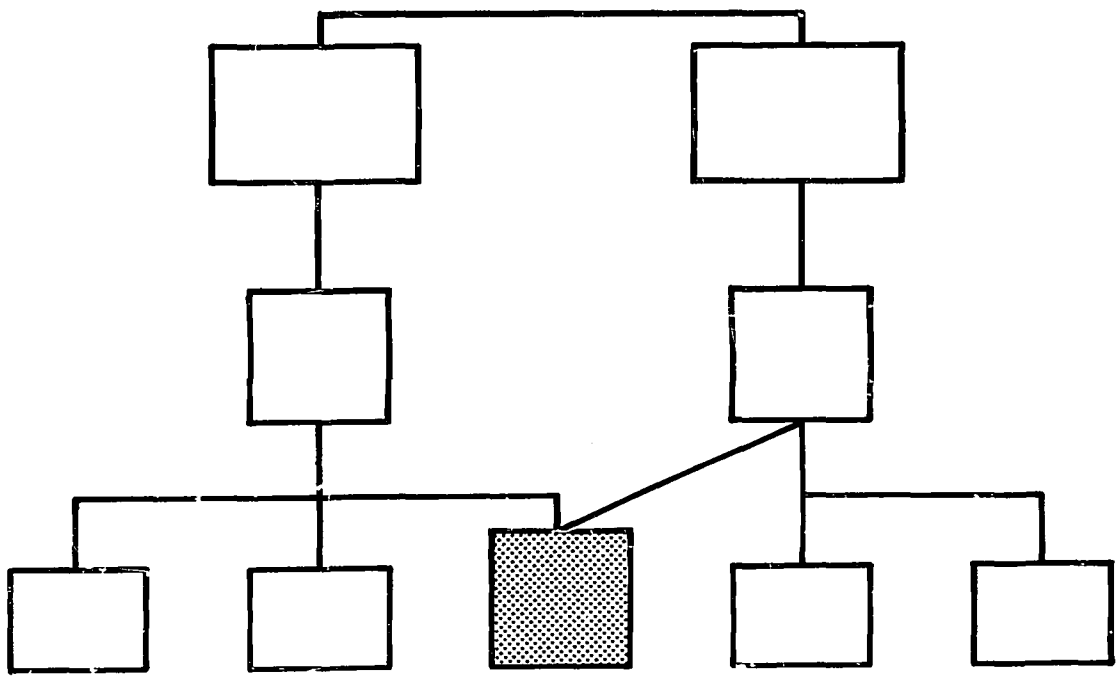
Larger organizations also spawn concurrent information system, especially as they begin to provide specialized internal products or services. Such organizations, however, tend to have formal information systems, often evolving from the top down.

Today, small companies may never get a formal system unless they are acquired by a larger organization. The

introduction of a more formal information system, understood by the acquirer, not only represents another concurrent system to the small company but a mode for bringing that company within the acquirer's span of control. This step is taken to reduce the uncertainty level or "concept noise" in terms and figures exchanged between the organizations and to create a common frame of reference for stating goals and measuring progress.*

*Similar steps are being taken within government; the state and Federal governments are trying to create frames of reference from which progress can be measured and future expenditures justified..

CONCURRENCY OF MANY SYSTEMS

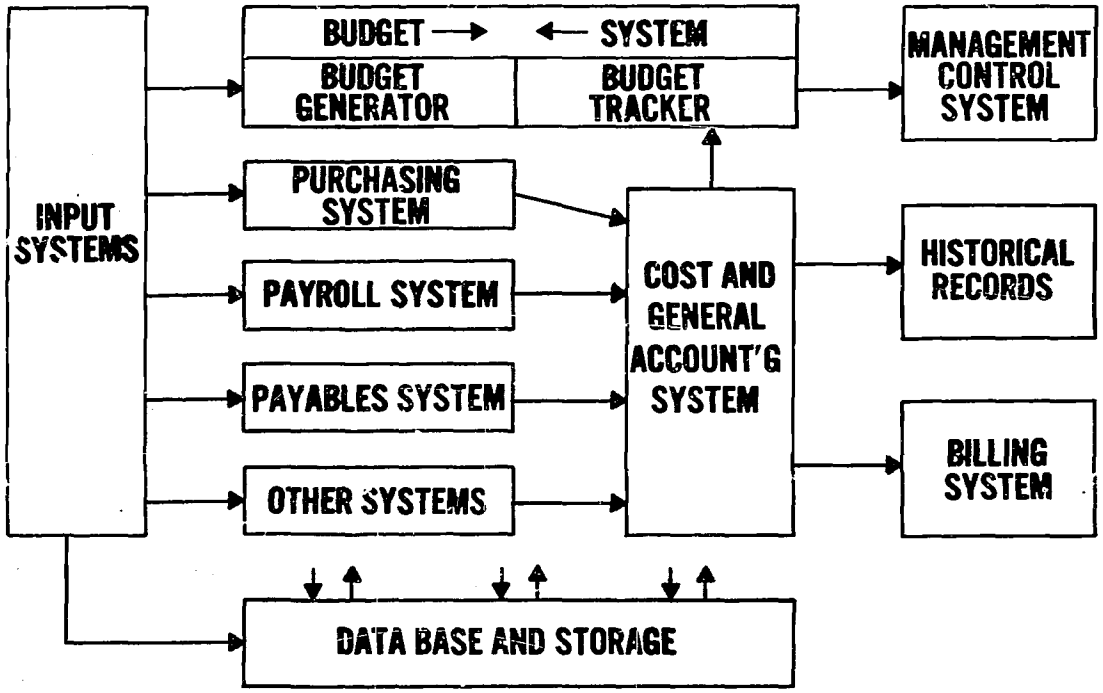


A phenomenon that appears to violate early 20th century management principles is the existence of two bosses, a not infrequent position for most of us these days. This makes it difficult to define upward reporting systems because these bosses have differing, albeit quite similar, frames of reference. In a manual or an informal system the troubles are not so clear as they are in a formal, automated system. Here extreme care must be taken to respond appropriately to the differing viewpoints and to minimize the costs of so doing, either by negotiating the differences away or building a little more flexibility into the system so as to eliminate a duplicate reporting system from bottom to top.

I might comment that "two bosses" is a way of life caused by specialization of functions and the economies gained from such specialization, especially in the supporting areas such as finance and logistics.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW

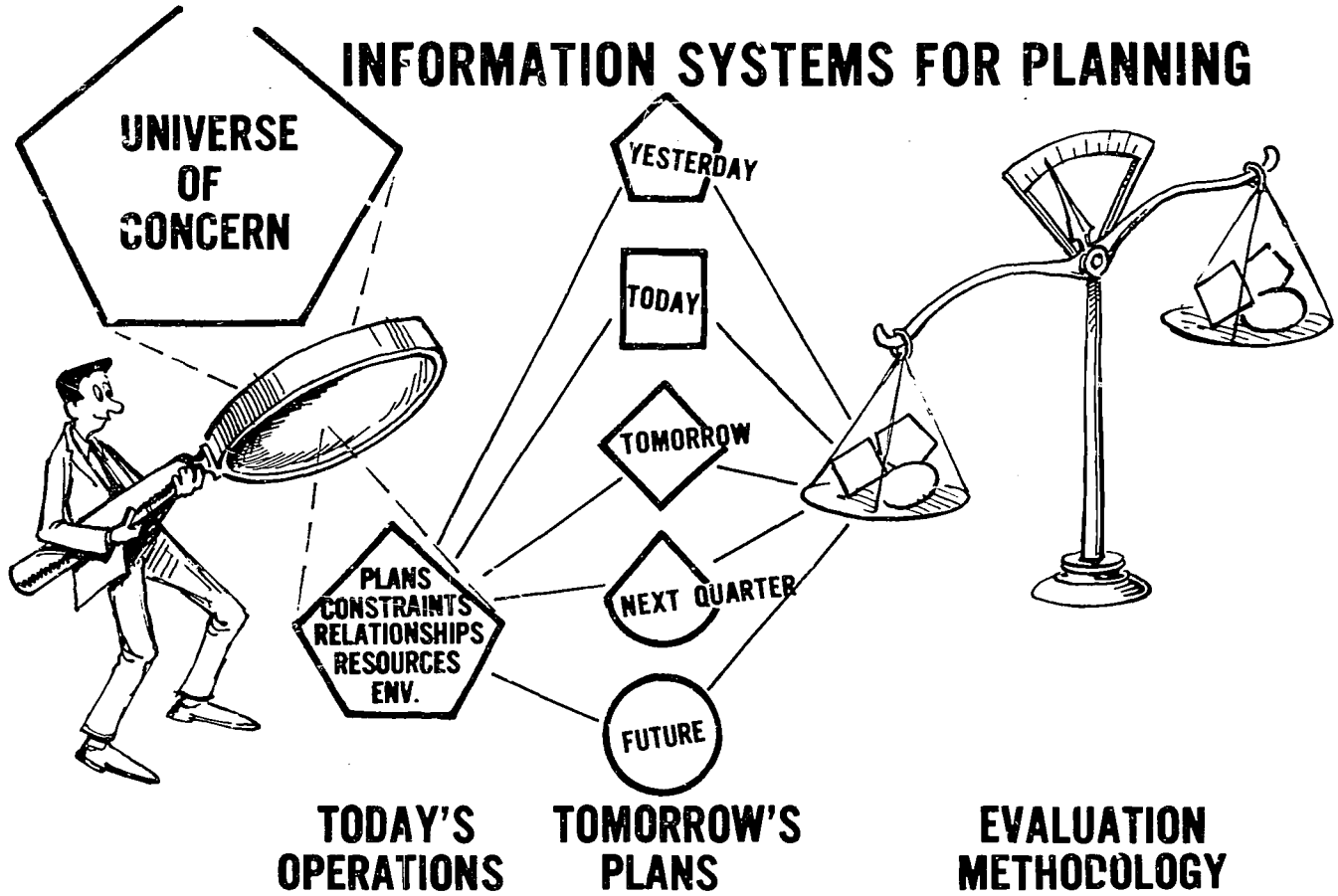
SYSTEMS FOR OPERATIONS (PROCESS EXAMPLE)



Information systems reflect the needs of the operating entity that they support. The general accounting system (shaded area) is one of the standard tools used in detailed form to guide the activities at the lowest or operational control level. Such systems, especially those in government, are usually the first to be standardized within and across organizations. The opposite chart depicts the position of general accounting system within the broader financial system, showing the interfaces between the two systems.

Similar examples in industry exist in production control, general management, and marketing, to name a few. Correlative systems are being developed at this time in governmental areas, and we are about to have an expansion of information systems concerned with social need and response to that need, that is, the output or the product of our governmental service industries, as distinct from input or cost systems currently used by both the legislator and the manager.

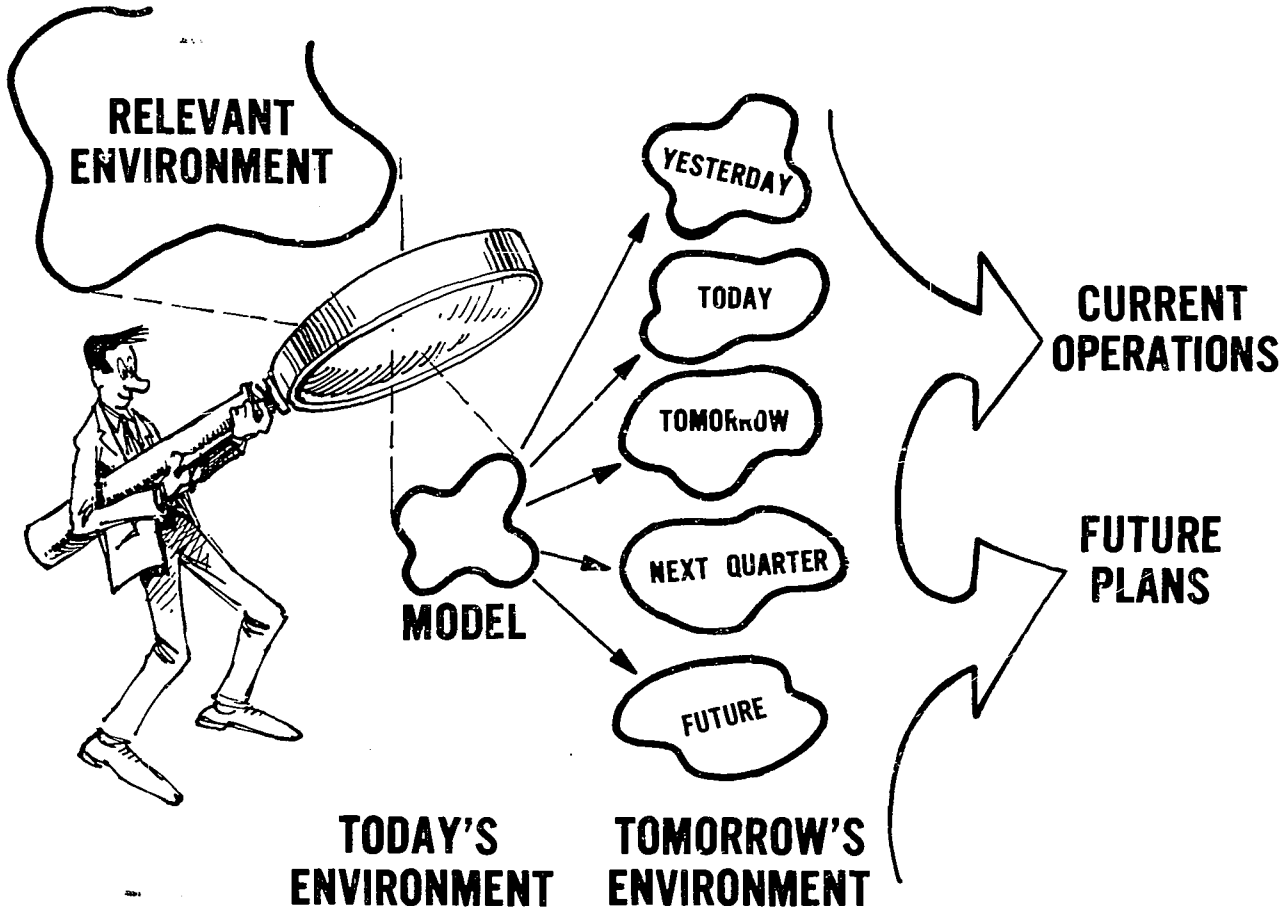
EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



Probably the toughest system (conceptually) to build is that which supports planning. This is true for many reasons. The key to effective planning is wrapped up in the identification of both the goals of the future organization and the objective measures capable of satisfying the elements concerned that the plan does point toward the goals and has a good chance of succeeding. Without such agreed upon criteria, plans appear to be arbitrary and conceived at the whim of the planner. Alternative plans with differing objectives cannot be compared. Alternative plans with the same objectives cannot be ranked without knowing other external criteria such as cost and flexibility.

This, however, is not the only difficult task that an organization must undertake in order to give the planner a good beginning for his exercise. Past performance measured in similar criteria along with historical records of intent, resource commitment, constraints imposed by policy and organization, and environmental factors in the institutional sense, for example, reaction and posture of the market, are essential to the development of a feel for the relationships which control and fashion the outcome of resource commitment.

EXECUTIVE INFORMATION SYSTEMS	INFORMATION SYSTEM OVERVIEW



Once the goals, objectives and criteria have been identified, a model, either dynamic or static, of the operating process or its effect can be developed. This model can be used to predict the outcome or results of actions taken now and in the future. Such models exist in at least three conceptual frameworks:

(a) local past history, (b) comparative past history; and (c) relational.

Most operating managers have an internalized model of their business which is based on past history, mainly their own, which may or may not include that of the local organization, and which probably will contain aspects of "before now." Such models are seldom found on paper but can be manipulated to bring forth previous experiences when decisions are needed. Such models are suitable for handling short-term decision making in the face of time pressures.

Many managers have a comparative model — how are others doing it. These models allow one to benefit from "going concerns" of similar environments and even, by appropriate screening, from those with dissimilar

environments. Such models tend to be more conceptual for two reasons: the perspective look at an external organization tends (a) to force coalescence upon the detail, just to get it into manageable or descriptive terms, and (b) to force a frame of reference for comparisons, allowing focus upon the similarities and differences.

These models are extremely useful in cases of a time lag in environmental development. They allow the planners to foresee the implications of introducing industry into an agricultural nation or, on a more common level, the effects of the broad distribution of automobiles on the environment. These models do get put on paper by students doing comparative studies, but each of us spends time developing these models for ourselves. Both of these initial types of models allow concepts to be framed and some qualitative indication of expected output or benefit to be determined. However, neither usually reveals the effects of such plans on the internal organization or on its operation.

Such details require more work to produce a phased plan of resource acquisition and commitment.

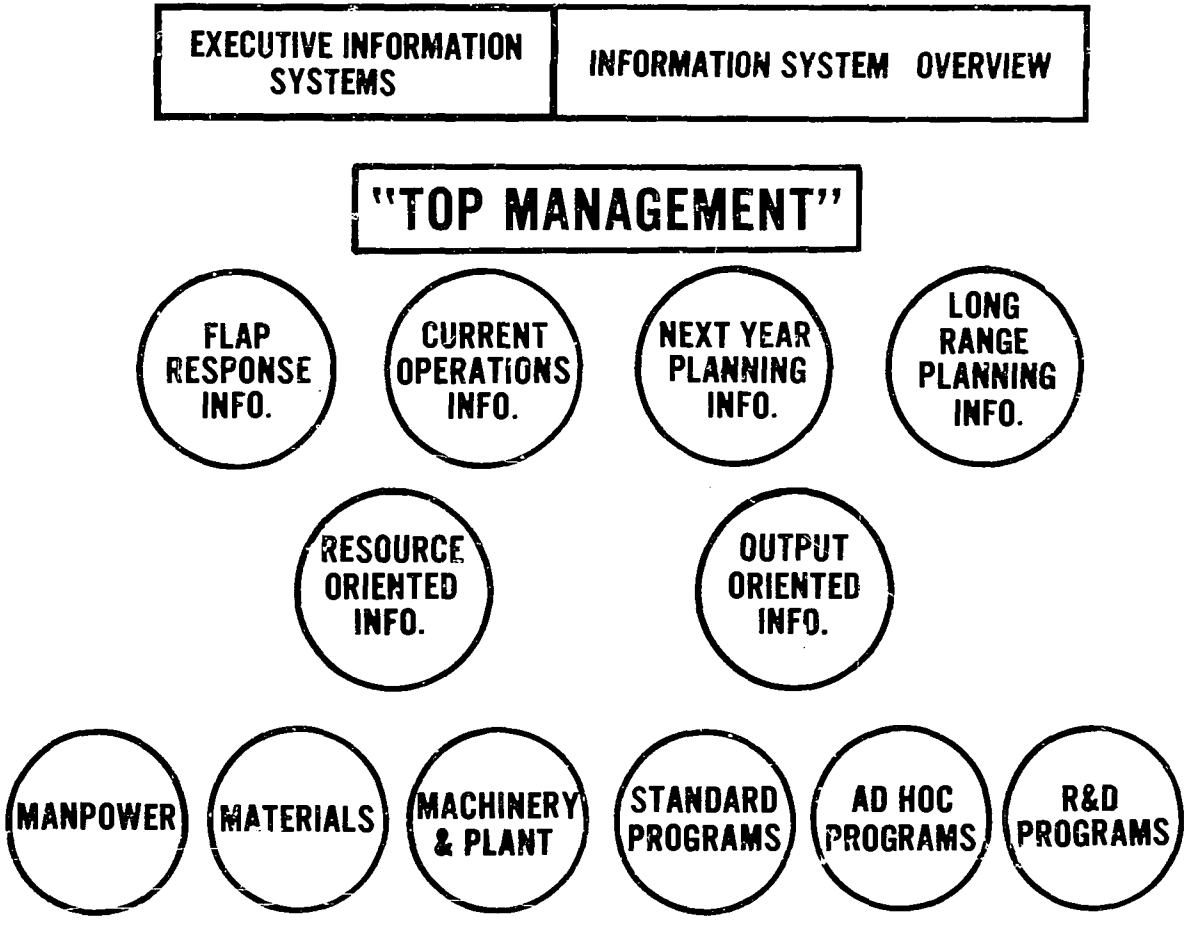
The final form of model, a relational model, attempts to start from the more basic interactions and to dynamically move the current operation forward in time, changing the external environment, such as load, market expectation, and legislation, according to the best predictions of the planners. These last-cited planners may not be inside the educational organization, but they make their data available to many organizations. Activities such as resource acquisition and community orientation are phased into the plan at the appropriate times. Contingent plans that depend upon year of adoption of policy and fiscal

budgeting are required, as expenditures and output are keyed in many areas to these dates. This type of expenditure plan and expected output as determined from expected workload or market are the corporate staff tools used to plan, project, and control the growth course of modern-day ventures.

The reasons for the frequently increasing application of this type of modeling are both technical and operational.

> First, the digital computer provides the capability for keeping track of many time-dependent variables and projecting their progress over time according to developed relationships while simultaneously applying predicted extern l variables.

Second, past local and comparative history models are useful within a future like the present. Introduction of new technologies, resources, procedures, and so forth, requires a return to basic and rational dynamics rather than simple or complex trend analysis. Innovation upsets the "it happened before in '06" form of management. These days innovation is taking place within and outside the establishment.


EXECUTIVE INFORMATION SYSTEMS
INFORMATION SYSTEM OVERVIEW
"TOP MANAGEMENT"
FLAP RESPONSE INFO.
CURRENT OPERATIONS INFO.
NEXT YEAR PLANNING INFO.
LONG RANGE PLANNING INFO.
RESOURCE ORIENTED INFO.
OUTPUT ORIENTED INFO.
MANPOWER
MATERIALS
MACHINERY & PLANT
STANDARD PROGRAMS
AD HOC PROGRAMS
R&D PROGRAMS

In summary, I want to emphasize that we all have, use and are part of an information system. The higher in the organization we sit, the clearer is our dependence on information for execution of our job.

The function of our "executive" information system is to organize the data for us and to process it in ways that make the implications of our decisions clearer to us. We all know that critical information is missing and that many decisions are made, of necessity, before "the facts" are available. This lack of data which could have been available is a continuing problem in information system design and requires continual analysis of the trade offs between the costs of collecting and processing data and the value of the expected benefits. The absence of "hard" data at the time of planning can only be dealt with by probing the future.

From our perspective, then, it is clear that information is necessary for control and management, that it gives power to the owner if he uses it, and that it is important to plan the flow and use of information to have a healthy organization.

The other reports in this series (see Preface) will introduce to you in a more specific way the technology, how to apply it, and some of the problems. They will also give you some insight into its current and possible applications.