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ABSTRACT

Educational development requires management, which is basically decision-making based upon information. Information must be processed, involving movement from its source, analysis, transmission, storage, retrieval, summarization, transformation, and reporting. The regulation of this process is the purview of the information management system (IMS), an essential ingredient of educational development. The characteristics of an effective IMS are: relevancy, timeliness, accuracy, comprehensiveness, conciseness, accessibility, and inexpensiveness. Difficulties involved in establishing an IMS in educational development projects stem from the high costs involved, the lack of a stable setting in which to place the system, the changing needs for information, and the danger of inundation by information overload. Such a system is possible, however, if developers: 1) select the decisions which need to be made; 2) identify the needed information and its sources; 3) choose the proper means of information processing; 4) estimate costs and curtail the system to match cost constraints; and 5) implement and revise the system. (PB)

THE MANAGEMENT OF INFORMATION IN DEVELOPMENT PROJECTS

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Instructional developers have never denied the eclectic nature of their field. To borrow Singh's remark about systems analysis, development "does not hesitate to make any branch of science carry grist to its own mill." (1) This phenomenon has been nowhere more evident than in the area of management theory and practice.

MANAGERS AND DECISION-MAKING. It is axiomatic that a manager is foremost a decision-maker. Confronted by a given set of circumstances, he formulates a response which, he hypothesizes, will bring optimum results. If, in fact, the results are disappointing, he will then select different alternatives so as to amend the results. In this respect, effective decision-making is a cybernetic loop, a succession of adjustments, large or small, tending toward increasingly more satisfactory results.

Development--instructional or otherwise--does not merely happen; it requires management. The same cybernetic decision process of management comes into play in development, and this

pertains whether the development effort is limited to one teacher preparing the day's lesson or consists of a sizable team reformulating an entire curriculum. It follows that all developers are managers, and hence decision-makers.

DECISIONS AND INFORMATION. Good decisions are based on good information. Forrester observes that "management is the process of converting information into action," (2) and he equates this activity with decision-making. To be useful in effective decision-making, information is required about the present state of the system, the desired state of the system, and the alternative means of getting from one to the other. Absence of the right information is probably the leading cause of failure in instructional development.

INFORMATION PROCESSING. Information remains useless until it is processed, i.e., put into meaningful, usable form. Just as complex organisms cannot utilize nourishment directly, but must assimilate it, complex decision-making requires "digestion" of data.* Information must move from its point of origin, must be obtained, analyzed, transmitted, stored, retrieved, summarized, transformed, and reported (Fig. 1).

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*The distinction commonly made in the literature between information and data is acknowledged. For purposes of this paper, data are regarded as bits of intelligence unprocessed for decision-making, whereas information consists of interpretations of data suitable for making decisions (as well as for other purposes). The distinction, however, is not critical to most points made in the paper, and the two terms are used somewhat interchangably.

THE IMS. Information and information processing do not manage themselves--they too must be managed. This suggestion may raise images of "wheels within wheels," but there are sound reasons for paying attention to the management of information. As the complexity of the developmental effort increases beyond the most elemental level (i.e., one developer, one client), the need to attend to information management increases arithmetically or even exponentially (see Fig. 2).

A valuable distinction for the developer is that between the management information system (MIS) by which information is processed and channelled to top management for action, and the information management system (IMS) in which the flow and processing of information itself is the subject of the management effort. The two systems are completely compatable, and each is essential to the effective management of development efforts. The importance of the distinction lies in the necessity of attending to both kinds of endeavors, supplying proper information for management purposes and properly managing that information.

The characteristics of an effectual information management system are known. Information is to be:

1. Relevant (i.e., targetted to specific decisions)
2. Timely
3. Accurate
4. Comprehensive
5. Concisely packaged
6. Accessible to those with right of entry
7. Inexpensive.

These desiderata may be considered the goals of the IMS. Unfortunately, the goals are in many cases at variance with each other. For instance, timely or current information may prove to be inaccurate due to the lack of time to verify it. Comprehensiveness and conciseness are antagonistic qualities. And cost considerations mitigate against other desirable characteristics of the needed information.

Trade-offs represent the only solution; the task of managing information suddenly appears more demanding than it might have at first.

COST OF INFORMATION PROCESSING. All information bears a price tag, unusually high. Information processing can cut deeply into scarce developmental resources. Administrators who view development as a somewhat unjustifiable luxury on the educational scene will probably regard the additive cost of information processing with even less joy.

Only a modicum of the "nice-to-know" information may be realistically obtainable within the range of resources normally available to a development project. Extraordinarily hard choices between high-cost-high-gain information and low-cost-low-gain information may have to be faced. Inevitably, there seems to be a dearth of low-cost-high-gain information!

OTHER TYPICAL PROBLEMS. Additional problems in managing information are created by the nature of development itself:

1. Techniques of information processing flourish in a corporate environment in which needs, sources, channels, and so on remain relatively stable over time. This is much less the case in developmental settings in which change is the rule and the customary technology of information processing (e.g., computers) lacks the adaptability to match the dynamics of development. This circumstance argues for less complex, more responsive technologies for processing information in all but the most extensive development projects. In Fig. 3 exemplars of more and less powerful, more and less adaptable techniques are shown. The least powerful (most adaptable) are recommended for elementary development efforts; the middle range is suggested for development as generally practiced, and the upper range is reserved for only the most arduous and long-term projects.

2. A similar problem lies in the fact that informational needs change as development proceeds. During the early stages, team members will need quite different kinds of information than during later stages. Planning decisions, as defined by Stufflebeam et al., (3) predominate in the early phase and demand information unlike that required by structuring decisions, recycling decisions, and implementing decisions which follow (see Fig. 4). The situation is further compounded by transience among personnel, particularly characteristic of development in higher education, which disrupts information flow and requires frequent orienting of new personnel to the information system.

3. "Information overload" may plague decision-makers.

In the classic situation, two executives stand bewilderedly before a massive computer, and one says, "What it comes down to, is this thing is capable of telling us a lot more than we really want to know." As projects move upward in complexity, the sheer volume of newly created information, the demand for previously unneeded information, and the physical remoteness of many of the participants may overwhelm the unprepared developer. Unless a workable information management system is hurriedly erected, the project may collapse. This critical stage often occurs just beyond the threshold at which most developers now stand--the transition from projects focussed on a single unit or course to multiple-course projects, with a concommitant increase in team membership and complexity.

RELATE. These problems, and the pleasures of finding viable answers to some of them, are aptly illustrated by Project RELATE, one of the most ambitious development efforts undertaken at Indiana University since the creation of an Instructional Development Department in 1968. RELATE is an acronym for REading and Language Arts Teacher Education. It consists of a sizable portion of the pre-service elementary education major's block of professional courses (24 semester hours in all, including student teaching). At one time or another, representatives from Reading, Elementary Education Language Arts, Linguistics, and Educational Psychology have held membership on the team, as has one member of the public school administration. The project also has an inter-campus and

inter-institutional flavor, with input received from nine campuses in Indiana and use of the product currently on four campuses of the nine.

Shortly after the project's inception in the spring of 1970, teams were organized along the lines of a "specialized" model (Fig. 5) in which each team applied its specialty to each of the units as they were passed from team to team, assembly-line fashion. Almost immediately, the project was inundated with information as the teams attempted to communicate with the directors and with each other, and the directors sought to communicate with the teams and with various other "audiences." Numerous early attempts to expedite the flow of information (meetings, memos, speed mailings, installation of a copy machine for exclusive use of the project) met with mixed success. After some months and a few critical moments, team membership was pared back, teams were re-organized somewhat along the lines of the "generalized" model (Fig. 5) and better match between needs and processing techniques was achieved. Productivity increased with each improvement, and Project RELATE was able to claim "mission accomplished" in slightly over three years. Not all the credit can be claimed by the IMS for these results, but unquestionably the emergence of more effective communications made a significant contribution to productivity and laid the groundwork for effectual project management.

DEVELOPMENT OF AN IMS. The steps in establishing a system for managing information may appear deceptively easy (Fig. 6).

They are not easy, but on the other hand, they are attainable. Some notes on each:

1. Select decisions. Perhaps the most intriguing step, this is certainly the most neglected. The Stufflebeam decision matrix referenced in Fig. 4 serves as a useful base for this step of the process. Stufflebeam and his colleagues remark:

> Within each decision-making setting are literally thousands of specific educational decisions, all different from each other. Unless ways can be found for grouping these individual decisions, it will be necessary to contrive a different design for every conceivable decision. (4)

This matrix represents their solution, the foundation of the well known CIPP model.*

In Project RELATE, specific decisions gradually evolved over time, as shown in Fig. 7. These decisions have a ready generalizability to most, if not all, instructional development. Note that each decision subsumes a large class of sub-decisions which are commonly encountered by developers. Much of the art of development lies in keeping these in focus as the project proceeds.

The tightest possible decision design also calls for specifying each plausible condition, or status, which could

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*As the reader has no doubt noted, the management information process bears a strong resemblance to present-day concepts of evaluation. Most of the statements made in this paper could be made of evaluation just as readily, and the evaluation literature will continue to make an invaluable contribution to the developer-manager.

conceivably come to bear upon a given decision, and stipulating the appropriate course of action for each*

2. Identify appropriate information. At this step, information needs are identified for each decision. This procedure helps to ensure the relevance and comprehensiveness of the information so identified, targetting it on specific decisions. In instructional development, such information is typically composed of student performance data, time-to-criterion data, and development time and cost data.

3. Identify sources of information. The tentative instruments, channels, networks, and data systems are identified and matched with the decision matrix. A sizable number of sources has proved useful to RELATE at one time or another during its formulation (Fig. 8). Especially promising is the Student Data Management System, under development as a data bank feeding a large number of decisions concerning student entry into the program and placement within the units and modules. Also of interest is TRAC-COST, originally a computerized development cost analysis package prepared specifically for RELATE. Unfortunately, the computerized version proved too complex, rigid, and costly to serve this type of a project well; TRAC-COST is now coupled with manual processing of the data, but its essential design is proving very servicable.

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*Management literature has shown increasing interest in the problems of decision-making under conditions of uncertainty. Undoubtedly, such conditions characterize much of the development process, particularly during the early phases, but the models for this type of decision-making offered to date seem to be too expensive or otherwise unsuited to development as it is currently practiced.

Each data system, as it emerged, was targetted into the decision matrix (Fig. 9). In this way, relevance of the information was ensured and the probability of its actual (not merely planned) use in making decisions was enhanced.

4. Identify means of information processing. A broad distinction between two types of data is in order here. Quantifiable data are processable through customary routes (e.g., ledger sheets, unit record equipment, computers, etc.). More unwieldy are the non-quantifiable data, such as descriptive statements, subjective opinion, and even intuition. Many management information system authorities have chosen to ignore this latter category, but a brief reflection on the nature of most development decisions will reveal that, given the present state of the art, they rely heavily upon non-quantitative but highly persuasive information. Forrester asserts that "we should rely less exclusively on statistics and formal data and make better use of our vast store of descriptive information." (5) The means of "processing" this type of information is not so apparent as, say, using a card sorter, but the adroit developer will frequently make use of devices such as thoughtfully planned agendas for team meetings or reports judiciously abstracted from tape-recorded proceedings to structure the team's decision processes for optimum impact by these less rigorous kinds of data.

It is encouraging that data collected across many development projects are highly similar in nature. This fact allows a development agency which has a number of projects

in progress at any given time to effect economies in information processing through the use of uniform procedures. Even though no computer may be involved, this arrangement can still be termed a "time-shared" one. The ID Department at Indiana has programmed SILA, a student data bank which can store data from several projects simultaneously and which was designed to transmit data from the bank to any one of several statistical routines. Technical problems have forced an overhaul of the package, but the basic principle is an attractive one, promising greatly increased power in decision-making at little or no additional cost.

5. Estimate cost. Experience will soon enable the neophyte developer to make reasonably reliable estimates of processing costs early in the life of the project. In actual practice, the developer will keep a sort of mental "running total" at each stage and will usually not be caught by a sudden realization that his information management system will consume, say, 2.5 times the total project allocation.

6. Curtail the design to match cost constraints. If the logic outlined so far has been closely applied, the design should already be "lean." The seemingly trivial act of targetting information to specific decisions should significantly reduce unwanted (and unwonted) data. Time-sharing capabilities will further increase the return on the investment of meager resources. Even so, the design may yet be too ambitious. Rank ordering of the information types--with careful regard to the cost/gain ratio of each--will permit sound paring of portions of the design until a feasible plan emerges.

7. Implement. The plan, in draft form, is ready to place into operation. In most cases, information management systems should be put into service incrementally. It requires time to identify the ultimately crucial types of data and to debug the operation. Gingerly testing the system part by part will help avoid casualities and "system breaks," and will be conducive to a climate of acceptance by team members, who may initially be wary of the whole thing.

8. Revise as required. Revisions, either major or minor, will frequently be in order. Whether it is worthwhile to alter the formal design on paper, or merely to make the needed adjustments in practice, will depend on circumstances. Small scale, short term projects probably need few formal documents to begin with, and will probably require very little alteration in them. But as scale and complexity increases, alterations in information processing may need team ratification and elaborate reformulation of the stated design. In any event, the ultimate IMS design will gradually evolve, through successive approximations, in a way that parallels the development process itself. The developer, if at all temperamentally suited to his profession, should find this a comfortable state of affairs.

Notes

1. Singh, Jagjit. GREAT IDEAS OF OPERATIONS RESEARCH. New York: Dover Publications, Inc., 1968, p. 185.

2. Forrester, Jay W. INDUSTRIAL DYNAMICS. Cambridge: The Massachusetts Institute of Technology Press, 1961, p. 93.

3. Stufflebeam, Daniel L., et al. EDUCATIONAL EVALUATION AND DECISION MAKING. Itasca, Ill.: F. E. Peacock Publishers, Inc., 1971.

4. Ibid. p. 79.

5. Forrester, Op. Cit., p. 54.

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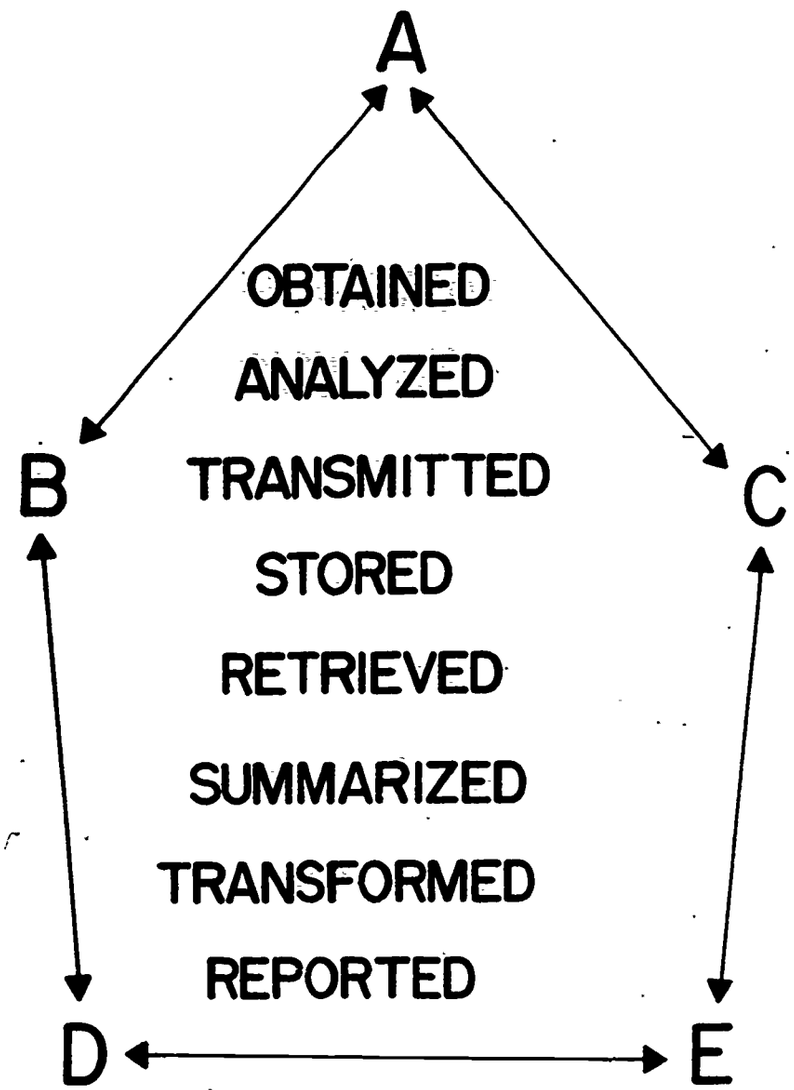
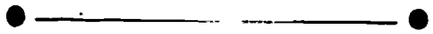

A
OBTAINED
ANALYZED
B
TRANSMITTED
C
STORED
RETRIEVED
SUMMARIZED
TRANSFORMED
REPORTED
D
E

Fig. 1

Fig. 2



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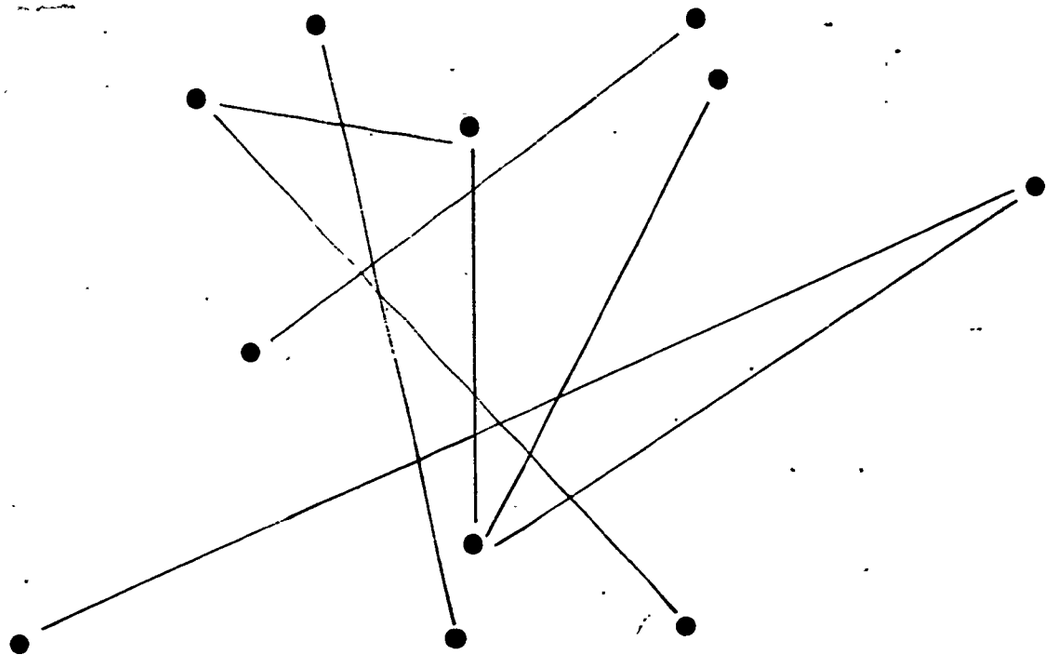

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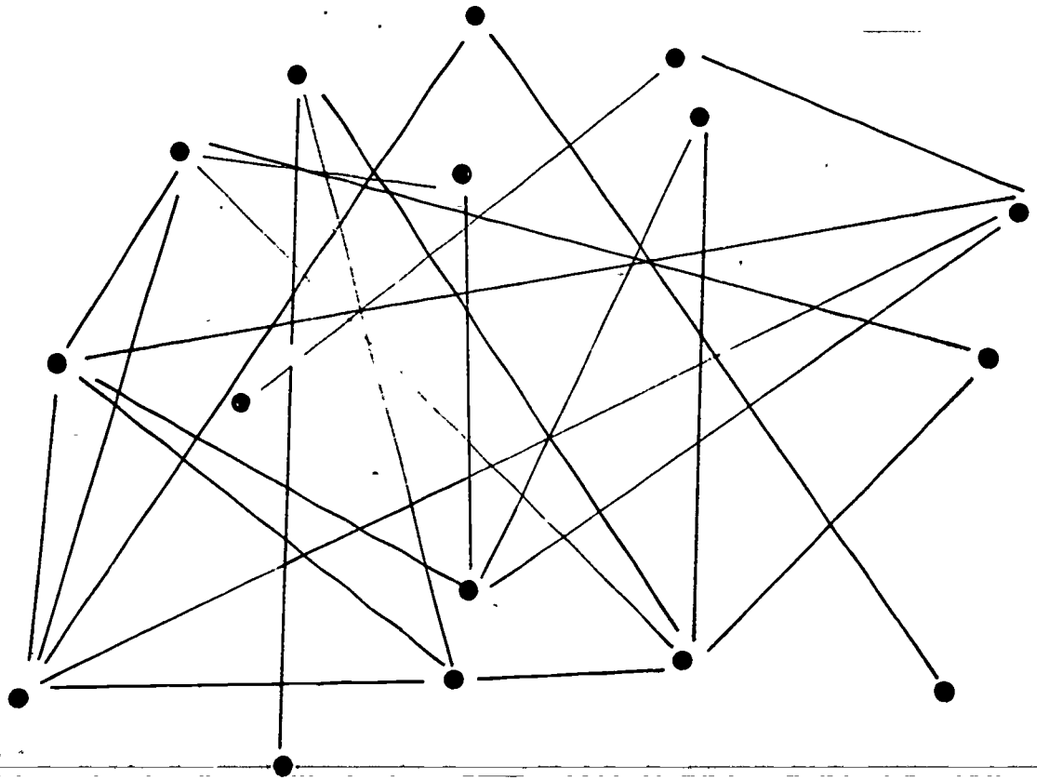

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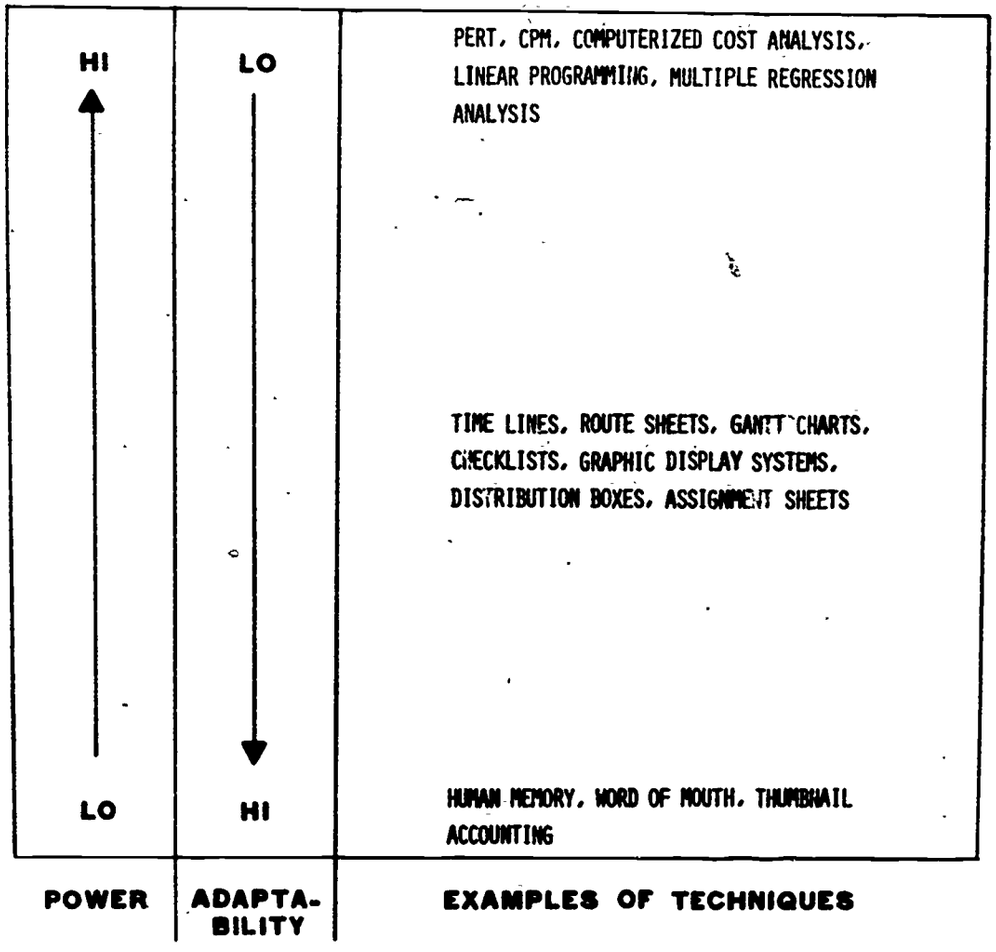
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HUMAN MEMORY, WORD OF MOUTH, THUMBNAIL ACCOUNTING
POWER
ADAPTA-BILITY
EXAMPLES OF TECHNIQUES

Fig. 3

DECISION MATRIX

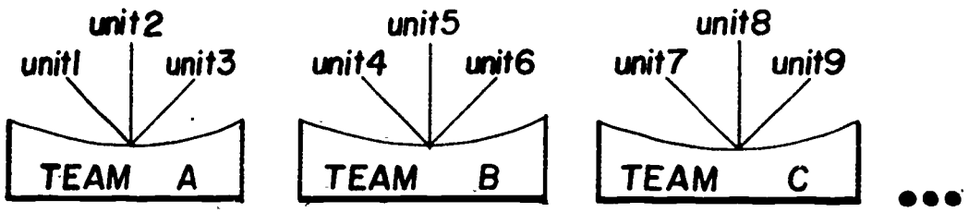
	INTENDED	ACTUAL
ENDS	PLANNING DECISIONS	RECYCLING DECISIONS
MEANS	STRUCTURING DECISIONS	IMPLEMENTING DECISIONS

Fig. 4

After Stufflebeam, et al

Educational Evaluation and Decision Making

"GENERALIZED" MODEL:



"SPECIALIZED" MODEL:

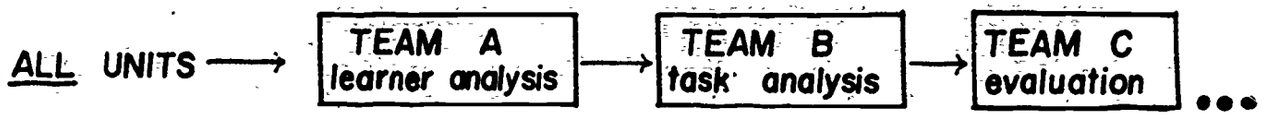


Fig. 5

STEPS TO MANAGING INFORMATION

- Select decisions
- Identify appropriate information
- Identify sources of information
- Identify means of information processing
- Estimate cost
- Curtail design to match cost constraints
- Implement
- Revise as required

Fig. 6

DECISION MATRIX

	INTENDED	ACTUAL
ENDS	PLAN OBJECTIVES DESIGN INSTRUCTION	MODIFY OBJECTIVES MODIFY INSTRUCTION
MEANS	ASSIGN PERSONNEL ALLOCATE RESOURCES	RE-ASSIGN PERSONNEL REALLOCATE RESOURCES

Fig. 7

INFORMATION SOURCES (PROJECT RELATE)

A. PILOT TESTS

B. FIELD TESTS

C. STUDENT MANAGEMENT DATA SYSTEM

D. TRAC-COST

E. COMPONENT RECORD SYSTEM

F. ROUTE SYSTEM

G. ASSIGNMENT SYSTEM

H. TIME RECORD SYSTEM

I. INFORMAL DATA

Fig. 8

DECISION MATRIX

	INTENDED	ACTUAL
ENDS	PLAN OBJECTIVES A I DESIGN INSTRUCTION A I	MODIFY OBJECTIVES A B C D I MODIFY INSTRUCTION A B C D E H I
MEANS	ASSIGN PERSONNEL C E G H I ALLOCATE RESOURCES D F I	RE-ASSIGN PERSONNEL C E G H I REALLOCATE RESOURCES A B C D E F G H I

Information Sources Developed For Project RELATE

Fig. 9