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ABSTRACT

This paper describes systems analysis in general terms, suggests some applications for education, and discusses the limitations of its use. Such problems as the political conditions, the lack of clear-cut goals, and the failure to plan alternative methods for achieving goals are seen as major limitations. To overcome these conditions and to permit positive planning, an "educational service system" is proposed as an analytical method. It is emphasized throughout that system procedures can contribute to education only as they are adjusted to the realities of the educational context. The six major steps in the process of systems analysis which are identified and discussed are: conceptualizing the system or the "problem universe," defining the "subsystems," stating the objectives of the system, developing alternative procedures, selecting the best alternative, and implementing the system. (Author/JS)

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System Theory: Some Applications for Curriculum and Instruction

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INTRODUCTION

"Systems Analysis" has become a popular catchword indicating a process for the application of scientific thinking to large problems. The phrase is used indiscriminately to mean the analysis of information for computer programming, the development of planned management activities, or, on other occasions, simply the orderly relationship between any two or more things or ideas. These uses, at least in the popular sense, seem to convey some special magic of science.

There has never been one system methodology; indeed, the tradition of systematic analysis in one sense is as old as Aristotle. What is new, though, is the concentration on quantifiable aspects of analysis (to the extent that this is possible), and on the isolation and control of the numerous factors and variables made possible through the power of the computer. This, in turn, has led to a revolution in our thinking about the nature, organization, and use of information, so that at the heart of systems procedures there exists a philosophy of information.

This philosophy, essentially evolutionary, views development as a process of increasing sophistication in the organism's ability to get and use information, leading to more effective interaction with the environment. Experimental technique evolved as a means for determining improved patterns of interaction, and judgments were essentially pragmatic. Increasing information and experimentation now lead to increased control over the environment, including the areas of social problems such as education, but this fact makes necessary means for dealing with the results of experimentation in a systematic and rapid manner.

These processes of information science and experimentation are developing and changing so rapidly that effective control and planning are critical areas of concern. As Galbraith has pointed out:

> "Nearly all the consequences of technology, and much of the shape of modern industry, derive from a need to divide and subdivide tasks and from the further need to bring knowledge to bear on these fractions and from the final need to combine the finished elements of the task into the finished product as a whole."1*

It was out of this context of evolution, pragmatism, information science, and technology that systems analysis developed in its present form.

During the 1950's and 1960's, the development of huge weapon systems involving large investments, a number of contractors and subcontractors, the design and scheduled construction of hardware, and the appropriate procurement and training of manpower, required orderly procedures for the mounting of these tasks. As a result of these challenges, the group generally called "the aerospace industry" developed processes of systematic design and control which have come to be known as systems procedures.

The success of these procedures in procuring large military systems provoked the consideration of their application to social problems. Major examples are the use of aerospace contractors by the State of California to study the problems of waste management, information systems, crime prevention, and transportation.

Systems analysis techniques have been applied to education in the areas of business and administration, classroom and instructional management, and the applications of technologies, especially the computer. To some extent, systems

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1*Footnotes on page 22.

principles have been used as an aid to our understanding of the change and implementation process. In general, however, the impact of systems procedures on education seems to be limited.

The word system is used by different people to communicate different ideas, among them: the connective idea, the idea of control, the inter-disciplinary idea, the "big picture" idea, and the organism idea. A great deal of confusion has resulted from overpacking the term.

"System analysis" or "systems procedures" are two of the terms used to describe a common process, and in this paper they will be used interchangeably. Usually, systems procedures include both analysis and design, but since most systems analysis is intended as support for design, the distinction becomes a matter of emphasis. Other terms, such as "Planning-Programming-Budgeting", "PERT" (Program Evaluation and Review Technique), or "Cost-Effectiveness Planning" are frequently confused with systems analysis. These areas are better thought of as specialties within the field.

In this paper, I would like to define systems analysis as a process and indicate some of the problems in the application of systems procedures to educational issues.

WHAT IS SYSTEMS ANALYSIS?

"The central idea of the system analytic approach", according to Thomas Rowan, "is that functional components are related and that a complex process can best be understood if it is treated as a whole."[2] Systems analysis is, in short, an orderly approach for first, defining and describing a universe of interest (and the significant factors and their interrelationships within that universe); and second, determining what changes in that universe will cause a desired effect.

A system, therefore, can be any view of the whole. Systems analysis generally begins with the broadest statement of the universe, and then subdivides this universe into its component parts. These subdivisions are governed by two important considerations: first, parts of a system are isolated and defined according to their functions; and second, the interrelationships among their functions are noted. These viewpoints, the functions, and the interrelations are the distinguishing characteristics of this form of analysis.

There are six steps in the process of systems analysis. Each step requires its own group of techniques and suggests a different set of problems and limitations. Systems analysis has perhaps been viewed with greatest alarm through pre-occupation with these limitations.

STEP ONE: CONCEPTUALIZING THE SYSTEM OR THE "PROBLEM UNIVERSE"

The first step develops a clear statement of the system of concern. This definition includes all those elements which are a part of the problem universe. The analysis also sets limits to the problem by separating the system from its environment and by relating it to other distinct systems.

Every system is a subsystem of some larger system and is composed of a hierarchy or subsystems, sub-subsystems, etc., each of which is a system in its own right. The systems analyst, therefore, must select a universe which is consistent with the purposes of his analysis. A useful and productive analysis is distinguished by the formulation or design of the problem, the selection of appropriate objectives, the definition of the relevant and important environment or situation in which to test alternatives, and the provision of reliable cost data and other pertinent information.

Having selected an appropriate system, and hence having some notion of the subsystems, the analyst then isolates the parts of the system:

Determinants: elements outside the system that determine the nature, form, and limits of the system.

Components: the "moving parts" of the system which include the mechanisms, men, and facilities within the system.

System Integrators: the elements that integrate the moving parts.

There are different approaches to the description and design of systems. Economic modeling is perhaps the earliest approach and led to the development of mathematical modeling for a number of areas. Where mathematical models are not feasible, other forms of symbolic representation are employed. A second approach, the operating unit approach, involves task and performance analysis. The ad hoc approach "proceeds with a view of present reality as the only constant in its equation and uses it as a means of moving from the current state of affairs to the desired system state."[3] A fourth approach is called heuristic and uses principles as guides to action. Boguslaw suggests that this approach "is not bound by preconceptions about the situations the system will encounter. Its principles provide action guides even in the fact of completely unanticipated situations and in situations for which no formal model or analytic solution is available."[4] An approach is selected because of the nature of the available information and according to the degree of abstraction appropriate for the analysis.

STEP TWO: DEFINING THE "SUBSYSTEMS"

A subsystem is an operational entity within a system, capable of functioning independently or of permitting independent design and analysis. Subsystems are defined according to sets of common properties. In the design of weapons systems, the major subsystems are "hardware", training (or personnel), and administration. Subsystems interact at the system level through a process called "systems integration".

In the field of education it is possible to suggest a number of viewpoints for the selection of subsystems. If the school is considered as the universe (the total system), the following subsystems might be considered:

1. Hardware subsystems: including production, transmission, reception and related equipments, software, and service.

2. Specific curriculum areas (i.e., subject matter, but longitudinally, throughout the school experience).

3. Grade-level programs (the total program for the kindergarten).

4. "Package procurements" -- (perhaps a major unit of study organized around a major theme).

5. One or more specific and persistent educational problems (good health, physical handicap, reading difficulties, etc.).

6. Specific and persistent problems unique to the environment (poverty, isolation, teacher shortage, etc.).

7. Assumed needs (based on present inadequacies, conjecture that the present will not prepare for the future, "band-wagon applications", "equal education" themes, etc.).

Compatibility of system description is maintained when subsystems are selected according to a common viewpoint. The selection of a particular viewpoint represents an important decision for the systems analyst and is governed by a number of significant considerations aimed at permitting ease of analysis and design. Among these are the availability and form of required information, the avoidance of "sensitive spots", administrative decree (a weak viewpoint, at best), and the ability to operationally define the span of control. An effective viewpoint will avoid areas which cannot be changed or in which resistance to analysis is predictable. State-of-the-art information and prior experience with the system provide useful guidelines. The critical factor in the selection of subsystems is the clear-cut and simple explanation of the important factors in the situation.

STEP THREE: STATING THE OBJECTIVES OF THE SYSTEM

Systems procedures have sometimes been defined in terms of two basic operations; first, state the goals for the resolution of a problem; and second, organize the means to achieve these goals. In any event, the critical point in understanding or using system procedures rests on the importance of clearly explicating the objectives of the system. Indeed, every element within a system is evaluated in terms of one basic question: Does it contribute effectively to the achievement of system goals? A mechanism, therefore, for determining the objectives of the system, for ranking multiple objectives, and for choosing between incompatible objectives is a first requisite for effective systems planning.

System Objectives in Education

Two types of objectives exist in education. The first focuses on the student by determining what changes in his behavior are desirable. These goals are usually expressed in terms of information learned, attitudes evidenced, and general increase in maturity. There are usually statements of short-range objectives by grade level (or subject matter) and long-range objectives such as college entrance, effective employment, and a satisfactory adult life as individual and citizen.

Since the application of Skinnerian psychology to the development of programmed instruction, it has become fashionable to specify behavioristic goals for educational activity. While their development has increased the ability to control and direct the educational experience (more significantly in some areas than others), too often behavioristic (and simply quantifiable) goals omit the necessary consideration of attitudes or other presently unmeasurable qualities. Their greatest defect as system design guides remains in their inability to express either long-range behaviors or the steps required for achieving those behaviors.

Instructional Systems

Using goals for the student as the base leads to the concept of instructional systems. "An instructional system is defined as an integrated set of media, equipment, methods, and personnel performing efficiently the functions required to accomplish one or more training objectives."[5] Robert Smith lists seven steps in the design of instructional systems:

1. Preparing the training objectives.
2. Sequencing the objectives of the system.
3. Identifying required functions.
4. Selecting components and procedures.
5. Analyzing cost-effectiveness.
6. Coordinating components and procedures.
7. Evaluating the system.

There is a certain familiar ring about this orderly curriculum design process, but two aspects of it require comment, and I am going to digress at this point to talk about them. The first point is that instructional systems, as they have been developed as parts of total system design, have been based on an analysis of the required performance or activity needed by the student after training. The presentation and practice of knowledge in the system are governed by these performance requirements. Nothing is included in the system because it is "nice to know" or may be "needed later on in life", or because some group brought pressure to bear on the school board. Such a systematic analysis of present school practices would undoubtedly reveal disparities between what is going on in the classroom and what is expected of students thereafter.

(Shortly after the march on the Pentagon last fall, I suggested to teacher friends that it seemed each marcher deserved an "A" in his Social Studies course, since any citizen who would perform to that level of action had certainly learned a great deal about liberty. The argument about the appropriateness of the action seems to me secondary in this case, because any real action is usually discouraged by school officials anyway.)

Man-Machine Systems

The selection of components and procedures for instruction is a process which I believe needs tremendous overhauling in the field of public education. One basis suggested by system procedures is usually referred to as man-machine systems, a collection of concepts virtually ignored by educators despite some excellent articles on their uses. The area becomes critical, however, when one begins to examine the presently ineffective use of such potentially great resources as multi-media, computers, and television.

A man-machine system implies the interrelationship and joint functioning of man and machine in the accomplishment of a particular goal. Within the system, tasks are assigned to men and to machines, and each is held responsible for the achievement of its function. In those systems where this concept has been applied, certain tasks have been designated as appropriate to the machine, while others have been reserved for the man. As the total system develops, the machine is designed to relate to the man, and the man is trained to operate and interact effectively with the machine. Since both men and machines "fail" on occasion, "back-up" systems are designed to cover emergencies, but full operation is achieved only when the men and the machines are functioning properly.

The application of man-machine systems concepts to educational planning holds great promise. Indeed, such planning is requisite for the development of adequate mediated systems. Unfortunately, insufficient attention has been devoted to this area, probably because of exaggerated fears about the dehumanization of education by machines. The planner attempting to employ such techniques is usually greeted with a barrage of ethical and moral quandaries concerning the nature of the individual and, while these arguments are extremely significant, they are usually presented in a form which impedes progress rather than suggests alternatives. The questions of appropriate functions for a man or appropriate responsibilities for a machine, especially within an educational environment, are extremely real and difficult, but they cannot be avoided.

Objectives for the System

The second form of goal setting focuses on the operation of the system. These goals concentrate first on how the system is intended to affect groups of students and then on the effective management of the system. Programming, Planning, and Budgeting Systems (PPBS) and other cost-effectiveness techniques are designed to help assess the operation of systems in relation to previously stated goals. The establishment of system-level goals is important because it permits the efficient and effective selection of alternatives. For educational planning, however, a concentration on the system level may omit an adequate view of the final product, the student.

The system procedures techniques, developed for the design and delivery of hardware systems and their required support systems, tend to concentrate on aspects other than the individual. They are appropriate to the design of such technological systems as educational television, mobile facilities, or a computer system, but once these systems are designed, they must be seen as means for the achievement of goals relating to the individual. This consideration suggests that a dynamic interaction between these two design levels should be maintained to insure a fit of the system with the essential purposes.

The question of an appropriate statement of objectives within the framework of systems procedures has received considerable attention, especially since these techniques have begun to move into the social sphere. There is no doubt that to the degree objectives can be made explicit and goals objectified, the deliberate design and analysis of systems is enhanced. Some writers have gone so far as to suggest that systems analysis represents a viable approach only in situations where the goals permit quantifiable measurement, but this position remains extreme.

Since the public schools have never clearly stated a system of objectives in a manner more explicit than the most general, nor have they arrived at any strong consensus about goals, the first task of analysis is to discover why the system exists. There is, of course, no general agreement on this matter, so the application of systems techniques is in trouble already. Yet assuming that a system of goals can be found and explicated, the means--the whole of public education--appears to fit only incidentally to it.

Dr. Ida Hoos, in her analysis of the California studies, put this matter in clear perspective:

> "The rationale for inviting systems engineers into the arena of public affairs stems from the assumption that their capability in managing large-scale, complicated projects can be applied to large-scale, complicated social problems. This hypothesis will probably never be entirely proved or disproved because of the hydra-headed nature of social problems and also because a diagnosis, no more so than a remedy, is not a cure, especially in situations in which there are so many political overtones. Space Age magic may be evoked, but implementation of good programs is what is decisive, and that must be accomplished in the framework of 19th century institutions, to say nothing of the restless flow of action and reaction in the political tides."[6]

There is reason to suggest that systems procedures applied to the whole of education, or to the whole universe of the schools, will be ineffective because the institution grew at random and remains relatively limited in the methods and means it can apply to the problems confronting it. What is required seems to be a methodology for arranging objectives into meaningful subsystems based on major educational problems and needs, and I will digress once more to suggest such a procedure.

An Educational Service System

An Educational Service System is any organized grouping of resources charged with the accomplishment of specific objectives which are only a part of the total educational program. The educational service system represents less than the total school system and, therefore, less than the total allocation of resources--time, money, people. It represents a system, however, because its planning (and definition) begins with a clearly identified goal or set of goals, includes the explication of alternative uses of resources to achieve the goals, selects the preferred alternative because of its relevance for the operational environment, predetermines the requisite and appropriate evaluation procedures and critical check points (including procedures for adjustment), and states the operational relationships (and necessary linkages) of this system with other systems and the total educational effort.

The advantages of this concept and its application stem from its ability to permit the generation of a clear-cut view of a particular aspect of the total educational effort. The system should not be organized around a subject or a grade level. These concepts are worn out and apparently useless as integrating devices for planning. Some creativity should be devoted to the statement and description of new bases for the organization of objectives, and such developments as the reorganization of basic skills, pre-vocational curricula, symbol systems, and individually guided instruction should be expanded. These new statements of objectives would lead to new organizations of the other parts of the system.

This process of design assumes no immediate connection between the educational service system and the operating school program, and in this respect an attempt is made at original design rather than at refitting the elements in the present system. Once the educational service system has been designed, its applicability and relevance become questions of implementation. This technique represents a useful tool for dealing with a complex and poorly defined environment. At some point the whole of education becomes greater than the sum of these parts, and while these techniques put the parts in perspective, the view of the whole should be kept firmly in mind.

STEP FOUR: DEVELOPING ALTERNATIVE PROCEDURES

Once the goals for the system have been established, the system designers will explore the various alternatives available to them for the accomplishment of the goals. Some of the bases for the selection of alternatives are worth noting.

Cost-Effectiveness

The vehicle for cost-effectiveness decisions is the program budget, a document which organizes all costs connected with the achievement of a particular objective or set of objectives. Alternative combinations of resources (for example, teachers, para-professionals, automated teaching devices, teacher aiding technologies) could be organized to achieve a common objective--perhaps learning to read at the sixth grade level within two years beginning at age four. (Let's assume, just for fun, that we all know what is meant by that objective!) By constructing various hypothetical descriptions of the organization of these means, it is possible to draw some conclusions about which combinations are less expensive than others. One caution: if they are to be useful, cost-effectiveness analyses must include not only operating expenses but also the cost of design and invention, procurement, maintenance, and replacement. The point is worth emphasizing in education, for we are accustomed to thinking of these costs in relation to machines and overlooking them in terms of our teachers. (It has always seemed to me that in-service education should be budgeted as maintenance in exactly the same way that school buses are budgeted to receive regular service attention.)

Cost-effectiveness analyses in education have not been completely successful, partly because of the difficulty in developing a program budget; that is, of isolating the actual costs for a specific goal directed activity. The data for such studies are rarely available in a form which permits analysis. But the most serious detriment to cost-effectiveness analyses stems from the lack of alternative systems for achieving objectives.

Constraints on the Selection of Alternatives

The constraints imposed upon the selection of various alternatives are important to the systems analyst. These constraints include such operational considerations as time, space, personnel, available information, appropriate equipment, and the level of funding. It is frequently possible to plan around one or more constraints. The careful description and design of components and alternative configurations from which selections can be made has produced new insights concerning the use of resources. Consequently, effective savings have been accomplished. This fact, however, does not mean that systems procedures may provide a new rationalization for operating below minimums. If the task cannot be accomplished within available resources, the responsible systems analyst will of necessity report this conclusion.

Systems Analysis and Political Decisions

I believe the most significant and least adequately discussed area of systems analysis concerns its relation to the political process. James Schlesinger has commented strongly on the constraints imposed by government on the use of systems procedures:

> "In the variegated structure of government deliberate distortion is reinforced by honest conviction, bias, recruitment, limited information, and the structure of power.... How much systems analysis can do to counteract the pernicious results of such [mutually reinforcing tendencies] remains an open question [because] the resistances to the application of systematic and rigorous analysis in a highly politicized environment are sufficient to make even the stoutest heart grow faint."[7]

The political context in which education operates includes several detriments to the application of systems procedures. These include: relatively poorly constructed management units (local districts), a history of minimum funding (and a consequent concentration on saving at the expense of accomplishing), a separation from the whole of government and hence from the active political process (and a resulting high degree of safety and cohesiveness against threat), and a lack of sufficient critical study of the "politics of education".

Having made this rather bold statement, I must pause to concur in the perspective given such feelings by Stephen K. Bailey, who concluded in his study of northeastern educational-political problems that schoolmen were very clever politicians. They have to be in order to operate within their present system. I share his enthusiasm for the New York State Educational Conference Board, developed by Paul Mort, and its record of legislative achievement. Despite this example, I think the generalization still holds that the field of education has not devoted sufficient energies to these important areas.

A somewhat similar political situation appears to have existed within the military establishment, and the implementation of PPBS and other techniques required a good deal of political skill. However, there appears to be a more clear-cut mission and decision process for defense than for education. Education is also more directly responsive to the public than are the military leaders. This relationship has been put in perspective by Charles Hitch:

> "Much of the criticism directed against the technique of using cost-effectiveness studies or systems analysis is really related to specific decisions; people who for one reason or another dislike a particular decision attempt to fault the technique and rationale which led to it.... Computers do not make decisions, and neither do systems analysts. The job of the systems analyst is to free the decision maker from questions which can best be resolved through analysis.... The systems analyst, for example, can tell the decision maker how many more targets would be destroyed if 200 new bombers were added to the planned force and how much they would cost; he can rarely demonstrate whether they should or should not be added."[8]

The Total Design Process

The effective application of systems procedures in education (or any social field) requires, I believe, a perspective which views the total design process as composed of three interrelated but distinct aspects. These are the task of system design, the analysis of the system environment, and the change or implementation process. I would represent this relationship graphically by embedding each of these elements within a circle and enclosing these circles in a box. Between each circle is a two-headed arrow indicating the necessary intercommunication among the elements.

The system environment includes both the explicit and the implicit political, economic, and social forces which impinge upon the system. I suggested earlier that these considerations may be a part of system design. This is still true, but at a higher level there are forces which will affect the existence of the system because it is thrust upon a pre-existing, external set of conditions.

There is perhaps a more significant aspect in the consideration of system environment. Many problems can be handled more effectively outside of the system. For example, suppose a mandatory program of training emphasizing child growth and development were provided to all expectant mothers. I would conjecture that such an alternative would produce greater results than a similar expenditure for additional pre-schools or nursery-level educational television. This essentially educational program, however, while affecting the K-12 input and thus the educational system, would require changes in areas beyond the limits of the system.

The literature on change and implementation appears to be growing by leaps and bounds, both within and outside the field of education. The effectiveness of the various models has improved the evaluation effort. Effective feedback, especially concerning input-output relationships, is beginning to yield some effective observations of educational programs. It still appears unwise to put absolute faith in analyses of critical factors in education and predictions based upon them, but they certainly have become useful and important guides to judgment.

These three areas, <u>the system design</u>, <u>the system environment</u>, and <u>the change process</u>, have not received sufficient attention as integral parts of a single process for discovering and implementing improvements in highly charged political and institutional environments. Such an understanding, however, seems vital if systems procedures are to become useful in social areas.

STEP FIVE: SELECTING THE BEST ALTERNATIVE

The selection of the best alternative depends upon the values assigned to those considerations we have just discussed. It is at this point that the philosophical orientation of the decision maker comes most into play. Having determined that the objectives can be accomplished and that an effective system can be implemented, careful consideration should be given to the extent to which the job is worth doing, and then whether it is worth doing through the use of the most effective system.

Some time ago, I had the pleasure of visiting a school which used an almost totally automated, self-instructional approach to the teaching of reading and other subjects to first and second graders. Each child listened to a tape and worked with his own pre-arranged bag of instructional "goodies". His lesson was selected daily based on feedback and analysis provided through a computerized instructional management system. A "teacher" was always available in the classroom to answer questions, and one "teacher's aide" passed out the supplies while another scored the tests. I was assured that the students missed nothing in learning to read this way because they also had time for group reading, story listening, and the other "candy of the language arts!" (This phase, believe it or not, was used by the curriculum coordinator.)

The selection of this program as the best alternative was obviously based on assumptions about the nature of children, the role of the schools, and the values inherent within the subject. In this case, the goals were short range--the teaching of grade-level skills in basic reading. In point of fact, I was extremely impressed with the quality of the whole design and operation. It seemed to be one of the best examples of a new direction in education that I have yet seen.

Toward the end of the visit, I expressed my enthusiasm to the principal and asked what I thought would be a rather basic question. "What relationship do you see between this program and your final objective; that is, what do you want the product (the student) to look like when he leaves the sixth grade, or completes his education?" I discovered that no answer to my question existed! In fact, the principal informed me that beginning within a week, representatives of the school and the cooperating university were going to begin working on these areas. Yet, the program I had observed was in the middle of its second year of operation!

Systems procedures cannot answer these questions, but they can provide a mechanism for insuring that questions of this nature are asked. They can also provide an important organization of information for the guidance of judgments about the effects of program decisions. It is in this area that the potential value of systems methods is greatest for education.

STEP SIX: IMPLEMENTING THE SYSTEM

Systems implementation should be relatively automatic if the system has been carefully designed and tested, but systems procedures include several important aspects of implementation. The first is <u>feedback</u>. In fact, testing and the collection of adequate and appropriate data throughout the system process is a central concept in the field of systems procedures. This effort continues throughout the operation of the system in order to assist three purposes:

1. The continuing effectiveness of the system or the requirement for changes.
2. The continuing relevance of the system in terms of its objectives.
3. The need for the creation of new systems as a result of changing objectives, new developments, or new criteria for selecting alternatives.

One important development of this testing requirement has been the simulating of operational environments prior to implementation in the real world. Simulation techniques have been developed to a high degree of usability, especially with technological systems and "operator environments". The first use of simulation is system testing; thereafter, it is used for system training. These developments appear to hold great promise for educational planning. It appears that simulations of classroom situations, multi-media uses, teacher reaction simulations, total school environments, and total school programs are all within the realm of possibility. They would permit what Olaf Helmer calls "pseudo-experimentation"; that is, hypothesis and prediction about the model rather than about the real world where such activities are impossible or impractical.

CONCLUSION

Through a number of digressions, we have now covered the six steps in the process of systems analysis. They are, in short:

STEP ONE:	Conceptualizing the System or the "Problem Universe"
STEP TWO:	Defining the "Subsystems"
STEP THREE:	Stating the Objectives of the System
STEP FOUR:	Developing Alternative Procedures
STEP FIVE:	Selecting the Best Alternative
STEP SIX:	Implementing the System

In this presentation, I have tried to avoid several of the pitfalls often occurring in discussions of these areas, not because they are unimportant but because they represent unproductive departure points for critical analysis. For example, many writers today are deploring the "demon technology" and the "automation of education". To me, these thinkers seem anxious to cling to a past already lost. Further, they confuse political responsibility with technological responsibility. They forget that in the last analysis, man is the decision maker.

The great advantage of the new technology is that we now have the excess time and energy to spend arguing about its merits. If we choose to use this time defending the institutional arrangements of the nineteenth century, we may indeed be unprepared to cope adequately with the twenty-first. Unfortunately, I find too much evidence of this attitude among the educators I encounter.

On the other hand, the "people be damned, let's build the automated school", is equally distressing. Too much technology in education has not been planned around the real educational needs of people; too much money has been spent without adequate breakthroughs in learning, methods of teaching, and viable educational alternatives. The single, most significant, reason appears to be a too narrow definition of the problem situation. Coupled with this appears to be the apparent inability to develop alternatives within the schools--at least so that many choices are available for consideration.

It was these kinds of considerations which led me to study the application of systems procedures to education. They appear to offer the educator the following advantages:

1. A way of viewing large problems within a productive perspective.
2. The effective organization of the parts into meaningful systems for dealing with problems.

3. The effective application of resources based on alternative organizations.

4. A context for understanding the constraints imposed upon the institutional structure of education.

5. A group of planning techniques which makes possible large-scale, long-range planning.

6. An interdisciplinary, problem-oriented approach to research and development.

On the other hand, systems procedures are no magical scientific savior for the complex problems implied by technology. There are some things that they simply cannot do, despite occasional claims to the contrary.

1. Systems procedures cannot show ways to operate below certain necessary minimums.

2. They cannot remove the constraints imposed by institutional force, but they may suggest ways to work around them.

3. Systems analysis cannot compensate for a lack of clear-cut purpose or for a confused operational philosophy.

4. Systems analysis cannot provide simplistic procedures for arriving at incontestable conclusions.

5. There can be no guarantee that procedures developed in one discipline will be automatically transferable to another field.

6. Systems analysis cannot replace judgments.

In brief, systems procedures, if properly considered, can be effective tools for dealing with major educational needs. There are many problems in their adaptation, but with adequate attention to the techniques of application we may expect to see some important new directions for effective planning.

Footnotes

[1] John Kenneth Galbraith. The New Industrial State. (Boston: Houghton-Mifflin, 1967) p. 13.

[2] Thomas C. Rowan. Systems Analysis: Problems, Progress, and Potentials. (Santa Monica: System Development Corporation (SP-2615), October 1966) p. 2.

[3] Robert Boguslaw. The New Utopians: A Study of System Design. (Englewood Cliffs: Prentice-Hall, 1965) p. 13.

[4] Ibid. p. 16.

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