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AUTHOR	Young, Flora
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ABSTRACT

This document reports on an investigation which surveyed process analysis and documentation concepts, practices, and standards in light of the need for communicating the processes and outcomes of educational research and development. The survey demonstrated that the areas of impartial process analysis and documentation are both important and neglected. The ability of people to implement programs is significantly impaired by the lack of understanding of what is really involved. In programs in which process is central, like career education programs, knowledge of how operations are brought into being is of equal importance to knowledge of the substance and effect of the program. Various recommendations based on the findings of the survey are made. These are aimed at three specific groups: the applicant organization wishing to undertake solving the problem at hand, the funding agency providing the resources to be used in the investigation, and the group undertaking process analysis and documentation. Appended to the report are a list of key concepts suggested by the research plan and a reprint of an article, "Goal-Process-System Interaction in Management: Correcting and Imbalance", by John W. Buckley. A bibliography is also included. (DDO)

REPORT

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PROCESS ANALYSIS AND DOCUMENTATION FOR UTILIZATION OF RESEARCH FINDINGS

Flora Young, Principal Investigator

Northwest Regional Educational Laboratory
710 S.W. Second Avenue
Portland, Oregon 97204

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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Career Education Program

PREFACE

The need for this investigation traces back to the early days of the Career Education Development Task Force, when it operated under the jurisdiction of the Office of Education. The Task Force wanted to find out what is known about the process of developing an educational innovation and determine how to persuade the educational community to make use of a new product or process once its effectiveness has been demonstrated.

At that time, several large field development projects were being started that were expected to take three to five years. It was intended that, if they were successful, those projects would go through a replication phase and eventually be transported to other communities.

Members of the Task Force assumed that, in order to get the decision makers in a community to make use of a new educational product, it would be necessary to provide them with some information about how the product was developed, as well as to show them how it could contribute to and improve their educational operations; what would be involved in adapting the program; and how would it fit in with existing organizational structures in that community.

The Task Force also assumed that there are many factors that mold a project and make it go the way that it does, which have little to do with the original plan, but found that these are not often documented.

The documentation that comes from funding agencies, for example, rarely (if ever) reports the internal and external pressures that result from semantic problems, from disagreements among the experts, from conflicts with labor unions and vocational educators, or the way in which career education is defined. Equally rare are descriptions of alternatives that had to be set aside and the rationale for doing so. The way in which the definition of career education has been communicated has been a major influence on the kinds of programs that were generated and the way in which these programs were able to develop in their immediate community.

It seemed obvious that if a developmental project were to become an operational one, in other words, if the findings were to be used, the implementing community would need some information about the process in order to make the transition--some kind of a record of the actions that occur throughout the life cycle of the project.

ACKNOWLEDGMENTS

It is not possible to name the many people who have patiently contributed their time, ideas, and shared their references to make this report possible. To them all, we express our thanks.

We are particularly grateful to Dr. Garth Sorenson for his patient guidance and support in developing this report; to Dr. John W. Buckley for the perspective he brought to the project; and to Dr. Rue W. Harris for his support and guidance in reaching the best resources.

Flora Young	Principal Investigator
Stan Abraham	Research Assistant
Lilian Penny	Secretary

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I. INTRODUCTION

In this era of accountability, concern has grown regarding government funding of research, the reasons for doing so, and the conditions which are likely to make research worthwhile. How are useful research ideas generated? How does a project get funding? What factors influence the success or failure of a project? Under what circumstances will research findings be utilized? Are there more effective ways of disseminating successful innovative practices, thereby reducing the lag time between research and utilization? If individuals who do research and who utilize research findings were to share their experiences with one another and make information about those experiences available to new generations of researchers and users, perhaps the processes of research, dissemination of results, and utilization of findings could be speeded somewhat and resources could be used more effectively.

This report should be of value to funding agencies in the writing of RFP's* and reviewing of proposals, to those who write proposals and direct research projects, to project monitors, and to decision makers who would consider the adoption and implementation of the products and processes of educational R&D. It might well provide insights into ways in which the findings and experiences gained from career education projects can be applied to operational situations.

It is also hoped that the conclusions that have been drawn from the literature will suffice to stimulate interest of funding agencies

*requests for proposals

and project directors in the early recording of a description of the process of development to increase the utilization of research. If research is to be utilized, then product information such as materials, costs, and effects on program participants is as essential to the decision maker and the implementer as is information relating to actions, alternatives, roles and interagency relations.

A. Methodology

1. Statement of Work:

"Survey, organize and analyze developmental project documentation concepts, practices, and standards in light of the need for communicating the content and outcomes of career education projects and the process of the development of the projects. Attention is to be paid to shaping mechanisms, forcing functions, factors promoting and inhibiting project growth, and its environment. In addition to the library and document research, extensive field work is expected. Organize and summarize interim documentation and reporting processes which best present interim results for assessment and possible transport to other operating programs."

The underlying intent of the Statement of Work was interpreted to relate to accountability, not only in the sense of documentation for the purpose of fulfilling contractual obligations, but more importantly, documentation that facilitates the utilization of research findings by describing adequately what happened and why, and what steps have to be taken to replicate the findings and then transport them to another community.

The portion of the statement that refers to shaping mechanisms, forcing functions, factors promoting and inhibiting project growth, and the environment in which the project develops were interpreted to mean those factors which most directly influence the way in which a project evolves, and which therefore effect its success.

2. Procedures

Because the topic was so broadly defined, the procedures for conducting this investigation had to be sufficiently comprehensive yet manageable. Accordingly, the following resources were used: library bibliographic search; materials known experientially; materials known, produced or recommended by knowledgeable persons in the field; and interviews.

A list of key concepts suggested by the Statement of Work was prepared (see Appendix I). After a preliminary search of the readily available relevant documents, interviews were held with knowledgeable people in the fields of education, social science, research methodology and information technology. Among these were Robert F. Boruch, John W. Buckley, Edward Glaser, Egon Guba, Ronald Havelock, John R. Seeley, Garth Sorenson and Ralph Tyler. An extensive literature search followed.

A model of the R&D process was constructed by specifying the steps or phases through which a project might normally be expected to progress, beginning with an idea being formulated about an area of need and ending with the adoption of an innovation. The steps were conceptualized as the points at which significant decisions are made regarding the kind of support a research project would get and how it would develop.

Abstractions from the literature and notes taken during interviews were synthesized to produce comments and generalizations about the kinds of events and other factors which influence each phase in the R&D process. These comments and generalizations were then translated into rules of thumb--do's and don't's for persons involved in various phases of research and product development. These rules appear as recommendations in the Summary chapter.

B. Sources of Information

Some of the dynamics of the management process and the information systems required to support that process are described, at an abstract level, in the literature of management science and information technology. However, much of this work is theoretical and geared to large information systems that must be handled on a computer. Since much of the work is abstract, in that it describes someone's ideas of how a system might work rather than describing the precise operations of an actual organization or institution, it does not provide documentation of the processes with which this report is concerned. That is not to deny the usefulness of abstract models, but merely to indicate the paucity of the kinds of data on process documentation relative to all that has been written at the theoretical level.

A number of articles have been published that describe the role of a change agent--the person charged with implementing an innovation. Emphasis is on the behavioral aspects of what a change agent must do to gain acceptance. From this literature it is possible to deduce what some of the information needs of the change agent are. However, few references were found that described in any detail the actions that have been taken by a particular change agent to effect the implementation of an innovation--actions that need to be accomplished to meet the project's objectives, alternative conditions, and descriptions of the forcing functions and shaping mechanisms which mold and direct the overall process and character of pilot projects.

Some efforts to describe the R&D process have been generated within the National Institute of Education with the establishment of a special task force that is concerned with dissemination strategies. CEDTF made an early attempt to document the process of development of some of the career education models. Aries' (1972) operational plan for the design, review, operational analysis and documentation of CEDTF models was produced along with a contextual analysis of each of the models. The purpose was to provide information that would facilitate the transport of career education practices, but this effort turned out to be premature. More recently, CEDTF requested that the employer-based development projects produce replication plans and embark on a major collaboration activity in exploration of the social, economic and political implications of transportability. This action, however, was taken too recently to produce results usable in this report.

Centers for research on the utilization of scientific knowledge have been established at universities such as Indiana and Michigan, and organizations such as Human Interaction Research Institute and HumRRO. They are generating information in the areas of implementing change; role of the change agent; utilization of research findings; characteristics of a usable innovation, etc. Most of what has been written describes objectives to be achieved rather than actions that were taken by people in the process of implementing a specific developmental project. Therefore, there is a wealth of suggestions about what the change agent must do to implement an innovation, but less on the actual behaviors that motivate people to accept change.

C. Limitations of the Report

The nature of this study is that it is a survey and not an experiment. It is concerned with one area of research having to do directly or indirectly with R&D in education. The report does not deal with basic research or, indeed, most of the activities that are implied by the term "research." Rather, it is concerned with efforts to get the products and processes of educational R&D transported or utilized in operational settings. Since the experts borrow many of their ideas from other disciplines, material for this report was collected from the fields of management science, information technology, organizational change and the behavioral sciences.

* * * * *

It is not the purpose of this study to concern itself with documentation as it is traditionally discussed under such headings as information science, cost benefit analysis, decision theory, systems analysis, methods and procedures, operations research, journalism, library science and research methodology. Rather, focus is directed toward documentation as a means of communicating the process, content and outcomes of developmental projects to best present results for assessment and expedite transport to other operating programs. Attention is to be paid to the context within which a project develops, and to the factors promoting and inhibiting project growth and development as they may relate to eventual transportability.

A summary will be presented in sections relating to process analysis and documentation, the life cycle of a project, factors that influence the success of a research and development project, and utilization of research findings.

II. PROCESS ANALYSIS AND DOCUMENTATION

Process analysis and documentation is concerned with describing the elements, events, and relationships in the life cycle of a research project that converge around a set of objectives involving people, organizations and products. The availability of a description of these events, objectives, and of the domain in which they occur is a major determinant of the effectiveness of the utilization of research findings.

A. Process Analysis

Process analysis deals with the description of functional relationships and activities. A process is a series of events, constrained by time and money, that leads to a particular goal and is promoted because of implications for potential replication and transport. The events themselves may be interrelated in that they occur in a sequence that describes the project. They may relate in the domain of the project and its objectives but seem to be unrelated at the time they occur. They may also seem to be related at the time they occur but be unrelated within the framework of the project.

A simple and fairly direct process is the one by which newsprint is manufactured. All the events and related costs that occur in the production process are fairly clear-cut and well-understood. In a well-run operation, the planning, quality control, operational and specification documents are available at several levels of detail so that decision makers can have whatever information they need for replication or transport.

Social science research processes are more complex and often less clearly understood. The number of factors is immense, not always controllable, and often unpredictable. As a result they are less often documented in a way that provides for replication and transport.

1. Paucity of Process Data

Buckley (1971) noted that the ultimate objective in management is to reach goals in the most efficient way. Making efficiency judgments requires both process and systems data. A major characteristic of conventional decision making is an abundance of systems data and a paucity of process data. In an age where qualitative factors are reaching parity with economic concerns, the need to define and measure processes emerges as a major challenge.

Lippitt (1965) found that the inaccessibility of many creative new practices results from the concept of social invention not being adequately developed and the procedures for documentation and validation being sketchy or non-existent.

Sarason (1972) also comments on the scarcity of process data. The number of adequate descriptions of actual attempts to create settings is almost nonexistent. Those that exist omit important areas of activity and thinking, and what is described is usually fragmentary and subject to all the limitations of retrospective thinking and description. Needed is an organized set of conceptions which would help select and order data according to the basic problems confronting the creation of any setting. Consensus about values does not instruct one in how to create settings consistent with these values. An obstacle to undertaking and formulating the creation of settings is the lack of well-described instances.

Developmental or research projects fit in with Sarason's description of the creation of new settings. He contends that the creation of settings as a problem has been unformulated in several respects. First, there has been little attempt to seek similarities in different settings. Second, we do not have the concepts to direct us to the developmental tasks and problems which are encountered. Third, opinion people have great differences in understanding success and failure. Explanations of failure are usually oversimplified and do not do justice to what one observes about the creation of settings. Last, because people tend to focus on problems for which they get paid, the developmental aspects of the creation of settings have not been covered.

2. Goals, Processes and Systems

Buckley (1971) differentiates between general systems theory and operating systems theory. He describes general systems as a problem solving framework which proposes a structured approach to problem solving and uses explicit methodology with guidelines to problem solving. Boundaries of the problem are identified. All feasible solutions are measured in terms of cost benefit, and the best solution in the light of technical, economic, and social considerations is adopted.

Operating systems, on the other hand, are those in which goals are reached through processes within a system. A goal is an objective and explains the reason for an action, whereas a process is a set of prescribed activities or strategies by which we attain goals. It defines the essence of an activity by telling what is happening. A system, on the other hand, is the network of resources needed to perform the activity and describes the mechanics that allow processes to occur. (Appendix II).

3. Understanding a Process

Understanding the dynamics of a process requires the gathering of relevant information both internal and external to the project, synthesizing and analyzing the information, and then describing the process itself in a comprehensive manner. Data gathering, analysis and synthesis are ongoing activities from the beginning of the concept development phase of a research project to the point where the project becomes operational. The analyst is constantly involved in making judgments of fact--reality judgments--about the project and its environment, and developing hypotheses and further judgments regarding its past, present or future.

These are followed by value judgments about the significance of the facts. Reality concepts classify experience in ways which may be variously valued, and value concepts classify types of relation which may appear in various configurations of experience. Value judgments of men and societies cannot be proved correct or incorrect; they can only be approved as right or condemned as wrong by the exercise of another value judgment. (Vickers, 1966).

B. Documentation

Buckley (1973) describes documentation as a means of facilitating the design, evaluation and replication of processes. Its purpose is to organize process events and record them for subsequent use.

A document is a record within a system that has been created for the purpose of accounting to funding agencies, parent organizations and client populations and for fulfilling legal and staff requirements or providing communication to an assortment of end users. Traditional forms of documentation record information that provides the basis for assessments about whether or not more money should go into a project, where and how money was spent, and how much time was involved.

Documentation systems are a structured means of handling the acquisition, storage and retrieval of information about the various parameters of an organization, program or project.

Traditional information systems that support research set up in advance the data items that are to be selected to describe the project, and they cover the kind of research that is going to be conducted in great detail--what are the data that are to be collected, how are the data to be analyzed, what are the hypotheses to be tested, what is the research design, what are the parameters? These data items are not the same as those which characterize developmental projects in the real world, where the number of factors is immense, not controllable, and it is not known what influence will be exerted by evolving developments.

The environment in which a project develops often imposes modifying forces on the project as a result of social conditions, timing and organizational relationships. These forces can be generated from within the project, from external organizations, or from interactions of the two. Because of the large number of variables that characterize developmental projects, it is not possible to identify all of the parameters in advance for each project. Even if it were possible, it is questionable whether it would be possible to routinize procedures for implementation to any degree. As a consequence of the many purposes for creating and handling documents, practices may vary widely in accordance with the purposes of the document.

1. Documentation Practices.

The literature reflects little, if any, agreement among major forces in the educational world on how to document the developmental process. Buckley (1973) and Sarason (1972) expressed concern over the scarcity of techniques and support for the documentation of a process which both feel are essential to good management. Other than the recent attempt by Aries (1972), the notion of having noninvolved trained field observers pay attention to the documentation of developmental processes seems to have been ignored. That is not to say that there are not some people who have ideas about how this should be done.

Many agencies require reports of specific types with varying degrees of frequency, and recently, some have been requiring evaluation and replication plans as well as a description of data gathering techniques which allow for cost benefit analysis. But the most detailed requirements, and those most relevant to process documentation, were the ones issued by the U.S. Air Force as the AFR 375 Series. These regulations specified documentation requirements for certain kinds of large weapon systems procurement programs. They established policy, explained principles involved, and identified the responsibilities, relationships and procedures for preparing and using system program documentation. It was felt that the effectiveness of systems management was directly related to Air Force capability to concurrently identify and describe all aspects of a system program, so that each participating organization had the necessary support and guidance to execute its actions in context with efforts of all other participants.

The stated objectives were to:

- Identify responsibilities, tasks, and time-phasing of major actions of each participating organization and contractor.
- Insure that all participating organizations are provided with adequate, consistent and current decisions, guidance and resource allocations.
- Record in a single document the principal objectives of and major decisions on the system program.
- Provide necessary information to management levels concerned with the system program.

The degree of specificity of these requirements was uniform across all programs, regardless of scope, and proved somewhat constraining to contractors who sometimes felt that the level of detail requested was inappropriate to their project. In some cases, the documentation that was produced provided decision makers with an overabundance of information. Recently, after some discussion, the requirements were reassessed then modified to accommodate the scope of each individual program, thus allowing contractors to negotiate specifics of documentation for each project.

The Air Force experience, however, is somewhat unique. Most of their developmental or pilot programs are directed towards goals that seem more visibly critical than those of other organizations. More often, the documentation that does occur in the early stage of a developmental project tends to be designed to accommodate the requirements of accountability for money spent and to meet evaluation criteria associated with the project. Time and resources are usually not available for documentation of the developmental process, as it is rarely a contractual requirement.

The need for documentation of the process of development usually becomes apparent when utilization is being considered. However, in most instances, project directors start to consider transportability when they are well on their way towards completion of the project, and have some idea of whether findings appear to be usable. Experts like Tyler and Sarason feel that by then it is too late.

Some trends are beginning to evolve although they have not really taken shape yet. Presently, evaluation and accountability appear to offer the major lever for having any kind of documentation.

2. Documentation Problems

The most basic problem faced by persons concerned with process documentation is that of deciding what to document. Identifying and recording those factors that tell the story of what happened in the developmental process is a very difficult task. Tuma (1971) notes that the value of data depends in large part on their relevance to a problem under investigation.

"The deepest problem of leadership is that of selecting the domains of concern. Judgments must be made about what aspects of the environment are to be of concern, what phenomena should be noticed, and what variables should be introduced into the criterion function for the project's performance. Both valuing and awareness of reality begin with the act of noticing. The development of elemental awareness into a domain of concern is one of joint development of the evaluation of facts provided by a search and of a reality testing of the value concepts in the context of other prior valuations." (McWhinney, 1969).

Another difficulty in documenting the process lies in the dilemma of perspective. People are asked to look for and document events that are important to somebody else but are not specifically or definitively measurable because (a) they occur before anyone can predict that they are coming up, or (b) they just happen, e.g., the resignation of Sidney Marland and the murder of Marcus Foster. Conflict of interest, observer bias, hidden agendas of various types will surely influence what gets recorded, just as reader perspective, reader skepticism, too much or too little information, and interaction between observer and the event will affect how the documentation is interpreted.

The process analyst faces the problem of selecting, validating and evaluating relevant data. Most often, the data are collected after the fact, which has the advantage of allowing the reporter to present a concise but flowing description of the events that led to realization of the goals and objectives. Its disadvantage lies in the dependence that is placed on the memory of the observer-reporter in retrieving all relevant events and separating biases from recollection. This raises questions of representativeness, validity and reliability of the data. Concurrent data collection, which also is subject to some reporter bias, is more likely to provide complete documentation. The bias can be somewhat neutralized by having the observer-reporter be independent of the project staff. Ideally, the data should be collected from more than one perspective.

Even the most accurate reporting can be limited by:

- The limitations of the reporter--his ability to understand what has happened and to translate that into words.

- The experience and background of the person doing the reporting. An equally accurate, but different, report is possible from persons with a different set of experiences.

- The attention span of the reporter. If the reporter's attention wanders for any reason or is directed to one place when the action is occurring in another, the report may vary from what happened.

- The ability of the reporter to separate his biases and interpretation from the facts and appropriately tag what is being reported.

Reporting is frequently distorted by:

- Reluctance of the reporter to document sensitive events.

- Personality problems of the reporter that inhibit accurate reporting.

- Inability of the reporter to interpret political and social undertones.

- Omissions which cause an incomplete and therefore misleading picture.

- Too much detail to be useful.

It should be noted that, despite the attempts of action people to be completely objective in instances where they have to rely on reconstruction of events or use secondary sources for data collection, such reconstruction is often contaminated with post factum motives, rationalizations, and interpretations that are consistent with outcomes, rather than with true intent at the time the actions were undertaken. In reconstruction, it is often difficult to collect complete data that capture true intent, process, and outcomes. (Beal et al. 1966).

Sorenson (1973) notes that researchers are rarely given explicit instructions about what to observe, nor are they provided with tools and check lists or with the training necessary to use them. He urges researchers to keep a log of unanticipated events as they occur so that they can be accurately analyzed and described in the final report.

It is essential that the person who generates a document and the person who uses the document have the same clear understanding of the purpose of the document and the characteristics of the intended user, for, if the purpose is misunderstood, the use is likely to be distorted, and if the characteristics of the intended user are unknown, the document is likely to be misunderstood.

C. Role of the Process Analyst and Documentarian

The role of the process analyst and documentarian is reflected in Guba's (1965) model. He suggests that the most effective general strategy for inquiries in the area of educational change is the field study strategy in which the investigator may be unsure of the variables that are relevant to his problem and not interested in studying them in any form except as they occur naturally. He notes that data collection is characterized by a unique relationship between the investigator and the field. Since the conditions are not controlled, changes in the experimental conditions are expected and the field investigator should attempt to capitalize on such changes. Because of the probabilistic nature of field data and the impressionistic way that these are gathered, constant replication and recycling are necessary to build confidence in conclusions.

Fischer (1970) suggests some question-framing axioms for the purpose of ferreting out information about events in a developmental process that appear to describe the role of the process analyst. The questions should be:

- Resolvable in empirical terms. The concepts used in the description of experiences should be framed in terms of operations which can be unequivocally performed.

- Open-ended but not wide open. The question should dictate the kinds of facts that will serve to solve a problem without dictating the solution itself.

- Flexible, conceived as approximations which are open to infinite refinement.

- Analytical in order to help a historian break down his problem into its constituent parts so that he can deal with them one at a time.

- Both explicit and precise. Assumptions and implications of the question must be spelled out in full detail, not merely for the sake of the reader, but for the sake of the researcher himself.

- Tested. No hypothesis can be conceived as empirically verifiable except in the degree to which it is verified.

Landes et al. (1971) noted that whereas it is the job of the scientist to concentrate on similarities, the historian is interested in what differentiates. The process analyst is interested in recording both.

The documentarian is called upon to observe, interpret and abstract the essence of events. He must be able to make judgments about which events were significant and why; be able to measure the impact of these events on the outcome of the project; perceive where the roles of people and the skills they brought to the project were a determinant of how the project evolved; and analyze and understand the background in its context. It is a matter of gathering relevant information, analyzing and synthesizing the data, and describing the process in a comprehensive manner.

The action-oriented research person must be able to operationalize his concepts so they can be communicated to actors in a meaningful manner. If role performance is to make its expected contribution to goal fulfillment, communication must motivate human behavior within an expected structure and role framework. (Beal et al. 1966).

D. Why Do Development Project Documentation?

The broader the potential applicability of a project, the more important it is to describe the developmental process for future transport. At least five broad reasons can be given for doing developmental project documentation.

The first reason is planning. The planning process starts with the development of the goals and objectives which become one part of the planning data base. The Normative Plan addresses the long-range questions of where the project ought to be and why. The Strategic Plan addresses the question of where the project can be and how. The Operations Plan describes where the project will be and when. All of the planning documents provide a framework for developmental activities and for different kinds of evaluation. In addition, the planning data base provides information for planning successive years of the same project or new projects in which the findings may be utilized.

Accountability is the most widely accepted reason. Funding agencies have to know what they are spending money on, how much, and what they have to show for it. Some data have been collected, but most of the documentation which has been traditionally collected for the purpose of accountability has not been complete enough to provide an adequate description of the process involved in achieving the goals of the project.

Another reason is evaluation--formative evaluation for the purpose of improving the products that are being developed, summative evaluation to assess whether the project is meeting its stated goals and objectives. However, the documentation also can provide information for evaluations of the program or of the funding agency, evaluations within the organization under whose jurisdiction the project falls, and value judgments that will inevitably be made by persons in influential positions. In this instance, documentation is a matter of sampling at certain points in time and at certain places to see if something specific is happening. But this does not usually show enough about how a project develops to provide insight, understanding and substantive and attitudinal information to those who want to replicate or transport or in some way implement a program of a similar type some place else. Documentation of the process of development inevitably reflects much of the data that are used for the purpose of evaluation, although it is not intended that they be used for that purpose.

Replication is a fourth reason. Reliable validation of the outcomes of a project by duplicating them in another setting is dependent upon having available clear descriptions of products, processes, costs, and the environment in which the original project developed. These data provide the basis for determinations of feasibility and scope of potential for utilization of the findings.

Transportability, the fifth reason, is concerned with the utilization of research findings. It is a form of diffusion, in that a project is moved to an operational setting, usually after the method and findings have been replicated. To be effective, the documentation should include identification of the social, economic, political and educational factors that influenced the development of the project in its home community, so that decisions can be made regarding the viability of a program at a wider level.

Even if a project is discontinued for any reason, it would still be of value to other researchers to have available the description of the developmental process in designing other programs that might achieve the same goal without stumbling over the same obstacles.

Knowing about all of the factors that push a developmental project one way or another can be of great value to those who are installing a program in another community. If the future implementor is likely to have additional developmental activities in adapting an innovation to a new environment, a description of the development process can offer support for a more effective implementation.

III. LIFE CYCLE

The life cycle of a research project begins with a concept and ends either with the utilization of research findings in an operational situation or a determination that the findings are not usable. The research process evolves over several phases which comprise its life cycle and are not necessarily sequential. The success or failure of the project and the way in which it develops are determined at many points in the process. For present purposes, it may be useful to think of the life cycle as including the following phases:

1. A need is recognized and a concept is formulated.
2. A survey of the present state of knowledge about the need is commissioned.
3. A request for a proposal is generated.
4. Proposals for solution to the problem stated in the RFP are generated.
5. Proposals are reviewed by an evaluation team.
6. A contract is awarded.
7. The project is activated and development begun.
8. Project is monitored and evaluated.
9. Dissemination is begun.
10. Project is completed.
11. Report is submitted.
12. Product is made available for utilization.

There are many ways of conceptualizing the life cycle. The example cited above was constructed because it seemed most relevant to the scope of this report. It is not offered as a comprehensive coverage of life cycles, but rather is intended to suggest that there are many decision points that affect the development of a research project and determine its fate. A number of other ways of conceptualizing the life cycle are presented below.

Carlson (1968), for example, described the life cycle of an innovation as consisting of the story of the invention, development, promotion, adoption, diffusion and demise of the innovation, along with an account of the problems encountered and solution developed in introducing and maintaining the innovation in the school setting, as well as the unanticipated consequences growing out of its use. It is this story that needs to be told in the documentation of process, for without this information it is difficult to show the significance of successes and failures, and how to use each to achieve similar goals.

Glaser and Taylor (1973) described six stages in the life cycle of a project: the idea that began the process; the original design of the project, including revisions; overall funding of the project; actual conduct of the research; the findings and their dissemination; and the actual or planned use of the findings.

Brickell (1964) examined the phases of a project and concluded that in education, the design, evaluation and dissemination of innovations are three distinctly different, irreconcilable processes and that the circumstances which are right for one are essentially wrong for the others.

The design state requires a group of highly intelligent people, a limited problem, adequate time and resources, and the freedom to experiment with new methods. In the evaluation stage, the evaluator needs to be able to control those forces which might influence the success of the new approach. The dissemination stage calls for an everyday situation in which observers may see clearly that the new approach will be effective in their schools and communities. Brickell noted that friction is common among people concerned with innovation and concluded that failure to distinguish between the three phases of change is the most formidable block to instructional improvement.

The distinction between the three stages and the different techniques required to deal with each are well documented by experts like Glaser, Guba, Havelock and Tyler. However, they go on to point out the relationships between the processes of each phase, and comment on the need for special linkage agencies to deal effectively with the transitions between each and the role of the change agent in implementing the change.

Guba (1965) contends that the process of educational change involves four stages: research, development, diffusion and adoption. Whether or not these objectives are met is judged by the application of certain criteria which are different for each stage. Each stage bears a particular relation to the change process.

In examining the life cycle of a project, Jain (1969) identified three types of social systems involved in the research dissemination and utilization process:

- the research system, producing and developing research findings

- the linking system, disseminating and facilitating the utilization of research findings

- the client system

Jain points out that there are three different but interrelated processes involved in information handling: information inputting, information processing, and information outputting. Communication patterns vary with each aspect. His work provides another dimension to the notion that documentation should be designed for the user, and the more complex the project the greater the number of levels of documentation that will be required.

Joly (1967) notes that fundamental research, development and dissemination are three distinct jobs. When successfully conducted, research produces understanding; development results in proven practical procedures and products; and dissemination leads to adoption of the products and procedures. The author suggests that entrusting two or more of these tasks to the same person is not necessarily an ideal solution, and warns against the adoption of innovation without properly researched study of the effects of the innovation.

The U.S. Air Force characterizes the life cycle of a system as occurring over a Concept phase when the idea is generated; a Validation phase during which chosen alternatives are validated; a Development phase during which the system and documentation are designed for the next phase; a Production phase during which the system is tested; and a Deployment phase when the system gets transported and becomes operational. (U.S. AFR 375).

Each phase is described as beginning and ending with a unique set of actions that relate to that phase. It is recognized that the phases are interrelated and in many instances overlap. Documentation requirements are tailored to the needs of each individual program. They specify that test and evaluation begin as early as possible and that logistic support requirements be included in determinations of operational suitability.

The National Institute of Mental Health (1971) presents an examination of the life cycle of a project in terms of planning the research, designing the proposal, conducting the research, and diffusion. (See Table I).

IV. FACTORS INFLUENCING THE SUCCESS OF R&D PROJECTS

The success or failure of a project can be influenced at any point in its life cycle. The reasons may relate to value judgments arrived at by persons in positions of influence from the time when the concept is generated to any point of time when it is in use. They may also relate to formative evaluations that make the objectives appear too difficult to achieve, summative evaluations that point up the disparity between the project and its objectives, or re-evaluations of the programs within which the project falls. All these factors are significant in determining what shape the project will take and can provide valuable insights to replicators and transporters regardless of the outcome.

Buckley (1973) describes the characteristics of a model research project as having:

- Goals that are explicit and make clear what is to be accomplished.
- Operational goals that state how these goals are to be achieved.
- A set of procedures or operations to reach these goals.
- Sub-goals or milestones for each step so that it will be obvious when the milestone is accomplished.
- An explicit set of decision rules to say when it is time to move to another milestone.
- Decision rules that are based on evidence rather than on pure reason.

After an analysis of ten projects designated by a funding agency as successful or unsuccessful, Glaser (1969) described the characteristics of a successful project as:

- Ongoing effective communication, awareness and involvement with people and groups within and outside the immediate project environment.

- Totally involved principal investigator who designed the research and remained with the project from onset to utilization.

- Research focused on perceived need and enjoyed shared interest.

- Commitment from host agency.

- Early dissemination of findings and consideration of implications for utilization.

- Adequate project structure and good management techniques.

Rein and Miller (1966) noted that in order for demonstration projects to achieve any degree of success, the following questions must be answered: What kind of influence do the promoters of the demonstration intend to have with respect to spread, spillover and continuity? Whom do they hope to influence? How will influence be exerted? They offer the following suggestions to improve the position of demonstration projects as agents of change:

- Funders should insist that the demonstration be relevant to the social problem involved and that the staff be clear on questions of social policy.

- Greater clarity of purpose should be pursued.

- The funders must stay with the projects, not quit when the going gets rough.

- The funders must be more concerned with getting and maintaining quality.

- New methods of reporting and accountability are needed.

- A program cannot promise (or deliver) everything; it must make choices.

- Adaptation must be built into the design of all demonstrations.

- Demonstration staffs must be prepared for conflict, and must learn to live with it.

- Research should be relevant to all social needs; each project must be part of an overall pattern.

Sorenson (1973) identified a successful project as one which produced products and processes that effected positive change without negative side effects and are widely accepted and used. He analyzed four successful educational R&D projects in order to identify those characteristics that were common to all, and therefore likely to have strongly influenced their success. He found that each project:

- Had been designed to meet a recognized need.

- Started with a system that was directed toward a target population.

- Defined the goals of the program in terms of student performance and had a way of assessing the student's educational needs.

- Had repeatable criterion-referenced instructional procedures that took the student through a graded sequence of steps.

- Had a corrective feedback element operating from the early developmental phase-formative evaluation components.

- Was demonstrably effective.

- Had sufficiently well described processes and products, in terms of being explicit, concrete and complete, so that if someone wanted to use it they could.

Tyler (1973) described a successful R&D project as one which:

- Has a clear statement of purpose and goals that identifies the problem.

- Reflects an understanding of the problem and its environment.

- Spells out the educational objectives and target population.
- Describes its basic principles, processes, products and roles.
- Anticipates where modifications may be appropriate.

If an innovation is to be accepted, it must be presented with persuasive arguments showing why it is better than competing ideas. The positions of a few critics should be aired, as both sides of a disagreement deserve a hearing. (Sturtz, 1973).

Success cannot be attained without first having some harmony with the funding agency and with other important dispensers of similar services. It requires patience, tact and diplomacy. Even if the idea is right, proper timing and necessary community support must be there or the idea must wait. (Auster, 1973).

Every problem has a wide variety of alternative solutions, any one of which may be correct. A set of rules is required by which the individuals will be governed in resolving problems. It is important that one figure out ahead of time the possible consequences of using or not using a particular variable or procedure, the effect of one variable on another, and the adequacy of controls against human and mechanical defects and failures. It is important to consider as many alternatives as can be generated in arriving at a final solution, and it should be recognized that there is no single correct solution. (Sarason, 1973).

With respect to evaluation of an innovation in different organizations, Manela (1969) noted that the range of variability between agencies makes it difficult to replicate any given test of the effectiveness of an innovation. Even within a single agency, operating conditions and operating personnel change so much over a period of time that scientifically valid comparisons are hard to come by. In short, one's aspirations concerning evaluation should be realistic rather than rigorous.

Social programs such as Title I program for elementary and secondary education of disadvantaged children, manpower development and training programs, and the Model Cities program are designed on the assumption that certain courses of action will improve education, increase employment and income, or reverse the process of urban decay. However, relatively little is known about the effectiveness of such programs in meeting their objectives. Overcoming this lack of information is impeded by severe problems in developing and executing evaluation studies. Among these problems are the difficulties of defining social program objectives and output measures, methodological, bureaucratic, and practiced constraints, shortages of trained personnel, lack of funds, and the absence of clearly defined evaluation policies. (Wholey et al., 1971).

Wholey urged emphasis on the development of valid short-term and long-term indicators of effectiveness, systems for assessing the relative effectiveness of comparable local projects, and standard systems for comparing project costs.

Information requirements for producing utilizable research were described by the National Institute of Mental Health (1971). The principles are presented within the phases in the life cycle of a research project and are shown in Table I below.

TABLE I

INFORMATION REQUIREMENTS FOR PROVIDING UTILIZABLE RESEARCH

I. Planning the Research

A. Anticipate crisis.
B. Use future techniques to predict critical problems.
C. Identify the categories of potential users of research finding.
D. Understand the user and understand the difference in attitudes and goals.
E. Search the literature.
F. Consider a pilot project approach.
G. Consider long-range efforts in seeking financial support to provide for diffusion efforts.
H. Seek cross-validation if results seem promising.
I. Simulate user conditions in research design. Research activities which are user-oriented stand a better chance of replication.
J. Use advisory groups--preferably including potential users.
K. Involve potential users at the start.

II. Designing the Proposal

A. Credibility--via sound evidence espousal by highly respected persons.
B. Observability--through demonstrations.
C. Relevance--to coping with problem of concern and show measures like costs.
D. Relative advantage--evaluation design should yield clear, cogent data.
E. Ease of understanding an installation--should be clearly and briefly described.
F. Compatibility with prevailing values.
G. Trialability, divisibility or reversibility.

III. Conducting the Research

A. Sensitivity to host agency--mutual trust and candor--give credit where due--prepare administrator of host agency for possible discomfort over results.
B. Target audience participation--involve potential users as consultants or colleagues.
C. Regular reports--progress reports to funding agency should be widely circulated and comments invited.
D. Conferences--for problem resolution, influx of ideas, and diffusion.
E. Communications--internal and external to project.
F. Dissemination should be planned at beginning for spread, spillover, continuity or spinoff.

TABLE I

(contd.)

G. Readable reports:
  1. Communication should identify with audience.
  2. Presentation should be readable, coherent and understandable by target audience.
  3. Report should be factual and invite agreement of people of influence.
  4. Benefits and risks clearly stated and discussed.
  5. Combine logical and non-exaggerated emotional appeals.
  6. Use illustrative material.
  7. Address anticipated objections.
  8. Repeat essential information.

  Reports may have to be written in several forms to accommodate various level readers.

H. Mass communication followed by interpersonal communication.

IV. Diffusion

A. Aim at stage-by-stage installation.
B. Establish egalitarian climate.
C. Admit doubts, reservations and pitfalls.

* * * * *

A hypothetical case that is not unique is that of the contractor who was awarded a large multi-phase contract after an open procurement, only to have the funding agency undergo a massive reorganization and and major change of staff in the middle of its effort to produce an operational plan. The project director, who was not the author of the winning proposal, determined that his primary goal was to provide the funding agency with any service they might be interested in requesting. In order to accomplish this, he indicated his interest in setting aside the contracted statement of work, goals and objectives. The new staff in the funding agency was involved in spelling out their goals and objectives and developing an operational plan for achieving them.

When the contractor realized that a change in the scope of the work was not going to be imposed, he attempted to design a plan that met the contractual obligations and anticipated the needs of the funding agency. By this time major staff changes occurred within the project team. Reviewers of the plan were unable to detect a clear statement of mission in the plan or conviction on the part of the project staff that paralleled the specificity of their winning proposal. As a result, the scope of work was considerably modified in size and scope.

* * * * *

In summary, among the factors that influence the success of an educational R&D project are the following: clarity of purpose, breadth and level of support, soundness of research, timing, and the quality of staff performance. Information about all of these factors must be transmitted to potential users, largely through documentation. But the experts feel that personal contact, demonstration and presentation comprise an essential, additional strategy for dissemination.

The most effective projects have been those in which the research focused on a generally recognized need, had a principal investigator who both wrote the proposal and stayed with the project until completion, and committed staff members who were clear about the social implications of their efforts. (Glaser 1969, Sorenson 1973, Tyler 1973, Rein & Miller 1966, NIMH 1971.)

One of the essentials of an effective project is an operational plan in which the target population is identified at the outset and a strategy or program for influencing that population in positive ways is described in detail. A good plan also includes procedures for measuring the changes, realistic formative evaluation plans, and a strategy for dissemination and utilization of findings. (Glaser 1969, Sorenson 1973, Tyler 1973, Rein & Miller 1966, NIMH 1971)

It is important that project goals are defined as a sequence of steps or milestones. There also should be a set of decision rules specifying the kind of evidence that will indicate that one milestone has been achieved and that it is time to go on to the next. (Buckley 1973, Sorenson 1973, Sarason 1972, Rein & Miller 1966, Tyler 1973)

Breadth and level of support are critical factors in determining the success of a project. An educational R&D project requires an effective, ongoing communication network that involves people both within and external to the project. One effective technique is to appoint and make use of an advisory committee that includes potential users. A harmonious and ongoing commitment from both the host agency and the funding agency is essential, as are effective communications and sound management techniques. (Auster 1973, Glaser 1969, NIMH 1971, Rein & Miller 1966, Sorenson 1973)

It is important that the potential advantages and limitations of the educational product that is being developed be discussed openly with all interested parties and dealt with on a practical level rather than a theoretical one. Communication networks with feedback mechanisms which provide a project director with information at any given time about those elements of the project that are working well and those that are not working, have proved to be most useful. (Auster 1973, Sturtz 1973, Sarason 1972, Sorenson 1973, Glaser 1969, NIMH 1971)

Successful project directors have given continued attention to the task of establishing and maintaining credibility by providing sound evidence and persuasive arguments as to why a particular approach is better than competing approaches. (Rein & Miller 1966, Sarason 1972, NIMH 1971, Sturtz 1973, Tyler 1972).

Although documentation has been relied upon as a major vehicle of dissemination, there is some evidence that utilization of the findings of research results from other means of communication, namely, word of mouth. Nevertheless, it is important that written reports be clear and in the language of the target audience. Written reports are more likely to be useful when they describe benefits and risks and the roles of the staff members as well as the potential advantages of a new product. (NIMH 1971, Rein & Miller 1966, Sorenson 1973, Tyler 1973)

VI. UTILIZATION OF RESEARCH FINDINGS

In considering ways to maximize the uses of research, it is useful to describe social research processes as a series of interrelated events that are directed toward specific goals. Each event presumably occurs for a reason and has some relationship to subsequent and sometimes parallel events. These events combine to achieve milestones and shape goals.

Documentation of this process must reflect the events--milestones, timing, interrelationships, dissemination strategies and evaluations of the products and processes--if effective utilization is to be accomplished.

The decision maker who may want to replicate all or part of a social experiment must be adequately informed about the process. Why did it go the way it did? What alternatives were possible at various points in time? What were the reasons for making the decisions that were made? What alternative courses were not pursued. Why? What were the factors both internal and external to the project that shaped its development?

The lag time between innovation and utilization was recently reported at fifteen years in the fields of agriculture, education, engineering, information technology, medicine, military science and psychology. In 1940 the reported time was fifty years.

Most of the literature in this field addresses innovation, change and diffusion in terms of the actions that must be pursued by the change agent to gain acceptance of the innovation. The actions are predicated on the assumption that a decision maker has decided that the implementation will occur and the descriptions are offered in behavioral terms.

Bhola (1965) explains the process of innovation diffusion in Table II below. This is an adaptation and expansion of Guba and Clark's theory into action model, with the addition of a service and support phase.

TABLE II.

CHANGE IN A SOCIAL PROCESS FIELD

	Research	Development	Dissemination	Demonstration	Implementation	Service and Support
Objective	Advance knowledge.	Apply knowledge.	Distribute knowledge.	Build conviction.	Facilitate action.	Consolidation of adoption.
Criteria	Validity of knowledge produced.	Feasibility Perf. .mance.	Intelligibility Fidelity. Comprehensiveness. Pervasiveness.	Credibility	Effectiveness Efficiency.	Generalizibility. Acceptibility. Accessibility.
Relation to change.	Provides basis for innovation.	Produces innovation.	Informs about innovation.	Promotes innovation.	Incorporates innovation.	Integrates innovation.

He suggests that the resources necessary for innovation diffusion are material resources, conceptual skills, personnel and influence. Since the environment in which the diffusion takes place can be supportive, neutral or inhibiting, and can be either strong or weak, the combination of resources needed for diffusion will vary directly with the environment. The selection of resources can be accomplished far more effectively when the available documentation reflects a description of the resources used, the environment in which the project evolved and the interrelationships of all.

Donley (1965) noted that the requirements for dissemination to increase utilization of research are facilities, personnel, equipment, material and finances. A central coordinating agency for dissemination should direct information and demonstration centers, conduct basic research, train local people and develop community working relationships. This should be supported by a strong field organization trained in the change process and able to be a social catalyst. Training programs are also needed in research design, evaluation research, internal and external communications systems, and culture lag with respect to innovation, experimentation, development, and human relations. Provision for feedback should occur through evaluation, meetings, surveys and visits.

Glaser (1972) analyzed the factors specifically related to successful transfer of R&D findings. He found that

- The characteristics of the innovation must reflect credibility, observability, relevance to a problem of concern to many people, relative advantage over existing practices, ease in understanding and installation, compatibility with new environment, and a pilot that can be tried one step at a time to allow for a reversal in the decision to implement.

- The characteristics of the potential user must reflect a willingness to entertain challenge, capability of staff, availability of necessary resources, sensitivity to environmental factors, and leadership skill in working through resistance.

- The dissemination activities should include early involvement of influential potential users, balanced dissemination strategies, personal interaction and thoughtful planning.

- The facilitating forces that needed most attention were identified as leadership, outside pressures, surface information, active interest, an incentive system, structural reorganization, shared interest in problem solving, adequate resources, and the onset of internal deterioration.

Generally, he noted the research design and findings should be described in terms of the potential uses and users with special consideration for replicability and implementation. A utilization strategy should be built in with credit and appreciation noted to all who supported or helped. The final report should be treated as the instrument for dissemination and should specify the necessary conditions for replication.

Gross et al. (1971) concluded that success in implementing innovation depends on overcoming initial resistance to change and anticipating and neutralizing potential development of resistance during implementation. The degree of success, however, depends on clarity of understanding of the innovation, capabilities of staff to carry it out, availability of resources, compatibility of existing organizational arrangements and staff cooperation. This is a function of the performance of management and requires their ongoing involvement in developing and using feedback mechanisms and ability to assess potential problem areas. The strategy for implementation should consider staff difficulties, include feedback mechanisms and provide a clear picture of role requirements. The innovation should be compatible with organizational arrangements, provide for necessary training, resources and supports, and involve a total commitment.

The role of the change agent in implementing and gaining acceptance of educational innovation has been studied extensively by Havelock (1970).

Much of the information that he describes as needed by the change agent in relating to the client system and to the larger social environment provides the basis for information that will be needed in the implementation of change: norms of the community, who are its leaders, who provides informal leadership, who are the gatekeepers, what is the quality of community leadership, who are the influential persons in the community, to what extent should the change agent devote his effort to these outside forces? He goes on to point out the importance of handbooks and reference manuals with respect to the change process as an aid in capitalizing on the successful experiences of others tackling comparable problems.

Elsewhere, Havelock (1972) describes the role of the change agent in terms of building relationships, making diagnoses, acquiring relevant resources, choosing solutions, gaining acceptance and stabilizing the innovation in its new environment.

Since personal interaction is always an essential element in replication or transportability, the documentation should support this. Outstanding personal interactions can overcome poor quality and incomplete documentation, just as poor personal interactions can undercut the feasibility of success. (Tyler 1973)

Cawelti (1967) stressed the need for careful planning before adoption and careful attention during early years as a means of minimizing the high abandonment rate for some innovations. He further suggests the need for a clear conception of what is being attempted, how it is to be done, and what the ground rules are. Guidelines for the installation of innovations are very important.

Rittenhouse (1970) noted that those institutions that engage in long-range planning tend to be orderly and rational about anticipating future change and preparing for it. The preparation includes making use of available research.

Utilization and application of findings requires serious attention during the planning of the research project. If the researcher starts to attend to it during the writing of his research report, it is usually too late. (Van den Ban 1963)

The technique of applied research, a rational strategy for change, attempts to introduce a well-researched innovation into a practice setting to see whether it can be applied to other settings. The question of how to get a fair trial and how to install an innovation in an ongoing system are not ordinarily built into this strategy. (Umans 1971)

The assumption is that because it has been well researched and is beneficial, one can assume acceptance and disregard the 'how to do it' phase. People are more likely to adopt innovations if a strategy for use and implementation is included with a display of the favorable results and the rationale behind them. Scientific tradition is described as requiring that results be obtained by processes that another scientist can duplicate to attain the same results; all calculations, assumptions, data and judgments be made explicit and thus subject to checking, criticism and disagreement; and the scientific method be objective, (its propositions not dependent on personalities, reputations or vested interests) quantitative and experimental.

Miles (1964) noted that many innovations, once accepted, are continued without valid and dispassionate evaluation concerning effectiveness.

Likewise many innovations have a short life and are abandoned without rational evaluation.

Archibald (1968) assumes that many of the problems arising in the applied social sciences can best be understood as problems of the role of the applied social scientist. She characterizes these roles in terms of basic orientations and summarizes the difference in Table III below. The underlying suggestion is that the potential user of research knowledge outside the specific scientific community may be ignored if the academically-oriented social scientist is not sensitized to his needs.

TABLE III

SUMMARY OF TYPOLOGY OF ORIENTATIONS

Academic orientation	Clinical orientation	Strategic orientation
Applied activities bounded by discipline.	Applied activities bounded by alter.[1]	Applied activities bounded by problem.
Nonspecific diagnosis. Works in *area* defined by policy concerns, but on problems chosen in terms of disciplinary criteria.	Specific diagnosis concerning alter, that is, the user audience itself. Talks about policymakers or policy process.	Specific diagnosis concerning alter's resources and/or environment. Talks about policy, content of policy.
Alter assumed to know own problem, or at least not the expert's worry if alter does not.	Alter assumed not to understand own problem: expert performs interpretive function.	Alter may or may not know own problem, but assumed to often ask the wrong *questions* about it.
Contributes to alter: Conceptual framework, general principles, and/or empirical information.	Contributes to alter: New way of approaching reality, self-understanding, and/or techniques.	Contributes to alter: Analysis of practical problem as it "should" confront alter, explication of alternatives, and/or specific recommendations.
Disciplinary colleagues remain the primary audience, user audiences secondary.	User audiences at least as important as disciplinary colleagues.	User audiences at least as important as disciplinary colleagues.
Insignia of expertise: precision on disciplinary details.	Insignia of expertise: perhaps careful specification of intentions and values.	Insignia of expertise: precision on the details of alter's data.
Expert feels he or his discipline has *some* responsibility to contribute to the solution of practical problems.	Expert feels it is *his* responsibility, and his discipline's, to contribute as much as possible to the solution of practical problems.	Responsibility defined in terms of being careful and precise when working on practical problems and when interacting with user audiences.
Stated interest in communicating to alter, often through intermediary.	States interest in helping alter. Asymmetrical.[2]	Stated interest in influencing alter. Symmetrical[2]
Alter seen as different. Nonutilization explained by cultural gap, missing middlemen, or fact that expert contribution is only one of many inputs.	Alter seen as often irrational, constrained. Nonutilization explained by resistance and/or nonsupportive environment.	Alter seen as usually rational but not always intelligent. Nonutilization explained by misunderstanding, ignorance, parochial interests, and/or inertia.

[1] Alter is a synonym of client, user, target, or practitioner.

[2] An asymmetrical relationship implies help for the alter; the expert does not expect to be helped in return. A symmetrical relationship with the alter means the expert expects to influence the alter and he expects the alter to influence him, in turn. It implies the probability of mutual influence.

Lyons (1966), in describing the HumRRO experience with the U.S. Army in the implementation of research, noted the importance of the research results being communicated in terms that the implementor can understand rather than in terms of a research product understood only by colleagues.

Rosenblatt (1968) found that the report of research findings is often slanted to meet the needs of the other researchers rather than those of the practitioner. He urges that reports be written in language that will reach the user. Perhaps more than one level of reporting is required.

Three general categories of approaches to change strategies have been proposed by Chin (1967). In the empirical-rational approach, the primary task is seen as one demonstrating through the best known method the validity of the proposed change in terms of the increased benefits to be gained from adopting it. Normative re-educative approaches are usually based on some theory of change as applied to individual behavior in small groups, organizations and communities. Power approaches are used to alter conditions within which other people act by limiting alternatives or by shaping the consequences of their acts or by directly influencing and controlling actions.

McClelland (1968) contends that different strategies are geared for special users. He states that the value systems of the change agent and client, the assumptions the change agent makes about the change process and about the client, and the special circumstances surrounding the client or target system should markedly influence the type of strategy to be adopted.

Roberts and Larsen (1971) studied the sources of innovations that have occurred in mental health services and found that the initial stimulation had come from printed material in 8.7% of the instances observed. Formal retrieval systems were found to have been used the least of all methods to arrive at solutions to pressing problems.

In another study, Roberts and Larsen (1971) tried to correlate staff use of the scientific literature with rates of innovation, but the extent to which staff had used printed material was so little as to render further study useless. They imply that the reason may be that oral communication is more effective than written communication in stimulating the adoption of innovation. However, they were unclear about having assessed whether the quality and content of the documentation made a difference.

* * * * *

To a large extent, those who have addressed the issue of utilization of research results have limited their inquiry in two ways. First, they have paid little attention to programs in which process and human attitudes are more central than procedures and objective products. Career Education and other programs of like concern cannot meaningfully be defined in terms of procedures and products, even though there are those who attempt a fruitless search for simplification of that which is necessarily complex.

Second, those who have concerned themselves with the implementation of innovation--i.e., the utilization of research results in operational settings--have looked more to the "sales" aspect of the task than to the details of both the facilitating and inhibiting forces which might be active. Clearly a positive sales campaign or dissemination strategy is appropriate. Equally necessary, however, are the records of bad decisions, wrong turns, blind alleys and negative factors and the records of good decisions, correct turns, through-streets and positive factors which influenced the prototype effort or field experiment. When were things going well? What inhibited project development? These same or similar factors will assuredly be in play during the implementation of other operating programs; an operational implementation will also have a beginning, growth and synamic continuity. It will have many of the same problems as those experienced by the field experiment. In some cases the problems may be greater due to expectations of performance and cost that are not predominant in the research setting.

Notwithstanding the above, utilization is most likely to occur when the potential user has a clear conception of what is being attempted, how it is to be done, what the ground rules are, and what handbooks or guidelines for utilization are available. The researcher should be sensitive to the needs of potential users; strategies for replication and implementation should be built into his reports, along with a description of necessary conditions for use. (Archibald 1968, Cawelti 1967, Glaser 1972, Havelock 1970, Lyons 1966, Rosenblatt 1968, Tyler 1973)

The strategies for implementation should be related to the value system of the users and present a clear description of potential staff difficulties, areas of resistance to the innovation and ways of neutralizing any resistence that may develop. (Gross 1971, McClelland 1968)

Success of the implementation depends on the capabilities of the staff, availability of resources, incentive systems, compatibility with existing organizational arrangements, staff cooperation and interrelationships between resources and processes. Management should be strong and offer a total commitment using feedback mechanisms to assess potential problem areas. A central coordinating group for disseminations can be a powerful tool in effecting utilization, particularly if it is also charged with training local people in user communities and developing community relationships. The coordinating group can also provide feedback through evaluations, meetings, surveys and visits. (Bhola 1965, Donley 1965, Glaser 1972, Gross 1971, Havelock 1972)

Documentation is central to both dissemination and utilization. It must provide the change agent and decision makers with needed information relating to the client system and the innovation. A clear display of the relevance of the innovation to a recognized need, its ease of installation, compatibility with the new environment and evidence of the benefits to be gained in adopting the practice must be clearly stated. It is also important to describe the relevant environmental factors that influence the acceptance of the innovation, such as community leaders whose support was significant, characteristics of the community in which the innovation developed, and how involvement of the community was built. The documentation should reflect early attention to strategies for dissemination and utilization and provide for an orderly change process. Guidelines for installation should include a description of ideal conditions for installation. (Cawelti 1967, Chin 1967, Glaser 1972, Havelock 1970, Tyler 1972)

Herein lies an almost insurmountable problem. Researchers, regardless of the field in which they work, are usually not oriented toward the practical utilization of the results of their efforts. They are somewhat sensitive to replication--that activity which is bounded by acceptable controls--but not sensitive to operation in a totally operational setting. In such situations researchers generally take one of two approaches: (a) the operators of the program should impose more controls, or (b) the researcher cannot be responsible for failure in a real world setting. It is this problem, more than all others, which suggests the involvement of process analysis and documentation teams exogenous to the conduct of the field experiment or research study in process-oriented activities.

VI. CONCLUSIONS

The government funds educational research with the expectation that findings useful in improving education will emerge. Therefore, the cycle of research, development, evaluation, dissemination, replication and utilization should be planned at the outset in a way that accommodates the final user and provides, in as concise a manner as is possible, information needed for implementation. The Federal government spends ten times as much on research as it does on utilization. On the other hand, industry spends ten to twenty times as much on marketing a new product (utilization) as it does on the research that led to the development of that product. There appears to be a need for some movement in both cases.

The history of the cycle of research to utilization has been one in which researchers have communicated with each other in documenting their findings, and have neglected to provide decision makers with descriptive reports about their findings in suitable language. Indeed, researchers appear to have been consistent in not attending to the effects of exogenous forces and uncontrolled factors in their studies. Nor have there been many instances where dissemination strategies and utilization plans were built into research and development plans, thereby assuring reports that contained adequate guidelines for implementation. August groups of "scientists" and "researchers" have repeatedly taken the position that implementation strategies should not be addressed in the early stages of research investigations. They offer such reasons as biasing the research and assuming the character of the results. They do not see the importance of dispassionate detecting, interpreting and recording of events of significance--or potential significance--of process-oriented programs.

As a result, the utilization of research findings, particularly in process-oriented projects, has been somewhat spotty, with a large lag time between discovery and use. In the field of education, there has been a tendency to try innovations that appear interesting even when evaluation data have been scarce and less than conclusive. The tendency to "try things" has been accompanied by the abandonment of practices that seemed to work, not necessarily because there was evidence that they were either working or not working. Rather, reasons appear to relate to a decision maker feeling that some new practice is more interesting and wanting to try it, or, more insidiously, money is available for the "new" programs from public sources.

The purpose of this investigation has been to survey process analysis and documentation concepts, practices and standards in light of the need for communicating the processes and outcomes of educational research and development. Suggestions are provided which will be of use to those who are concerned with the utilization of research findings. The recommendations are clearly warranted from the findings of the study, even though further sharpening and explication may well be indicated as additional evidence becomes available. Recommendations are presented for each of three specific groups--or individuals representing these groups. The first is the applicant organization wishing to undertake to solve the problem at hand. The second is the funding agency which provides for the resources to be used in the investigation. The third is the one undertaking process analysis and documentation of the project execution.

The recommendations may well be appropriate to a wide variety of research and development activities, but the focus is specifically constrained to those which are field projects in real settings; dependent more on human attitudes, behaviors and interactions than on procedures and products; and major undertakings with complex environmental (milieu) interfaces, multiple audiences and significant time durations.

- In addition to a clear description of the need that is being addressed, provision of data to support the extent of the need, and a presentation of what is to be done, proposals for R & D projects should address the issues of replication, dissemination and utilization of results of the study. Included are considerations regarding the continuing analysis and assessment of the progress of the project and the recording of the items of significance in this process in language which is meaningful to those who would put the results to use in operational settings. The intent, importance and meaning behind the terminology in the criteria specified by the funding agency should be clearly stated and followed. Hidden agendas are counterproductive.

- The research plan should be consistent with the proposal. It should include specification of the target population, a description of the kinds of changes to be produced in the target population, and procedures for measuring those changes that operationally define the target population. Change measures should be identified before programs for producing the change are developed.

- Plans for process documentation, evaluation and dissemination strategies should be built into the research plan. Do not wait for demonstrable success first--that is too late.

- The "research" team and the "process analysis and documentation" team should be established at the outset with clear role definitions and task orientations. It is rarely possible, however, to predict in advance what the process analysis and documentation demands will be. As a research project unfolds, its problems, modifications, personnel characteristics, findings, etc., all impact the need for, and allocation of resources. Analysis and documentation priorities must be continuously reviewed with respect to areas most in need of attention

- Actions taken to meet the projects objectives should be recorded as they occur. Alternatives that were considered and reasons for selecting the ones that were chosen should be described. A running log of problems and unanticipated events that arose, how they were resolved and the roles of people in the resolution should be maintained. It is unwise to count on remembering or reconstruction at a later point in time.

- The documentation should include a description of the economic, political, social and legal conditions in the project environment that impacted the project and affected the way in which it developed. These should relate to client populations (program participants), communities, governmental controls and public opinion. Do not assume that all communities have the same values and norms and accept new practices in the same way.

- Documentation of relevant aspects of a program should be clearly written in the language of the target audience. Several layers of documentation may be required. It is rarely possible to meet the needs of fellow researchers and potential users in the same document.

- Establish communication lines with as many community agencies as possible to win their support. The use of advisory panels composed of potential users is particularly effective. This process should be recorded with a description of the kind of support that was generated, and the degree of acceptance that was gained.

- The host agency in which a practice is being developed or tried needs special attention. Open communication lines with built-in feedback mechanisms are required to be sure that decision makers understand what is being done and will continue to provide support. It is wrong to assume that support will automatically continue once a committment has been made.

- The project director should be the person who wrote the proposal and research plan and should stay with the project to completion. Do not use professional proposal writers and then expect the project director to be committed to someone else's plan.

- Select project staff who understand the project, are committed to it, and can demonstrate their ability to deal with criticism, conflict and change. Do not depend on staff to fill roles that do not match their abilities.

- Monitors and evaluators should be trained people who are capable of making constructive suggestions, point out limitations and can keep anxiety levels of the project staff down to a minimum. An evaluator or monitor who limits his activities to telling what will not work, is likely to be ignored for lack of credibility.

- Establish the credibility of the innovation by presenting sound evidence to support the findings and citing the expressed espousal of respected persons or institutions. The relative advantage over existing practices should be clearly spelled out. Do not assume that logic alone makes the importance of an innovation apparent.

- Describe processes, products, principles and roles in explicit and concrete terms so that they can be understood and readily replicated. The process of installation should include a description of the problems that were encountered and how they were resolved. Do not assume that potential users will be able to figure out for themselves "how to do it".

* * * * *

This survey has demonstrated clearly that attention to the area of impartial process analysis and documentation is both important and neglected. The ability of people to implement programs is significantly impaired by the lack of understanding of what is really involved. In programs in which process is central, knowledge of <u>how</u> operations are brought into being is undoubtedly of equal importance to knowledge of the substance and effect of the program.

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PERSONAL INTERVIEWS-1973

Boruch, Robert F. Department of Psychology, Northwestern University, Evanston, Ill.

Buckley, John W. Graduate School of Management, University of California, Los Angeles, California.

Glaser, Edward M. President, Human Interaction Research Institute, Los Angeles, California.

Guba, Egon G. Dean, School of Education, University of Indiana, Bloomington, Indiana.

Havelock, Ronald G. Institute for Social Research, University of Michigan, Ann Arbor, Michigan.

Seeley, John R. Director, Scientific Analysis Corporation, Berkeley, California.

Sorenson, Garth. Graduate School of Education, University of California, Los Angeles, California.

Tyler, Ralph. Graduate School of Education, University of California, Los Angeles, California.

KEY CONCEPTS

Accountability
Change
Communication
Cost-Benefit Analysis
Decision Theory
Development Programs
Diffusion
Dissemination
Documentation
Educational R & D
Environmental Analysis
Evaluation
Historical Method
Implementation of Change
Information Technology
Innovation
Journalism
Library Science
Management Science
Methods and Procedures
Process
Replication
Research Methodology
Social Science Research
Transport
Utilization of Research Findings

JOHN W. BUCKLEY

GOAL-PROCESS-SYSTEM INTERACTION IN MANAGEMENT

Correcting an imbalance

John W. Buckley is director of the Study Center in Accounting-Information Systems, Graduate School of Management, UCLA.

The imprecise meaning of the term "systems" hampers our efforts to manage organizations effectively. We can achieve a better understanding of the concept in the operational sense by relating it to two other concepts: "goal" and "process." Altogether, they form a cohesive theoretic structure called the GPS Complex. Three basic types of structures are described, and the G, P, and S elements are examined in detail. The author notes that efficiency judgments are possible only in the context of both process and systems data, and that our traditional information structures are impoverished as to process data. This imbalance is viewed as a major obstacle to advancing the technology of management.

Most of us were introduced to this word "systems" at an early age. We learned of school systems, the solar system, and other elementary systems, and this vocabulary grew as our education progressed. We learned of physiological, transportation, political, and planning and control systems, and the systems approach. Clearly, the term is one of the most ubiquitous in our vocabulary.

Unforunately, the meaning of "systems" is also shrouded in ambiguity. Ask for a succinct definition of the word, and you will be surprised at the vagueness of the answers. Those with more exposure to systems theory couch their ambiguity in such expressions as "interconnected networks of interrelated entities," leaving themselves and their listeners with uneasiness as to the meaning of the word.

This ambiguity leads to abuse of systems concepts and hinders our efforts to design, operate, and evaluate systems. But the notion of a system is so basic and so potentially useful that we should try to clarify it.

TWO GENERAL USES

We can distinguish at once between two broad uses of the word as it is used in general systems theory and in operating systems theory.

General systems theory refers to a way or approach by which to observe and solve problems. Because of its emphasis on the way problems are tackled, it is often referred to as the systems approach, or, more viscerally, as "organized common sense." The systems approach insists on the broadest possible understanding of a problem, involves exploring all feasible alternatives, and selects the best solution through rational means.

To illustrate the systems approach, consider the problem of meeting the demand

"Thus, it is not practical to think of zero-cost solutions, but rather to seek the option which has the lowest relative cost and highest benefit."

for more electricity. A search for feasible alternatives begins. Long-range solutions provide more flexibility in that they allow us to consider alternatives which may not be feasible at present. If the need is immediate, our search is bounded by the existing state of technology.

There are basically three means for generating electricity at present: hydroelectric power, the use of hydrocarbons such as coal or oil, and nuclear power. Feasibility involves technological, economic, and social considerations. There are pros and cons to each alternative. While hydroelectric power plants produce "clean" electricity at relatively low cost, there are not enough suitable sites for dams, and the distances to major user areas are too great. A new social cost has been added recently in the destruction of scenic river beds. Conventional power plants using coal or oil produce smog and other contaminants, and are inefficient in converting hydrocarbons into electric power. Nuclear plants are more efficient, but the problem of thermal pollution and the fear of accidents weigh heavily on the negative scale.

In the language of general systems theory, every alternative is a cost-benefit relationship. Thus, it is not practical to think of zero-cost solutions, but rather to seek the option which has the lowest relative cost and highest benefit. (This may involve a combination of alternatives.) In our example, a decision not to pollute the air may necessitate a decision to pollute the water. A final decision of this type is often made in the social arena.

Suppose that perfect data are available that lead us to favor nuclear plants for technoeconomic reasons. While our problem may appear to be solved in quantitative terms, the systems approach requires that we go further, for even good theoretic solutions may fail for want of public acceptance.

The systems approach requires us to consult public opinion. If it is favorable, implementation can proceed, but if it is opposed, it is necessary either to change public opinion or to choose a less optimal strategy.

In those instances where the best solution involves a technology which has no operating history, the systems approach calls for testing under real-world conditions. These simulations provide decision makers with real instead of theoretical data and reduce the risks of choosing and implementing faulty solutions.

To summarize, some fundamentals of general systems theory are as follows: (1) it proposes a structured approach to problem solving; (2) its methodology is explicit, which means that there are guidelines to problem solving; (3) the boundaries of a problem are identified; (4) all feasible solutions are measured in terms of cost-benefit; and (5) the best solution in the light of technical, economic, and social considerations is adopted.

Operating systems theory involves a second broad use of the term systems. Here the meaning is different from the meaning of the term when used in general systems theory, where systems is synonymous with a particular problem-solving framework. When we speak of a transportation, an accounting, or a weapons delivery system, we do not think of a methodology or approach, but of a functioning medium through which actions are undertaken.

We can achieve a better understanding of systems in the operational sense by placing it in a context with two other concepts with which it is closely related. These related terms are "goal" and "process"; with "system," they form a cohesive theoretic structure which we will call a GPS Complex.

A goal is an objective, a desired attainment. It answers the question "why" and explains the reason for an action. A process is a set of prescribed activities or strategies by which we attain goals. It answers the question "what is happening" and defines the essence of an activity. A system is the network of resources needed to perform the activity. It answers the question "how" and describes the mechanics that allow processes to occur.

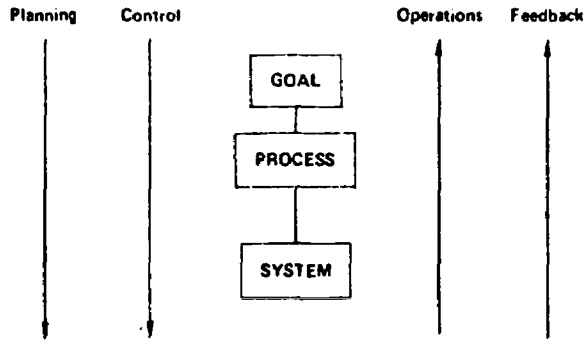
The logic of the GPS Complex can be illustrated by an example from physiology, where the goal (satisfaction of the hunger need) is achieved by the process (eating) through a system (a network of resource elements which enable us to eat, such as food, utensils, heat and cold, and so on). We observe that goals cannot be reached without processes, and that processes cannot take place without systems.[1]

Another observation is appropriate at this point. Our options increase as we move downward through the GPS Complex. Having asserted a goal, we have no option but to fulfill it, to abandon it, or to modify it in favor of a new goal. However, given a goal, a limited choice exists as to processes. In our example, the hunger need could be "satisfied" in a limited number of ways. An alternative to eating would be surgery to remove the hunger-inducing impulses, or a process by which mental control is exercised over the physical urge. Moving to the systems level, however, we find that alternatives are numerous, as illustrated by the many possible resource combinations for satisfying hunger.

The GPS Complex has other implications

FIGURE 1

Management Flows Through the GPS Complex



for management planning and control as shown in Figure 1. Effective planning is possible only as we move from known goals to the definition of processes and the design of systems. Hence the flow is downward through the GPS Complex. Similarly, controls flow from goals; their purpose is to assure that activities conform to plans.

Operations, on the other hand, begin at the systems level, generating an activity flow that culminates in results (achieved goals). Feedback also originates at the systems level in the form of reports on the level of activity, on exceptions, on the functioning of controls, and the interpretation of events.

GPS STRUCTURES

The GPS Complex assumes many different forms. These can be grouped under the three basic types shown in Figure 2.

Type A Structure

In Type A, each element is related exclusively to the other elements. For example, to meet the goal of telling time, we have the time-keeping process, and the system element is a watch. Unless the watch also serves some other objective, such as decoration, its role

1. Robert Anthony, *Planning and Control Systems: a Framework for Analysis* (Cambridge: Harvard University Press, 1965), p. 5, distinguishes between processes and systems in these words: "In brief, a system facilitates a process; it is the means by which processes occur. The distinction is similar to that between anatomy and physiology. Anatomy deals with structure what it is; whereas physiology deals with process - how it functions. The digestive system facilitates the process of digestion."

FIGURE 2

Three Basic Types of GPS Complex

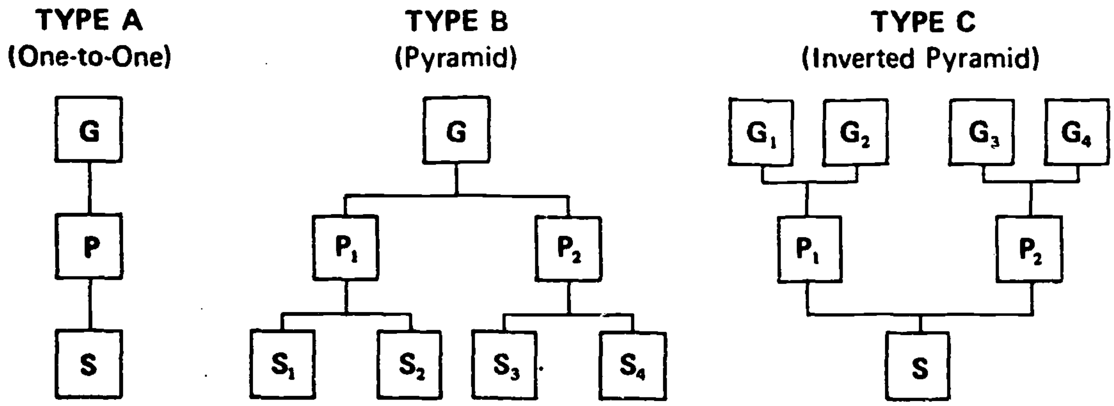
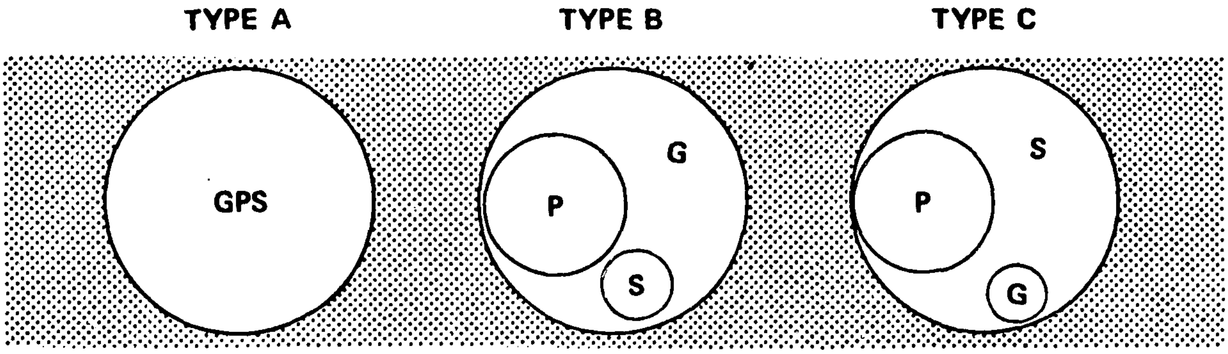


FIGURE 3

GPS Elements in Three Basic Structures



function is to enable us to tell time through the process of timekeeping. In the language of set theory, the elements G, P, and S occupy continguous areas in the Type A structure (Figure 3).

Compared with Types B and C, Type A is relatively easy to design and operate. Cost-benefit analysis is aided in that there are no shared systems costs or process benefits.

Type B Structure

In Type B the whole focus of the structure is on a single important (and usually complex) goal, for example, the task of getting man to the moon and back. A goal like this requires several processes and many systems. Each process and system is a necessary but not a sufficient factor in reaching the goal. Processes must be combined with other processes, and systems with other systems in order to reach the objective; hence, we have an interdependency between processes and between systems. In terms of set theory, Type B structure consists of a hierarchy of importance in the order G, P, and S, as shown in Figure 3.

The pyramid is characterized by its sensitivity. As in the marble games we play, removal of one supporting element leads to the collapse of the whole structure. Also, it is difficult to add new elements after the initial design without destroying its symmetry. Major modifications call for redesign of the structure as a whole. Managing a pyramid requires a holistic approach; each part must be viewed in terms of its impact on the whole. Because of the sensitive interdependencies between the elements, network techniques such as PERT are useful management tools.

The singular advantage of the pyramid is that all energy is directed toward one goal. This has both behavioral and economic implications. The behavioral implication is that employees in a pyramid have a discernible goal (motivator) and can measure their contribution towards its attainment. From an economic viewpoint, it is relatively easy to calculate the final cost of achieving a goal because there are no shared costs at the goal level.

The pyramid is typical of most projects and is also found in new organizations, which often begin with a single major purpose but transform progressively into the inverted pyramid form. This transformation gives rise to behavioral and economic problems which we will discuss.

Type C Structure

Because many of our major organizations are of the inverted pyramid form, we need to study and understand them if we are to prevent the organizational senility that now appears inevitable. This structure is one large system with many goals and fewer processes. It is typical of large organizations, particularly of government, where the multiple goals are financed through one large revenue collection system (IRS).

In the Type C structure, a goal is a necessary but not a sufficient reason for having the underlying process, and, similarly, a process is a necessary but not a sufficient reason for the existence of the system. In other words, a system serves a number of processes, and a process serves a number of goals. A set theory view of the "inverted pyramid" would show S as occupying the area of most importance, ranging from P to G, as shown in Figure 3.

The inverted pyramid is characterized by its insensitivity and impersonality. If we remove a goal, we cannot remove the underlying elements because they serve other goals as well. Removing goals creates redundancy (unused capacity) with its attendant economic costs. On the other hand, if we keep adding goals we increasingly strain (overload) the underlying processes and systems. Because there is no direct linkage between goals and the supporting elements, there is a tendency to think in terms of goals without concern for their impact on the process-system elements.

We referred earlier to the economic and behavioral problems that are inherent in the inverted pyramid. The economic problem is posed by the difficulty of tracing costs. Since process and system costs are shared among many goals, it is difficult to know the cost of reaching a particular goal. At best, we have to rely on fairly arbitrary devices for allocating costs.

The behavioral problem arises from the intrinsic impersonality of the inverted pyramid. Employees, who form part of the systems network, have difficulty in relating to multiple goals, some of which are in conflict with each other. Therefore, preservation of the system becomes a goal in its own right.

We mentioned the typical transformation of pyramids into inverted pyramids. A scenario of this metamorphosis might run as follows. A single, visible goal gives way to many goals that become more obscure and meaningless. Employees are progressively isolated from the goal orientation of the organization. Altruistic motivation gives way to self-interest, and performance becomes competitive. Self-interest progresses into fear and insecurity, and pronounced efforts are made to obtain insularity and invulnerability per the organization itself. Efforts toward change are viewed as personal threats. In lieu of extraorganization (social) goals, the major goal becomes one of sustaining the system and making it impervious to attack. Lacking social motivation, the organization progressively fails.

Investment behavior also illustrates the transformation of a pyramid into an inverted pyramid. A new firm appeals to investors on the basis of social goals: it intends to provide goods or services that will have social (and hence economic) appeal. COMSAT is a case in point. There were many years of active trading in COMSAT stock before it launched its first satellite. In such a case, there is no history of earnings. Generally, the financial statements reveal minimal collateral in the event of failure. What then are investors buying? Simply stated, they are sharing a dream; they believe in the basic purpose of the firm.

When an organization inverts, however, investors too lack knowledge or association with its goals. The stock market now pulses on earnings and other internal data rather than on exogenous factors. Somewhere in the process of changing its GPS structure, the dream is lost.

PROPERTIES OF G, P, AND S

Goals

Goals are assertive. They are stated objectives. I can assert a goal; you can assert a goal. Some goals are more important than others because they are based in part on who makes the assertion and the willingness of others to accept his goal. Rank, the art of persuasion, access to media, and many other factors improve one's position to assert goals on behalf of others.

Goals are neutral. They are not intrinsically right or wrong. What makes some good and others bad is determined by existing social values. A good goal at one time may be a bad one at another if the value set has changed in the interval. For example, in 1960 President John F. Kennedy announced the goal of sending a "man to the moon and back within the decade." In the social climate of 1960 this was viewed by most of us as a good goal. The same objective articulated in 1971 might have far less acceptance.

This fact makes it necessary for goal-setters to tap the social mainstream constantly if they are to set forth goals which will have general acceptance. Unfortunately, this need is frustrated by the increasing insularity of higher offices.

Goals may be implicit or explicit. The confusion that results when we attempt to define the goals of government indicates that many of our large organizations function without explicit goals, by which we mean higher level or external goals as opposed to internal goals, such as improving efficiency or earnings. Yet each system is producing results (which we will call achieved goals), so that failure to articulate goals does not imply their nonexistence.

Where goals are not explicit we can deduce them by observing the system at work. This is a poor substitute for explicit goals in that the ability and resources of observers differ widely, leading to different conclusions as to the goals in question. The story of the four blind men and the elephant comes to mind. Each concluded it was a different creature because he was able to feel only a small part of the elephant's body. Making goals explicit raises the level of argument to the goals themselves, and to variances between goals and actual results, rather than to powers of observation.

Goals may be compatible or incompatible. Goals must be compatible with the supporting processes and systems if we are to have achievement. We noted that any system at work produces results (achieved goals). Therefore, if a new goal is incompatible with the existing substructure, and no changes are made in the substructure, the old results will continue and the new goals will become empty promises. To expect achievement by simply stating a goal in the context of an incompatible substructure is an idle wish.

Many of these process-system structures are deeply entrenched, and knowledge regarding their resistance to change is advisable before setting objectives. It is perhaps failure to recognize incompatibility and entrenchment that leads many office-seekers to overstate their intentions.

Goals are impossible to reach where the needed processes cannot be defined and/or systems implemented. Goals are impractical where the cost of changing the substructure exceeds the derived benefit.

Goals may be operational or nonoperational. An operational goal lends itself to measurement; a nonoperational goal is purely subjective. An operational goal provides a basis for monitoring progress and achievement, but need not be quantitative in nature. To agree to meet a friend at a certain time and place is an operational goal because you either did or did not meet. (Where operational goals are not quantified we are limited to a yes-no outcome.)

On the other hand, a goal such as improvement of employee morale is nonoperational because what constitutes morale is uncertain in the first place. Many important goals are subjective or nonoperational. For this reason we should seek ways to make them operational rather than abandon them. Improving morale is a case in point. If you ask an executive why he believes morale has improved, he will likely cite an increase in productivity, a decrease in turnover, and other objective indexes to support his claim. If these are, in fact, the means by which morale is measured, then we can formalize these indexes as part of the goal itself.

Indirect measures for subjective goals are termed surrogates.[2] Surrogates for morale might include productivity, turnover, absenteeism, and formal complaints. Only indexes that are capable of objective measurement can be used as surrogates. Also, there must be agreement that certain surrogates will be accepted as the means for operationalizing a goal.

For purposes of measurement, it is necessary to go one step beyond identifying surrogates. They are unlikely to be of equal importance vis-a-vis a goal. Hence we must weight them in the order of their perceived importance to a goal:

Productivity	40%
Turnover	30
Absenteeism	20
Formal complaints	10
Morale	*100%*

The above weighting implies that a change in productivity has four times the significance of a change in the number of formal complaints on the issue of morale.

Complex goals such as improvement of morale usually require several surrogates. If only one were needed it should, of course, replace the goal as being a more useful statement of purpose. On the other hand, it is not necessary to exhaust the universe of surrogates. Once we have accounted for 90 percent or more of the goal activity through the weighting of surrogates, the rest can be ignored as being statistically insignificant.[3]

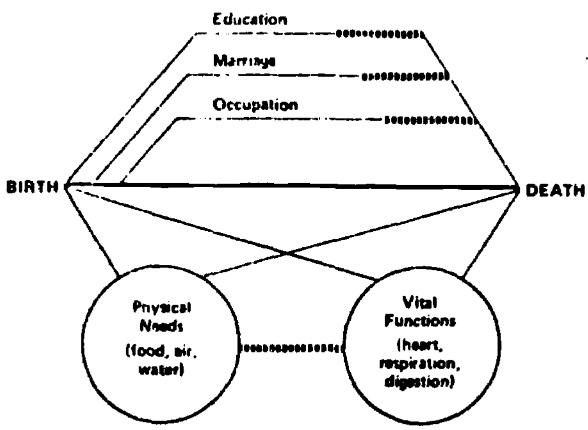
Operational goals provide a number of benefits. In terms of motivation, employees will have a clear picture of what is expected of them and what indexes will be used to measure goal attainment. From a measure-

2. A more intensive treatment of the relationship between principals and surrogates is provided by S. I. Hayakawa, *Language in Thought and Action* (2nd ed.; New York: Harcourt, Brace & World, Inc., 1964), Chapter 2, and Yuji Ijiri, *The Foundations of Accounting Measurement* (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1967), pp. 1-31.

3. This observation is germane to many data collection problems. For example, in obtaining credit information it may not be necessary to exhaust the possible pools of information, but rather to collect data on the most significant surrogates for the complex principals of "character" and "capacity."

FIGURE 4

Network of Major Life Processes



ment viewpoint, operational goals force us to clarify our objectives, and this in turn facilitates evaluation in that we know the extent to which we have met our objectives.

Processes

A process is *a set of activities pertinent to a goal or result.* Processes can be thought of transformations: food is digested, persons are transported, presidents are elected, raw material is converted into products, and so forth. As noted in these examples, processes move things from one state of natuie to another.

Processes are finite or repetitive. Finite (terminal) processes can be represented by a straight line. Examples are the processes of life, production of a product, a college education, or electing a president.

Other processes are repetitive and can be represented by a circle. The function of a repetitive process is to maintain a level of activity. The heart function and circulation are examples in physiology; the weekly payroll is an example in finance. There are processes within processes, and we can depict these relationships as networks. A network of the major life processes is illustrated in Figure 4.

In all process networks there is one macroprocess. In our example it is the life process beginning with birth and ending with death.

Our observations lead us to believe that all macroprocesses are finite (in the absence of proof of eternity or perpetual motion). Hence, all repetitive processes exist in support of one or more finite processes. The objective of a repetitive process is to maintain a cycle of activity in favor of some larger finite process. There is no aggregation or procession of events in repetitive processes. A repetitive process can be said to succeed or fail on the basis of its ability to maintain a desired level of activity in a larger finite process.

It follows that breakdown in a repetitive process affects some larger finite process. Conversely, ending a finite process also ends its supporting repetitive functions.

Organizations have three major process elements. We refer to this structure as a triprocess complex (see Figure 5, which also illustrates the trisystem complex, discussed in a section that follows).

The macroprocess transforms inputs into outputs. Input-output varies in terms of the function of the organization. Schools transform unskilled persons into skilled ones; manufacturers convert raw materials into products; and accountants produce financial statements out of raw data.

Control ensures that results conform to plans. The purpose of feedback is to monitor transformation activities, report on the state of control, and interpret results. Of course, there are many subprocesses that underlie transformation, control, and feedback.

We shall see that in operating terms triprocess complexes have counterpart trisystem complexes. But let us first consider two problems associated with the management of processes: measurement and formalization.

FIGURE 5

The TriProcess (TriSystem) Complex in Organizations

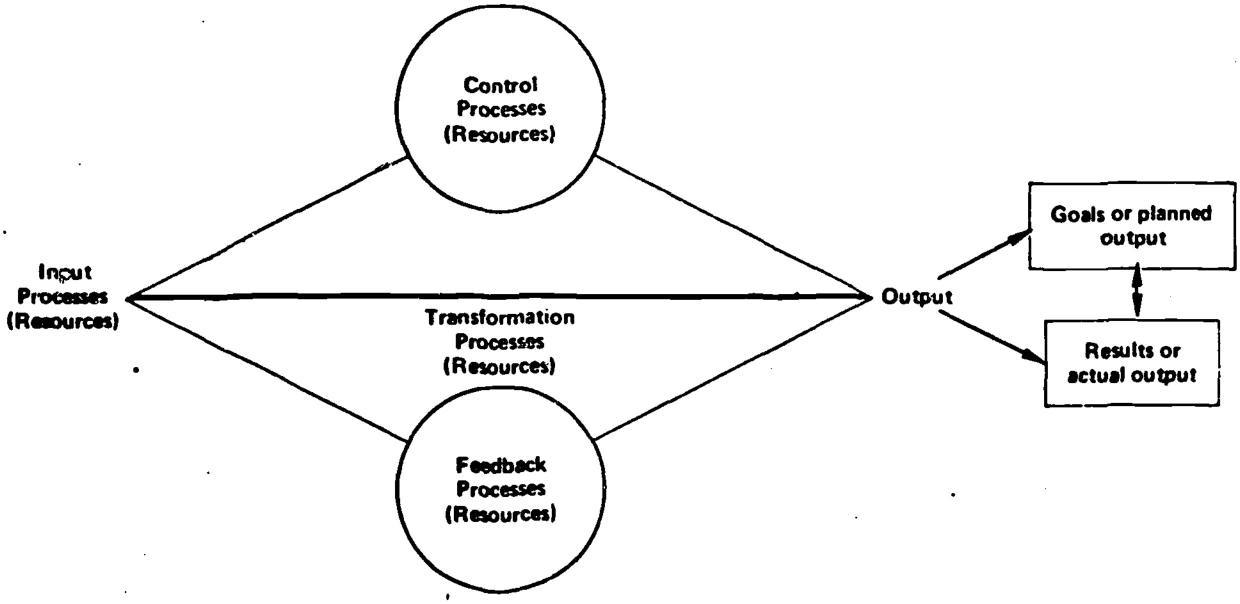
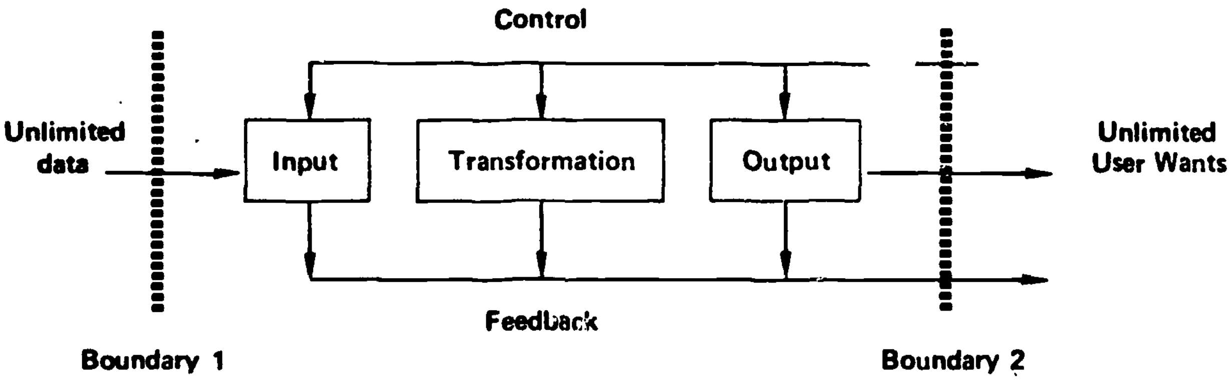


FIGURE 6

An Operating System for Accounting



Processes also pose problems of measurement because there is infinite gradation within processes. For example, we age constantly, not once a year on our birthday. The problem of infinite gradation is resolved through scaling.

Scales may be quantitative; for example, we measure time in units such as seconds, minutes, hours, and days. We can measure speed in miles per hour and lifespans in years. Scales may also be qualitative. For example, we may measure the progress in construction of a house in steps: digging for the foundation, erecting the framing, completing the room, and installing the plumbing.

With qualitative scaling persons must be thoroughly familiar with the process in order to monitor progress. For someone knowledgeable in house construction a report to the effect that "we are at the plumbing stage" would be meaningful process information.

For most purposes, however, quantitative scales are necessary. We note that all scales are arbitrary. Why do we measure life in years of age rather than in mental or physiological terms? Why do some measure distance in yards while others use meters? Scales are essentially conventional, and it is difficult to alter long-standing measures as we have noted in the conversion of the British currency and will note in the move toward the metric system in the United States.

Scales can be refined. We now refer to computer speeds in nanoseconds (one-billionth of a second). The refinement of scales conforms to a general rule of economics in that an optimal scale exists at the point where the marginal benefits of refinement exceed marginal costs to the widest extent.

Processes may be formal or informal. We formalize processes through such media as maps, blueprints, flowcharts, descriptions, instructions, guides, organization charts, and manuals. Informal processes are communicated through skill exchanges, work experiences, verbal instructions, and observation. Some fairly complex processes take place without formalization. Persons thoroughly familiar with the process of construction, for example, can build a house without blueprints.

While systems management has made great strides in the past decade, the management of processes is not yet off home base. Many complex processes in organization, not the least being decision processes, are now uncharted. This paucity of formalized processes lies at the root of much mismanagement.

Many informal processes could be formalized if we made the effort. Some processes, which have previously been held to be too complex to formalize, are yielding to advanced techniques such as decision modeling, simulation, and dynamic programming. We can expect greater advances in formalizing processes in the years ahead. Perhaps in time we will even have process specialists. The reason for this prognosis is that our search for efficiency must come to include process factors in addition to systems factors.

Systems

We have defined a system as "a resource network geared to a purposive end"; it is the means by which processes occur. Resources available to systems managers comprise labor, capital, and materials. Combining these resources in meaningful ways enables managers to attain organization goals.

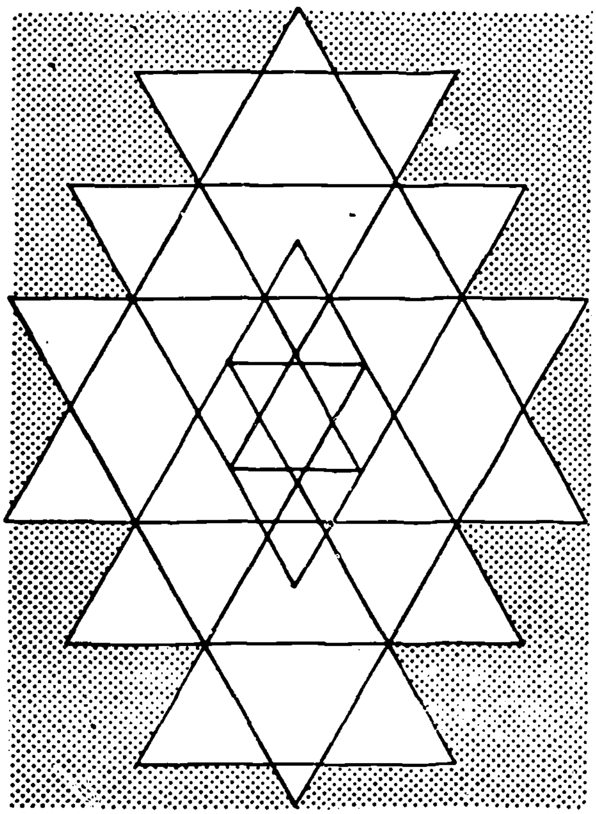
We stated earlier that the triprocess complex has an alter ego in the trisystems complex (Figure 5). We are concerned with the same elements of input, output, feedback, and transformation, but our viewpoint is different. The difference is that we are concerned with the essence of the activity in process terms, but from a systems perspective we are concerned with the mix of resources required to make the process operational. What takes place in the context of operations defines its processes; how those operations occur defines its systems.

Consider accounting as an operating system. Its purpose is to facilitate the decision-making processes of users. The input is raw data, which are admitted to the accounting system, are transformed, and leave the system in the form of financial reports (Figure 6).

On the one hand, the system faces an environment of unlimited data, while on the other it faces unlimited user wants. No system can cope with these conditions. Accordingly, each system has its limitations as denoted by boundaries 1 and 2. Boundary 1 serves as a screen in that only a portion of the data in the environment is admitted to the system. Boundary 2 serves as a screen in that various users get certain information based on their needs, whether they are entitled to the information, and the constraints (including costs) of providing it. Without boundaries we have no system. The nature of these boundaries also distinguishes one system from another.

The admission of data to the accounting system is not random, that is, we do not take every *n*th item in a newspaper, for example, and admit it to the system. Rather, well-defined input rules facilitate a rational screening. It follows that there are transformation, control, feedback, and output rules and procedures.

Systems too can be formalized through design and engineering. Many of the devices by which processes are formalized, as described earlier, are used in formalizing systems. Again the difference is substantive—what is being formalized. In the case of processes, we are defining the nature of operations, while in formalizing systems we are designing the utilization of resource elements.



EFFICIENCY

The ultimate objective in management is to reach goals in the most efficient way. Making efficiency judgments requires both process and systems data. For example, the most efficient water delivery project is the one that delivers the greatest quantity of the highest quality water (process data) at the lowest cost and in the least time (systems data).

Process data are qualitative in nature, while systems data are generally expressed in terms of cost or time cost. A process can be said to yield *activity* data, while a system gives us *energy* data. The notion of activity stems from the fact that something is happening in a process, while the concept of energy arises from the fact that resources are being consumed (hence releasing energy) in order to make things happen.

For example, to measure efficiency in operating a delivery truck, we juxtapose an activity scale (mileage or value of deliveries) against an energy scale (operating and maintenance expense). Neither scale alone gives us sufficient data for efficiency judgments. Similarly, the efficiency of a government or any other organization cannot be measured by the amount of its budget or level of its operations (a decrease in the budget is not necessarily an act of efficiency or vice versa). Instead, efficiency is measured in terms of what is accomplished in the light of available resources.

A major characteristic of conventional decision making is an abundance of systems data but a paucity of process data. In an age where qualitative factors are reaching parity with economic concerns, the need to define and measure processes emerges as a major challenge. For this reason, we have sought to make these distinctions clear.

The lack of clarity concerning the use of the terms "process" and "systems" hampers our efforts to manage organizations effectively. These terms bear a close relationship to the goals of an organization. We have expressed this relationship as a goal-process-system or GPS Complex. Goals are defined as objectives, processes as activities, and systems as resource networks. GPS Complexes can assume different forms, which are the basis for both behavioral and economic considerations.

Examination of the G, P and S elements in more detail indicate that efficiency judgments are only possible in the context of both process and systems data. Our traditional information structures, particularly in accounting, have been rich sources of systems data but are impoverished as to process data. We view this imbalance as a major obstacle to advancing the technology of management. Our hope is that this conceptual treatment will serve at least to highlight a significant problem, and perhaps point to more useful frameworks.