This is to certify that the

thesis entitled

A THEORETICAL ISOMORPHIC SYSTEMS APPROACH TO
THE DESIGN OF A MODEL FOR MECHANIZATION
OF AGRICULTURE FOR ADULTS

presented by

Hooshang Iravani

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Administration & Higher Education

Carroll H. Wamhoff
Major professor

Date 7-16-80

O-7639

A THEORETICAL ISOMORPHIC SYSTEMS APPROACH TO THE DESIGN OF A MODEL FOR MECHANIZATION OF AGRICULTURE FOR ADULTS

By

Hooshang Iravani

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Administration and Higher Education

1980

ABSTRACT

A THEORETICAL ISOMORPHIC SYSTEMS APPROACH TO
THE DESIGN OF A MODEL FOR MECHANIZATION
OF AGRICULTURE FOR ADULTS

By

Hooshang Iravani

The main purpose of this study was to design a theoretical isomorphic system for mechanization of agriculture for adults, to be represented in conceptual-graphical models. The second purpose was to explore, identify, and describe a methodology for the design of such a system. The third purpose was to use Tel-Plan Computer Program 70 to develop a theoretical model budget for production of soybeans, wheat, and corn, based on average prices in Michigan.

Systems approach, based on the application of General Systems Theory, was identified as a methodology to conduct this study.

The study was creative library reference materials oriented, where the procedure was: (1) the identification of the problem; (2) the identification and definition of goals/objectives; (3) the preliminary collection of pertinent information and facts; (4) the use of systems approach to define a system for mechanization of agriculture; (5) the formulation of a preliminary model of the proposed system; (6) the statements of research questions based on the application of General Systems Theory; (7) the review of pertinent literature and collecting facts; (8) the itemizing of inputs, throughputs, and

Aims in a theoretical isomorphic system for mechanization of agriculture were identified as: (1) establishing new mechanized farms, (2) providing on-the-job training, (3) financing the farms with reasonable monthly payments, (4) supervising for maintenance, (5) communicating about innovations, and (6) facilitating marketing.

Inputs were identified as: (1) land, (2) capital, (3) machinery, (4) technology, (5) materials, (6) methods, (7) animals, (8) ideas, (9) personnel, (10) adults, (11) goals, (12) objectives, (13) seeds, (14) plants, (15) fertilizers, (16) chemicals, (17) water, (18) time schedule, (19) priorities, (20) structure, (21) content, (22) learning aids, (23) facilities, (24) mechanized farms, (25) farm mangers, (26) buildings, (27) equipment, (28) tools, (29) products, (30) educational technology, (31) extension methods, and (32) extension materials.

Throughputs were identified as: (1) assessment, (2) diagnosis, (3) intervention, (4) development, (5) selection, (6) evaluation, (7) reporting, (8) recommendation, (9) implementation, (10) refinement, (11) trial, (12) communication, (13) prediction, (14) regulation, (15) preparation, (16) processing, (17) searching, (18) coordination, and (19) accountability.

Outputs were identified as: (1) grain, (2) dairy, (3) poultry, (4) vegetables, (5) beef, (6) sheep, (7) agricultural products, (8) well maintained farms, (9) trained farm managers, (10) farm owners, and (11) farm income.

outputs; (9) the formative testing of the model, and (10) the development of conceptual-graphical models of the proposed system, using the creative approach.

Conceptually, a system is defined as a set of interrelated, interdependent elements in continuous action, interaction, and transaction within the system and with its environment, exchanging matter, energy, and information in the form of inputs, throughputs, outputs, and feedback. The system has both subsystems and suprasystems, characterized by supersummation, meaning that the whole is greater than the sum of its parts. Models are used to represent the patterns of a system. The conceptual model theory is characterized by four distinctive functions: (1) the organizing, (2) the heuristic, (3) the predictive, and (4) the mensurative. A dimension of evaluation of models is based on four factors: (1) the importance of a model's generality or organizing power, (2) the fruitfulness or heuristic value, (3) the significance of verifiable predictions which it yields, and (4) the accuracy of the operations of measurement that can be developed with its aid. Other characteristics of a good model include: (1) originality, (2) simplicity, and (3) realism.

Specific objectives were to explore, identify, and describe aims, inputs, throughputs, outputs, feedback, constraints, boundaries, environment, etc., of a system for the Mechanization of Agriculture.

Subsystems were identified as: (1) farm establishment, (2) training, (3) financing, (4) maintenance, (5) extension, and (6) marketing.

Constraints were predicted as lack of: (1) capital, (2) favorable agricultural policies, (3) necessary resources, (4) proper management, (5) proper skills, (6) time, (7) timing, (8) facilities, (9) machinery, (10) equipment, (11) communication channels, and (12) favorable environment.

Linkages were identified with: (1) agricultural colleges, (2) ministry of agriculture, and (3) other remote resources specialized in agriculture and rural development.

The Tel-Plan Computer Program 70 was employed to analyze the cost of the production of soybeans, wheat, and corn, based on 1979 Michigan prices.

DEDICATION

To my father Yahya Iravani

and

my mother Fakhromoluk Azarmi-Iravani

1980

ACKNOWLEDGMENTS

I would like to extend special thanks to several people for their support and encouragement at various stages in the completion of this dissertation.

I am grateful to Dr. Carroll H. Wamhoff, Director of the Agriculture and Natural Resources Education Institute, for having faith in my ability and for providing me with the necessary encouragement toward completion of the requirements.

Appreciation is extended to Dr. Richard L. Featherstone for being the epitome of professionalism, and for providing practical guidance along with support and encouragement.

Appreciation is also extended to Dr. James L. Page for his support, advice, and encouragement from the very beginning of the study and for his dedication to creativity based on individual interest and performance.

A special thanks to Dr. S. J. Levine, Director of Programs in Adult and Continuing Education for his unfailing interest in observing the standards of professional study.

TABLE OF CONTENTS

Chapter | Page

Chapter | Page

Appendix

LIST OF TABLES

LIST OF FIGURES

Figure | Page

In the name of the Almighty, the Beneficent,
the Merciful.

Assist the agricultural sector with what improves the conditions of its people. The improvement of the land and the condition of the farmers is an improvement to the rest of society which cannot truly prosper without the farmer's prosperity.

The Imam Ali

ABDOELVAHABELVAHEED

CHAPTER I

PURPOSE, PROBLEM, THEORIES, LIMITATIONS, AND DEFINITION OF TERMS

The major thrust of this chapter is to present the reader with the following information: the purpose of the study, an introduction to the problem, and possible recommendations for the solution of the problem. This chapter also includes a brief discussion of some of the basic terms used in the paper such as: accountability, definition of a system, systems approach, General Systems Theory, characteristics of General Systems Theory, learning theories, working toward a theory of creativity, limitations, assumptions, procedure , operational definitions, and an overview of the study.

Purposes of the Study

The main purpose of this study is to design a theoretical isomorphic system for mechanization of agriculture for adults to be represented in conceptual-graphical models. The second purpose is to explore, identify and describe a methodology for designing such a system. The third purpose is to use the Tel-Plan Computer Program 70 to develop a theoretical cost model for production of soybeans, wheat, and corn, based on Michigan prices.

Introduction to the Problem

The world population at the present time is 4.2 billion, and the facts are: (1) population is increasing, and (2) poverty is increasing in spite of the world attention and awareness for solving the problem. Most indications point to 7 billion individuals living on earth by the year 2000.

> Three overwhelming and highly visible dangers are threatening the future of mankind: (1) nuclear warfare, (2) the population explosion, and (3) the hunger gap. They are imtimately related . . . life for more than two-thirds of 4.2 billion humans, on earth, is highly precarious. They are short of most of the necessities of life: food, water, shelter, fuel and metals. Available land for tillage and forestry is inadequate. In a few words: they exist in various degrees of poverty and misery. . . . All estimates and projections agree that there is little likelihood the globe will have fewer than 6 billion people by year 2000. Even this figure is predicted upon the assumption that some degree of success can be attained in current measures to curb the population growth. This estimate is highly conjectural, and most indications point to 7 billion.[1]

At the present time 30 to 35 percent of the world population is astonishingly poor, and 15 percent is starving. In other words, 50 percent or 2,100,000,000 individuals have incomes of less than 200 dollars per year. In an overview in alternatives for balancing world food production and needs, Brown indicates that:

> the food problem has been characterized as a race between food and people. In fact, it is a race between world food demand and population. Food shortages will continue over the years ahead as the population juggernaut continues to gain momentum in the less developed world, and as incomes

---

[1]George Borgstrom, Harvesting the Earth (New York: Abelard-Schuman, 1973), pp. 1 and 169.

continue the rapid rise of recent years in the more advanced countries.[1]

The natural question arises as to what should be done to solve the problem and also to help people to learn to participate in the production processes. Possible recommendations for the solution of the problem might be as indicated in the following section.

What Should Be Done?

1. More food must be produced to reduce starvation. This is only possible if mechanization of agriculture is introduced and successfully implemented.
2. Increased education must be provided for poor people in order to help them to help themselves. This calls for continuing adult education in all its forms.
3. Research must be increased, based on systems perspectives to design systems, strategies, and models in order to be implemented, evaluated, and held accountable for its success.

Developing countries are very much impressed by the advancement of science, technology, industry, and agriculture in developed countries, and fully see the value of development as destiny for better quality of life, but the development of a country does not just happen by accident.

---

[1]Lester R. Brown, Alternatives for Balancing World Food Production and Needs (Ames: The Iowa State University Press, 1967).

Rodinelli points out that projects are the basic building blocks of development. Without successful project identification, preparation, and implementation, development plans are no more than wishes, and developing nations would remain stagnant or regress.[1]

Gerlach and Hines make a fine differentiation between two types of social change. They consider developmental social change and revolutionary social change with the following definitions:

> Developmental social change is change within an ongoing social system, adding to it or improving it, rather than replacing some of its key elements.
>
> Revolutionary social change is change that replaces existing goals with an entirely different set of goals, steering society in a very different direction.[2]

It is valuable to point out the application of these two definitions to the fields of Extension, Adult Education, and Mechanization. If the intention in a given developing country is to develop existing cultural practices, we are indeed aiming at developmental social change, where non-systematic approaches can be of value in being designed and implemented, in order to improve and develop local practices. But, if the intention is to introduce new methods and replace the old cultural practices, then our aim is revolutionary social change, and one can assume that only systematic

---

[1]Denis A. Rodinelli, "Why Development Projects Fail, Problems of Project Management in Developing Countries," <u>Project Management Quarterly</u>, March 1976, p. 10.

[2]Garlach and Hines, in <u>Strategies for Planned Change</u>, ed. G. Zaltman and R. Duncan (New York: John Wiley & Sons, Inc., 1977), p. 8.

approaches to change would lead to success for differentiation, reintegration, and adaptation of the introduced innovation.

Accountability

The request for accountability in the sense of holding the rural development systems responsible for the successful achievement of improving rural areas in developing countries is crucial and must be considered.

The concept of accountability in a system for mechanization of agriculture has several primary concerns: (1) the responsibility of the Mechanization Enterprise to provide a mechanized base for agricultural productions, (2) the provision of programs which will effectively develop the human potential for management of mechanized farms in a wide variety of agricultural products, (3) the responsibility of the enterprise to efficiently utilize the various resources available, and (4) the responsibility for optimal attainment of objectives and goals.

Lopez indicates that:

> accountability refers to the process of expecting each member of an organization to answer to someone for doing specific things according to specific plans and against certain timetables to accomplish tangible performance results. It assumes that everyone who joins an organization does so presumably to help in the achievement of its purposes; it assumes that individual behavior, which contributes to these purposes, is functional and that which does not, is dysfunctional. Accountability is intended, therefore, to insure that the behavior of every member of an organization is largely functional.[1]

---

[1]M. Felix Lopez, Accountability in Education in Emerging Patterns of Administrative Accountability, ed. Lesley H. Browder, Jr. (New York: McCutcheon Publishing Co.,), p. 197.

Cunningham points out that accountability and evaluation are not synonymous. Accountability is dependent upon evaluation, obviously, but it is a broader concept. The accountability responsibility extends beyond appraisal; it includes informing constituents about the performance of the enterprise. Similarly, it implies responding to feedback.[1]

Lovett constructs the following questions for viewing accountability within a system:

1. Who is accountable?
2. To whom is he accountable?
3. For what is he responsible?
4. What if it does not work?[2]

Alkin defines accountability in the following manner: "Accountability means (1) a negotiated relationship, (2) designed to produce increased productivity, (3) in which the participants agree in advance to accept specified rewards and costs, (4) on the basis of evaluation findings on the attainment of specified ends."[3]

---

[1]L. Luvern Cunningham,"Our Accountability Problems," in Accountability in American Education, ed. Frank J. Sciara and Richard J. Kantz (Boston: Allyn and Bacon, Inc., 1972), p. 78.

[2]Robert Lovett, "Professional Accountability in Schools," in Accountability in American Education, ed. Frank J. Sciara and Richard J. Kantz (Boston: Allyn and Bacon, Inc., 1972), p. 129.

[3]Marvin C. Alkin, Accountability, A State, A Process or a Product?" ed. Gephart J. William (New York: Phi Delta Kappa, Inc., 1975), p. 24.

Definition of a System

According to Hall and Hagen, a system is a set of objects together with relationships between the objects and their attributes.

- Objects are simply the parts of components of a system, and these parts are unlimited in variety.
- Attributes are properties of objects.
- Relationships are those that "tie the system together." It is, in fact, these relationships that make the notion of "system" useful.[1]

The Systems Approach

The systems approach is a methodology aiming at the understanding of the totality of a phenomena in order to explain the viable parts and their interrelationships. According to Schoderbek et al.,

> the systems approach is a Gestalt type of approach, attempting to view the whole with all its interrelated and interdependent parts in interaction. The systems oriented researcher employs the holistic method. This approach forces him to acquire an adequate knowledge of the whole before he proceeds to an accurate knowledge of the workings of its parts.[2]

General Systems Theory

Bertalanffy postulated a new discipline called General Systems Theory. The subject matter of General Systems Theory is the formulation and derivation of those principles which are valid for "systems" in general. He states that,

---

[1]A. D. Hall and R. E. Hagen, "Definition of a System," in Organizations, Systems, Control and Adaptation, ed. Joseph A. Litterer (New York: John Wiley & Sons, Inc., 1969), p. 31.

[2]Peter P. Schoderbek et al., Management Systems Conceptual Consideration, Business Publications, Inc., 1975, p. 13.

> there exists models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations or 'forces' between them. It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general.[1]

According to Boulding, General Systems Theory is the label given to describe a level of theoretical model-building which lies somewhere between the highly generalized constructions of pure mathematics and the specific theories of specialized disciplines.[2] Immegart and Pilecki, in regard to General Systems Theory, state that,

> General Systems Theory, as first set forth by Bertalanffy, forms 'the skeleton of a science,' and seeks to integrate all of the sciences within a common conceptual framework using uniform and systematically derive terminology. Of interest to General Systems scholars are the nature of systems, the universality of systems properties and states, and the generalization of scientific findings from one kind of system to another. The perspective and methodology of this emphasis ranges from the purely descriptive to the most rigorous of mathematical formulations. The dynamics, functions, development, and composition of systems are studied to generate further research as well as a universal scientific theory.[3]

Characteristics of General Systems Theory

According to a number of systems theorists, characteristics of General Systems Theory are: (1) interrelationship and interdependence

---

[1]Ludwig Von Bertalanffy, General System Theory Foundations, Development Applications (New York: George Braziller, 1968), p. 32.

[2]Kenneth E. Boulding, General Systems Theory, The Skeleton of Science in Management Systems, ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), p. 7.

[3]Glenn L. Immegart and Francis J. Pilecki, An Introduction to Systems for Educational Administrator (Reading, Mass.: Addison Wesley Publications, 1973), p. 9.

of objects, attributes, events and the like, (2) holism, (3) goal seeking, (4) inputs, (5) throughputs, (6) outputs, (7) entropy, (8) negentropy, (9) regulation, (10) hierarchy, (11) differentiation, (12) equifinality, (13) existence in time and space, (14) boundaries, (15) environment, (16) dynamic interaction, (17) structure, (18) progressive mechanization.[1]

Characteristics of the Model Theory

According to Deutsch, characteristics of the model theory are four distinct functions: (1) the organizing, (2) the heuristic, (3) the predictive, and (4) the mensurative.

Learning Theories

Some of the most prevalent learning theories are stated by John Dewey, B. F. Skinner, Jerome S. Brunner, Jean Piaget, and Robert M. Gagne.

Dewey, in his theory of experience, states that educative experience in a certain sense, is an experience that does something to prepare a person for later experience of a deeper and more expansive quality, and that is the very meaning of growth, continuity, and

---

[1]For example, Ludwig Von Vertalanffy, General Systems Theory Foundations, Development, Applications (New York: George Braziller, 1968); Kenneth T. Berrion, General and Social Systems (New Bruswick, N.J.: Rutgers University Press, 1968); G. J. Miller, "Living Systems, Basic Concepts," Behavioral Science, July 1965, pp. 193-234; and Ervin Laszlo, The Systems View of the World (New York: Braziller, 1972), p. 11.

[2]Karl W. Deutsch, The Evaluation of Models in Management Systems, ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), p. 338.

reconstruction of experience. He further states that the experiential continuum, experiential interaction, and value judgment of experience are important to consider.[1]

The experiential continuum is characterized in the Dictionary of Education as a series of ongoing experiences with the following conditions: (a) the present experience gains meaning from and enhances the meaning of previous experiences, (b) the present experience is a potential for more enriching future experience, and (c) thinking occurs within and following the experience which reconstructs the individual's value and alters the direction of future experiences.[2] Experiential continuum expresses the first chief principle for interpreting an educative experience.

According to Dewey,

> all human experiences are ultimately social, in the sense that they involve contact and communication. The word interaction expresses the second chief principle for interpreting an experience in its educational function and force. . . . Every experience is a moving force. Its value can be judged only on its ground of what it moves toward, and into. Each experience of the learner can be evaluated in a way in which the one having the less mature experience cannot do.[3]

Continuous reconstruction of experience for physical, intellectual and moral development should be a concern in regard to the outcome of the education process.

---

[1]John Dewey, Experience and Education (New York: Collier Macmillan Publishers, 1977), p. 47.

[2]Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Co., 1973), p. 227.

[3]Dewey, pp. 42 and 43.

Skinner believed that an individual enters this world without any knowledge and experience. It was his theory that learning is achieved within and from the environment; therefore, a person should be rewarded for his correct responses. When a person accumulates enough experiences in the environment, he is ready to learn. Programmed instruction should be provided for learners, whereby they can work at their own rate.[1]

Bruner stated the hypothesis that any subject can be taught effectively in some intellectually honest form to any child at any stage of development. To put it into other words, the desired content should be offered in terms that the learner can comprehend.[2]

Gagne believed in a hierarchy of skills. As one masters or gains a mastery of more difficult skills, he becomes motivated. The mastery of the difficult tasks becomes a source of satisfaction for a learner, and this generates a desire for improvement.[3]

Piaget believed in stages of development. The major factors in cognitive development are the interaction of maturation, experience, social interactions, and equilibration. The implication of Piaget's theory for educators is that curriculum sequences should be designed with the student's cognitive status in mind. If curricula does not

---

[1]F. B. Skinner, Beyond Freedom and Dignity (New York: Random House, 1971).

[2]Jerome S. Bruner, The Process of Education (New York: Random House, 1960).

[3]Robert M. Gagne, The Conditions of Learning (New York: Holt, Rinehart & Winston, Inc., 1970), pp. 83, 237-276.

consider the student's levels of conceptual development, learning will be ineffective.[1]

Bloom indicates that the cognitive domain is characterized by the following stages:

- Knowledge--Primarily recall, requires the learner to store information and to remember it at a later time.
- Comprehension--Understanding the literal message contained in a communication, basic understanding, does not require seeing fullest implications.
- Application--Using abstractions in concrete situations, will use the abstraction correctly even though no mode of solution is specified.
- Analysis--Breakdown of a function into constituent parts, intended to clarify a communication, to indicate how the communication is organized, and the way in which it manages to convey its effects, as well as its basis and arrangement.
- Synthesis--Putting together elements so as to form a whole, arranging and combining elements in such a way as to constitute a pattern or structure not clearly there before.
- Evaluation--Judgments about the value of materials or methods, quantitative or qualitative judgments about the extent to which material and methods satisfy criteria.[2]

The Gestalt theory of learning originated in Germany in the early twentieth century; introduced into the United States in the 1920s, it defines learning as the reorganization of the learner's perceptual or

---

[1]Barry Wadsworth, Piaget's Theory of Cognitive Development (New York: David McKay Co., Inc., 1971).

[2]Benjamin S. Bloom et al. Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (New York: David McKay Co., 1956), pp. 190-193.

psychological world.[1] Gestalt is a term designating an undivided articulate whole that cannot be made up by the mere addition of independent elements, the nature of each element depending on its relationship to the whole. As a theory of perception, it places stress upon structural unity, the wholeness by which consciousness gives order to experience.[2]

Toward a Theory of Creativity

A creative approach to understanding a system for mechanization of agriculture also has important implications for this kind of study. Most researchers, in the area of creativity, have pointed out the need for ideation and reconceptualization as relevant to understanding a phenomena, that which seems to have no previous pattern of recognition.

According to Muller, the creator is he who defies existing notions in search of the unknown. The creator has an unexplainable faith in change and the fact of originality. Whether an artist or a scientist, the creator searches for skeletons in the cupboard, areas where loose ends exist, need for change.[3]

Rogers has identified a significant relationship existing between the creative individual and his openness to experience, operation at a level of evaluation and ability to reorganize concepts.

---

[1]Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Co., 1973), p. 333.

[2]Ibid., p. 261.

[3]Robert E. Muller, Inventivity, How Man Creates in Art and Science (New York: The John Day Co., 1963), p. 81.

He has given emphasis to qualities that are characteristic of a potentially creative person.

> 1. Openness to experience: "extensionality." This is the opposite of psychological defensiveness, when to protect the organization of the self certain experiences are prevented from coming into awareness except in distorted fashion. In a person who is open to experience, each stimulus is freely relayed through the nervous system, without being distorted by any process of defensiveness. . . . This means that instead of perceiving in predetermined categories, the individual is aware of the existential moment as it is, thus being alive to many experiences which fall outside the usual categories.
>
> 2. An internal locus of evaluation. Perhaps the most fundamental condition of creativity is that the source or locus of evaluative judgment is internal. The value of his product is, for the creative person, established not by the praise or criticism of others, but by himself. Have I created something satisfying to me? Does it express a part of me--my feeling or my thought, my pain or my ecstasy? These are the only questions which really matter to the creative person, or to any person when he is being creative.
>
> 3. The ability to toy with elements and concepts. . . . Associated with the openness and lack of rigidity is the ability to play spontaneously with ideas, colors, shapes, relationships--to juggle elements into impossible juxtaposition, to shape wild hypotheses, to make the given problematic, to express the ridiculous, to translate from one form to another, to transform into improbable equivalents. It is from this spontaneous toying and exploration that there arises the hunch, the creative seeing of life in a new and significant way. . . .[1]

Intuition, imagination, visualization, supporting some experience or observation provides potential for creativity. Barnes has indicated that,

---

[1]C. R. Rogers, "Towards a Theory of Creativity," in Creativity and Its Cultivation, ed. H. H. Anderson (New York: Harper & Brothers, 1959), pp. 75-76.

> it is when we think or describe an event, that we fill in the gaps between a series of otherwise disconnected sense-impressions with an imagined continuity . . . to observe--to take notice of--is in some measure to experience, and observation, therefore, implies imagination. No knowledge is possible without an act of synthesis on the part of the knower, some kind of putting together, the imagining of a relationship--there can be no such thing as a "mere" observation, a passive mind receiving an imprint. We bring something of ourselves to the discrimination of the most trivial object in the outside world.[1]

The very meaning of creativity implies that one is willing to break from a traditional point of view, and to rearrange or reorganize symbols and concepts in order to solve a problem.[2]

It seems logical to assume that a creative approach, along with a systems approach based on the application of General Systems Theory, facilitates the process of understanding the nature of a theoretical isomorphic system for mechanization of agriculture for adults.

In an attempt to eliminate much of the ambiguity presently associated with mechanization of agriculture in developing countries, this study is concerned with a systems approach based on an application of General Systems Theory to design a theoretical isomorphic system, to be represented in conceptual-graphical models.

Assumptions

1. A general systems perspective provides conceptual links between relevant disciplines to mechanization of agriculture by presenting professionals with a common language, unrestricted to subject

---

[1]Kenneth C. Barnes, The Creative Imagination (London: Swathmore College Press, 1960), p. 9.

[2]H. H. Anderson, ed., Creativity and Its Cultivation (New York: Harper & Brothers, 1959), p. 23.

matter boundaries, thus allowing for meaningful dialogue in the midst of increasing specialization and fragmentation of knowledge. This aspect is important for the mechanization of agriculture, since supporting services such as training, supervision, maintenance, financing, extension, and marketing are important in a system for mechanization of agriculture.

2. A general systems perspective permits the organization of a vast number of theories, and concepts into a meaningful framework as a basis for making planning judgment. This aspect is very important for developing countries, where national planning for development has taken momentum in recent years.

3. A general systems perspective, with its focus on systems inputs, throughputs, and outputs facilitates a process orientation to mechanization, training, supervision, marketing, and extension, which is dynamic and applicable in a wide variety of food production.

Procedure

The following steps are identified for conduting this study. For further understanding of the procedure, the publications listed in footnote are recommended.[1]

1. Identification of the problem.
2. Identification and definition of goals, objectives.

---

[1]Harry H. Goode and Robert E. Machole, Systems Engineering (New York: McGraw-Hill Book Co., 1957), pp. 305-306; P. P. Schoderbek et al. Management Systems Conceptual Considerations, Business Publications, Inc., 1975, pp. 237-263; and V. Vemuri, Modeling of Complex Systems, An Introduction (New York: Academic Press, 1978), p. 9.

3. Preliminary collection of pertinent information and data.
4. Defining a system (systems approach).
5. Identifying the structure of the model.
6. Statements of research questions based on an application of General Systems Theory (GST).
7. Reviewing pertinent literature and collecting relevant facts.
8. Itemizing inputs, throughputs, and outputs.
9. Formative testing of the model.
10. Developing a conceptual-graphical model (creative approach).

Limitations

The GST makes use of the process of analogy. One must keep in mind that analogizing is a very tempting but a potentially dangerous enterprise. Therefore, the usual dangers are inherent in the use of GST application to the mechanization of agriculture for adults. Systems, when represented in models, are subject to the dangers typically inherent in abstraction, where important factors may be left out, and less important factors being given higher priorities. There is no guarantee that investment of time and effort in constructing a model will pay dividends in the form of satisfactory results. The model designer may become so devoted to his model that he may insist that this model is the real world. The study is at macro level, and the scope of the system to be simulated and visualized and studied is so wide that exhaustive efforts are needed to conceptualize a system for mechanization of agriculture to be represented in models.

The system designer is not expert in all the related fields which contributes to the totality of a system for mechanization of agriculture for adults and, therefore, some important factors for success of such a system may have been overlooked.

The maximum strength of a chain is equal to the weakest part of a chain. This also applies to a system; the maximum strength in the performance of a system is equal to the weakest performance of a subsystem within the system. This indicates another limitation of a system in that if a subsystem is not doing its job it has an effect on the total system, and if a subsystem is poorly designed, it will weaken the results of the overall system design.

Operational Definitions[1]

Accommodation is a sytem-environment interaction or process by which the environment satisfies the changing requirements of the system.

Adaptive systems are capable of adjusting themselves to meet changing requirements.

Adjustment is a systems-environment interaction or process by which the system responds to the changing requirements of its environment.

Adjustments are changes brought about within a system in order to modify its behavior, structure, and characteristics, so that it can produce improved system output or system state.

---

[1]See, for example, Bela H. Banathy, Developing a Systems View of Education, Lear Siegler, Inc., 1973, where these operational definitions are being quoted; and Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Co., 1973), p. 16.

Adult is a person who has come into that stage of life in which he has assumed responsibility for himself and usually for others.

Boundaries of a system delimit the system space and set aside from the environment all those entities that make up the system.

Components are integral parts of a system, selected on the basis of their potential to carry out functions required for the achievement of the system's goal.

Constraints are known limitations or restrictions imposed upon a system that curtail resources or operations.

Entity is a definable element of a system.

Environment is the context within which a system exists. It is composed of all the things that surround the system, and it includes everything that may affect the system and that may be affected by the system.

Feedback is a process by which information concerning the state of the output and the operation of the system is introduced into a system.

Feedback and adjustment provide for the analysis and interpretation of information about the assessment of the output and the operation of the system. This information is used for introducing adjustments into the system in order to bring about more adequate output and improved system operations.

Functions are activities that have to be carried out in order to achieve the goal of the system.

General system functions are functions that are characteristic of systems in general.

General systems research identifies elements that are common to systems in general, and it develops and tests models that represent systems in general.

General Systems Theory presents concepts, principles, and models that are common to systems in general, and it identifies structural similarities between systems.

Goal seeking is a characteristic of systems by which they are directed toward the achievement of goals.

Hierarchical relationship is one in which one subsystem is superior to others.

Input includes information, people, energies, and materials that enter into the system from the environment. It is also the process by which such entry occurs.

Input processing refers to operations that provide for (1) the interaction between the system and its environment, (2) the identification of systems-relevant input, and (3) the introduction of system-relevant input into the system.

Interdependence of components within a system means that change in one component brings about changes in others.

Model may be (1) a representation or abstraction of a real system or (2) a theoretical projection or display of a possible system.

Model building is the strategy by which a conceptual representation of a system or a solution is constructed and from which specified outcomes can be determined.

Model theoretical isomorphic is a theoretical model which maintains the existence of one-to-one correspondence between the concepts and assumptions of the theoretical model and the observed world; the relationships in each also take the same form.

Multisystem is a complex of several related systems.

Open refers to a state in which a system is continuously interacting and interchanging with its environment.

Output is whatever the system produces and sends back into its environment.

Patterned relationships are connections between the components of a system. These relationships make up the interactive functions that components carry out by design and that display the structure of the system.

Peer systems are related systems that make up a larger system.

Progressive integration fuses the components of a system into increasingly more wholeness.

Resources are information, people, materials, money or other means that are at the disposal of a system.

Self-regulating systems are able to modify their own behavior in order to enhance the production of the desired output.

Social systems are adaptive and complex systems composed of casually related components. The interrelationship of the components constitutes the structure of social systems and provides for their wholeness.

Subject (of a system) is the entity around which the system is organized and which has to be transformed by the system from an input state to a specified output state.

Subsystem is a component part of a system. It is made up of two or more components. With a goal of its own, it interacts with its peer subsystems, in order to achieve the overall goal of the system.

Suprasystem is a system that is made up of a number of component systems.

System is an interacting group of entities forming an organized whole.

System concept refers to an aspect of systems, such as "input" or "transformation."

System control is a process by which the system regulates itself or by which the behavior of the system is regulated.

System design aims at the construction of a model or a "blueprint" of a system to be developed.

System development involves the formulation, testing, revision, and validation of a system.

System-environment coactions are processes by which the system adjusts to the changing requirements of its environment, and the environment accommodates to the changing requirements of the system.

System requirements are the specific demands and conditions that the system is to satisfy.

System space is the domain that the system occupies as defined by its boundaries.

Systemization is a transformation process by which components of a system are fused and become increasingly more system-like.

Systems models organize and present in a scheme, system concepts and principles.

Systems operations are components of the major systems processes of inputs, transformation, output, and feedback and adjustment.

Systems principles are constructed from related system concepts. They display the laws that regulate and describe systems. For example, the more complex the input, the more complex the system.

Systems research studies the structure, organization, and behavior of systems, and it develops and tests generalizations derived from such studies.

Systems theory presents concepts, principles, and models that describe the structure, organization, and behavior of systems.

Systems thinking is thinking that is influenced and guided by systems concepts, principles, and models.

Systems view develops as systems concepts, principles, and models become integrated into one's own thinking.

Transformation is the process by which the input is changed into output.

Transformation control and adjustment are operations whereby transformation is monitored. The information gathered through monitoring is analyzed and interpreted in order to introduce adjustments by which to improve transformation.

Wholeness (of system) refers to the integrated, fused state of the components of a system by which the system becomes indivisible.

Overview of the Study

Chapter I includes an overview of: the purpose of the study, the significance of the problem, suggestions on what should be done, accountability, the definition of a system, systems approach, General Systems Theory, model theory, some learning theories, a theory of creativity, limitations, assumptions, procedure, and operational definitions.

In Chapter II, the review of relevant literature to development of a theoretical isomorphic system for mechanization of agriculture for adults is presented. Topics of concern in this chapter include: system sciences, system thinking, definition of a system, open system, sub-systems, boundary of a system, General Systems Theory, systems con-structs, linkages, relationships, environment of a system, a modern systems approach, world of models, definition of a model, taxonomy of model types, motivation for modeling, theoretical models, physical models, analogue models, conceptual models, graphic models, symbolic models, use of the models, model theory, disadvantages of model design, systems approach and modeling, behavioral systems design, a theory of experience, cooperative extension service, communication of innovation, demand for technical know-how, adult education, the adult as a learner, the role of adult educators, assumptions in non-formal adult education, and principles for guiding formal adult instruction.

In Chapter III, the design of the study is presented. This chapter is concerned with systems thinking, a definition of systems approach, General Systems Theory as a methodology, characteristics of General Systems Theory, interrelatedness and interdependence of objects, attributes and events, holism, goal seeking, inputs, throughputs, outputs, negentropy, entropy, regulation, hierarchy, suprasystem, differentiation, equifinality, boundaries, environment, feedback, model theory, evaluation of models, evolution of a successful model, a diagrammatical presentation of a system, assumptions, research questions, procedure, Tel-Plan Computer Program 70.

In Chapter IV, the results of the study are presented, including: (1) a conceptual-graphical model of a system for mechanization of agriculture in general; (2) a conceptual-graphical model of a system for mechanization of soybeans, wheat, and corn; (3) a conceptual-graphical model of a training subsystem; (4) a conceptual-graphical model of a financing subsystem; (5) a conceptual-graphical model of a supervision subsystem; (6) a conceptual-graphical model of extension subsystem; and (7) a conceptual-graphical model of a marketing subsystem. Aims, linkages, inputs, throughputs, outputs, feedback, boundary, constraints, and environment are given extraordinary attention.

In Chapter V, conclusions, implications, discussion, and recommendations are presented.

The study is a design to develop a theoretical isomorphic system for the mechanization of agriculture for adults, to be represented in conceptual-graphical models, for bringing into focus, ideas and methods suggested by numerous educational and agricultural mechanization researchers, scientists, and innovators, for providing a conceptual link between relevant disciplines to the mechanization of agriculture, and for presenting professionals with a common language, unrestricted by subject matter boundaries, thus allowing for meaningful dialogue in viewing the mechanization of agriculture in its totality.

CHAPTER II

REVIEW OF THE LITERATURE

In this chapter, the major thrust is to consider the review of the literature pertinent to the design of a system and the development of a model based on the systems approach and General Systems Theory.

This review is concerned with topics such as system thinking, definition of a system, subsystems, boundary, environment of a system, General Systems Theory, characteristics of General Systems Theory (GST), linkages, relationships, systems approach, world of models, diversity of models, motivation for modeling, types of models, conceptual model theory, advantages and disadvantages of models, systems approach and modeling, behavioral system design, a theory of experience, cooperative extension service, communication of innovations, types of strategies, the need for adult education, views of development, the adult as a learner, and the role of the adult educator.

Introduction

A system is a set of interrelated interdependent elements in continuous action, interaction, and transaction within the system and with its environment, exchanging matter, energy, and information in the forms of inputs, throughputs, outputs, and feedback. The system has both a subsystem and a suprasystem, characterized by supersummation, meaning the whole is greater than the sum of its parts.

According to Schoderbek et al.,

> System sciences represent a direction in the intellectual universe that has changed the general frame of reference, resulting in viewing physical and social phenomena as systems, i.e., organized complexities that exhibit (1) organization, (2) wholeness, (3) openness, (4) self-regulation, and (5) teleology.[1]

According to Immegart and Pilecki, the major approaches to systems thinking are the following: "(1) general systems theory, (2) cybernetics, (3) holism, (4) operations research, (5) systems design, (6) information theory, (7) systems analysis, (8) systems engineering, (9) output analysis, (10) mathematical programming, and (11) computer science."[2]

Systems Thinking

As it has been defined in the Dictionary of Education,

> A system is the structure of an orderly whole, showing interrelationships and interrelatedness of the parts to each other and to the whole itself. . . . Thinking is an unregulated flow of ideas or stream of images, impressions, recollections, and hopes.[3]

Therefore, systems thinking is that activity of the mind aiming at the comprehension of the system's patterns which can be identified within the context of a totality or a phenomena.

---

[1]Peter P. Schoderbek et al., Management Systems Conceptual Consideration, Business Publications, Inc., 1975.

[2]Glenn L. Immegart and Francis J. Pilecki, An Introduction to Systems for Educational Administrator (Reading, Mass.: Addison-Wesley Publications, 1973).

[3]Carter V. Good, ed., Dictionary of Education (New York: McGraw-Hill Book Co., 1973), pp. 580 and 608.

According to Schoderbek et al., the main objective of systems thinking is to reverse the subdivision of the sciences into smaller and more highly specialized disciplines, through an interdisciplinary synthesis of existing scientific knowledge. He states that the world of the systems thinker is based upon four major pillars:

1. Organicism, i.e., the philosophy of putting the organism at the center of one's conceptual scheme.

2. Holism, in viewing phenomena as organisms that exhibit order, openness, self regulation, and teleology (goal-directiveness), one focuses on the whole rather than the parts.

3. Modeling, instead of breaking the whole into arbitrary parts, one attempts to map his conception of the real phenomena onto the real phenomena. This can be done by abstracting from the real phenomena those characteristics that are relevant, and by disregarding those features of the real phenomena that are not needed for the explanation or predicted of the system's behavior.

4. Understanding, i.e., realizing (a) that life in an organismic system is an ongoing process, (b) that one gains knowledge of the whole, not by observing the parts, but by observing the processes taking place within the whole, and (c) that what is observed is not reality itself, but rather the observer's conception of reality.[1]

The systems oriented researcher, therefore, is aiming at an adequate knowledge of the whole, rather than an accurate knowledge for the totality of a given phenomena. The latter is an ideal he can never hope to achieve. Systems thinking is a more meaningful way of understanding and approaching the study of complex organized wholes.[2]

---

[1]Peter P. Schoderbek et al., Management Systems Conceptual Considerations, Business Publications, Inc., 1975, p. 8.

[2]Ibid.

Definition of a System

A system is here defined as: "a set of objects together with relationships between the objects and between their attributes, connected or related to each other and to their environment in such a manner as to form an entirety or whole."[1] In order to reduce the vagueness inherent in this definition, the terms set, objects, attributes, relationships, environment, and whole, will be explained. Set means any collection of objects which need have no common property, other than that of belonging to a set.[2] Objects are simply the parts of components of a system, and these parts are unlimited in variety. Attributes are properties of objects. Relationships to which we refer are those that "tie the system together." It is, in fact, these relationships that make the notion of "system" useful.[3] Environment is everything which is outside of the system's boundary. Environment, then, is contingent on the definition of the system and may vary as the system's boundary varies.[4] The whole in a universe, a phenomena, a situation, and a problem, constitutes all relevant entities and subentities which are viable and the interrelated parts, conducive to the totality of the given phenomena.

---

[1]This is a commonly accepted definition. See, for example, A. D. Hall and R. E. Hagen, "Definition of System," in Organizations, Systems, Control and Adaptation, ed. Joseph A. Litterer (New York: John Wiley & Sons, Inc., 1969), p. 31; and S. Optner, Systems Analysis for Industrial and Business Problem Solving (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1965).

[2]Carter V. Good, Dictionary of Education, p. 530.

[3]Hall and Hagen, p. 31.

[4]Immegart and Pilecki, p. 36.

According to Leadley and Pignone, a system is a distribution of members in a dimensional domain. A system is, roughly speaking, a bundle of relationships. A system is an organized or complex whole. A system is a configuration of components interconnected for purposes according to a plan. In other words,

> when a number of activities take place, such that each activity directly or indirectly is related to at least some other activity or activities in a seemingly more or less stable way within a specified period of time, we say we have a system.[1]

With respect to what constitutes a system, Bertalanffy had the following comments:

> A system is a model of general nature; that is, a conceptual analog of certain rather universal traits of observed entities. A system may be defined as a set of elements standing in interaction among themselves and with the environment.[2]

Buckley, Bertalanffy, and other system theorists hold the same concept that in an open system there is <u>interchange</u> of <u>matter</u>, <u>information</u>, and <u>energy</u> between the system and the environment.[3]

Subsystems

Any given system can be divided into subsystems. In other words, every system is an entity composed of subentities, which are

---

[1]S. M. Leadley and M. M. Pignone, eds., <u>Systems Analysis for Rural Community Services</u> (Washington, D.C.: Cooperative State Research Service (DOA), ED 110262, 29 July 1972, p. 5.

[2]Ludwig Von Bertalanffy, <u>Perspectives on General Systems Theory</u> (New York: George Braziller, 1975), p. 159.

[3]W. Buckley, <u>Sociology and Modern Systems Theory</u> (Englewood Cliffs, N.J.: Prentice-Hall, 1967); and Ludwig Von Vertalanffy, <u>Perspectives on General System's Theory</u>, p. 39.

interrelated and interdependent within the context of its boundary. According to Hall and Hagen,

> objects belonging to one subsystem may well be considered as part of the environment of another subsystem. Bertalanffy refers to the property hierarchical order of systems. This is simply the partition of system into subsystems. Alternatively, we may say that the elements of a system may themselves be systems of a lower order.[1]

Boundary of a System

The purpose of the boundary of a system is to delimit whatever is within the system from whatever is outside the system, in order to control the rate of exchange of matter, energy, and information which is needed as input to the system. According to Miller, "Boundary is a region where energy and information exchange is significantly less than inside or outside the system."[2]

According to Leadley and Pignone, one of the most important concepts in the systems thinking is that the burden is on the observer to define the system and determine a boundary for that system. He states that,

> the determination of and the extent of a system depends solely upon the observer and his ability to make order of perceived matter and energy in a universe. What this is saying is that there is no a priori system out there. By definition or assumption, everything in the universe is

---

[1]A. D. Hall and R. E. Hagen, "Definition of System," in Organizations, Systems, Control and Adaptation, ed. Joseph A. Litterer (New York: John Wiley & Sons, Inc., 1969), p. 34.

[2]James G. Miller, "Toward a General Theory for Behavioral Sciences," in Organizations, Systems, Control, and Adaptation, ed. Joseph A. Litterer (New York: John Wiley & Sons, Inc., 1969).

interrelated. The design of a system depends on our ability to determine the number of activities, objects, relationships, and span of time.[1]

Hall and Hagen, in regard to delimitation of a system from its environment, make the following observation:

> One may have the natural question of when an object belongs to a system and when it belongs to the environment; for, if an object reacts with a system in the way described, should it not be considered a part of the system? The answer is by no means definite. In a sense, a system, together with its environment, makes up the universe of all things of interest in a given context. Subdivision of this universe into two sets, system and environment, can be done in many ways which are, in fact, quite arbitrary.[2]

According to Banathy,

> systems exist in their environment, from which they are set apart by their boundaries. Some systems are rather closed and are isolated from their environment by their boundaries. However, at this time we are considering systems that are somewhat open, systems that have breaks in their boundaries, enabling exchange with their environment through input-output interactions. Systems of this kind are adaptive. They maintain compatibility by adjusting to the demands and expectancies of their environment. This adjustment is made possible through self-regulating feedback control, which activates changes in order to ensure that the system output will be acceptable to the environment.[3]

Figure 2.3 attempts to further clarify the relationship between a system and its environment, in regard to what constitutes a system of production, and how it is related to the factors of

---

[1]S. M. Leadley and M. M. Pignone, eds. Systems Analysis for Rural Community Services (Washington, D.C.: Cooperative State Research Service (DOA), ED 110262, 29 July 1972, p. 6.

[2]Hall and Hagen, "Definition of System," p. 33.

[3]Bela H. Banathy, Developing a Systems View of Education. The Systems Model Approach, Lear Siegler, Inc., 1973.

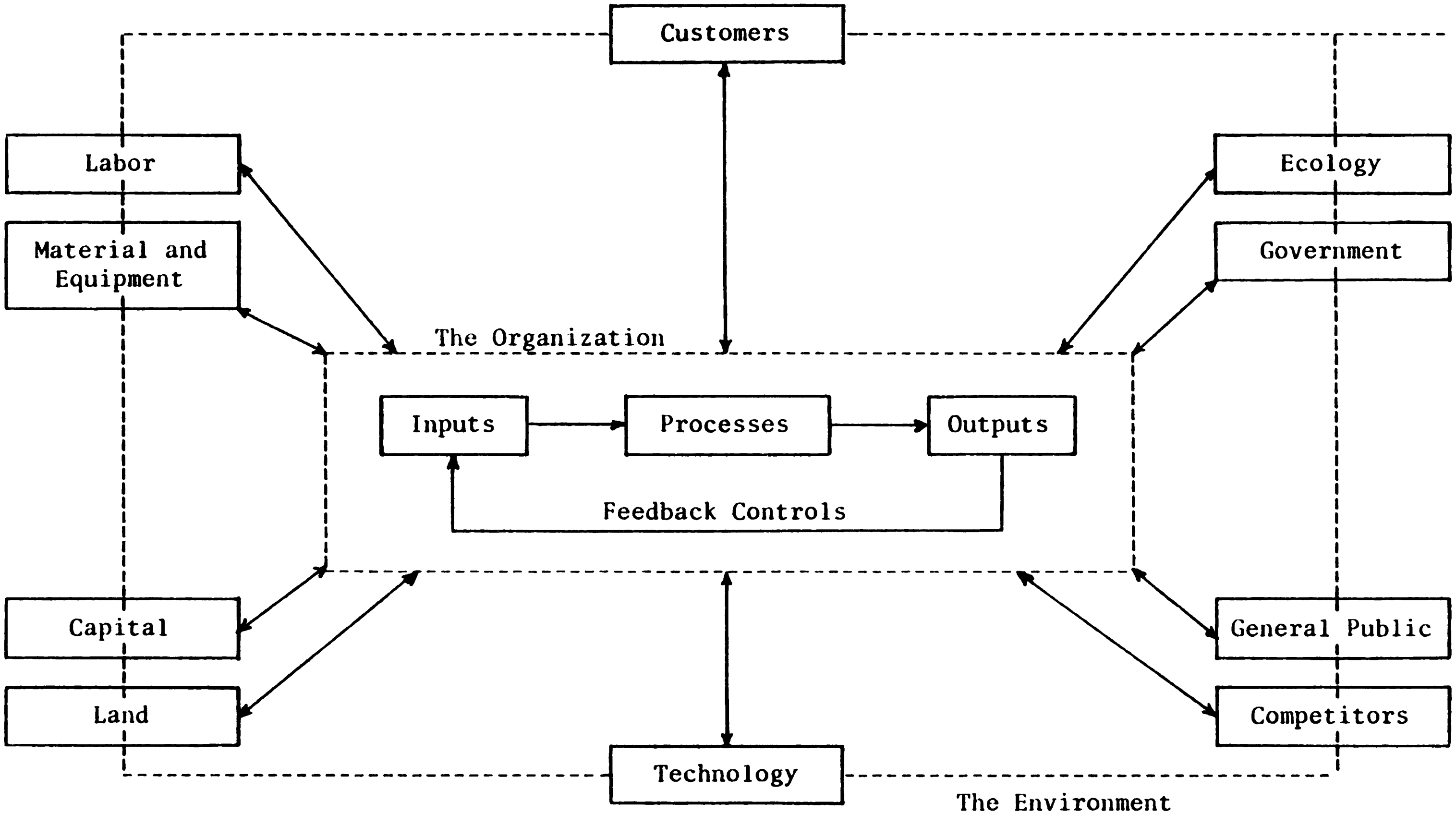

Figure 2.1 The Organization, Its Resources and Its Environment.
Source: Schoderbek et al., 1975, p. 42.

production, within the environment. There are three categories of factors: (1) relatively high controllable, (2) semi-controllable, and (3) low controllable. As can be seen in Figure 2.1, Schoderbek et al. have indicated that,

> the four major inputs of the organization, that is, the so-called major factors of production (labor, material and equipment, capital, and land) are relatively highly controllable by the organization. On the other hand, the degree of control of the four major external factors depicted in the right-hand side of Figure 2.1 (ecology, government, general public, and competitors), is very low. These are, therefore, the organization's major environmental factors.
>
> Between these two extremes of the largely controllable factors (resources) and the largely uncontrollable variables (environment), lie two additional sets of factors which are relatively less controllable than resources but relatively more controllable than environment. These factors are consumers and technology.[1]

General Systems Theory

General Systems Theory is a theory aiming at universal properties applicable to systems in general. It is an orderly arrangement of general truths drawn from experience. Bertalanffy states that,

> its task is to study general system characteristics and to concentrate on those aspects of reality which are inaccessible to conventional scientific treatment, organization, hierarchy, differentiation, competition, finality, and equifinality--these are some of the concepts in question.[2]

---

[1]Peter P. Schoderbek et al., Management Systems Conceptual Considerations, Business Publications, Inc., 1975, p. 42.

[2]Ludwig Von Bertalanffy, Perspectives on General Systems Theory (New York: George Braziller, 1975), p. 122.

Mann advanced the notion that in terms of the General Systems Theory, a school can be recognized as a system, since it has the following six elements, which all systems have: (1) sets of interrelated objects, (2) an environment, (3) inputs, (4) process, (5) output, and (6) feedback. He further stated that component subsystems are generally utilized to regulate the responses of open systems to the demands of the environment.[1]

Authors, Bertalanffy, Buckley, and Mann, advanced the concept of equifinality as a principle of the General Systems Theory. Buckley further indicated that within the General Systems Theory, there inheres also the concept of multifinality.[2]

According to Mann, the concepts of equifinality and multifinality are fundamental to systems approach research, and the underlying principle of these concepts may be stated accordingly, in the following manner: "Different initial conditions lead to similar end effects, or similar initial conditions lead to different end effects."[3]

In a philosophical mode, Bertalanffy stated that,

> isomorphic structured uniformities can be sensitized from the total observable events of different levels. Thus, speaking in what has been called the "formal" mode, i.e., looking at the conceptual constructs of science, this means structural uniformities of the schemes we are applying. Speaking in "material" language, it means

---

[1]D. Mann, Policy Decision Making in Education (New York: Teachers College Press, 1975).

[2]Ludwig Von Bertalanffy, The Relevance of General Systems Theory (New York: George Braziller, 1972), p. 122; W. Buckley, Sociology and Modern Systems Theory (Englewood Cliffs, N.J.: Prentice Hall, 1967; and Mann.

[3]Mann, p. 78.

> that the world, i.e., total observable events, show structured uniformities manifesting themselves by isomorphic traces of order in different levels of realms.[1]

Bertalanffy also indicates that,

> the goal of General Systems Theory is clearly circumscribed. It aims at a general theory of wholeness, of entire systems in which many variables interact and in which their organization produces strong interactions. It does not deal with isolated processes, with relations between two or few variables or with linear causal relations. These are the domain of classical science.[2]

The characteristics attributed to General System Theory by the systems theorist are: (1) interrelationship and interdependence of objects, attributes, events and the like, (2) holism, (3) goal seeking, (4) inputs and outputs, (5) transformation, (6) entropy, (7) regulation, (8) hierarchy, (9) differentiation, (10) equifinality.[3]

Kaufman, commenting on the goals of the General Systems Theory, indicated that,

> the technique enables a continuous identification of the elements which are feasible for the solution of the problem. The information provided is pertinent, insofar as it indicates what must be undertaken, thus providing a data base of suitable alternatives to be utilized in system synthesis where specific determinations are made. Therefore, the use of systems approach virtually eliminates the possibility of solutions being introduced before the problem has been identified.[4]

---

[1]Ludwig Von Bertalanffy, General Systems Theory (New York: George Braziller, 1968), pp. 48-49.

[2]Ludwig Von Bertalanffy, Perspectives on General System's Theory (New York: George Braziller, 1975), p. 122.

[3]Joseph A. Litterer, Organizations, Systems, Control, and Adaptation (New York: John Wiley & Sons, Inc., 1969), pp. 3-6.

[4]R. A. Kaufman, "A Systems Approach to Education--Derivation and Definition," A. V. Communication Review, 1968, p. 421.

Systems Constructs

It will be of value to further define objects, inputs, throughputs, input-output linkage, relationships, attributes, environment of a system.

Objects are the components of a system. From the static viewpoint, the objects of a system would be the parts of which the system consists. From the functional viewpoint, however, a system's objects are the basic functions performed by the system's parts. Thus, the objects of a system are: the input(s), the process(es), the output(s), and the feedback control.[1]

According to Schoderbek et al., inputs to a system may be matter, energy, humans, or simply information. Inputs may vary from raw materials to specific tasks performed by people. Inputs can be of different kinds: (1) serial, (2) random, and (3) feedback inputs. Serial input is the result of a previous system with which the focal system (system in question) is serially or directly related. They present little problem to the researcher because their absence would be felt immediately as the lack of movement in the system. Figure 2.2 is a graphical presentation of serial or in-line input.

Random inputs are the most interesting kind of inputs for any researcher or observer to study. The reason for this is that their presence or absence is not as conspicuous as in the case of serial inputs: they usually affect the degree of operation of a system (i.e., its efficiency). Figure 2.3 is a graphical presentation of random inputs where the focal system is the purchasing subsystem of

[1]Schoderbek et al., p. 32.

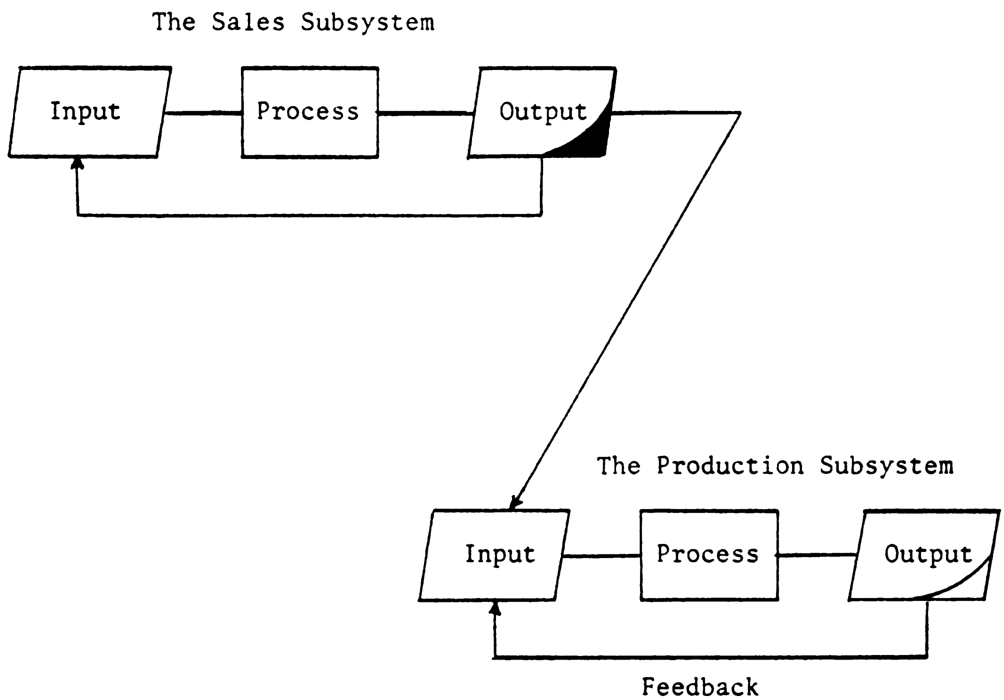

Figure 2.2 Serial or In-Line Input.

Source: Schoderbek et al., 1975, p. 33.

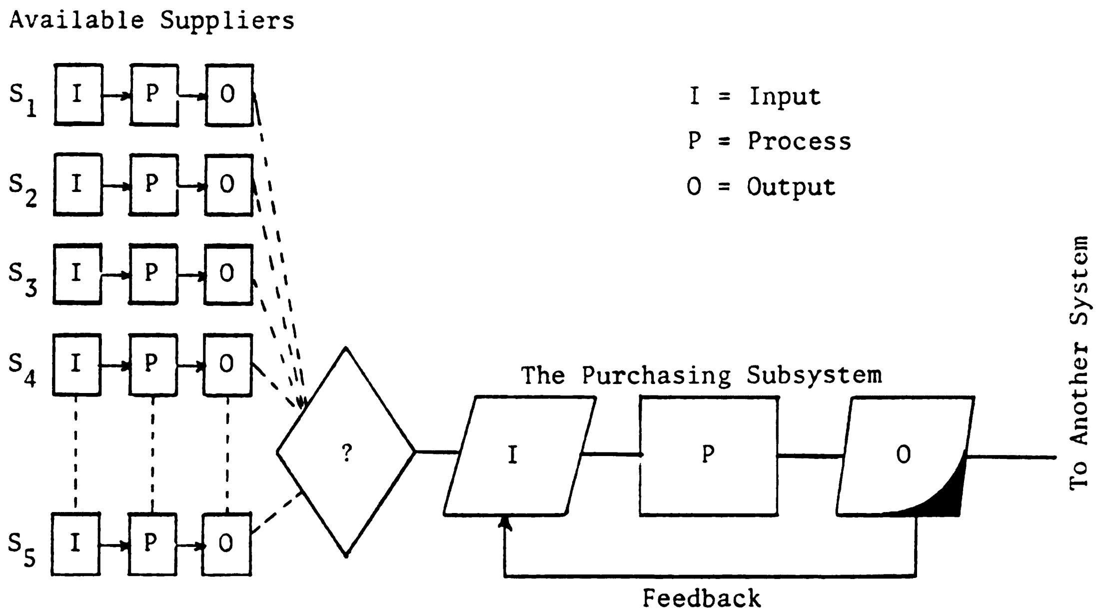

Figure 2.3 Random Inputs.

Source: Schoderbek et al., 1975, p. 34.

an organization. Its purpose is to secure the inputs (i.e., raw material, office supplies, machines) necessary for the transformation process. The left hand side of the graph (Figure 2.3) represents the available sources of these inputs. The purchasing subsystem depicted in the right-hand side of the graph is faced with the decision of choosing one or more of the available outputs, which will become the inputs to the production process. This decision situation is represented in the graph by a question mark inside the diamond. For example, the purchasing department will design a list of preferences, on the basis of the purchasing subsystem's knowledge of the specifications and the quality, timeliness, and general past experience of the production department with the potential suppliers. These preferences will reflect the purchasing department's satisfaction with each one of the suppliers in the form of the likelihood of choosing one or more of them.[1]

Feedback input represents only a very small portion of the system's output. This portion is identified as the difference between a desired state of affairs (i.e., a goal) and the actual performance (Ap) thus, Goal - Ap = ±d.

Throughputs

Throughputs are processes which transform the input to an output. As such, it may be a machine, an individual, a computer, a chemical or equipment, tasks performed by members of the organization,

[1]Schoderbek et al., pp. 32-36.

and so on. In the transformation of inputs into outputs, we must always know how this transformation takes place, for the purpose of planning and higher efficiency.

Outputs

Outputs are the results which a system produces after inputs are processed, according to the throughputs which are functioning within the context of a given system. Outputs can be (1) serial, (2) recycle, and (3) waste. Schoderbek et al. have indicated that,

> Outputs like inputs, may take the form of products, services, information such as a computer printout, or energy, such as the output of a hydroelectric plant. Outputs are the results of the operation of the process, or alternatively, the purpose for which the system exists.
>
> Serial output is output which is directly consumed by other systems. The main output of a business manufacturing firm, for instance, is sold to the customers for either consumption or further processing.
>
> Recycle output is the portion of the output which is consumed by the same system in the next production cycle. Defective products of a manufacturing process, for example, are usually reintroduced into the same production process.
>
> Waste output is the portion of the total output which is consumed neither by other systems nor by the system itself, but rather, is disposed of as waste which enters the ecological system as an input.[1]

Linkages

According to Immegart and Pilecki,

> to ensure most functional output, attention must be given to input-output linkage or to the processing of input variables.
>
> In open systems, inputs are linked to, or processed into, outputs by the structures and processes of these systems. These structures and processes are appropriately conceived as functional subsystems. As such, subsystems

---

[1]Schoderbek et al., p. 36.

> are input-output processing systems in and of themselves, but as linked in functional activity they are the components of the larger system, of which they are a part. As noted earlier, open systems operate and maintain themselves through the functional interplay and interrelationship of their subsystems. . . . Whenever more than one subsystem is utilized in processing system work, a functional linkage between the subsystems (beyond individual subsystem functionality) is necessary.[1]

Institutional Linkages

Axinn has identified four kinds of institutional linkages: (1) enabling, (2) functional, (3) normative, and (4) diffuse.

> Enabling linkages provide authority to operate and access to essential resources. Enabling linkages may also be used to protect the organization against attack and to guarantee its access to resources during the critical period, when it is developing its capabilities but is not yet strong enough to deal with its external environment on its own terms.
>
> Functional linkages provide the needed input into the organization and take away its output. This category of linkages includes relations with those institutions which are the real or potential competitors, which perform or seek to perform similar functions and services.
>
> Normative linkages provide relationships with other organizations which share overlapping interests in the objectives or the methods of the institution. These may be reinforcing or hostile. A faculty of agriculture at a university might have normative linkage with an agricultural research institute which has similar personnel, and which, from time to time, shares the same problems.
>
> Diffuse linkages are relationships with individuals or groups who are not organized in a formal organization, but who do influence the standing of the institution itself. An example of this might be the farm population served by a faculty of agriculture.[2]

---

[1]Glenn L. Immegart and Francis J. Pilecki, An Introduction to Systems for Educational Administrators (Reading, Mass.: Addison-Wesley Publication Co., 1973), pp. 90, 92.

[2]H. George Axinn, New Strategies for Rural Development, Rural Life Associates, 1978, p. 160.

Thus, systems linkages should be given attention, and proper linkages between relevant social systems must be encouraged and provided. For example, in the case of agricultural development, social systems, such as agricultural colleges, ministry of agriculture, ministry of education, can contribute to success of a new proposed system.

Relationships and Attributes

According to Schoderbek et al.,

> Relationships are the bonds that link the objects together. In complex systems, in which each object or parameter is a subsystem, relationships link these subsystems together. Relationships can be symbiotic, synergistic, and redundant.
>
> Symbiotic relationships are those in which the connected systems cannot continue to function alone.
>
> Synergistic relationships are those in which the cooperative action of semi-independent subsystems taken together, produces a total output greater than the sums of their outputs taken independently.
>
> Redundant relationships are those that duplicate other relationships. The reason for having redundancy is reliability. Redundant relationships increase the probability that a system will operate all of the time and not just some of the time.
>
> Attributes are properties of objects and of relationships. Attributes are of two general kinds: defining and accompanying.
>
> Defining attributes are those without which an entity would not be designated or defined as it is.
>
> Accompanying attributes are those whose presence or absence would not make any difference with respect to the use of the term describing it.[1]

Systems Approach

Sensitivity to the totality, the wholeness, of a given phenomena, situation, or problem is the fundamental aim of systems

---

[1]Schoderbek et al., pp. 37-38.

approach in order to promote understanding and explanation of whatever constitutes an organized complexity. According to Rudner, it is an ideal of science to organize the disjointed concepts related to a phenomena, to be represented in an orderly fashion. He states that,

> system is no mere adornment of science, it is the very heart. To say this is not merely to assert that it is not the business of science to heap up unrelated, haphazard, disconnected bits of information, but to point out that it is an ideal of science to give an organized account of the universe--to fit together in logical relations the concepts and statements embodying whatever knowledge has been acquired. Such organization is, in fact, a necessary condition for the accomplishments of two of science's chief functions: explanation and production.[1]

According to Schoderbek et al.,

> Organizations come into existence, change, and disappear and the man's role is basically that of a controller, a steerman of the structure, the function, and the evolution of these organizations. To fulfill that role, he needs a logically consistent and generalizable set of concepts which will make intelligible the changing structure and behavior of organizations, as well as, their effective control.
>
> The general philosophical and conceptual predisposition underlying modern systems thinking is "organicism." Organicism is the philosophy or viewpoint that puts the organism at the center of one's conceptual scheme. The term "organicism" has often been replaced by the term "organized complexities" or "organized systems," defined as entities composed of many subentities which are interrelated and interconnected with respect to each other and, more importantly, with respect to their environment and to the whole.[2]

In an attempt to understand the totality of a given phenomenon or organized complexity, the systems oriented researcher employs a

---

[1]Richard S. Rudner, "An Introduction to Simplicity," Philosophy of Science 28 (1961): 112.

[2]Schoderbek et al., p. 116.

holistic method based on systems principles, in order to acquire an adequate knowledge of the whole before he proceeds to an accurate knowledge of the workings of its parts.

Chinal has summarized the following about the teachable contents of the systems approach, which can be seen at three levels of formalization, those of principles, methods, and techniques.

1. Principles

   - Conduct analysis and design while constantly keeping in view the system as a whole.

   - Assume a priori existence of internal relationships between elements, subsystems, and external relationships with the system environment. Be ready for unexpected or latent relationships, other than those suggested by routine, experience, plain common sense and intuition.

   - Give explicit recognition to assumptions or axioms influencing system design. Beware of hidden assumptions left out as a result of mental inertia or blurred on purpose to hide deficiencies. Subject them to mental experiments to avoid omitting important assumptions which would be belatedly revealed by technological or managerial crises.

2. Methods

   - Methods or procedures express in relatively normative style the best known rules of the art, available, feasible, and applicable to the nature of the problem.

3. Techniques

   - Select those techniques which are the most typically systems oriented in that they relate behavior of complex structures to those of the elements and to the existing interactions.[1]

[1]Jean P. Chinal, "The Systems Approach: A French Experience," Interfaces 5 (February 1975): The Institute of Management Sciences.

The major problems, which are the focus of the systems approach, are summarized by Buckley:

> Wholes and how to deal with them as such; the general analysis of organization--the complex and the dynamic relations of parts, especially when the parts are themselves complex and changing and the relationships are non-rigid, symbolically mediated, often circular, and with many degrees of freedom; problems of intimate interchange with an environment, of goal seeking, of continual elaboration and creation of structure, or more or less, adaptive evolution; the mechanic of "control," of self regulation or self-direction.[1]

Krippendorff argues that,

> systems approaches provide a methodology for dealing, not with one communication link at a time, but with a large number of them simultaneously; not with binary relations among a single sender and a single receiver of information, but with many-valued and dynamic dependencies among a possibly large number of communicators; not with one-way processes of communication, but with interaction and with circular flows.[2]

Buckley stated:

> Modern systems approach aims to replace the older, analytic, atomic Laplacian technique with a more holistic orientation to the problem of complex organizations.[3]

In short, the approach attempts to examine the "whole" by identifying and studying the interrelated interdependent system's components instead of its separate parts. Thus, the system is treated within

---

[1]W. Buckley, Sociology and Modern Systems Theory (Englewood Cliffs, N.J.: Prentice-Hall, 1967).

[2]K. Krippendorff, Scope of the Information Systems Division, ed. D. R. Monge, Systems Letter, 1972, p. 1.

[3]Buckley, p. 38.

the context of a flexible structure in relation to inputs, processes, outputs, and feedbacks.

World of Models

Models are abstracts of a system which retain those characteristics of the system which are relevant and viable. A model helps scientists to understand and communicate the totality of a system within the abstracted frame of reference.

Authors McFarland, Rudwick, Massie and Douglas, Haynes and Henry, Morris, Albanese, and Buffa have defined models, respectively, as follows:

1. A model is a way of representing a situation or set of conditions so that behavior within it can be explained. Understanding, prediction, and control are enhanced in the real situation if it can be explained in terms of the model.[1]

2. A model can be defined as an explicit representation of some phenomenon or problem area of interest, including the various factors of interest and their relationship, and is used to predict the outcome of actions. Thus, a model is some analog or imitation of a real world. Note that this definition is a rather broad one, and so includes both qualitative and quantitative models.[2]

3. Models are simply defined as abstractions of real-world situations.[3]

---

[1]Dalton E. McFarland, Management Principles and Practices, 2nd ed. (New York: The Macmillan Co., 1974), p. 201.

[2]Bernard H. Rudwick, Systems Analysis for Effective Planning: Principles and Cases (New York: John Wiley & Sons, Inc., 1973), pp. 48-49.

[3]Joseph L. Massie and John Douglas, Managing: A Contemporary Introduction (Englewood Cliffs, N.J.: Prentice-Hall, 1977), p. 257.

4. Models are abstractions from reality that capture important relationships, allowing the analyst to understand, explain, and predict. The purpose of a model is to represent characteristics of a real system in a way that is simple enough to understand and manipulate, and yet similar enough to the more complicated operating system that satisfactory results are obtained when the model is used in decision making.[1]

5. By the broadest possible definition of the notion, a model is an attempt to impose a conceptual order on the perceptual confusion in which experience first comes to us. Everybody works with schemes for organizing the data of experience, but these schemes must be made explicit, their vagueness reduced to the point where they can be written down and expressed in a language that allows one to talk about them and teach them. As has been suggested, it is not entirely necessary that all the concepts in a model be operational in a strict sense. It is necessary, however, that the model produce some predictions both varifiable and interesting in the context of a management decision.[2]

6. A model is an abstraction of reality. Its purpose is to improve understanding and/or prediction of the reality. Modeling is a valuable managerial skill. Its essence is in abstracting only those components of reality that are important to the model's purpose.[3]

7. Models are invariably abstractions to some degree of the actual systems for which we wish to predict performance. A prominent example is the aerodynamicist's model used in conjunction with wind tunnels. Since the individual is primarily interested in aerodynamic performance, shape is the main characteristic of concern, and other factors in flight, such as weight, strength of individual parts, etc., are ignored.[4]

---

[1]Warren W. Haynes and William R. Henry, Managerial Economics Analysis and Cases, Business Publications, 1978, pp. 12-13.

[2]William T. Morris, Management Science in Action (Homewood, Ill.: Richard D. Irwin, Inc., 1963).

[3]Robert Albanese, Management Toward Accountability for Performance (Homewood, Ill.: Richard D. Irwin, Inc., 1975).

[4]Elwood S. Buffa, Models for Production and Operation Management (New York: John Wiley & Sons, Inc., 1963), p. 9.

According to Bertalanffy,

> a theoretical model is a conceptual construction, reflecting in a clear simplification manner, certain aspects of a natural phenomenon and permitting deductions and predictions which may be tested. In a wider sense, any scientific theory may be regarded as a conceptual model. In a narrower sense, a model is an auxiliary concept illustrating certain relations and facilitating working with them. And here, we may distinguish with Nagel, two types of the theoretical models. Substantive models relate elements of the system under investigation to corresponding similar elements in a known system. In formal models, the component parts are different, but their laws possess a similar formal structure.[1]

According to Vemuri,

> there are great and viable differences between theories and models. A theory could state that the subject matter has a structure, but it is a well conceived model that reveals the structure. A model can be constructed as a specific form of a theory.
>
> A model is a representation of a system, it is the interpretation that a scientist gives to observed regularities and facts. One should keep in mind that facts remain unchanged, but models change. . . . In a descriptive model the attempt is to describe an observed, organized complexity or regularity, without necessarily seeking recourse to an explanation for the observation made. Description is the first stage of rationalization, generalization, and theory building, expressed in a native language. The major disadvantage is that the method of prediction is internal, but the advantage is that the cost of production is extremely low. . . . On the other hand, prescriptive models are normative. Normative science does not stop at describing and generalizing observations, since the term "normative" implies the establishment of standards of correctness, a normative model is more suitable for predictive purposes.[2]

---

[1]Ludwig Von Bertalanffy, Perspectives on General Systems Theory (New York: George Braziller, 1975), pp. 104-105.

[2]V. Vemuri, Modeling of Complex Systems, An Introduction (New York: Academic Press, 1978), pp. 67, 68, 69.

Every concern of man is represented in some form of a model. A diversity of models is represented in Figure 2.4.

Models are also diverse in methods which have been used to construct and present them in a formal language. Diversity of methods used in modeling is presented in Figure 2.5.

1. Model airplane
2. Model cars
3. Model cities
4. Model networks
5. Model ordinance
6. Model railroad
7. Model ships
8. Model soldiers
9. Model space vehicles
10. Model auto racing
11. Acoustic models
12. Architectural models
13. Fashion models
14. Astronomical models
15. Biological models
16. Chemical models
17. Hydraulic models
18. Mechanical models
19. Military models
20. Nuclear models
21. Zoological models
22. Clay models
23. Patent models
24. Machinery models
25. Engineering models
26. Hydrologic models
27. Linguistic models
28. Communication models
29. Economic models
30. Sociological models
31. Education models
32. Management models
33. Land use models
34. Hybrid models
35. Market demand models
36. Market supply models
37. Urban growth models
38. Retail growth models
39. Retail location models
40. Historical models
41. Geographical models
42. Political models

Figure 2.4 Diversity of Models

1. Analytical models
2. Prediction models
3. Poliometric models
4. Simulation models
5. Linear interaction models
6. Decision oriented models
7. Time oriented models
8. Rasch models
9. Causal models
10. Computer based feedback models
11. Decision models
12. Information models
13. Hypothetical models
14. Digital simulation models
15. Empirical models
16. Flow models
17. Theoretical models
18. Theoretical isomorphic models
19. Integrated models
20. Systems models
21. Sampling models
22. Econometric models
23. Diagnostic testing models
24. Evaluation models
25. Performance satisfaction models
26. Structural models
27. General linear models
28. Continuum models
29. Cost-effectiveness models
30. Cost models
31. Conceptual models
32. Synoptic models
33. Cybernetic models
34. Cost benefit models
35. Rasch simple logistic models
36. Procedural models
37. Diffusion models
38. Electric models
39. Ontological models
40. Pluralistic models
41. Synergistic evaluation models
42. Circuit models
43. Time series forecasting models
44. Generic models
45. Consensus models
46. System design models
47. Operational flow models
48. Systems approach models
49. Functional models
50. General systems theory models

Figure 2.5 Diversity of Methods Used in Modeling.

Motivation for Modeling

According to Morris, the role of models is to express the links of reason which bind concepts into a system, for, as Sir James Jeans insisted, a heap of facts is no more science than a heap of bricks is a house.[1]

Buffa points out that,

> models are bases of the prediction systems, and are vital to the formal decision making process. Indeed, they are vital to an intellectual attack on any problem. Models come to us from scientific methods, the scientist attempts to duplicate, in some kind of a model, the behavior of the system or subsystem with which he is working. Once he has achieved this parallelism between the real phenomena and his model, it is usually easier to manipulate the model to study its characteristics in which he is interested than it is to try to work with the real phenomena or the system in question.[2]

According to Vemuri, the reasons for constructing a model and the ultimate use of the model, differ markedly. He indicates these differences through the use of different shades of gray as shown in Figure 2.6. As one proceeds from the light end of the spectrum to the dark end, there is a gradual but steady shift from the quantitative to the qualititative.

Near the "white box" end of the spectrum, models are an important tool for design. For example, in electrical circuit design, models permit experimentation with various combinations of circuit elements to obtain optimum filter characteristics. Closer to the "black box" side

---

[1]William T. Morris, Management Science in Action (Homewood, Ill.: Richard D. Irwin, Inc., 1965), p. 84.

[2]Elwood S. Buffa, Models for Production and Operation Management (New York: John Wiley & Sons, Inc., 1963), p. 9.

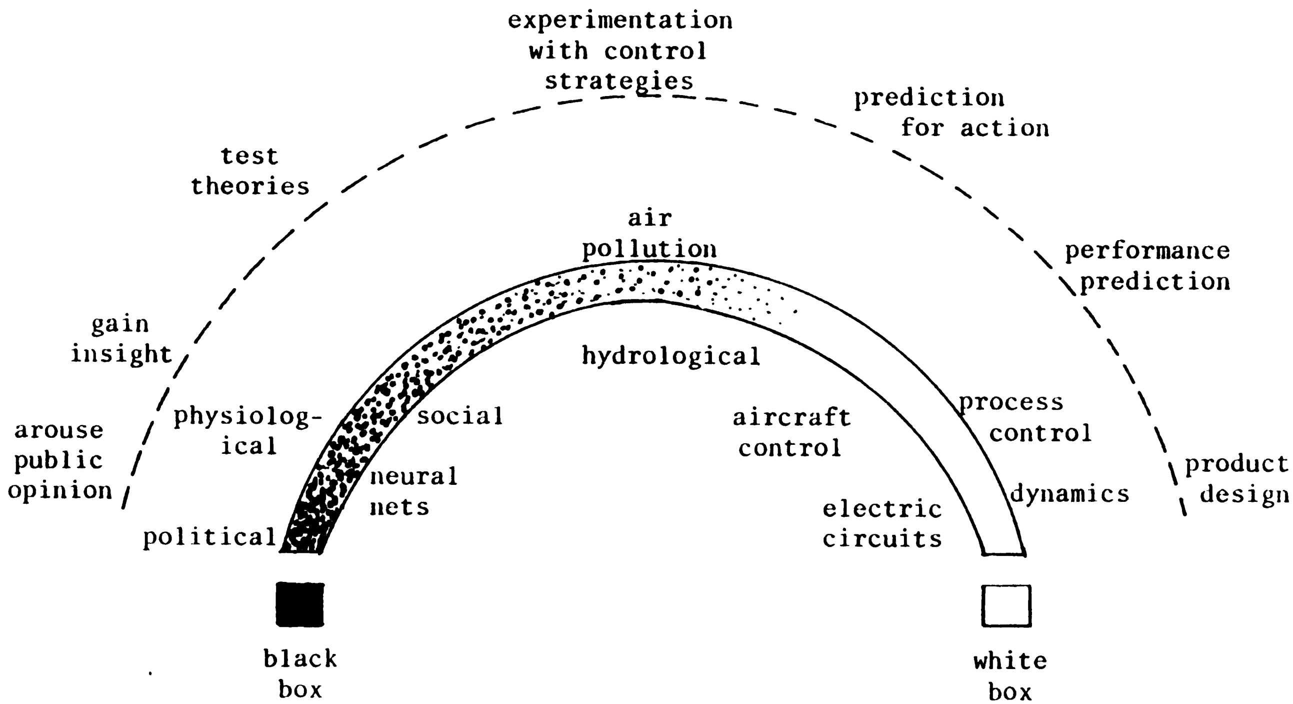

Figure 2.6 Objectives of Modeling.

Source: *V. Vemuri,* *Modeling of Complex Systems,* *p. 81.*

of the spectrum, models play an entirely different role. Frequently they are used to provide a general insight into system behavior. Occasionally, the primary objective of the model is to arouse public opinion and promote political action by suggesting that the current trends lead to disaster in the not too distant future.[1]

Iconic Models

Authors Buffa, Hull et al., and Massie and Douglas have defined an iconic model as a physical representation of certain characteristics of the real system, usually scaled up or down.[2] Iconic models also graphically or pictorially represent certain important characteristics of the real world.

According to Buffa, good examples of iconic models are "aerodynamicist's models, planetariums, engineering blue prints, globe of the world, photographs, and three-dimensional models of physical facilities."[3]

Bross's iconic models are called physical models. In his definition of physical models he exemplifies model aircrafts and states,

---

[1]V. Vemuri, Modeling of Complex Systems, An Introduction (New York: Academic Press, 1978), pp. 81-82.

[2]Elwood S. Buffa, Models for Production and Operation Management (New York: John Wiley & Sons, Inc.,), pp. 10-11; D. A. Hull, John Mapes and Brian Wheeler, Model Building Techniques for Management (Saxon House: Cranfield Institute Press, 1976), p. 7; and Joseph L. Massie and John Douglas, Managing: A Contemporary Introduction (Englewood Cliffs, N.J.: Prentice Hall, 1977), p. 257.

[3]Buffa, p. 10.

> there are several kinds of model aircraft: (1) solid scale models resemble the actual planes in general appearance (shape, markings, etc.), (2) the flying model aircraft not only resembles the originals in appearance, but to some extent, in function as well (i.e., they are capable of free flight), (3) some very elaborate models are essentially simplified versions of real aircraft; they have gasoline engines, operable controls, and may even have radio-control mechanisms which allow the plane to be directed from the ground. . . . The model aircraft is easier to study than a full-size aircraft; it is more convenient to handle and manipulate. It is also simpler than the original and principles of operation may be more apparent. There is some danger of oversimplification, of course, but adult scientists use model aircraft to learn about the performance of full-sized aircraft. This particular type of abstraction, the construction of a physical model, is used in various branches of science, engineering, and industry.[1]

Analogue Models

According to Hull et al., an analogue model is one in which certain aspects of the behavior of the real system are produced in a different medium. A popular form of analogue model involves the use of flows of electricity as an analogue for flows of material or information in a system. Such models are expensive to construct, so that they are only feasible for applications where the model will be used on a regular basis for planning purposes.[2]

Buffa points out that,

> analogue models establish a relationship between a variable in the system and an analogous variable in the model. Thus a graph of sales by months uses the length of lines as

---

[1]Irwin D. J. Bross, Models in Management Systems, ed. Peter Schoderbek (New York: John Wiley & Sons, Inc., 1968), p. 327.

[2]John Hull, John Mapes and Brian Wheeler, Model Building Techniques for Management (Saxon House: Cranfield Institute Press, 1976), p. 8.

> analogous to the magnitude of sales and time. Various kinds of flow charts use lines as analogous to material flow. Analogue computers establish a relationship between variables in a real world problem and an electrical system. Analogue models are often useful for the study of dynamic situations. Usually, changes in an analogue model can be made more easily than in an iconic model, so they can fit more different situations, and thus have greater generality.[1]

Conceptual Models

In understanding a structure, a process, or a complexity, scientists attempt to develop a conceptual model. This is usually done when the phenomena under consideration would otherwise be incomprehensible.

McFarland indicates that,

> a description of the duties and responsibilities of a particular job is actually a model depicting the organization's expectation as to what work shall be done. Such intangibles as time, employer satisfaction, or customer preference may be components of the model.[2]

All of us are accustomed to using verbal models in our thinking processes and we do it intuitively. Verbal models have played an important role in science, especially in the preliminary exploration of a topic and presentation of results.[3]

Bross exemplifies a conceptual model as the following:

---

[1]Elwood S. Buffa, Models for Production and Operation Management (New York: John Wiley & Sons, Inc.,), p. 11.

[2]Dalton E. McFarland, Management Principles and Practices (New York: The Macmillan Co., 1974), p. 201.

[3]W. Warren Haynes and Joseph L. Massie, Management Analysis, Concepts, and Cases (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1975), p. 442.

> The solar model, which you can see in a planetarium has had a very interesting history. Nowadays, we think of the sun as a giant globe with a large family of little spheres circling around it. We locate ourselves on the third little sphere (counting out from the sun), and this notion does not cause us any mental anguish. In earlier days, the picture was quite different and the earth was regarded as the center of the system. Of course, if we go back still further, there are all sorts of fabulous models which involve giants, turtles, and sea serpents. The history of astronomy is the story of evolution of a model. Did you notice that in describing the solar model, I was actually taking a further step in abstraction? I was going from a physical model to a verbal model. The little balls were replaced by their symbols, the words "little balls."[1]

Graphic Models

Graphical models are being used as a convenient abstraction of reality (i.e., a phenomena, a situation, a problem), by many managers, even though most managers would not express what they were doing in model building terms. A very simple example of a graphical model is the breakeven chart.[2] A breakeven chart shows graphically the relationship between fixed costs, total costs, and sales revenue. The chart shows the point or area of operations that allows a business firm to neither make a profit nor a loss.[3]

A flow chart model is a graphic analogue showing the total structure, organization, and interrelationships of a process, event,

---

[1] Irwin D. J. Bross, Models in Management Systems, ed. Peter Schoderbek (New York: John Wiley & Sons, Inc., 1968), p. 328.

[2] John Hull, John Mapes and Brian Wheeler, Model Building Techniques for Management (Saxon House: Cranfield Institute Press, 1976), p. 7.

[3] Robert Albanese, Management Toward Accountability for Performance (Homewood, Ill.: Richard D. Irwin, Inc., 1975), p. 107.

or other phenomenon. Flow chart symbols represent ideas, information flow, and human action with narrative explanation provided for each symbol. The LOGOS symbol system (Language for Optimizing Graphically Ordered Systems) developed by Silvern can be used, in developing a flow chart model.[1]

Symbolic Models

According to Buffa,

> symbolic models substitute symbols for components or variables in the real world system, and the symbols are generally related mathematically. The symbolic system, then, is a model of some aspect of the real situation. For example, Newton's second law of motion, $F = MA$, states a relationship between three variables, force, mass, and acceleration. The symbolic model is the most difficult and expensive to construct, yet it is usually more general in application than other types of models and yields the most information.[2]

Massie and Douglas use symbolic and mathematical models synonymously and specify that,

> the most generally used type of model in decision making is a symbolic or mathematical model that uses symbols to specify important properties to be considered. Symbolic models can be constructed to show the relationships among variables; these symbols can be expressed as equations.[3]

According to Turban and Meredity, the complexity of relationships in some systems cannot be represented physically. Therefore,

---

[1]Leonard C. Silvern,"LOGOS: A System Language for Flowchart Modeling," Educational Technology 9 (June 1969): 18-23.

[2]Elwood S. Buffa, Models for Production and Operations Management (New York: John Wiley & Sons, Inc., 1963), p. 11.

[3]Joseph L. Massie and John Douglas, Managing: A Contemporary Introduction (Englewood Cliffs, N.J.: Prentice Hall, 1977), p. 257.

a more abstract model is used with the aid of symbols. These models are usually general rather than specific and can describe diverse situations.[1]

Use of Models

According to Hull et al., there are three main reasons for constructing a model: (1) description, (2) prediction, and (3) analysis. In defining each, respectively, he states that,

> 1. A descriptive model helps us to understand rapidly the salient features of the systems being modeled. If a model is to be used purely for descriptive purposes, it can be much simpler than corresponding predictive and analytical models. For example, an organization chart is a typical descriptive model. It can be used to determine rapidly who reports to whom in a large organization. If, however, we wish to estimate the effects of altering the organizational structure, a much more complex model would be necessary, incorporating informal communication channels, the competence of existing managers and a host of other factors.
>
> 2. Prediction. A number of models are constructed in order to make predictions about the future behavior of the real system. Such models will vary considerably in complexity, depending on the required accuracy of the prediction. Graphical extrapolation of past data in order to forecast future sales is an example of a simple predictive model.
>
> 3. Analysis. Usually, the model builder wishes to manipulate the model in order to determine the best method of achieving specified objectives. Clearly, use of a model for this purpose will still involve elements of description and prediction but it will also require a

[1]Turban and Meredity, Fundamentals of Management Science (Dallas, Texas: Business Publications, 1977), p. 21.

> greater understanding of the interrelationships between the variables in the model.[1]

Model Theory

According to Deutch, a model is a structure of symbols and operating rules which is supposed to match a set of relevant points in an existing structure or process. In order to understand complex processes, models are being made. The only alternative to their use would be an attempt to consider a system with all its interrelated interdependent elements directly, and to match it completely, point for point. This is manifestly impossible.

> Each model implies a theory asserting a structural correspondence between the model and certain aspects of the thing supposed to be modeled. It also implies judgments of relevance; it suggests that the particular aspect to which it corresponds are in fact the important aspects of the thing for the purposes of the model makers or users.[2]

Conceptual model theory is characterized more or less imperfectly by four distinct functions. These functions are (1) the organizing, (2) the heuristic, (3) the predictive, and (4) the measuring or mensurative. According to Deutch, the definitions of each function can be stated as follows:

> By the <u>organizing function</u>, is meant the ability of a model to order and relate disjointed data, and to show similarities or connections between them which had previously remained unperceived. To make isolated pieces of information fall

---

[1]John Hull, John Mapes and Brian Wheeler, Modeling Building Techniques for Management (Saxon House: Cranfield Institute Press, 1976), p. 10.

[2]Karl W. Deutch, The Evaluation of Models in Management Systems ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), p. 337-338.

suddenly into a meaningful pattern is to furnish an aesthetic experience.[1]

Heuristic is defined as having to do with the art of discovery. It pertains to those methods by which one finds and applies strategies that may transfer across tasks.[2]

The heuristic function helps one to discover new facts and new methods even though these novel facts and methods cannot be verified by the techniques which are available. The heuristic function of a model may be independent to a considerable degree from its orderliness or organizing power, as well as, from its predictive and mensurative performance.[3]

Predictive function of a model is a probability statement of the degree of success likely to be achieved.[4]

There are different kinds of predictions. At one extreme, we find simple yes and no predictions: at higher degrees of specificity, we get qualitative predictions of similarity or matching, where the result is predicted to be of this kind or of that kind, or of this particular delicate shade, and at the other extreme, we find completely quantitative predictions which may give us elaborate time series which may answer the questions of when and how much.[5]

The mensurative function of a model would provide us with an indicant and a measure. (1) If the model is related to the things modeled by laws, which are not clearly understood, the data it yields may serve as indicants. (2) If it is connected to the things modeled by processes clearly understood, we may call the data obtained with its help a measure--and measures

---

[1]Ibid., p. 339.

[2]Carter V. Good, Dictionary of Education (New York: McGraw-Hill Book Co., 1973), p. 280.

[3]Deutch, p. 338.

[4]Good, p. 433.

[5]Deutch, p. 338.

> again may range all the way from simple rank orderings to full fledged ratio scales.[1]

Deutch also points out that,

> a dimension of evaluation corresponds to each of these four functions of a model, and users of the model must address the following questions to each function.
> 1. How great is a model's generality or organizing power?
> 2. What is its fruitfulness or heuristic value?
> 3. How important or strategic are the verifiable predictions which it yields?
> 4. How accurate are the operations of measurement that can be developed with its aid?[2]

If we collect the answers to these four questions under the heading of the "performance" of a model, we may then evaluate the model still further in terms of the three additional considerations of (1) originality, (2) simplicity, and (3) realism.

> Originality of a model. We mean its improbability. Any idea, scheme or model may be thought of as the product of the recombination of previously existing elements, and perhaps of a subsequent process of abstraction omitting some of the traces of its combinational origin. The greater the probability or obviousness or triteness, of a model, the more frequent is this particular recombination in the ensemble of combinatorial possibilities at the immediately preceding stage. Originality or improbability is the reverse of this value.[3]

Models should be evaluated for their simplicity or economy of means. Simplicity is tantamount to economy, and it was compared to efficiency in economics by Deutch when he declared that efficiency in economics denotes the attainment of a given result with the greatest

---

[1]Ibid., p. 339.

[2]Ibid.

[3]Ibid.

economy in the employment of these means which are shortest in supply at each particular time, place, or situation.

The last consideration for evaluating a model or a conceptual scheme, is its realism, that is, the degree of reliance which we may place on it, representing some approximation to physical reality.[1]

Promulgating the idea that a model can be an effective change agent, Chin constructed five questions he felt a model must answer:

1. Does the model account for the stability and continuity in the events studied at the same time that it accounts for changes in them? How do processes of change develop, given the innerlocking factors in the situation that make for stability?

2. Where does the model locate the source of change? What place among these sources do the deliberate and conscious effort of the client-system and change-agent occupy?

3. What does the model assume about how goals and directions are determined? What or who sets the direction for movement of the processes of change?

4. Does the model provide the change agent with levers or handles for affecting the direction, tempo, and quality, of these processes of change?

5. How does the model "place" the change-agent in the scheme of things? What is the shifting character of his relationship to the client-system, initially and at the termination of relationship, that affects his perceptions and actions? The question of relationship of change-agent to others need to be part and parcel of the model, since the existential relationship of the change-agent engaged in processes of planned change becomes "part of the problem" to be investigated.[2]

---

[1]Ibid.

[2]Robert Chin, "The Utility of Systems Models and Developmental Models for Practitioners," in Planning Change, ed. William G. Bennis Kenneth Benne and Robert Chin (New York: Holt, Rinehart & Winston, Inc., 1961), pp. 201-214.

Bross said that models have various advantages, among which he listed (1) their remarkable record of prediction in the past history of mankind, (2) their use as a frame of reference on which to "hang the problem," (3) their use in fruitful avenues of research, (4) their simplification of the problem by employing only the significant attributes abstracted from the real world, (5) their use of symbolic language for both manipulation of the model and for purposes of easy communication, and (6) finally, their economical approach to the costs of prediction.[1]

Chin indicated these advantages of a model:

1. The model provides "mind-holds" to the practitioner in diagnosis.

2. A model lessens the danger of overlooking the indirect effects of a change of relationship.

3. The identification of and analysis of how tension operates in a system are by all odds the major utility of system analysis for practitioners of change.

4. A model can be used for a diagnosis of persons, groups, organizations and communities for the purpose of change.

5. A model can provide directional focus for analysis and action and a temporal frame of reference.[2]

---

[1]Irwin D. J. Bross, Models in Management Systems, ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1968), pp. 330-331.

[2]Robert Chin, "The Utility of Systems Models and Developmental Models for Practitioners," in Planning Change, ed. William G. Bennis, Kenneth Benne and Robert Chin (New York: Holt, Rinehart & Winston, Inc., 1961), p. 421.

Disadvantages of Models

The use of models also has some drawbacks. Bross indicated these disadvantages of models as the following:

1. The model is subject to the usual dangers inherent in abstraction.

2. A mathematically feasible model may require gross oversimplifications.

3. There is no guarantee that an investment of time and effort in constructing the model will pay dividends in the form of satisfactory predictions. No process, however, can provide such a guarantee.

4. The symbolic language is also subject to limitations. It may be beyond the ability of mathematicians to manipulate the symbolic language so as to obtain useful results.

5. After a scientist plays for a long time with a given model, he may become attached to it, just as a child may become, in the course of time, very attached to a doll (which is also a model). A child may become so devoted to the doll that she insists that her doll is a real baby, and some scientists become so devoted to their model (especially if it is a brain child), that they will insist that this model is the real world. The same sort of things happen with verbal models, as the semanticists point out, when a word and its counterpart in the real world are regarded as the same thing. This identification in the world of words has led to unhappy results which are reflected in the real world.[1]

Systems Approach and Modeling

According to Schoderbek et al., the application of the systems approach to management can be conceived as consisting of the following three steps:

---

[1]Irwin D. J. Bross, Models in Management Systems, ed. Peter P. Schoderbek (New York: John Wiley & Sons, Inc., 1968), p. 331.

1. Viewing the organization as a system.

2. Building a model.

3. Using information technology as a tool both for model building and for experimentation with the model; i.e., simulation.

Developing a system viewpoint of an organization is primarily a matter of the manager's adopting a new philosophy of the world. . . . A systems-oriented manager is a manager of the whole. Every manager can be a systems manager as long as his approaches are governed by the two following principles formulated by B. Fuller.

1. I always start with the universe: an organization of regenerative principles frequently manifest as energy (and/or information) systems of which all our experiences and possible experiences are only local instances.

2. Whenever I draw a circle, I immediately want to step out of it.[1]

He further states that the manager whose style is directed by these two principles begins his investigation of the world about him in order to identify his universe and to gain the ability to view his department as a system functioning within its environment. He then continues his investigation by gathering and analyzing the facts pertaining to happenings within "his" department. This definition of a manager's department, along with its environment, will provisionally determine the boundary of his system.

About this system, the manager will want to know its inputs, throughputs, outputs, feed-backs, relationships, as well as their attributes. His search for these system

---

[1]Peter P. Schoderbek et al., Management Systems Conceptual Consideration, Business Publications, Inc., 1975, p. 239; and B. Fuller, I Seem to Be a Verb, Management Systems, Business Publications, Inc. (New York: Bantam Books, 1970).

determinants begins with construction of a conceptual model. Thus, the model becomes the link between the real phenomenon, and the manager's system. Figure 2.7 depicts the relationship between the real phenomenon (RP), the Model (ML) and the System (SY).

The systems-oriented investigator, who looks at phenomena from the holistic viewpoint, perceives them as an orderly summary of these features of the physical and/or social world that affect his behavior, thus, the box labeled "real phenomenon" (RP) represents the observer's interpretation of what is really out there.[1]

Behavioral Systems Design

Good and Machol have suggested that the design process for a behavioral system consists of:

1. A statement of the problem.
2. The formulation of a model.
3. The collection and application of data.[2]

In stating the problem, one would sketch the proposed system either by starting with an existant system or beginning anew.

The next step in the design process is to formulate a model or representation of the proposed system. The key to effective design is the ability to simulate the system in its present state as well as any modification that would be made. Such a representation can take a variety of forms from a relatively simple flow diagram to a highly sophisticated mathematical model. However, the block diagram, or flow chart, is one of the basic tools in systems design.

Whether or not the model is descriptive or mathematical, at this early model building stage, one would only have an approximation

---

[1]Schoderbek et al., p. 239.

[2]Harry H. Goode and Robert Machol, System Engineering (New York: McGraw-Hill Book Co., 1957), pp. 305-306.

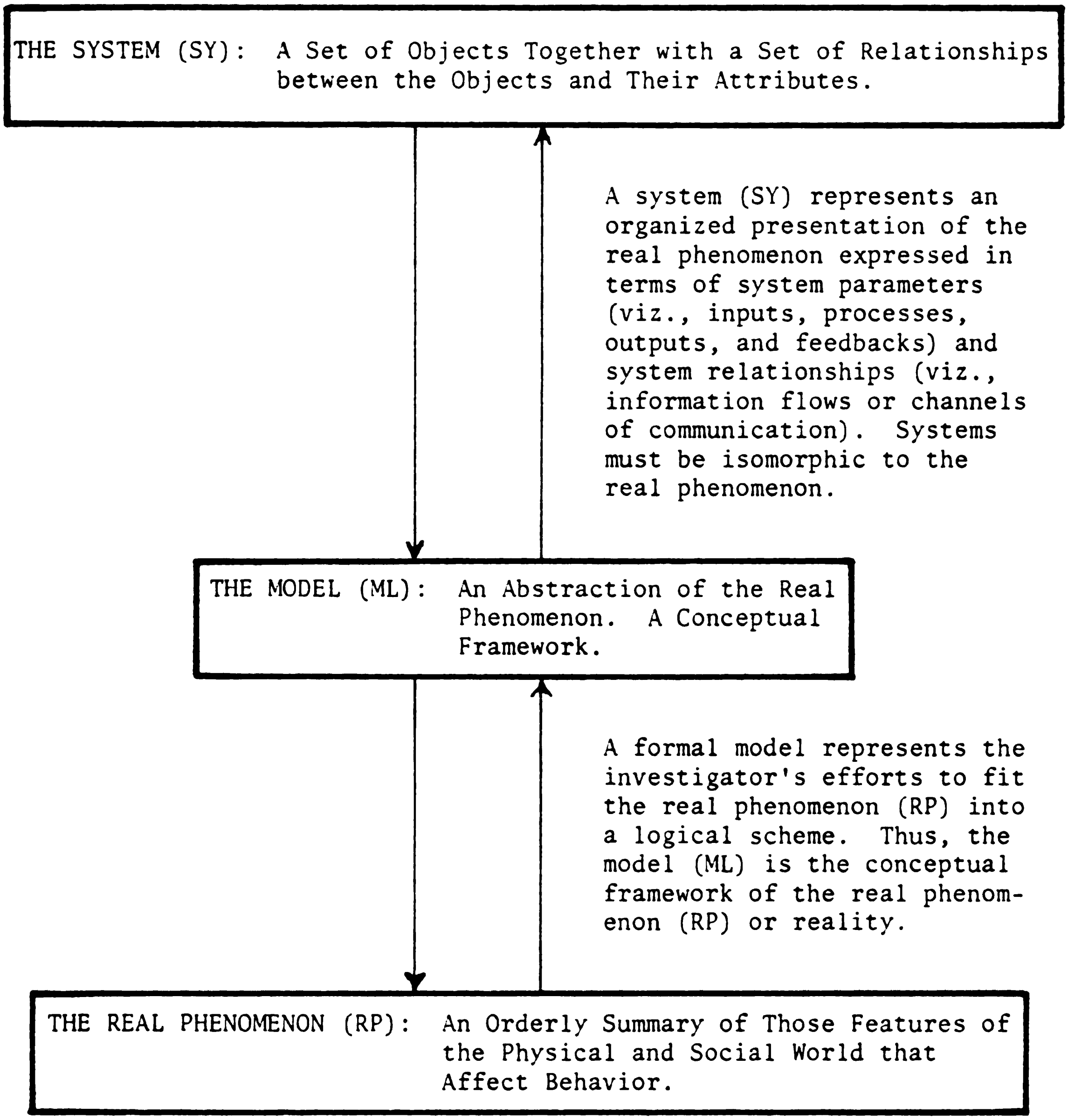

Figure 2.7 The System, the Model, and the Real Phenomenon.

Note: The Model (ML) is always "smaller" than the Real Phenomenon, or the System, the System must be as complex as the Real Phenomenon. There is a homomorphism between the model and reality but an isomorphism between the system and reality. (Source: Schoderbek et al., p. 240.)

of its operation. Additional data would have to be acquired. One must determine what additional data is required and how it is to be obtained. For the most part, a constant feedback should exist between the collection and analysis of data and the completeness of the model. With this data, one would be able to assign realistic values to listed parameters.

Guidelines in Behavioral System Design specified by Goode and Machol are as follows:

1. Output is the final product expected from the system.

2. Payoff is the human utility or satisfaction that will result from system operation or that which the system is to optimize.

3. Requirements are standards of performance which the system must meet.

4. Stability would mean the continuity of output.

5. Reliability refers to consistency of operation of components.

6. Description of the environment, general area of permissible or acceptable solutions and measures of effectiveness must be considered.

7. Description of the environment would involve noting the different expected inputs that will either enter or affect the system.

8. The area of acceptable solutions would relate essentially to a review of the present technology relative to the operation of the system.[1]

---

[1]Harry H. Goode and Robert Machol, System Engineering (New York: McGraw-Hill Book Co., 1957), p. 306.

Toward a Theory of Experience

Experience, learning by doing, is identified as a meaningful way of learning in a system for mechanization of agriculture. Therefore, in this study, understanding the theory of experience will be of great value.

According to Dewey, experience is a single dynamic, unified whole in which everything is ultimately interrelated. He thought of experience as interaction between the individual and his environment, subjective and objective elements, or inner and outer elements.[1]

He insisted that life consists of a series of overlapping and interpenetrating experiences, each of which has its own internal qualitative integrity. The individual experience is the primary unit of life, and experience is all inclusive in the sense that man is involved in continuous transactions with his environment, and through systematic inquiry he can come to understand the essential characteristics of nature and his environment.

Furthermore, within an experiential transaction, we can institute distinction between what is subjective and what is objective, but such distinctions are relative to and dependent on the context in in which they are made. All experiences are not equally educative, and some experiences may even be miseducative. To differentiate between what constitutes an educative experience and what constitutes a miseducative experience, one must have a set of rules, definitions,

---

[1]John Dewey, Experience and Education (New York: Collier, Macmillan Publishers, 1977), pp. 26, 27, 47.

and principles. According to Dewey, educative and miseducative experiences can be defined as follows:

> 1. Educative Experience: In a certain sense every experience should do something to prepare a person for later experiences of a deeper and more expansive quality. This is the very meaning of growth, continuity, reconstruction of experience. . . .
>
> 2. Quality of Experience: It is not enough to insist upon the necessity of experience, nor even of activity in experience. Everything depends upon the quality of experience. The quality of experience has two aspects: (1) immediate aspect of agreeableness or disagreeableness, and (2) its influence upon later experience.
>
> 3. Miseducative Experience: Any experience is miseducative that has the effect of arresting or distorting the growth of further experience. It may produce a lack of sensitivity and of responsiveness. Then the possibilities of having richer experiences in the future are restricted. An experience may be immediately enjoyable and yet promote the formation of a slack and careless attitude.[1]

Criteria of Experience

The experiential continuum, and the experiential interaction are the two principles stated by Dewey as inseparable elements of an educative experience.

> Principle I. The Experiential Continuum. The expeiential continuum or the category of continuity attempts to discriminate between experiences that are worthwhile educationally and those that are not. . . . This principle rests upon the fact of habit, when habit is interpreted biologically. The basic characteristic of habit is that every experience enacted and undergone modifies the one who acts and undergoes. The principle of habit so understood obviously goes deeper than the ordinary conception of a habit as a more or less fixed way of doing things, although it includes the latter as one of its special cases. It covers the formation of attitudes, both emotional and intellectual; it covers our basic sensitivities

---

[1]Ibid., pp. 26-27.

and ways of meeting and responding to all the conditions which we meet in living.

Growth or growing as developing, not only physically but intellectually and morally, is one exemplification of the principle of continuity. . . . Growth is not enough; we must also specify the direction in which growth takes place, the end towards which it tends. Growth as education and education as growth should create conditions for further growth in new directions.[1]

Principle II. Experiential Interaction. The word interaction expresses the second chief principle for interpreting an experience in its educational function and force. It assigns equal rights to both factors in experience--objective and internal conditions. Any normal experience is an interplay of these two sets of conditions, taken together or in their interaction, they form what we call a situation. . . . The statement that individuals live in a world means in the concrete, that they live in a series of situations. . . . The conceptions of situation and of interaction are inseparable from each other. An experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his environment. All human experiences are ultimately social, in that they involve contact and communication.

Also, the two principles of continuity and interaction are not separate from each other. They intercept and unite. They are, so to speak, the longitudinal and lateral aspects of experience.[2]

In regard to value judgment of experience, Dewey indicates that,

every experience is a moving force. Its value can be judged only on the ground of what it moves toward and into. Each experience of the learner can be evaluated in a way in which the one having the less mature experience cannot do.[3]

In other words, what an individual has learned in the way of knowledge and skill in one situation becomes an instrument for

---

[1]Ibid., pp. 35, 36.

[2]Ibid., pp. 43-43.

[3]Ibid., p. 31.

understanding and dealing effectively with the situation which follows. This process goes on as long as life and learning continue. Therefore, education as growth or enhancing maturity should be an ever-present process.[1]

Formation of the proper attitudes of the individual is the main concern in an educative experience. One must realize that ability to train thought is not achieved merely by knowledge of the best forms of thought. Possession of this information is no guarantee for ability to think.[2] The attitudes that need to be cultivated in order to secure their adoption and use, according to Dewey, are:

> 1. Open-Mindedness. This attitude may be defined as freedom from prejudice, partisanship, and such other habits as close the mind and make it unwilling to consider new problems and entertain new ideas.
>
> 2. Whole-Heartedness. When anyone is thoroughly interested in some subject and cause, he throws himself into it; he does so, as we say, heartily, or with a whole heart. The importance of this attitude or disposition is generally recognized in practical and moral affairs. But it is equally important in intellectual development.[3]

To summarize Dewey's thoughts on experience, he argues that education should be a continuous reconstruction of experience toward perfection of that experience founded with the skills and habits of intelligence.

---

[1]Ibid., pp. 44, 50.

[2]John Dewey, Selected Writings on Education, ed. Reginald Archambaalt (New York: The Modern Library, 1959), p. 223.

[3]Ibid., pp. 224, 235.

One of the dispositions having high value is the disposition to share: the sharing of viewpoints and opinions, the sharing of experiences, and the sharing of cooperative help in working out the learning projects, supported by new sources of information for growth and development of individuals.

Dewey said that the function of education should be to encourage those habits and dispositions that constitute intelligence and he placed great stress on creating the proper type of environment for experiences which would lead the individual to these attitudes and habits.

Cooperative Extension Service

In a system for Mechanization of Agriculture, Extension certainly has an important role and can be identified as a subsystem aimed at communication of innovations with the goal of higher quality inputs, throughputs, and ultimately outputs from the system. Therefore, it will be of value to understand the Cooperative Extension Service and the concepts related to this form of non-formal education.

In a report of the joint USDA-NASULGC[1] study committee, it defines the Cooperative Extension Service as "that organizational entity of the Department of Agriculture, and the Land Grant system created under provisions of the Smith Lever Act and subsequent related

---

[1]USDA, United States Department of Agriculture; and NASULGC, National Association of State University and Land Grant Colleges.

legislation which conducts educational programs of an informal non-resident, problem-oriented nature."[1]

Lincoln and Cannon define extension work as,

> an out of school system of education in which adults and young people learn by doing. It is a partnership between the government, the land grant colleges, and the people, which provides services and education designed to meet the needs of the people. Its fundamental objective is the development of people.[2]

Agricultural progress depends upon people for true progress. People must know, must understand, must act. How far people progress depends largely upon their access to accurate and reliable information they can use to help solve their problems.[3] An agricultural extension service has one main job, to get helpful information and innovation to people. Extension is the connecting link between the sources of knowledge and the receiver of knowledge.

Agricultural research and education is based upon these principles. Science investigates problems and builds a store of knowledge; classroom and extension teaching transmit the knowledge to people who want and need it.[4] Extension philosophy is to help people identify their own problems and opportunities, and then to

---

[1]A People and A Spirit, a report of the joint USDA-NASULGC Study Committee on Cooperative Extension, Colorado State University, Fort Collins, November 1968, p. 17.

[2]D. K. Lincoln and C. H. Cannon, Cooperative Extension Work (Ithaca, N.Y.: Comstock Publishing Co., 1963), p. 1.

[3]Bryant Kearl and Hardle Read, Agricultural Communication Service, p. 8.

[4]Ibid., p. 7.

provide practical research-based information that will help them overcome the problems and take advantage of opportunities.[1]

An extension agent is expected to: (1) plan programs, (2) work closely with people, and (3) deal with important problems of people and communities with the accent on action.

To help people to help themselves through education is the guiding principle of extension. Extension educators do this by assisting people to: (1) identify their needs, problems, and opportunities, (2) evaluate their resources, (3) determine alternative solutions, and (4) follow a suitable course of action.

An extension agent brings available research information to people and interprets and demonstrates its application.[2]

In addition to their own knowledge of agricultural technology, extension agents depend upon extension specialists and other resource persons for the latest research. As an extension specialist, the individual would:

1. Assist extension agents and advisory groups in planning educational programs designed to meet specific needs and interest of the people.

2. Keep extension agents posted on research findings and their application to practical problems.

3. Provide on-the-job training for extension agents, teach people through farm and home visits, meetings, tours, demonstrations, etc., in a way that will strengthen the position of extension personnel in the counties.

---

[1]Austin Vines and Marvin A. Anderson, eds., "Heritage Horizons, Extension's Commitment to People," Journal of Extension, 1976, p. 50.

[2]A Career with Cooperative Extension Service, Michigan State University, East Lansing, Michigan, 1P 3R-4-69-3M.

4. Conduct studies of county and state situations--assembling, analyzing, and interpreting facts, clarifying problems in the field of specialization and working out appropriate solutions for the people and groups involved.

5. Support county programs with teaching aids such as bulletins, newspaper stories, radio, and television programs, films, slides, exhibits, charts, etc.

6. Become a recognized authority and leader in his or her professional field.[1]

Extension agents will have unequaled opportunity for on-the-job training as they plan, analyze, and conduct extension programs. An annual extension conference, special training meetings, and workshops of many different types are held each year for the benefit of the staff. A constant flow of the latest findings of scientific research from many resources are sent to agricultural extension agents.[2] The extension worker's creed is considered to be the philosophical guide for the extension worker.

Extension Worker's Creed

I believe in people and their hopes, their aspirations, and their faith, in their right to make their own plans and arrive at their own decisions; in their ability and power to enlarge their lives and plan for the happiness of those they love.

I believe that education, of which extension work is an essential part, is basic in stimulating individual initiative, self-determination, and leadership, that these are the keys to democracy and that people, when given the facts they understand, will act, not only in their self-interest, but also in the interest of society.

---

[1]A Career With Cooperative Extension Service, Michigan State University, East Lansing, Michigan, 1P-9:78-4M-st.

[2]A Career With Cooperative Extension Service, Michigan State University, East Lansing, Michigan, 1P 3R-4-G9-3M.

> I believe that education is a lifelong process and the greatest university is the home; that my success as a teacher is proportional to those qualities of mind and spirit that give me welcome entrance to the homes of the families I serve.
>
> I believe that the extension service is a link between the people and the ever-changing discoveries in the laboratories.
>
> I believe in the public institutions of which I am a part.
>
> I believe in my own work and in the opportunity I have to make my life useful to mankind. Because I believe these things, I am an extension worker.[1]

In regard to advisory groups and their roles, Gordon Guyer, Director of Cooperative Extension Service at Michigan State University, indicates that,

> traditionally, extension programs have been guided by local citizens who serve in an advisory capacity and direct efforts in areas of greatest need. Such groups work closely with county commissioners. This has enabled extension work to be focused upon the common concerns and needs of people, their families and their communities.[2]
>
> "Cooperative" in the case of extension service, refers to the joint financing by federal, state, and county government of non-formal problem-oriented programs, based on local needs of the individuals, groups, and communities.[3]

Some characteristics of the cooperative extension system are:

1. The federal, state, and local government cooperatively share in its financial support and program direction.

---

[1]A Career With Cooperative Extension Service, Michigan State University, East Lansing, Michigan, IP-9:784 M-ST.

[2]The CES: A Guide Prepared for County Boards of Commissioners, Michigan State University, East Lansing, Michigan. Gordon E. Guyer, Director.

[3]Ibid.

2. It is administered by the Land Grant universities as designated by the state legislature through an extension director.

3. Extension programs are objective and based on factual information.

4. It provides practical, problem-oriented education for people of all ages.

5. It utilizes research from university, government, and other sources to help people make their own decisions.

6. It dispenses no funds to the public.

7. The extension staff educates people through personal contact, meetings, demonstrations, and mass media.

8. Specialists, agents, aides, and volunteers are helping people to help themselves.

Demand for Technical Know-How

In a study done by Webb and Knotts, duty areas of work in which grain farmers performed the tasks were:

1. Following legal practices in grain operations.
2. Following general safety precautions.
3. Maintaining equipment and vehicles.
4. Using and maintaining hand and power tools.
5. Testing soil and plant tissues.
6. Fertilizing grain crops.
7. Operating powered equipment and vehicles.
8. Controlling insects and diseases.
9. Controlling weeds.
10. Constructing and maintaining grain operations, buildings and structures.
11. Assembling and installing grain operation equipment.
12. Establishing grain crops.
13. Marketing and shipping grain crops.
14. Harvesting.
15. Storing grain crops.[1]

---

[1]Earl S. Webb and Clifton Don Knotts, Agricultural Mechanical Skills Needed by Farmers in Texas, Texas A & M University College Station, Department of Agricultural Education, ED 084460, September 1970.

The above list can be used as a guideline by extension departments to provide necessary services for the grain farmers. Other needed information and technical know-how by grain farmers are as follows:

1. Selection of a cropping system.
2. Selection of proper certified seeds.
3. Planning tillage system.
4. Determining plant nutrient requirements.
5. Diagnosing nutrient requirements.
6. Soil tests.
7. Lime requirement tests.
8. Water management.
9. Drainage maintenance.
10. Planting specifications.
11. Handling materials.
12. Keeping records.

A commercial farmer needs both formal and non-formal education in order to keep up with ever changing technology and research findings. Non-formal education in the form of cooperative extension has, and always will have, an important role in helping adult farmers to adapt new practices.

The extension aim in this study is identified as the communication of innovations. Therefore, it is important to understand some of the more important concepts related to social change and communication of innovations.

Communication of Innovations

Many authors have defined social change. A sample definition of social change developed by Zaltman and Duncan is represented in Figure 2.8.[1]

---

[1]Gerald Zaltman and Robert Duncan, Strategies for Planned Change (New York: John Wiley & Sons, Inc., 1977), p. 8.

Author	Definition
Gerlach and Hines	Developmental social change is change within an ongoing social system, adding to it or improving it rather than replacing some of its key elements. Revolutionary social change is change that replaces existing goals with an entirely different set of goals, steering society in a very different direction.
Hamblin, Jacobsen, and Miller	Quantitative processes that occur through time.
Abcarian	Structural tensions that result in widespread patterns of deviant norms and behavior.
Rogers	Alteration in the structure and function of a social change.
Etzioni	Reformulation of a social structure involving disequilibrium, forces for establishing equilibrium and the occurrence of a new equilibrium.
Lippitt	Any planned or unplanned alteration in the status quo in an organism, situation, or process.
Smith	Differentiation, reintegration, and adaptation.
Triandis	A new set of social relationships and social behavior that is most likely to lead to rewards.
Lenski	Innovation through discovery or invention or diffusion or alteration.
Dobny, Boskoff, and Pendleton	Alterations in the patterns of interactions or social behavior among individuals and groups within a society.
Niehoff	The implementation of a plan as mediated by actions of change agents and reactions of the community of (potential) adopters.
Schien	The induction of new patterns of action, belief, and attitudes among substantial segments of a population.

Figure 2.8 Sample Definitions of Social Change

Source: Zaltman and Duncan, Strategies for Planned Change, p. 8.

The Characteristics of Change

According to Zaltman and Duncan, the characteristics of change are identified as:

- relative advantage,
- impact on social relations,
- divisibility
- reversibility,
- complexity,
- compatibility,
- communicability, and
- time and timing.[1]

Relative advantage. This dimension refers to the unique benefit the change provides that other ideas, practices, or things do not provide at all or as well.

Impact on social relations. Many changes may have a persuasive impact on social relationships within the target system and those between the target system and persons and groups in the outside environment. An organizational development program may create entirely new relationships and alter communication patterns within a group.

Divisibility. Divisibility refers to the extent to which a change can be implemented on a limited scale.

Reversibility. The reversibility dimension is closely related to divisibility. It refers to the ease with which the status quo ante can be established if a change is introduced but is later rejected.

Complexity. The greater the degree of difficulty in using and understanding a change, the less likelihood that it will be adapted voluntarily.

---

[1]Ibid., pp. 13-23.

Compatibility. The "goodness of fit" a change has with the situation in which it is to be used is very important. The situation includes psychological, sociological, and cultural factors.

Communicability. The ease with which information about a change can be disseminated is another critical dimension.

Time and timing. The speed with which a change is introduced is an important dimension. It is necessary to think in terms of optimal time. Timing for introducing change is also important.

Participants in the Change Process

Participants in the change process are: change agent, change target, and client system. The change agent is a professional who influences innovation decisions in a direction deemed desirable by a change agency. The client system is a specific social system that requests a change agent to assist in altering its organization with the objective of improved performance. There is a difference between "client system" and "change target system." The change target system is the unit which the change agent is trying to alter the status quo in such a way that the individual, group, or organization must relearn how to perform its activities, while unwilling to do so and/or when it has made no request to do so. In contrast, the "client system" has requested and is willing to support the change.

Change efforts may have three basic instrumental goals or objectives. They may be to (1) change attitudes, (2) change behavior, or (3) change both attitude and behavior. The types of social change are shown in Figure 2.9.

	MICRO	INTERMEDIATE	MACRO
Short term	Behavior change	Normative change Administrative change	Innovation Invention Revolution
Long term	Life cycle change	Organizational change	Sociocultural evolution

Figure 2.9 Types of Social Change.

Concepts relevant to the communication of innovations are identified in Figure 2.10. For understanding and clarification of concepts in the communication of innovation presented in Figure 2.11, Zaltman and Duncan's, Rogers and Shoemaker's and Havelock's writings are recommended.[1]

Types of Strategies

According to Zaltman and Duncan, there are five types of strategies for the communication of innovations: (1) facilitative, (2) re-educative, (3) persuasive, (4) power, and (5) multiple.

In Figure 2.11 a comparative analysis of the four main strategies is made, where awareness, initial degree of commitment,

---

[1]Ibid.; Everett M. Rogers and Floyd F. Shoemaker, Communication of Innovations, A Cross-Cultural Approach, 2nd ed. (New York: Collier Macmillan Publishers, 1971); and Ronald G. Havelock, The Change Agent's Guide to Innovation in Education, Educational Technology Publications, 1978, pp. 90-224.

social change	commitment
change agent	long run social change
status quo	open system perspective
client system	historical background
rationalistic bias	organizational structure
technocratic bias	organizational processes
performance gap	individual characteristics
attributes of innovation	problems of innovation
relative advantages	nature of the problem
compatibility	symptoms of the problem
complexity	location of the problem
triability	past remedial effort
observability	policy problems
pitfalls in social change	organizational structure problems
poorly defined change goals	person problems
change goals	production process problems
attitude change	product problems
behavior change	categories of problems
normative change	recurrent problems
change target	re-recognized problems
social change	current problems
differentiation	refashioned problems
reintegration	unrecognized problems
adaptation	strategies for change
micro-social change	educative strategies
intermediate social change	persuasive strategies
macro-social change	power strategies
short run social change	cultural barriers to change
cultural values	social barriers to change
cultural beliefs	group solidarity
cultural ethnocentrism	rejection of outsider
saving face	conformity to norms
incompatibility of cultural trait with change	conflict
	group insight
organizational barrier to change	resistance to change
	ideologies
threat to power	health conditions
threat to influence	traditional heritage
behavior of top level admin.	social relationships
climate for change	personality needs
technological barriers	peer and authority relation
psychological barriers	personal attitude
perception	physical and temporal arrangements
homostasis	conformity
personality factors	environment

Figure 2.10 Concepts in Communication of Innovations.

	FACILITATIVE	RE-EDUCATIVE	PERSUASIVE	POWER
Strategy awareness	Yes	Sometimes	No	Not important
Initial degree of commitment	Strong in favor	Neutral or low	Low	Low
Perceived need for change	High	Relatively low	Low	Low
Capacity of the client to accept change	(Should be accommodated) Relatively high	Low	High	High
Capacity of the client to sustain change	Should be allowed to develop if not present	No--should be created	Yes--realization of resources may be necessary	Low
Resources available change agent	Limited but continue until self-supporting	Plenty for long time commitment	Limited	Very plentiful
Segmentation of target system and decision making stage	Adapt to different targets at different stages of the decision process			
Magnitude of change	Large	Medium	Small	Proportional to power available
Resistance to change	Low	Medium-high	High	High
Nature of change	Simple	Radical	Complex--incompatible	Complex--incompatible but observable and terrible
Time requirements	Long term	Long term	Medium term	Short term
Objectives	Prompt reinforcement	Awareness of problems and solutions	Attitude and behavior change	Behavior change

Figure 2.11 Strategies for Communication of Innovations.

Source: Gerald Zaltman and Robert Duncan, Strategies for Planned Change, Wiley-Interscience, 1977, prepared by Felipe Korzenny, Department of Communication, Michigan State University, East Lansing, Michigan.

perceived need for change, capacity of the client to accept change, capacity of the client to sustain change, resources available, segmentation of the target system and decision making stage, magnitude of change, resistance, nature of change, time requirements and objectives are of concern.

Pitfalls are potential problems which should be considered when various change strategies are analyzed. Pitfalls in social change are: (1) rationalistic bias, (2) poorly defined change goals, (3) poorly defined problems, (4) over-emphasis on individuals, and (5) technocratic bias.[1]

In this study, adult education is identified as a subsystem aiming at on-the-job training within the context of the proposed system for mechanization of agriculture for adults. Therefore, it will be of value to present the reader with some of the fundamentals related to adult learning activities.

In the following pages, the need for adult education, views on development, the adult as a learner, the role of the adult educator, and principles for guiding formal adult instruction are presented.

The Need for Adult Education

Human beings are born into an environment which contains numerous and continuous threats. There is a constant need for both physical and psychological survival. From the very beginning, there

---

[1]Gerald Zaltman and Robert Duncan, Strategies for Planned Change (New York: John Wiley & Sons, Inc., 1977), pp. 19-23.

has been a struggle to overcome difficulties and, depending on the environment, man has provided himself with know-how to survive.

Rapid expansion of science, emergence of highly technological, sociocultural, and psychological advancements and problems make it difficult to answer the question, "what is adult education?"

But if the aim is to provide such an environment that each individual can achieve growth and development, to become anything he or she is capable of becoming, and if education is to help the individual to be master of himself or herself and his or her environment, along with assuming responsibilities, then adult education is an educationally conditioned environment where action, interaction, and transaction takes place to help the adults to help themselves toward a higher quality of life.

Kleis indicates that,

> adult education is concerned with the basic human problem of accommodation between changing persons and a changing world. It treats education as the complex process by which a person learns to relate himself to his environment. It assumes that, as a person matures and changes, his relationships must change; that as various sectors of his world (family, vocational, civic, religious, physical, social, etc.) change, his relationships to them must change; and that rational approaches to change require effective and well ordered learning. It acknowledges that for contemporary man, both significance and locus of learning are profoundly affected by an accelerating rate of change.[1]

The nature of man is strange indeed. Man has a broad spectrum of needs and behaviors, and can function like a machine, like other animals, or like a human being. Physical development, intellectual

---

[1]Russell J. Kleis, Michigan State University, 1968, unpublished leaflet.

development, and moral development are all important in order for an individual to become a human being, and to adopt an attitude of being useful to mankind. Philosophers in the field of human development have expressed different views regarding human intellectual development. Major views on development are expressed as (1) organismic, (2) dialectic, (3) mechanistic, and (4) general systems perspective.

Views on Development

> Organismic concept of development emphasizes the · essential unity of inseparable wholeness of development; the concept as defined in psychology is that the local patterns of behavior, such as reflexes, emerge through maturation as recognizable entities from its total organismic pattern.[1]

Kohlberg, Loevinger, and Maslow view the man as an organic whole with goals,and support the idea that change is internal. There are universal stages of development and individuals must go through these stages for development.[2]

> The dialectic concept of development views the organism capable of dialectic. Dialectic in general is the logic of argument, such as the method of question and answer of Socrates, more technically, discourse in which the mutually exclusive ideas contained in opposed concepts are resolved in a higher conceptual synthesis; for example, the process of development said to be characteristic of the universal spirit (Hegel), of the history of societies (Marx),

---

[1]Carter V. Good, Dictionary of Education (New York: McGraw-Hill Book Co., 1973).

[2]Lawrence Kohlberg, Continuities in Childhood and Adult Moral Development Revisited (Carmbridge, Mass.: Harvard University Press,); Jane Loevinger et al., Ego Development Conceptions and Theories (San Francisco: Jossey Bass Publishers, 1976); and Harold A. Maslow, The Farther Reaches of Human Nature (New York: Viking Press, 1972).

> of the dialectics of nature (Engels), and of the science of first principles (Plato.)[1]

Riegel and Erikson support the dialectic concept, and indicate that development and growth can be expected only when there is a thesis and an antithesis, moving toward synthesis where the result will be learning and development.[2]

> The mechanistic concept of development is the viewpoint according to which nature, as a whole, and the processes of life are thought to be machinelike and mechanically necessitated and capable of explanation by the laws of physics and chemistry and which, in its intention to find immediate and efficient, rather than final origins, processes, and goals for human life, in other words, is allied to materialism.[3]

The mechanistic concept of development views the organism as a machine, reactive rather than active, with no inherent purpose.

Sills and Hall conclude the following about human beings from a general systems perspective.

> A general systems perspective presents a humanistic view of man as a holistic, goal-directed, self-maintaining, self-creating individual of intrinsic worth, capable of self reflection upon his uniqueness.
>
> A general systems perspective allows for an ecological view of man as an interrelated, interdependent, interacting complex organism, constantly influencing and being influenced by his environment. Man is viewed as part of nature, the suprasystem with which he must live in harmony if he is to function in an integrated manner in his environment.

---

[1] Good, Dictionary of Education, p. 179.

[2] Klaus F. Riegel and John A Meachem, The Developing Individual in a Changing World (The Hague: Mouton, 1976); Klaus F. Riegel, Psychology of Development and History (New York: Plenum Press, 1976); Erik H. Erikson, Identity and the Life Cycle, selected paper with a historical introduction by David Rapaport (New York: International Universities Press, 1959); and Erik Homburger Erikson, Adulthood Essays by Erik H. Erikson, ed. Erik H. Erikson (New York: Norton, 1978).

[3] Good, Dictionary of Education, p. 359.

> A general systems approach allows for consideration of man at his subsystem levels, as a total human being, and as a social creature who networks himself with others in hierarchically arranged human systems of increased complexity.[1]

The Adult as a Learner

Adults are different from each other. They have different backgrounds, experience, and formal education. They are not easily motivated, but when they are motivated, based on their experiences, they become more dedicated learners than children.

Adults are vast reservoirs of experience and they are problem oriented.[2] Adults want to control the conditions of learning, both pace and style. The adult learner wants to be the decision maker.[3] Cross et al. emphasize that there are certain teachable moments and the adult learner makes a deliberate effort in learning projects to gain a defined area of knowledge.[4]

---

[1]Grayce M. Sills and Joanne E. Hall, "A General Systems Perspective for Nursing," in A Systems Approach to Community Health, ed. Joanne E. Hall and Barbara R. Weaver (New York: J. D. Lippincott Co., 1977).

[2]Malcolm Shepherd Knowles, The Modern Practice of Adult Education (New York: Association Press, 1977).

[3]Allan Tough, Why Adults Learn: A Study of the Major Reasons for Beginning and Continuing a Learning Project, Monographs in Adult Education, No. 3 (Toronto, Canada: Ontario Institute for Studies in Education, 1968).

[4]Patricia K. Cross, Allen Tough and Rita Weathersby, Current Issues in Higher Education, The Adult Learner (Washington, D.C.: The American Association for Higher Education, 1978); and Patricia K. Cross, Accents on Learning, Improved Instruction and Reshaping the Curriculum (San Francisco: Jossey-Bass, 1976).

According to Knowles, technological implications for adult learning are (1) setting a climate, (2) diagnosing needs for learning, (3) designing a learning plan, (4) conducting learning outcomes, and (5) evaluating learning outcomes.

1. Setting a climate: A favorable climate for adult learning is a warm climate with mutual respect, clearness, mutual trust, respective roles and conducive to dialogue at a comfortable level of motivation.

2. Diagnosing needs for learning:
   a. Why self-directed learning? In order to develop the ability to learn on one's own, for the natural process of psychological development, and survival as an individual.
   b. What is self-directed learning? It describes a process in which individuals take the initiative, with or without help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.
   c. What competencies are needed for self-directed learning? Self-diagnostic guides can be used to determine competencies needed. Practitioners can help adults to follow self-diagnostic guides to diagnose their competencies and to determine what competencies are needed.

3. Designing a learning plan: There are many ways to design a learning plan. One way is to use a learning contract. The learning contract is a binding agreement between two or more persons, learner, and mentor. It enables the adults to organize their learning activities, it gives them an opportunity to be more creative in identifying learning resources, developing learning strategies, choosing their own ways of achieving, and measuring their own progress toward achieving them.

4. Conducting learning outcomes: The adult individuals can work on learning strategies specified on their learning contracts either individually or in groups.

5. Evaluating learning outcomes: The results and the evidence can be presented in the learning contract in order to share the contract and evidence between members

> of class, and to form new groups in which each individual can evaluate others' learning activities and exchange feedback.[1]

Knox suggests the same idea, that adults learn effectively when they are self-directed learners. He also indicates that adults tend to underestimate their learning ability by overemphasizing their early school experience and underestimating their recent informal learning experiences.[2]

The main problem in adults learning is that they have learned through vicarious experiences. Vicarious experience is experience acquired not by direct, concrete, personal, or first-hand means, but indirectly through the report of another person or group.

Serious thought should be given to using Dewey's theory of experience in adult education in order to enable adults to have first-hand experiences, and to view the experiences both with experimental continuum and experiential interaction where the quality of experience is given high priority.

Freire indicates that:

1. at the intransitive awareness stage, man does not perceive the dialectic relationship which unites him with nature.

2. at naive transitive awareness stage, man develops an initial perception of problems, but his examination is not pushed to its limits.

---

[1]Malcolm S. Knowles, Self-Directed Learning, A Guide for Learners and Teachers (New York: Association Press, 1975).

[2]Allan B. Knox, Adult Development and Learning (San Francisco: Jossey-Bass, 1977).

3. At critical transitive awareness stage, man can free himself from his alienation and take action upon his world. It is at this stage where true literacy appears.[1]

The Role of the Adult Educator

Watson observes that, although organisms are not naturally complacent, they do seek a comfortable level of arousal and stimulation and do try to maintain that state.[2]

It is important for adult educators to take this fact into consideration, because there are individuals who feel they are ready to assume self-directed learning projects. There are individuals who feel comfortable when information and facts are given to them. There are individuals who feel comfortable when they are only guided toward their goals, and also toward independent study, group discussion, role playing, problem solving, creative projects, etc.

One may assume that there will be times when an adult individual would feel comfortable to participate in, and take advantage of, any educational method available to him or her. Therefore, the role of the adult educator is to create a comfortable state of interaction and activities which are diverse and flexible and which can be performed according to the adult's interest and level of motivation toward a goal, keeping in mind the concept of equifinality, meaning that different initial conditions can lead to the same results.

---

[1] Paulo Freire, Education for Critical Consciousness (New York: Seabody Press, 1973).

[2] Goodwin Watson, "Resistance to Change," American Behavioral Scientist 14 (May-June 1971): 745-766.

Srinivasan has identified and described the following assumptions in non-formal adult education:

1. Adults in rural areas are more likely to accept new ideas when they can understand them in the context of their priorities and interrelated with the other important segments of their lives.

2. Effective learning takes place most easily when there is strong motivation to learn. The motive power needs to come from inner convictions and not from mere persuasion or external incentives.

3. The individual's capacity to contribute to development requires that he be able to clarify value positions, discern cause-effect relationships, make considered judgments and take responsibility for action. Learning experiences can be structured specifically to promote these attitudes, abilities and behavior.

4. The learning experience should further enable the learner to change the way he uses himself (e.g., from passive to active, timid to confident, routine to creative). This is a fundamental growth objective.

5. Conscientization is not something that can be "done" to people. It must spring from within. However, self-concepts can be strengthened and expanded through sensitive preparation of the learning experience and environment.

6. The cultural and social milieu of the rural adult can exercise a powerful and decisive hold in the individual's ability to select options. A curriculum is not likely to achieve developmental goals unless it treats integrally the "set" and the "setting"--the mind-set and the social context.

7. In rural development the people are often their own major resource. At every stage of the educational process, local leaders and learning group peers who can play an important role in reinforcing and legitimizing change should be trained and involved in a variety of leadership roles in support of the program. Further, a facilitator drawn from within the community or from a comparable setting will be at least as successful as an outsider, if not more so. The facilitator can help create the climate of trust which is the first

step in fostering human development. The selection, training, and use of facilitators is therefore of vital importance.

8. Technical cooperation among a variety of technical agencies and services is essential to the success of nonformal education processes and activities. Such cooperation must be based on common understanding and appreciation of human development principles and of the complimentarity of staff roles. Multi-level and joint training sessions are useful devices to achieve these ends.

9. Learning materials can be developed locally with the full creative involvement of learners and can greatly increase the relevance and impact of training programs.

10. Training as well as field operations must be carefully documented, analyzed, and evaluated. The experience must then be ploughed back into program planning and further training so that future programs can benefit from our experience today.[1]

According to Lorge et al., some principles for guidance in creating a favorable situation for adult learning can be classified in two groups: (1) statements about general socio-psychological conditions which facilitate learning in the formal instructional situation; and (2) statements pertaining to the guidance and control of various types of interactions which take place within a group during formal instruction. These fundamentals are quoted in the following pages.[2]

---

[1]Lyra Srinivasan, Perspectives on Non-Formal Adult Learning, Functional Education for Individual, Community and National Development (New York: World Education, 1977), pp. 76-77.

[2]Irving Lorge, Howard Y. McClusky, Gale G. Jensen, Wilbur C. Hallenbeck, Psychology of Adults (Washington, D.C.: Adult Education Association of the U.S.A.,   ), pp. 24-30.

Principles Pertaining to the General Socio-Psychological Conditions for Effective Formal Instruction

1. A balance must be maintained between the various types of socio-psychological interactions which insures that most of the energies of adult students and instructors are channeled into problem-solving and task interactions.

2. The psychological tension level of adult learners must be established and maintained at that level which permits the release of energy into problem-solving and task interactions at a rate required by the learning tasks and objectives.

3. Group pressures and norms which develop to regulate the behavior of adult learners must be guided and controlled by the instructor to make certain that they do not inhibit full participation in the instructional enterprise.

4. Adult learners must assume full responsibility for their participation in the instructional enterprise in a manner which provides the most effective contributions toward achieving the instructional goals.

Principles Pertaining to Interactions

A. Principles concerning the guidance and control of problem-solving and task interactions.

   1. Instructional goals proposing new behaviors for adults must be formulated in keeping with the personal needs and life situations of adults participating in formal instruction.

   2. The gratification or rewards adults experience in formal instruction situations must result primarily from the acquisition of new behaviors rather than from gratifications received from prestige, influence, and friendship interactions.

   3. The development of multiple learning goals for adult instruction must be permitted to the point (1) that the group is still able to function effectively as a group, and (2) that the fulfillment of individual learning needs is promised.

4. Cooperative (rather than competitive) problem-solving interactions must be developed between adult learners if the probabilities for the achievement of instructional goals are to be maximized.

5. The problem-solving interactions between adult students must provide for the use of objective, public methods for evaluating learning progress.

B. Principles concerning the guidance and control of decision-making interactions.

1. The authority and decision-making interactions between adult students and the instructor must be such that the adult students do not experience a loss of adult autonomy.

2. Adults must be free to decide to leave a formal instructional group whenever the learning experiences fail to contribute to their personal needs or to the problems present in their life situations.

3. The instructional and evaluation procedures used in adult instructional groups must be assessed and then accepted or rejected by the adult students themselves, to whatever degree they possess knowledges and skills to make these decisions.

4. Adults must be free to assess and reject or accept the expert knowledge of the instructor in light of the realities of their life experiences.

5. The level of aspiration or amount of learning proposed for a given time for an adult instructional group must represent a decision which reflects the feeling and wishes of the adult members.

6. Decisions to change the aspirational level for new learnings should be based on interactions which re-evaluate the instructional enterprise in light of the learning progress actually taking place.

7. Dependency relations between adult students and instructor must be permitted and maintained only so long as a student does not possess the skills for successfully performing or accomplishing a given learning task.

8. Adult learners must be free to decide whether they can or cannot effectively take part in a given learning venture.

C. Principles concerning social influence interactions.

1. Adult students must be able to influence the kind of learning goals chosen for the instructional group as a means of making certain that these goals take account of their needs and problems.

2. The instructor must not use his authority in a coercive or arbitrary manner should adults disagree with proposed learning goals or instructional procedures.

3. Adult learners must be free to influence the character and direction of the problem-solving and task interactions of the instructional group whenever they possess the skill and inclination to do so.

4. Aggressive reactions by adult students to the ideas, values, and actions contained in the instructional activities must be permitted by the instructor.

D. Principles concerning social acceptance and personal evaluation interactions.

1. Adult students must have full social acceptance by the instructor and fellow students for full release of energy for learning.

2. The learning tasks designed for adult students must be commensurate with the study skills they possess, so as not to confront them with a situation in which a loss of personal esteem is likely to result.

3. Adult students must be given an opportunity (devoid of loss of personal esteem and social acceptability) to realistically determine their present level of development with respect to a proposed learning goal.

4. No disrespect must be shown to adult students who feel that they are unable or not "ready" to participate in a learning venture. (This must be a group standard about participation.)

E. Principles concerning informal, private interactions.

1. Adult students must be free to have informal, private interactions with one another whenever the content of these interactions are concerned with experiences resulting from the problem-solving and task interactions.

2. Informal, private interactions must lead to the correction of personal disturbance of individual students, rather than to the development of hidden, organized resistances.

3. The instructor must encourage individual students to share the content of the informal, private interactions with him and other students.[1]

Problems of Adult Education

In a rapidly changing world, encountering something yesterday probably is not what you would encounter tomorrow. The adult's world is changing as a result of social mobility, migration, re-orientation, cross-cultural transplantation, where there is a need for adjustment and ability to cope with the new environment.

Adult education has far more importance for a given society than is usually realized, partly because of the adult education identity crisis, marginality, and lack of strong adult learning theories. This is due to the complexity of the adult's world and the adults themselves. What motivates adults, why they behave as they do, and how much they value change, etc., certainly has a broader spectrum than children. According to Essert, there are two major problems of adult education in relation to maturity: (1) bringing into focus a core of experiences that adults are having and want to have, and (2) discovering processes and techniques by which the leader can use his influence and understanding to help adults to help themselves wherever they are.

---

[1]Ibid.

[2]Paul L. Essert, Creative Leadership of Adult Education (Englewood Cliffs, N.J.: Prentice Hall, Inc., 1951).

The creative leadership has certainly a place in adult education. Essert has defined creative leadership of adult education in the following words: "The forwarding of social inventions in which people learn to use an increasing number of their total community resources to carry on continued learning that leads to an improved quality of living."[1]

In other words, creative leadership of adult education helps adults to discover or create a wealth of close-at-hand laboratories in which they can learn new behavior for their unique and changing functions within a dynamic environment by participating in the desired learning experiences.

The characteristics of learning experience are:

1. A learning experience is goal-directed and action centered.
2. A learning experience can be summarized, reviewed, and appraised.
3. A learning experience can take place both in formal and non-formal settings.
4. A learning experience is functional.
5. A learning experience is shared.
6. A learning experience is dynamic.
7. A learning experience is a means of discipline.

Summary

1. Systems science represents a change in the intellectual climate, viewing physical and social phenomena as systems, organized

---

[1]Ibid.

complexities that exhibit (a) organization, (b) wholeness, (c) openness, (d) self-regulation, and (e) teleology.

2. The major approaches to systems thinking are: (a) General Systems Theory, (b) cybernetics, (c) holism, (d) operations research, (e) systems design, (f) information theory, (g) systems analysis, (h) systems engineering, (i) output analysis, (j) mathematical programming, and (k) computer science.

3. Systems thinking is based on (a) organicism, (b) holism, (c) modeling, and (d) understanding systems.

4. Conceptually, a system is a set of interrelated, interdependent elements in continuous action, interaction and transaction within the system and with its environment exchanging matter, energy, and information in the form of inputs, throughputs, outputs, and feedback. The system has both subsystems and suprasystems, and the notion of supersummation meaning the whole is greater than the sum of its parts.

5. General Systems Theory is a theory aiming at universal properties of systems in general. Characteristics of the General Systems Theory are: (a) interrelationship and interdependence of objects, attributes, events and the like, (b) holism, (c) goal seeking, (d) inputs, (e) throughputs, (f) outputs, (g) entropy, (h) negentropy, (i) regulation, (j) hierarchy, (k) differentiation, (l) equifinality, (m) boundaries, (n) environment, (o) suprasystems, (p) feedback, and (q) supersummation.

6. Objects are components of the system. From the functional standpoint, they appear in the forms of inputs, throughputs, outputs, and feedback.

7. Inputs can be matter, energy, information, machinery, and man. Inputs are classified as (a) serial, (b) random, and (c) feedback.

8. Throughputs are processes which transform the inputs into outputs.

9. Outputs are end-results which can be products, services, information, trained individuals, and energy. Outputs are classified as (a) serial, (b) recycle, and (c) waste output.

10. Input-output linkage is realized by throughputs performed in functional subsystems.

11. Relationships are the bonds that link the objects together and can be: (a) symbiotic, (b) synergistic, and (c) redundant relationships.

12. Attributes are properties of objects and are classified as (a) defining, and (b) accompanying.

13. The environment of a system is defined as everything outside of the system boundary.

14. Systems approach is a modern approach to acquire an adequate knowledge of the whole before proceeding to an accurate knowledge of the working of a system's parts.

15. There are three levels of formalization in systems approach, those of (a) principles, (b) methods, and (c) techniques.

16. Another way of expressing a theory is by means of a model.

17. Models are representations of systems. They can be theoretical, theoretical isomorphic, or can represent real phenomena.

18. Models can be descriptive or prescriptive.

19. Models can be iconic, analog, and symbolic.

20. There are three main reasons for constructing a model: (a) description, (b) prediction, and (c) analysis.

21. Conceptual model theory identifies four distinct functions: (a) the organizing, (b) the heuristic, (c) the predictive, and (d) the mensurative.

22. Evaluation of models can be based on answering the following questions: (a) how great is a model's generality or organizing power? (b) what is its fruitfulness or heuristic value? (c) how important or strategic are the verifiable predictions which it yields? and (d) how accurate are the operations of measurement that can be developed with its aid? Other factors to consider in the evaluation of models are: (a) originality, (b) simplicity, and (c) realism.

23. The disadvantages of model construction are several: (a) dangers inherent in abstraction, (b) insistence that the model is the real world, and (c) limitation to manipulate the model.

24. Using the systems approach to construct a model, there are at least three steps: (a) viewing the organization as a system, (b) building a model, and (3) using information technology as a tool both for model building and for experimentation with the model.

25. Steps in designing a behavioral system are: (a) the statement of the problem, (b) the formulation of a model and (c) the selection and application of data.

26. Dewey's theory of experience differentiates between educative and miseducative experiences; attributes of educative experience are experiential continuum, experiential interaction, and value judgment of the experience.

27. Extension is a bridge between scientific facts and their application to daily life which is communicated by extension agents, supported by land-grant universities, the United States Department of Agriculture, and experiment stations.

28. Adult education is concerned with the basic human problem of accommodation between changing persons and a changing world.

29. Development of individuals has been viewed from different perspectives: (a) the organismic view, (b) the mechanistic view, (c) general systems perspective, and (d) the dialectic view.

30. Social change is defined as differentiation, reintegration and adaptation of innovations. Attributes of change are: (a) relative advantage, (b) impact on social relations, (c) divisibility, (d) reversibility, (e) complexity, (f) communicability, and (g) time and timing.

31. Five strategies can be used to introduce change: (1) facilitative, (2) re-educative, (3) persuasive, (4) power, and (5) multiple.

32. There are four ways which an individual can be a change agent: (1) as a catalyst, (2) as a resource linker, (3) as a process helper, and (4) as a solution giver.

CHAPTER III

DESIGN OF THE STUDY--SYSTEMS APPROACH BASED ON THE APPLICATION OF GENERAL SYSTEMS THEORY

The major thrust in this chapter is to present the reader with the necessary information and guidelines which are identified for conducting a study of this kind. Major topics are: A Procedure for Systems Approach based on the application of General Systems Theory to the design of a system; Research Questions; Assumptions; Application of the Procedure to the Design of a System for Mechanization of Agriculture for Adults; and Tel-Plan Computer Program 70.

A Procedure for Systems Approach

From a pragmatic point of view, the application of a systems approach, based on General Systems Theory for designing a system to be represented in conceptual-graphical models can be as follows:

1. Identification of the problem.
2. Identification of goals and objectives.
3. Preliminary collection of pertinent information and facts.
4. Definition of a system for the solution of the problem, based on systems approach philosophy.
5. Formulation of a preliminary conceptual model of the proposed system.

6. Statements of research questions based on the application of General Systems Theory.
7. Review of the pertinent literature and collection of facts and bits of information.
8. Itemization of inputs, throughputs, and outputs related to model(s) stated at step 5.
9. Formative tests of the models.
10. Development of conceptual-graphical models of the proposed system.

Research Questions

Whenever the systems approach based on the application of General Systems Theory is being used as a methodology, the following research questions are of concern:

1. What are the goals and objectives of the proposed system?
2. What are the components or subsystems?
3. What are the relevant inputs?
4. What are the relevant throughputs?
5. What are the relevant outputs?
6. What are the linkages?
7. What are the constraints causing entropy?
8. What are the other relevant characteristics of the system in question?

Assumptions

1. A key assumption is that General Systems Theory has application for the design of a theoretical isomorphic system.
2. General systems perspective provides for inputs from all segments of existing knowledge pertinent and relevant to the success of the system under study.
3. General systems perspective makes provisions for the development of a goal statement, and the writing of specific performance objectives.
4. General systems perspective makes provisions for evaluation of all its entities and subentities.
5. General systems perspective makes provision for accountability.
6. General systems perspective makes provision for problem identification.
7. General systems perspective provides for identification of inputs, throughputs, outputs, feedback, constraints, linkages, relationships, boundaries, and environment for designing a theoretical isomorphic system.
8. A general systems perspective provides conceptual links between relevant disciplines to a given phenomena by presenting professionals with a common language, unrestricted by subject matter boundaries, thus allowing for meaningful dialogue in viewing the phenomena in its totality with the notion of supersummation, meaning that the whole is greater than the sum of its parts.

9. A general systems perspective permits the organization of vast numbers of theories and concepts into a meaningful framework as a basis for making planning judgments.
10. A general systems perspective, with its focus on systems processes facilitates a process orientation to the Mechanization of Agriculture along with supporting services such as training, supervision, maintenance, and extension. This perspective is dynamic and applicable in a wide variety of systems design.

Application of the Procedure to the Design of a System for the Mechanization of Agriculture

In regard to developing a theoretical isomorphic system for the Mechanization of Agriculture, according to the procedure identified in the design of the study, the following statements are made as guidelines for conducting the study.

Identification of the problem. Traditionally, the Agricultural Mechanization process in developing countries has been viewed in a dyadic framework, in which problem solving steps have been employed to promote and maintain Mechanization of Agriculture, in order to replace the traditional methods of farming. Often this problem solving approach has not been successful.

Identification of goals and objectives of the study. This study attempts to translate the Agricultural Mechanization process into a systems perspective. In contrast to the usual dyadic Agricultural Mechanization practice, a systems approach to Agricultural Mechanization process incorporates many more process skills than the problem solving approach. The major thrust is to define inputs, throughputs, and outputs collaboratively, rather than in isolation, and to represent these factors in conceptual-graphical models.

Preliminary collection of pertinent information and facts. Library reference materials, including books, abstracts, extension publications, journals, and ERIC publications are employed for preliminary collection of pertinent information and facts relevant to systems approach, General Systems Theory, Mechanization of Agriculture and model development.

Definition of a system for the solution of the problem, based on systems approach philosophy. Systems approach is a Gestalt type of approach, attempting to view the whole with all its interrelated and interdependent parts in interaction. Therefore, a system for Mechanization of Agriculture must incorporate at least six subsystems performing interrelated and interdependent functions of:

1. establishing new mechanized farms.
2. providing for financial support.
3. providing for maintenance.
4. providing for training.
5. providing for extension.
6. providing for marketing.

The assumption here is that the whole in a system for Mechanization of Agriculture can be identified by understanding the inputs, throughputs, and outputs of the proposed subsystems, and also their interrelationships and interdependence.

Formulation of a preliminary conceptual model of the proposed system. The totality in a theoretical isomorphic system for Mechanization of Agriculture should have at least six subsystems which their models can be identified as follows:

1. A conceptual-graphical model of a subsystem for establishing new mechanized farms according to predetermined standards in regard to availability of resources within the environment.
2. A conceptual-graphical model of a subsystem for on-the-job training of the adults, in order for them to become farm managers.
3. A conceptual-graphical model of a subsystem for providing financial support for each adult to buy a farm with reasonable monthly payments.
4. A conceptual-graphical model of a subsystem for providing supervision, aiming at proper maintenance on the farms within the context of the proposed system.
5. A conceptual-graphical model of a subsystem for providing extension for communication of innovations.
6. A conceptual-graphical model of a subsystem for facilitating marketing of the products produced within the context of the proposed system.

Statements of research questions based on the application of General Systems Theory to Mechanization of Agriculture.

1. What are the goals and objectives of a system and its subsystems relevant to Mechanization of Agriculture?

2. What are the components of a system for the Mechanization of Agriculture and what are their relationships?
3. What are the inputs relevant to a system for the Mechanization of Agriculture?
4. What are the outputs expected from a system for the Mechanization of Agriculture?
5. What are the linkages in a system for the Mechanization of Agriculture?
6. What are the constraints causing entropy in a system for the Mechanization of Agriculture?
7. What are the other relevant characteristics of a system for the Mechanization of Agriculture?

Review of pertinent literature and collection of facts and bits of information. This study is at the macro level, and the system in question is a set of subsystems which may have no common properties. Therefore, relevant literature to each subsystem must be reviewed in order to identify as many inputs, throughputs, and outputs as possible, and also to identify their relationships.

Itemization of inputs, outputs, and throughputs related to each subsystem stated earlier in the study. At this stage the objective is to itemize inputs, throughputs, and outputs in regard to each subsystem.

Formative theoretical tests of the models. Since the purpose of this study is to develop a theoretical isomorphic system for the Mechanization of Agriculture to be represented in conceptual-graphical models, the formative theoretical tests of the models would be based on logical testing of inputs as they are transformed into outputs, according to a graphical presentation.

Development of conceptual-graphical models of the proposed system. In addition to the application of General Systems Theory and Model Theory, the creative approach is employed to represent the subsystems of a system for the Mechanization of Agriculture for adults in conceptual graphical models.

In this study the Tel-Plan Computer Program 70 is also used for developing a crop enterprise cost analysis for the production of soybeans, wheat, and corn.

Tel-Plan Computer Program 70

Tel-Plan 70 is a computer program for crop enterprise cost analysis. It has been developed by a cooperative extension service team of county agricultural agents, county directors, district horticultural agents, and Michigan State University agricultural economics specialists. According to the developers, G. Arent, H. Better, R. Earl, J. Neibauer, S. Harsh, M. Kelsey, F. Hennigson, M. Thomas, and W. Search, objectives in running Tel-Plan 70[1] are: (1) to organize the farm financial situation in such a manner that the cost of production for crops grown can be determined with reasonable accuracy; (2) to determine the financial outcome of a farming program with the greatest

---

[1]Tel-Plan Computer Program 70 can be obtained from the Department of Agricultural Economics, Michigan State University, East Lansing, Michigan 48823.

accuracy possible to predict prices and yield of commodities which are grown; (3) to make better decisions on which crops to grow, and how combinations of various acreages of crops may have impacts on earnings; and (4) to become better market planners, since when one becomes more informed about cost of production, he can better analyze the risk management question.

CHAPTER IV

SYSTEMS THINKING AND GENERAL SYSTEMS THEORY

Systems approach, based on the application of General Systems Theory, is identified as a methodology for conducting this study. It is important, therefore, to understand systems approach and General Systems Theory, and their usefulness in systems research.

In the following pages, Systems Thinking, A Definition of the Systems Approach, General Systems Theory as a Methodology, Characteristics of General Systems Theory, Conceptual Model Theory, Evaluation of Models, Evolution of a Successful Model, and A Diagrammatical Presentation of a System are discussed, concluding with a Summary of the chapter.

Systems Thinking

The real dynamic and totality of systems, as well as their interrelationships, interdependence, and influential forces, are emphasized within the context of systems thinking. It forces researchers to look at a situation, a phenomena, and/or a problem in its totality. Using a Gestalt approach, with emphasis on supersummation which states that the whole is greater than the sum of its parts.[1]

---

[1]Glenn L. Immegart and Francis J. Pilecki, An Introduction to Systems for Educational Administrator (Reading, Mass.: Addison Wesley Publication, 1973), p. 14.

According to Schoderbek et al.,

> Systems thinking, a logical step in the development of man's approach to the study of complex phenomena, has developed over the years from a shift in emphasis from a Macro, to a Micro, and back again to a Macro viewpoint.
> The original Macro level overlooked the many relevant details of the later Micro studies, while these in turn became too divorced from one another to adequately define the working of the whole.
> Systems thinking with a present Macro approach attempts to place components in the proper perspectives to one another, to study their mutual interactions and the effect of these interactions on the whole, as well as on the way the whole affects and is affected by its environment.[1]

A Definition of Systems Approach

The systems approach is a Gestalt type of approach, attempting to view the totality of a given phenomena, and identifying all its interrelated and interdependent parts as well as their relationships. To acquire an adequate knowledge of the whole is emphasized by the systems oriented researcher, before proceeding to an accurate knowledge of the desired functions and processes.[2] Churchman uses the familiar fable about several blind men each touching a different part of an elephant to illustrate his concept of systems. The moral of the story is that when confronted with a problem, one should view the whole picture which may be referred to as the totality of a phenomena.[3]

---

[1]Peter P. Schoderbek, Management Systems Conceptual Considerations, Business Publications, Inc., 1975, pp. 26-27.

[2]Ibid., p. 116.

[3]C. West Churchman, The Systems Approach (New York: Delacorte Press, 1968).

Gestalt is a term designating an undivided articulate whole that cannot be made up by the mere addition of independent elements. The nature of each element depends on its relationship to the whole. As a theory of perception it places stress upon structural unity, the wholeness, by which consciousness gives order to experience.[1]

General Systems Theory as a Methodology

According to Bertalanffy the aim of General Systems Theory (GST), in a narrower sense, is to derive from a general definition of systems those characteristics which are shared in all systems, such as interaction, sum, mechanization, centralization, competition, finality, etc. and apply them to concrete phenomena.[2]

In regard to the application of General Systems Theory to instructional development, Harries states that,

> although the potential of the systems approach based on General Systems Theory is truly remarkable, it remains only as a methodology, not a cure-all. In the past a technical methodology, such as General Systems Theory has often been applied to things, to materialistic considerations. Recently, however, General Systems Theory has been looked at with increasing interest by social scientists as a tool for understanding human behavior and for increasing the ability of individuals to work creatively and productively with one another.[3]

---

[1]Carter V. Good, ed. Dictionary of Education (New York: McGraw-Hill Book Co., 1973), p. 261.

[2]Ludwig Von Bertalanffy, General Systems Theory (New York: George Braziller, 1968), p. 91.

[3]Thomas E. Harries, Application of General Systems Theory to Instructional Development. Washington, D.C.: National Special Media Institute, 1971), p. 1.

In this study, systems approach, based on General Systems Theory, will be used as a methodology to design a theoretical isomorphic system for the Mechanization of Agriculture for adults with the following objectives: (1) identification of the problem, (2) formulation of the research questions, (3) review of pertinent literature, (4) development of a conceptual-graphical model of the system, and (5) development of conceptual-graphical models of the subsystems.

Characteristics of General Systems Theory

General Systems Theory is a name which has come into use to describe a level of theoretical model-building which lies somewhere between the highly generalized constructions of pure mathematics and the specific theories of the specialized disciplines.[1]

Litterer and Schoderbek have indicated that the characteristics attributed to General Systems Theory by the system's theorist are many and varied, for General Systems Theory has no definitive body of doctrine, aiming at uncovering the laws and order inherent in all systems.[2] The following characteristics, neither all-inclusive nor separate and distinct, are generally conceived to be the hallmarks of General Systems Theory: (1) interrelatedness and interdependence of objects, attributes, events and the like; (2) holism; (3) goal seeking;

---

[1]Kenneth E. Boulding, General Systems Theory, The Skeleton of Science and Management Systems, ed. P. P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), p. 7.

[2]A. Joseph Litterer, Organizations: Systems, Control and Adaptation, Vol. 2, 2nd ed. (New York: John Wiley & Sons, Inc., 1969), pp. 3-6; and Schoderbek et al., Management Systems, Business Publication, Inc., 1975, p. 12.

(4) inputs; (5) throughputs; (6) outputs; (7) entropy; (8) regulation; (9) hierarchy; (10) differentiation; and (11) equifinality. A brief discussion of each characteristic is presented here as follows.

Interrelatedness and interdependence of objects, attributes, and events. Perhaps the most frequently cited characteristic of a system is that it consists of a set of interrelated interdependent elements in the interaction. These elements are (1) objects, (2) attributes of those objects, and (3) events.[1]

Holism. The systems approach is a doctrine for viewing a phenomenon in its totality; it is the science and the art for attempting to view the whole with all its interrelated and interdependent parts in action, transaction, and interaction. According to Schoderbek,

> the systems approach is not an analytical one where the whole is broken down into its constituent parts and then each of the decomposed elements is studied in isolation. Rather, it is a Gestalt type of approach, attempting to view the whole with all its interrelated and interdependent parts in interaction.[2]

This is often and briefly stated in the observation that systems are characterized by the term supersummation, meaning that the whole is greater than the sum of its parts.[3]

Goal seeking. Systems are a set of acting, interacting, and transacting components for the purpose of attaining some final state or goal, or an equilibrium position where the activities are conducive

---

[1]Litterer, p. 4.

[2]Schoderbek et al., p. 12.

[3]Litterer, p. 4.

to goal attainment. Stability is necessary for a dynamic system in order to perform its functions and survive. In regard to this concept, Schoderbek et al. and Litterer indicate that "systems embody interacting components. Interaction results in some final state or goal or an equilibrium position where the activities are conducive to goal attainment."[1]

> An equilibrium position is a position where a system tends to return after it has been disturbed. This return is usually a result of compensating actions on the part of the system. . . . Stability is a characteristic of the whole, not of the parts.[2]

Inputs. Inputs are the matter, energy, and information introduced within a system from without or the environment of the system. Inputs are necessary for generating the throughputs or processes which ultimately result in the desired output. According to Schoderbek et al. and Litterer, "all systems are dependent on some inputs for generating the activities that will ultimately result in goal attainment."[3] "Systems, if they are open systems, receive things from the environment; in a broad sense, these are usually categorized as matter, energy, and information."[4]

---

[1]Schoderbek et al., p. 12.

[2]Litterer, p. 4.

[3]Schoderbek et al., p. 13.

[4]Litterer, p. 5.

Inputs of an educational system are the aims, priorities, students, managers, structure, time schedule, content, teachers, learning aids, facilities, technology, capital, etc.[1]

Throughputs. Throughputs are the processes which transform the inputs into outputs according to a plan of operation specified within the context of the given system. In this regard Schoderbek et al. state that,

> all systems are transformers of inputs into outputs. That which is received into the system is modified by the system, so that the form of the output differs from that which was originally put in.[2]

Outputs. Outputs are what a system delivers to the environment for the purposes of consumption by other systems. They can be in the form of products, services, information, and energy. Litterer indicates that,

> systems also deliver something to their environment which is called systems outputs. This output, in turn, can be the input of some other system or systems. Hence, all systems are dependent on receiving inputs produced by other systems and produce something needed by other systems.[3]

Negentropy. Negentropy is a process in open systems conducive to increasing order and progressive complexity. Sills and Hall, in their study of general systems, make the following statements.

---

[1]Richard W. Hostrop, Managing Education for Results, ETC Publication, 1975, p. 8.

[2]Schoderbek et al., p. 13.

[3]Litterer, p. 5.

> Negentropy is a process in open systems which leades to increasing order and complexity in the system. Thus, the system is ever increasing its processes and structures, thereby altering its state. . . . Negentropy is achieved by a systems process known as feedback. In feedback, information about systems output is monitored back into the system as information input.[1]

Weiner states that feedback is the property whereby a system adjusts future conduct based on past performance.[2]

Entropy. Entropy is the state where the interrelated and interdependent elements of a given system are in progressive condition of disorganization. Therefore, conducive to death in living systems, to revolution in social systems, and in running down in mechanical systems. According to Schoderbek et al. and Litterer,

> Maximum entropy could mean a lack of all necessary information for running the system, or a maximum condition of disorganization. For living systems, maximum entropy means death.[3]

> Entropy origin steeped in the field of thermodynamics, it designates the state of a closed system where all the elements are in maximum disorder; the system is run down.[4]

Regulation. Regulation is a body of rules existing to govern the operation of a system. This body of rules can be stated and enforced as a given system tends to exist within the time and space.

---

[1]Grayce M. Sills and Jeanne E. Hall, "A General Systems Perspective for Nursing," in A Systems Approach to Community Health, ed. Jeanne E. Hall and Barbara R. Weaver (New York: J. D. Lippincott Co., 1977), p. 22.

[2]Norbert Weiner, Cybernetics (New York: John Wiley & Sons, Inc., 1948), pp. 47-48.

[3]Schoderbek et al., p. 13.

[4]Litterer, p. 5.

In social systems this body of rule is prescribed by the leaders and managers of the system. According to Schoderbek et al.,

> if systems are sets of interrelated and interdependent components in interaction, then the interacting components must be regulated in some fashion so that the systems objectives will ultimately be realized. In human organizations, this implies the setting up of objectives and the determining of the activities that will result in goal fulfillment. This constitutes planning. Control implies that the original design for action will be adhered to and that untoward deviations from the plan will be noted and corrected. Feedback is a requisite of all effective control.[1]

Hierarchy. Hierarchy is the state where the components are presented as deductions from a small set of basic subsystems. According to Immegart and Pilecki,

> all systems have subsystems and like a system, a subsystem is a bounded unit composed of parts, relationships, and attributes. Thus any subsystem is a system in and of itself, and it functions or is classified as it is in relation to a suprasystem.[2]

Suprasystem. Subsystems, systems, and suprasystems are interrelated and interdependent; every system has subsystems and suprasystems. A suprasystem embodies whatever constitutes within a universe, a phenomenon and a problem.

According to Immegart and Pilecki,

> all systems have suprasystems, thus, just as all systems can analytically and practically be broken down into subsystems, all systems are, in fact, subsystems to larger and more complex systems.[3]

---

[1]Schoderbek et al., p. 13.

[2]Glenn L. Immegart and Francis J. Pilecki, *An Introduction to Systems for Educational Administrator* (Reading, Mass.: Addison Wesley Publications, 1973), p. 37.

[3]Ibid., p. 38.

Other characteristics of General Systems Theory, according to Schoderbek et al., Litterer, and Immegart and Pilecki, are (1) differentiation, (2) equifinality, (3) boundary, (4) environment, and (5) feedback. A discussion of each of these characteristics follows.

Differentiation. A complex system is a set of subsystems conducive to goal attainment. Each of these performing specialized systemic functions are interrelated. According to Schoderbek et al., "in complex systems, specialized units perform specialized systemic functions. This differentiation of functions by components is characteristic of all systems."[1]

Equifinality. Equifinality is a property in open systems, meaning that the same final state can be reached from several starting points, or from the different initial conditions. One result can have different causes.[2]

Boundary. Boundary delimits whatever is within the system from whatever is without the system for the purpose of control. According to Immegart and Pilecki, "all systems have boundaries which are more or less arbitrary demarcations of that which is included within the system and that which is excluded from it."[3]

Environment. The environment is everything existing outside the system's boundary in a given time and space. According to Immegart and Pilecki,

---

[1]Schoderbek et al., p. 13.

[2]Ibid., p. 14.

[3]Immegart and Pilecki, p. 35.

> All systems have an environment. A systems environment is everything which is outside of the system's boundary. Environment, then, is contingent on the definition of the system and may vary as the system's boundary varies. Consequently, systems need comprehensive knowledge about all related aspects of their environment. System environment is of two kinds: proximal, or that of which the system is aware; and distal, or that of which the system is unaware.[1]

Feedback. Feedback is a process and a property of General Systems Theory whereby future conducts are based on available facts and information about the present performance of the system in order to make the necessary corrections conducive to higher quality. In this regard Immegart and Pilecki state that "open systems, in part, maintain their steady states through the feedback processes. Feedback is the evaluative or monitoring process whereby open systems assess their outputs and their processes."[2]

Conceptual Model Theory

Deutch has integrated and linked together some significant characteristics of models relative to the development of a model, and he indicates that a model should perform at least four distinct functions: (1) the organizing, (2) the heuristic, (3) the productive, and (4) the mensurative.

> Organizing function means the model is structured in such a way to show similarities or connections by ordering and relating disjointed data, which had previously remained unperceived.[3]

---

[1]Immegart and Pilecki, p. 36.

[2]Ibid., P. 43.

[3]Karl W. Deutch, The Evaluation of Models in Management Systems ed. P. P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), pp. 337.

Heuristic function leads to the discovery of new facts and new methods, even if these predictions cannot be verified by techniques practicable at the present time.

Predictive function can be of different varieties. The most widely known and used is verification by physical operation. Other predictive functions are: the simple yes-no prediction, qualitative predictions of similarity or matching and quantitative predictions.

Mensurative function is the study or process of measurement. If the model is related to things modeled by laws which are not clearly understood, the data it yields may serve as indicants. If it is connected to the things modeled by processes clearly understood, we may call the data obtained with its help a measure--and measure again may range all the way from simple rank orderings to full-fledged ratio scales.[1]

Evaluations of Models

According to Deutch, a dimension of evaluation of models corresponds to each of the four functions of the conceptual model theory in order to determine the state of its organizing power, its fruitfulness, its strategic value and its usability. In regard to the evaluation of models, Deutch constructed four questions:

1. How great is a model's generaltiy or organizing power?
2. What is its fruitfulness, or heuristic value?
3. How important or strategic are the verifiable predictions which it yields?
4. How accurate are the operations of measurement that can be developed with its aid?[2]

In addition, there are other characteristics of a good model; those are (1) originality, (2) simplicity, and (3) realism.

---

[1]Deutch, pp. 337-342.

[2]Ibid., p. 342.

Evolution of a Successful Model

Bross indicates that the evolution of a successful model generally follows the pattern represented in Figure 4.1.[1]

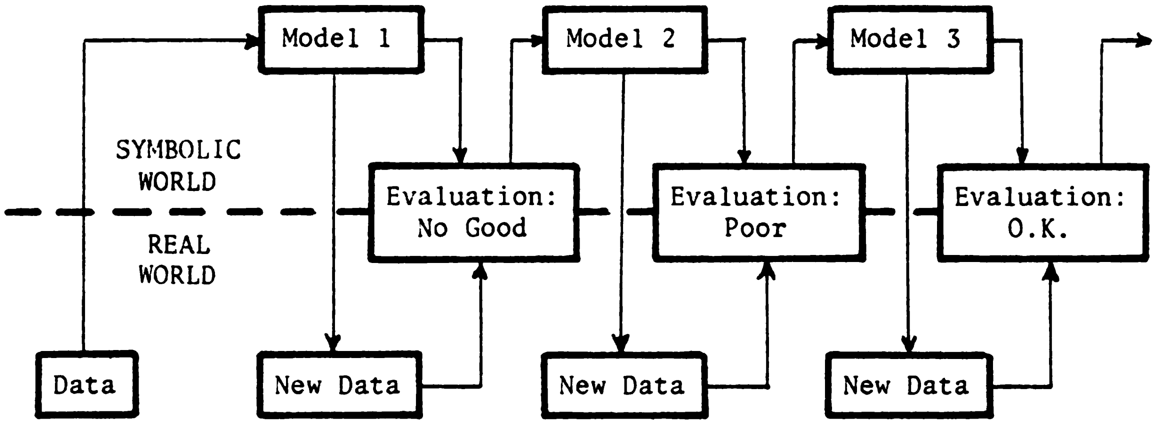

Figure 4.1 Evolution of a Successful Model.

The first shots are often very wide of the mark, but by gradual stages, the scientist zeroes in on his target. There is really no end to the sequence. Even after years of successful usage of a model, a situation may come along which will not be adequately predicted by the model.

---

[1]Irwin D. J. Bross, Models in Management Science, ed. P. P. Schoderbek (New York: John Wiley & Sons, Inc., 1967), p. 334.

A Diagrammatical Presentation of a System

A diagrammatical presentation of a system should embody such parameters as input, process, output, feedback, boundary, and environment. Figure 4.2 represents a diagrammatical model of a system in general. According to Schoderbek et al.,

> The first thing that one should notice when looking at Figure 4.2 is that the input to one system is the output to another system, and that the output to one system becomes the input to another system. Secondly, the line demarcating the system from its environment [which is called system boundary], is not solid. There are two reasons for this: (1) such a line indicates that there is a continuous interchange of matter, energy, and information between the open system and the environment, and (2) the broken line indicates that the boundary's actual position is more or less arbitrarily determined by designer, investigator, or observer of the system's structure. Thirdly, the control function has been incorporated into the feedback component. Finally, the lines connecting the system's parameters to each other, as well as the system to its environment, represent the system relationship.[1]

Summary

Systems thinking is an approach to the study of complex problems, situations, and phenomena. Emphasis is on the totality at the macro level in order to understand the interrelated, interdependent parts in interaction, realizing that the whole is greater than the sum of its parts. The systems approach then is a Gestalt type of approach in order to acquire an adequate knowledge of the whole before proceeding to an accurate knowledge of the entities and the subentities' functions.

---

[1]Schoderbek et al., pp. 31-33.

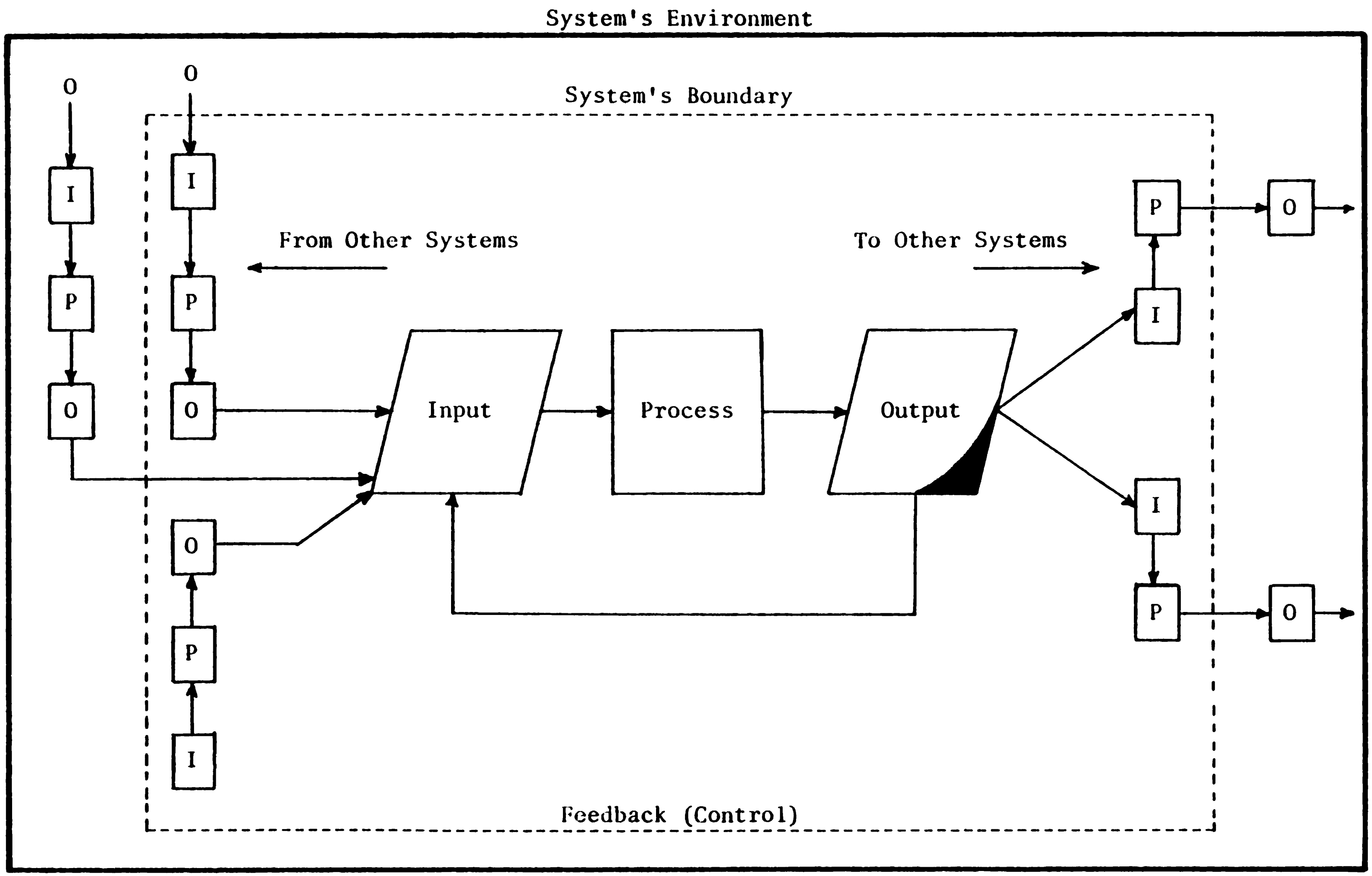

Figure 4.2 A Diagrammatical Presentation of a System's Parameters, Boundary, and Environment.

Source: Schoderbek et al., p. 31.

General Systems Theory can be used as a methodology whenever system approach to a given organized complexity is in concern. Characteristics of General Systems Theory are: interrelatedness and interdependence of objects, attributes and events, holism, goal seeking, inputs, throughputs, outputs, negentropy, entropy, regulation, hierarchy, suprasystem, differentiation, equifinality, boundaries, environment, feedback, etc.

Models are the abstracts of a system and conceptual model theory has four distinct features: the organizing, the heuristic, the predictive and the mensurative. A dimension of evaluation corresponds to each of these four functions of the conceptual model theory in order to realize its organizing power, its fruitfulness, its strategic value and its usability. Other characteristics of a good model are originality, simplicity and realism. Evolution of a successful model undergoes various stages where a line of communication between the real world and the symbolic world is necessary to understand a system within its environment and then represent it in the desired model. The line of communication in the design of a theoretical isomorphic system, represented in conceptual graphical models, can be between existing facts and information about the relevant inputs, throughputs, outputs, linkages, constraints, etc. to the system in question.

A diagrammatical presentation of a system would include inputs, throughputs, outputs, boundary, environment, linkages, and subsystems.

CHAPTER V

FUNCTIONAL APPLICATION OF GENERAL SYSTEMS THEORY TO THE MECHANIZATION OF AGRICULTURE

In this chapter the functional application of the systems approach, based on General Systems Theory to the Mechanization of Agriculture, is the concern. Seven conceptual-graphical models of a theoretical isomorphic system for the Mechanization of Agriculture for adults have been developed.

Included in this chapter are the following six subsystems:

1. The subsystem for the Mechanization of Agriculture for the production of soybeans, wheat, and corn;
2. The training subsystem;
3. The financing subsystem;
4. The maintenance subsystem;
5. The extension subsystem; and
6. The marketing subsystem.

A Theoretical Isomorphic System for the Mechanization of Agriculture for Adults

Figure 5.1 is a conceptual-graphical model of a theoretical isomorphic system for the Mechanization of Agriculture for adults. A systems approach based on the application of General Systems Theory

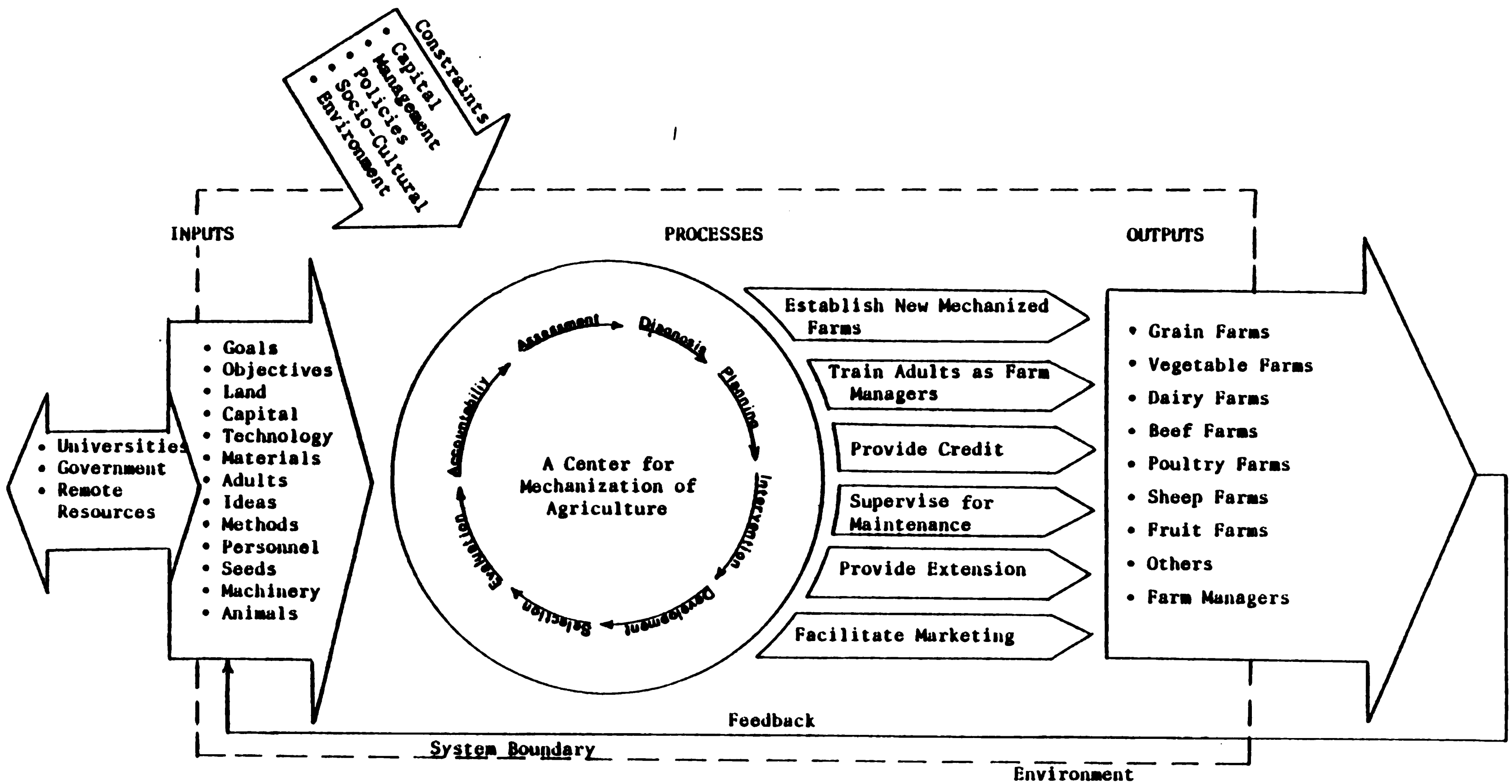

Figure 5.1 A Conceptual-Graphical Model of a System for Mechanization of Agriculture for Adults.

and Conceptual Model Theory is used to develop this theoretical system, which is comprised of six subsystems. In this theoretical system, inputs are transformed into outputs in order to establish a variety of new mechanized farms, along with supporting services. Attention is given to the goal, linkages, inputs, throughputs, outputs, feedbacks, constraints, boundary, and environment of such a system.

Goal

The goal for this proposed theoretical isomorphic system is the systematic Mechanization of Agriculture by mobilization of inputs, throughputs, and outputs to:

1. Establish new mechanized farms;
2. Train adults as farm managers, using the methods, on-the-job training and learning by doing;
3. Finance the farms in such a way that each adult may be able to buy a farm with reasonable monthly payments;
4. Supervise the farms for proper maintenance as long as needed;
5. Provide extension as life-long, non-formal education for adults; and
6. Facilitate marketing.

Linkage

The concept of linkage here is defined as the association of two or more systems, called systems co-actions, meaning related systems supporting each other toward their specific goals. In addition, the linkages of subsystems within a system themselves must be considered.

Universities, government, and international agencies, interested in agricultural and rural development, are other systems identified in this study which can make significant contributions to the success of the proposed system for the Mechanization of Agriculture for adults. Universities can contribute both in conducting relevant research, and by educating the necessary personnel for implementing such a system. The government can contribute by financing, introducing favorable agricultural policies, improving the roads, electrification of rural areas, providing land, storage facilities, fertilizers, etc., to facilitate the success of such a system in less developed areas.

Inputs

Inputs are everything that is "put into" any given system, generally. Inputs are in the form of matter, energy, and information. Matter is anything that occupies space and constitutes the substance of the physical universe. Inputs identified in the system are: goals, objectives, land, capital, technology, materials, adults, ideas, methods, personnel, seeds, machinery, and animals.

Throughputs

Troughputs are processes which transform the inputs, according to a plan and procedures of operation, in order to attain desired outputs by achieving short-run objectives toward long-run goals. Throughputs in the system will be realized in (1) a center for Mechanization of Agriculture and (2) on the newly established mechanized farms under such a system.

Throughputs, in the center for the Mechanization of Agriculture, were identified as: (1) assessment, (2) diagnosis, (3) purchasing, (4) intervention, (5) development, (6) selection, (7) evaluation, and (8) accountability. In this system each input would be processed according to these eight criteria for decision making, and ultimately to the outputs.

Outputs

Outputs are whatever the system produces and sends back into its environment. Outputs can be in the form of matter, energy, information, trained individuals, products, etc.

Outputs of the system under study were identified as: (1) grain farms, (2) dairy farms, (3) vegetable farms, (4) beef farms, (5) poultry farms, (6) sheep farms, (7) fruit farms, etc., and (8) farm managers.

Feedback

Sources of feedback may be from within and without the system. Feedback is the literal feeding back into the system, into its structure and processes, necessary evaluative information about the system, its activities, and its effect. Feedback enables the system to adjust and to correct its functions, based on the evaluations of its past performance toward equilibrium.

Systems Boundary

The systems boundary would separate whatever is within the system and whatever is without the system. The exchange of matter, energy, and information, are at their minimum level at the system's boundary. The system's boundary is identified by dotted lines in Figure 5.1.

Constraints

The constraints can be in two forms: internal and external. The internal constraints include misusing inputs and low quality transformation which ultimately downgrades the output. External constraints include the lack of inputs, socio-cultural resistance to change, the lack of favorable national policies for the Mechanization of Agriculture, the lack of communication channels, etc. Possible constraints against the system under study were identified as the lack of capital, the lack of proper management, the lack of favorable policies, socio-cultural resistance to change, and an unfavorable environment.

Environment

The environment of the system will depend on where this system will be utilized and implemented. The environment certainly affects the inputs, throughputs, and outputs of the system; therefore, preliminary studies must be conducted to make planning judgments for implementing such a system in a given environment.

The titles, authors, and publishers of some relevant literature are given in Appendix B.

Subsystem 1--A Subsystem for the Mechanization of Agriculture for the Production of Soybeans, Wheat, and Corn

Figure 5.2 is a conceptual-graphical model of the mechanization subsystem. Inputs are transformed into outputs in order to establish new mechanized farms for the production of soybeans, wheat, and corn, along with the supporting services. It can be viewed as a system in itself but when it is considered as part of the system for the Mechanization of Agriculture, it is a subsystem.

Goals

Goals for this subsystem are (1) the systematic Mechanization of Agriculture for the production of soybeans, wheat, and corn. These three agricultural commodities are being chosen as a possible rotation, necessary when selecting a cropping system; and (2) to receive problem messages from the farms and to conduct solution messages to the farms.

Linkages

Linkages in this subsystem would be local resources and also other remote resources which can provide the necessary inputs as needed by this subsystem.

Inputs

Inputs are identified as objectives, capital, land, machinery, equipment, seeds, fertilizers, chemicals, water, adults, and a time schedule.

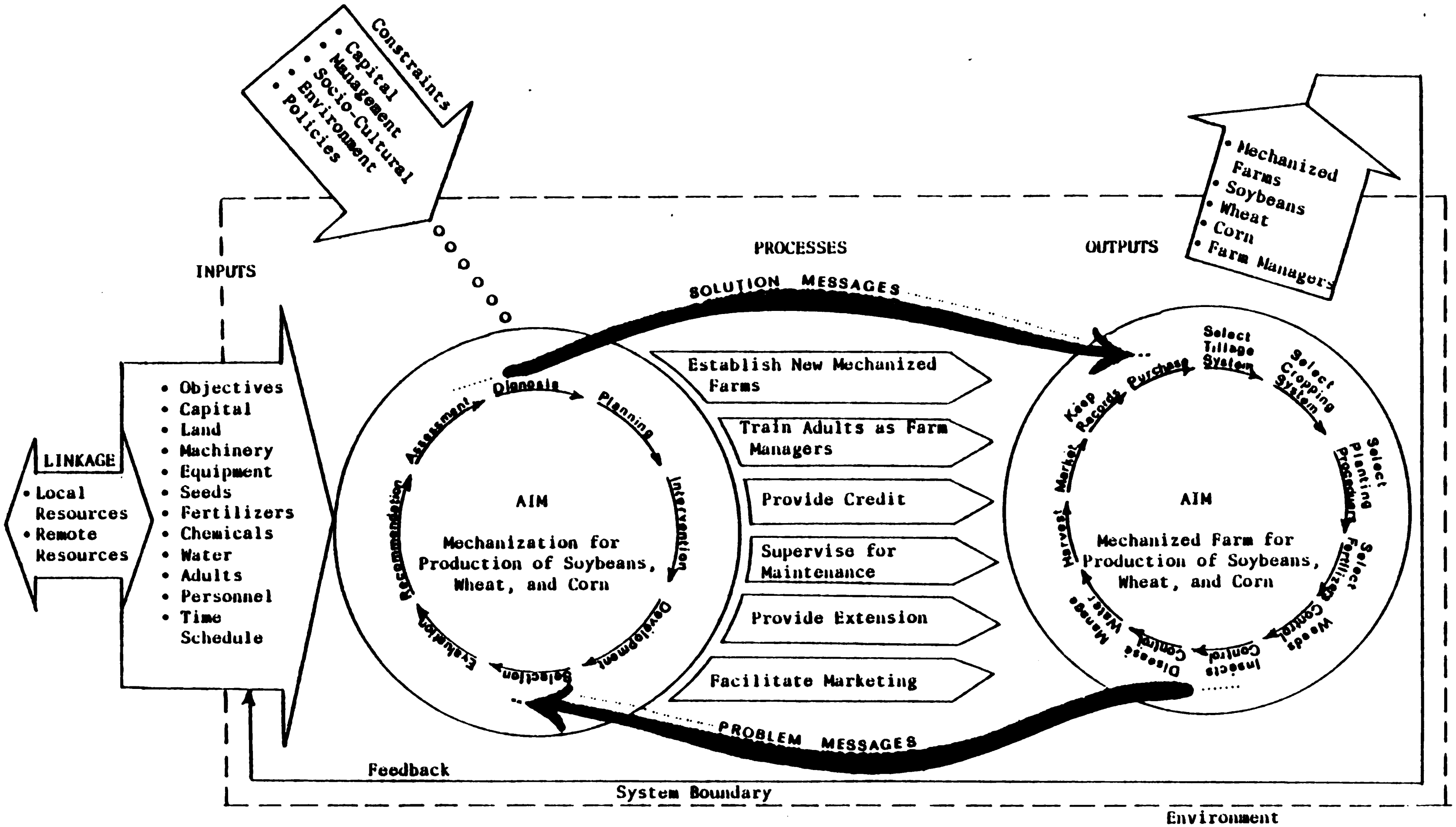

Figure 5.2 Subsystem 1--A Conceptual-Graphical Model of the Subsystem for Mechanization of Soybeans, Wheat, and Corn.

Throughputs

Throughputs at the center for the Mechanization of Agriculture for the production of soybeans, wheat, and corn, are identified as (a) assessment, (b) diagnosis, (c) purchasing, (d) intervention, (e) development, (f) selection, (g) evaluation, and (h) recommendation in order to:

1. Establish new mechanized farms for the production of soybeans, wheat, and corn as a possible rotation.
2. Train the adults as grain farmers to operate such farms.
3. Finance each farm to provide opportunities for the trained adult farmers to buy farms with reasonable monthly payments.
4. Supervise the farms with proper maintenance.
5. Provide the extension relevant to the production of soybeans, wheat, and corn.
6. Facilitate the marketing of the products within this system.

Throughputs on a Farm

Throughputs on a farm for the production of soybeans, wheat, and corn are identified as: (1) purchasing, (2) selecting tillage system, (3) selecting cropping system, (4) selection of planting procedures, (5) selecting fertilizers, (6) controlling weeds, (7) controlling insects, (8) controlling diseases, (9) management of water, (10) harvesting, (11) marketing, and (12) keeping records.

The production maintenance here refers to such processes as weed control, disease control, insect control, land fertility control, water control, and the like. Soybeans, wheat, and corn have been selected as a possible rotation recommended in this study.

Outputs

The outputs are identified as (1) soybeans, (2) wheat, (3) corn, (4) mechanized farms, (5) trained grain farm managers, and (6) extension publications relevant to the production of soybeans, wheat, and corn.

Constraints

The constraints are identified as the lack of capital, the lack of proper management, the lack of favorable agricultural policies, socio-cultural resistance to change, and an unfavorable environment, which may lower the success of such a system. Feedback, boundary, and environment are also considered in this conceptual-graphical model of a subsystem for the Mechanization of Agriculture for the production of soybeans, wheat, and corn.

The lines "problem messages" and "solution messages" in Figure 4.2 should be given careful attention. At first, a farm manager is expected to use the problem solving approach to solve the problems on the farm. Whenever there are problems on the farm which the farm manager cannot solve, he then communicates the problem messages to the center for the Mechanization of Agriculture. At the center a solution will be found and the solution messages communicated to the farm manager. Often it may happen that there is no immediate solution for a problem, and further research is needed. In this case, problem messages will be communicated to remote resources, such as universities or government agencies for conducting the proper research to find a solution.

Authors, titles, and publishers of some relevant literature to the Mechanization of Agriculture, and the production of soybeans, wheat, and corn, are given in Appendix B.

Subsystem 2--The Subsystem for On-the-Job Training

Figure 5.3 is a conceptual-graphical model of a subsystem for on-the-job training of adults. The inputs are transformed into outputs in order to provide the necessary learning activities relevant to the Mechanization of Agriculture.

Goals

The goals in this subsystem are: (1) on-the-job training of adult farmers to become farm managers; (2) adult farmers continuing education; (3) personnel continuing education; and (4) to receive problem messages from the farms and conduct solution messages to the farms. Learning by doing is emphasized in this subsystem as being the most relevant method of training farm practices.

Linkage

Since this subsystem has its aim for skill training and also adult education, linkage with universities, government, and remote resources would be highly desirable. These linkages would facilitate educational activities, both in the center and on the farm.

Inputs

Inputs are identified as aims, objectives, priorities, adults, structure, time schedule, content, learning aids, facilities, agricultural technology, educational technology, and capital.

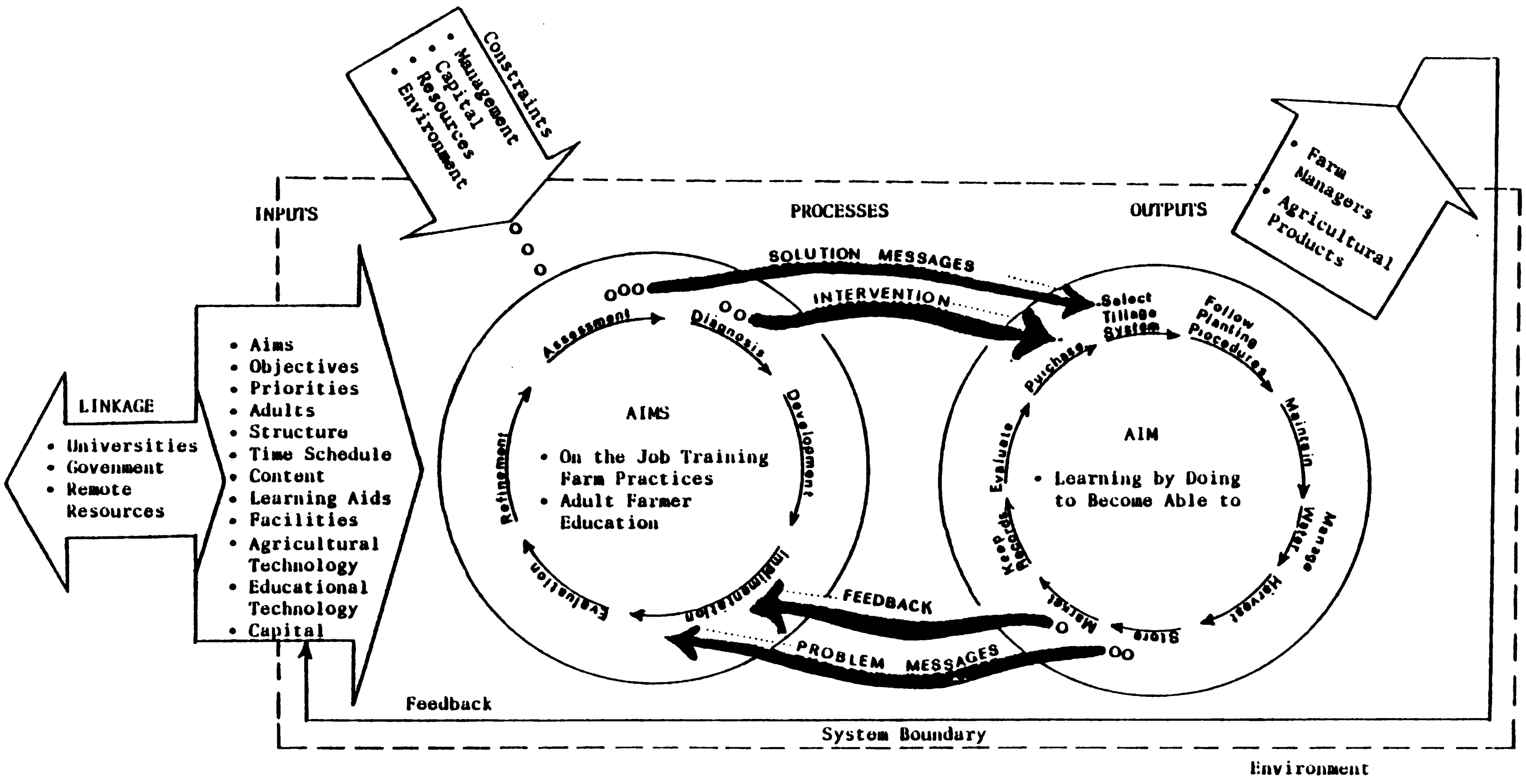

Figure 5.3 Subsystem 2--A Conceptual-Graphical Model of the Training Subsystem.

Throughputs

The throughputs in the training subsystem are identified as assessment, diagnosis, development, implementation, evaluation, refinement, and intervention in order to train adults on-the-job on a farm for the production of soybeans, corn, and wheat. This ensures that each adult will be able to properly conduct throughputs on the farm. These throughputs are identified as: purchasing, selecting, tillage systems, following planting procedures, maintenance, water management, harvesting, storing, marketing, keeping records, and evaluating.

Outputs

The outputs of this subsystem are (1) trained farm managers for the production of soybeans, corn, and wheat, and (2) the production of soybeans, corn, and wheat.

Constraints

The constraints may be identified as: the lack of management, the lack of capital, the lack of resources, and an unfavorable environment. Feedback, boundary, and environment were also considered in the training subsytem.

Training Objectives

After the on-the-job training activities are over, the adult is able to perform the following activities:

- purchase the necessary materials
- select a tillage system
- drive a tractor
- adjust a moldboard plow
- assemble the moldboard plow to the tractor
- start plowing
- determine the depth of planting

- determine the row width
- disassemble the moldboard plow
- assemble the disk to the tractor
- assemble the spring tooth harrow
- harrow correctly
- adjust a planter
- fill the planter with seeds
- determine seed population
- determine the kinds of fertiliziers
- determine the amount of fertilizer
- irrigate correctly and at the right time
- maintain drainage system if needed
- recognize wheat diseases
- recognize soybean diseases
- recognize corn diseases
- use right chemicals with right dosage for wheat diseases
- use right chemicals with right dosage for soybean diseases
- use right chemicals with right dosage for corn diseases
- control wheat weeds
- control soybean weeds
- control corn weeds
- use sprayer
- recognize wheat insects
- recognize soybean insects
- recognize corn insects
- control wheat insects
- control soybean insects
- control corn insects
- adjust a cultivator
- assemble the cultivator to tractor
- cultivate correctly
- disassemble the cultivator
- drive a combine
- determine the time for harvesting
- harvest the wheat
- harvest the soybeans
- harvest the corn
- drive a truck
- store wheat
- store corn
- store soybeans
- market wheat
- market corn
- market soybeans
- keep records
- determine the farm profit or loss
- determine the total farm income
- record farm expenses
- figure out the capital replacement allowance
- record wheat sales

- record soybean sales
- record corn sales
- record miscellaneous farm income
- figure out interests on direct cash expenses
- record cost for soybeans bought
- record cost for wheat bought
- record cost for corn bought
- record miscellaneous farm expenses
- record the cost of hired labor
- record property taxes
- determine cash available for non-real estate debt
- determine percentage of return to capital

In regard to electrical skills, the adult will be able to perform the following skills.

- apply basic electrical principles and measurement
- differentiate between AC and DC power factor and transformers
- apply basic devices and circuits
- select types and sizes of wires
- judge wire connectors and joints
- recognize outlets and switch boxes
- differentiate between service entrance and branch circuit
- estimate good lighting
- connect farm motors to power source
- plan an installation
- install service entrance and ground connection
- install specific outlets
- plan miscellaneous wiring
- wire heavy appliances
- plan farm wiring
- plan wirings of isolated buildings

In regard to plumbing skills, the adults will be able to perform the following skills.

- plan for plumbing
- work with cast iron pipes
- work with plastic DWV systems
- work with galvanized steel pipes
- work with rigid copper pipes
- work with soft copper tubing
- work with rigid plastic supply pipe
- work with cold water flexible pipe
- work with fixture fittings
- install water supply stops
- install a water heater
- install a water softener

Authors, titles, and publishers of some relevant literature to the training subsystem are given in Appendix B.

Subsystem 3--The Subsystem for Financing

Figure 5.4 is a conceptual-graphical model of a subsystem for providing and facilitating the necessary financial support for establishing new mechanized farms, training, extension, maintenance, marketing, and other relevant costs.

Goals

The goals in this subsystem are: (1) to search for new sources of credit, (2) to facilitate credit for other subsystems, (3) to provide credit for each or a group of adults to buy a mechanized and supervised farm established within the context of the system, and (4) to receive problem messages from the farms and to conduct solution messages to the farms.

Linkage

Banks, government, and universities are identified as local and remote resources where a linkage would be established for the functioning of this subsystem.

Inputs

The inputs in the financing subsystem are identified as capital, personnel, mechanized farms, and trained farm managers.

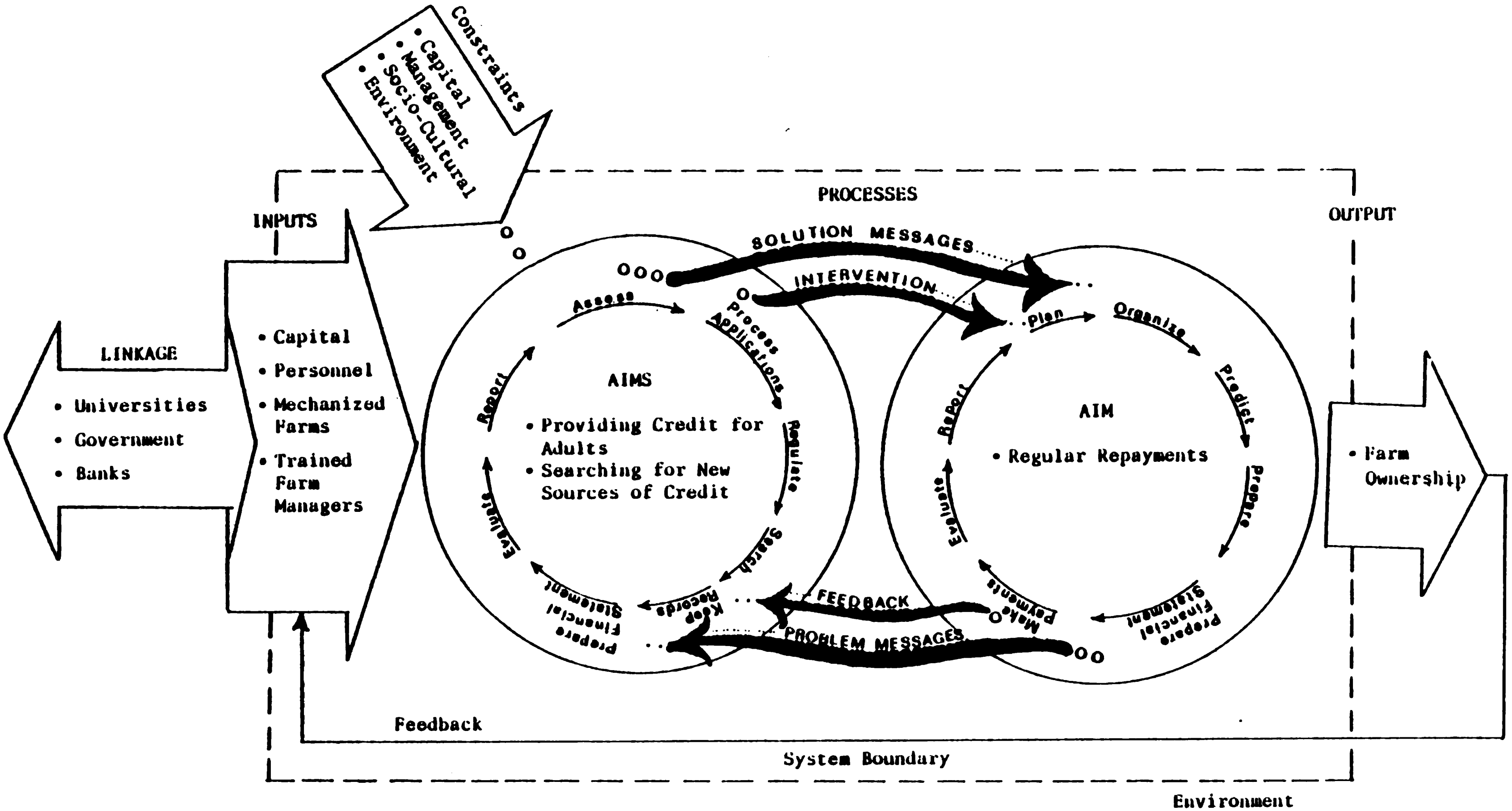

Figure 5.4 Subsystem 3--A Conceptual-Graphical Model of the Financing Subsystem.

Throughputs

The throughputs are identified as assessment, processing of the applications, regulations, searching for new sources of money, keeping records, preparing financial statements, the evaluation of activities, and the reporting of the progress.

The throughputs on the farm are identified as the planning, organizing and preparing for payments, predicting the time and problems, preparing the financial statements, making the payments, keeping the records, and evaluating the results.

Output

The output of this subsystem is identified as the farm owners managing a mechanized farm with reasonable monthly payments.

Constraints

The constraints against this subsystem's proper functioning may be identified as the lack of capital, the lack of proper management, socio-cultural resistance, and an unfavorable environment. The subsystem's boundary and feedback also are considered in the design of the training subsystem.

Authors, titles, and publishers of some relevant literature to the credit subsystems are given in Appendix B.

Subsystem 4--The Subsystem for Proper Maintenance

Figure 5.5 is a conceptual-graphical model of the subsystem for supervising the farms established within the context of the system for proper maintenance.

Goals

The goals in the maintenance subsystem are: (1) to supervise the farms for proper maintenance, and (2) to receive problem messages from the farms and conduct solution messages to the farms.

Linkage

The linkages in this subsystem are identified as local resources and remote resources for providing the necessary inputs for this subsystem.

Inputs

The inputs are identified as land, farm machinery, farm buildings, equipment, shop tools, farm records, and farm products.

Throughputs

The throughputs in the maintenance subsystem are identified as assessment, observation, production, taking preventive action, the evaluation, the recommendations and reporting in order to see that on each farm land, the machinery, equipment, buildings, tools, records, and products are properly used, stored, maintained, repaired, replaced, recorded, and evaluated. Throughputs on the farm were identified as

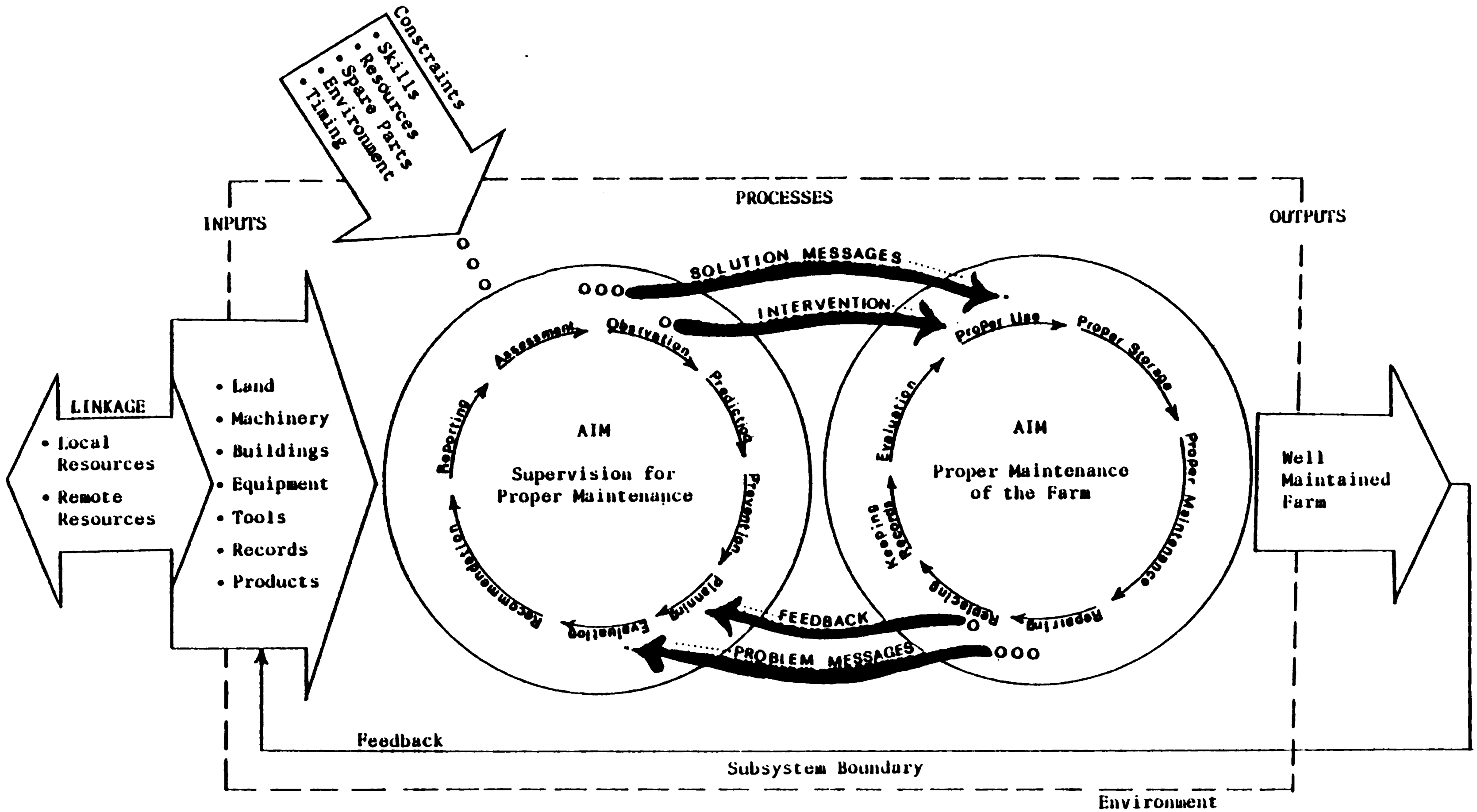

Figure 5.5 Subsystem 4--A Conceptual-Graphical Model of the Subsystem for Maintenance.

proper use of machinery, equipment, tools, the proper storage, proper maintenance, repairing, replacing defective parts, the keeping of records, and evaluation.

Outputs

The outputs of this subsystem are well-maintained farms for a more profitable operation.

Constraints

The constraints of the maintenance subsystem may be identified as the lack of skills, the lack of resources, socio-cultural resistance to change, and an unfavorable environment. The feedback, boundary, and environment are also considered in this subsystem.

Objectives

The objectives of supervision in the maintenance subsystem are to see that the adult will be able to maintain properly the following:

- tractor
- moldboard plow disc
- harrow
- planters
- grain drill
- cultivator
- combine
- spraying equipment
- shop tools
- field tools
- soil fertility
- farm ponds
- farm waterways
- farm buildings
- farm shop
- disease free crops
- insect free crops
- weed free crops
- timetable of operations
- chemical storage
- machinery storage
- equipment storage
- soybean storage
- wheat storage
- corn storage
- farm records

Authors, titles, and publishers of some resources relevant to this subsystem are given in Appendix B.

Subsystem 5--The Subsystem for Extension (Communication of Innovations)

Figure 5.6 is a conceptual-graphical model of the extension sybsystem. The inputs are transformed into outputs in order to communicate innovations relevant to the Mechanization of Agriculture and its management.

Goals

The goals of the extension subsystem are (1) communication of the innovations to the adult farmers and the personnel running the system, in order for them to acquire higher quality skills and to adapt new practices; and (2) to receive problem messages from the farms and to conduct solution messages to the farms within the context of this system. The extension subsystem seeks to solve relevant problems by using the existing knowledge and technology or by conducting new research for finding a suitable solution.

Linkage

The linkages of the extension subsystem are identified with universities, the government, and remote resources. The linkages with universities and the government are crucial since universities can contribute new research findings, and the government can facilitate extension activities and planning. This offers a wide variety of assistance in terms of in-service training, financial assistance, and evaluative activities.

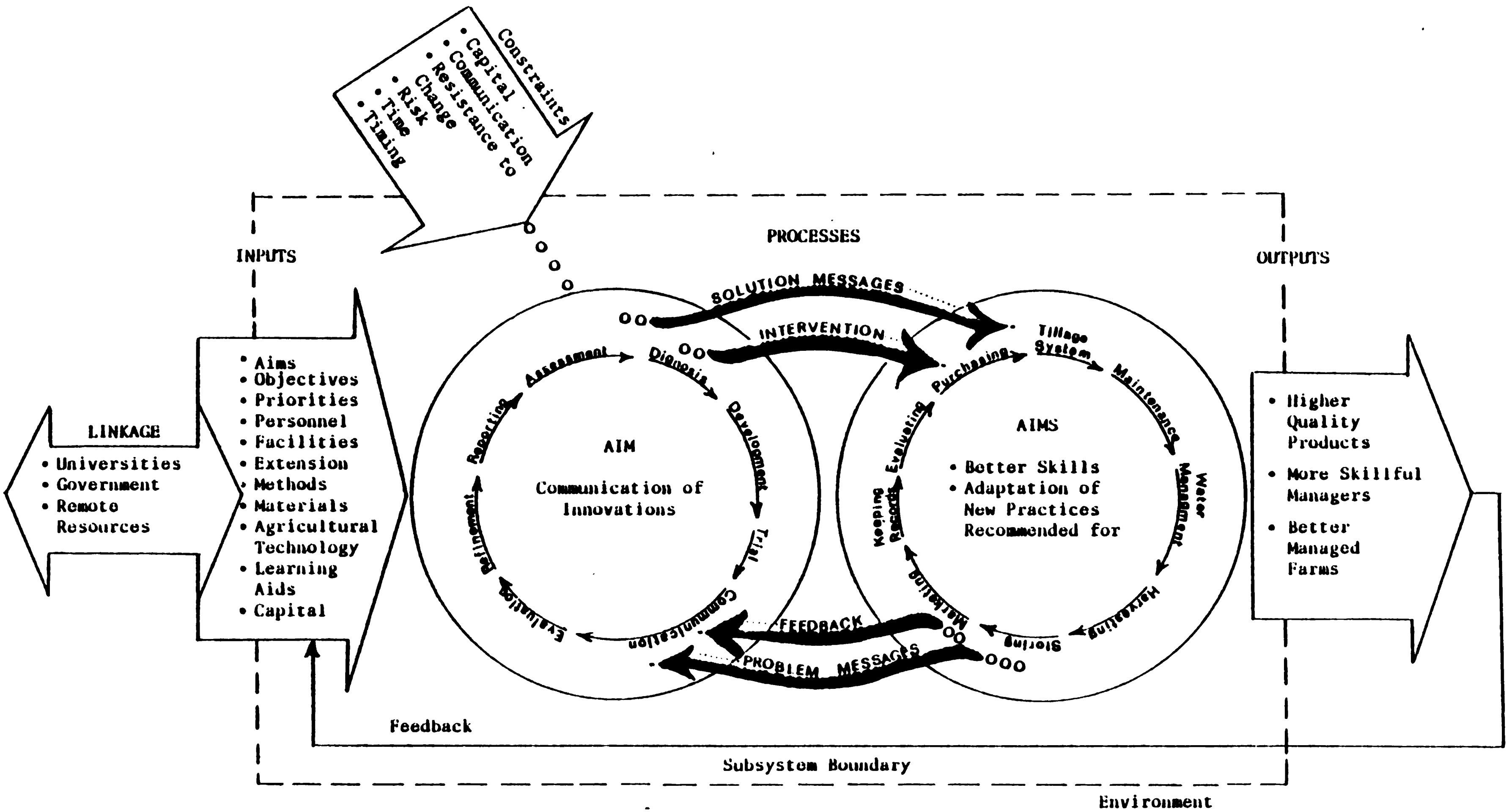

Figure 5.6 Subsystem 5--A Conceptual-Graphical Model of the Subsystem for Extension.

Inputs

The inputs for the extension subsystem are identified as aims, objectives, priorities, personnel, facilities, extension methods, materials, agricultural technology, learning aids, and capital.

Throughputs

The throughputs for the extension subsystem are identified as assessment, diagnosis, development, trial, communication, evaluation, refinement, and reporting, to realize higher quality throughputs on the farm, along with communication of innovations related to purchasing, the tillage systems, maintenance, water management, harvesting, storing, marketing, keeping of the records, and evaluation, in this case, for the production of soybeans, corn, and wheat.

Outputs

The outputs in the extension subsystem are identified as higher quality products, more skillful managers, and better managed farms, along with relevant extension publications.

Constraints

The constraints in the extension subsystem may be identified as capital, the problems of communication, resistance to change, the risk involved, time, timing, and an unfavorable environment. Feedback, boundary, and environment are also considered in this subsystem.

Objectives

Some of the objectives identified for the extension subsystem are (1) the publication of guides, and (2) on-the-farm demonstrations of relevant agricultural practices for the production and marketing of soybeans, wheat, and corn. The extension guides will incorporate the following subjects:

- understanding soil classifications
- suitability of soil
- irrigation scheduling and management
- soil sample gathering
- water erosion prevention
- wind erosion prevention
- understanding tractors
- maintenance of tractors
- moldboard plow--adjustment and maintenance
- disk--adjustment and maintenance
- planters--use, adjustment and maintenance
- grain drills--use, adjustment and maintenance
- cultivators--use, adjustment and maintenance
- combines--use, adjustment and maintenance
- storage of wheat
- storage of corn
- storage of soybeans
- better marketing
- trucking
- record keeping
- new small shop tools
- power shop tools
- hand field tools and equipment
- power field equipment
- essential fertilizers
- secondary elements
- better selection of seed
- chemicals and their use
- wheat diseases
- wheat insects
- wheat weeds
- soybean diseases
- soybean insects
- soybean weeds
- corn disease
- corn insects
- corn weeds
- plowing (know how)
- discing (know how)

- harrowing (know how)
- spraying (know how)

Authors, titles, and publishers of some books and publications relevant to the extension subsystems are given in Appendix B.

Subsystem 6--The Subsystem for Marketing

Figure 5.7 is a conceptual-graphical model of the marketing subsystem. Inputs are transformed into outputs in order to facilitate marketing of agricultural commodities produced within the context of this system.

Goals

The goals of this subsystem are: (1) to provide marketing channels for the agricultural products, (2) to regulate such activities, and (3) to receive problem messages from the farms and to conduct solution messages to the farms.

Linkages

The linkages in this subsystem may be identified as local markets, remote markets, and government. The linkage with the government is very important, because a marketing network without government planning for the construction of roads, storage facilities, and transportation would constitute a great constraint.

Inputs

The inputs in this case are soybeans, wheat, and corn, which are produced on grain farms within this system.

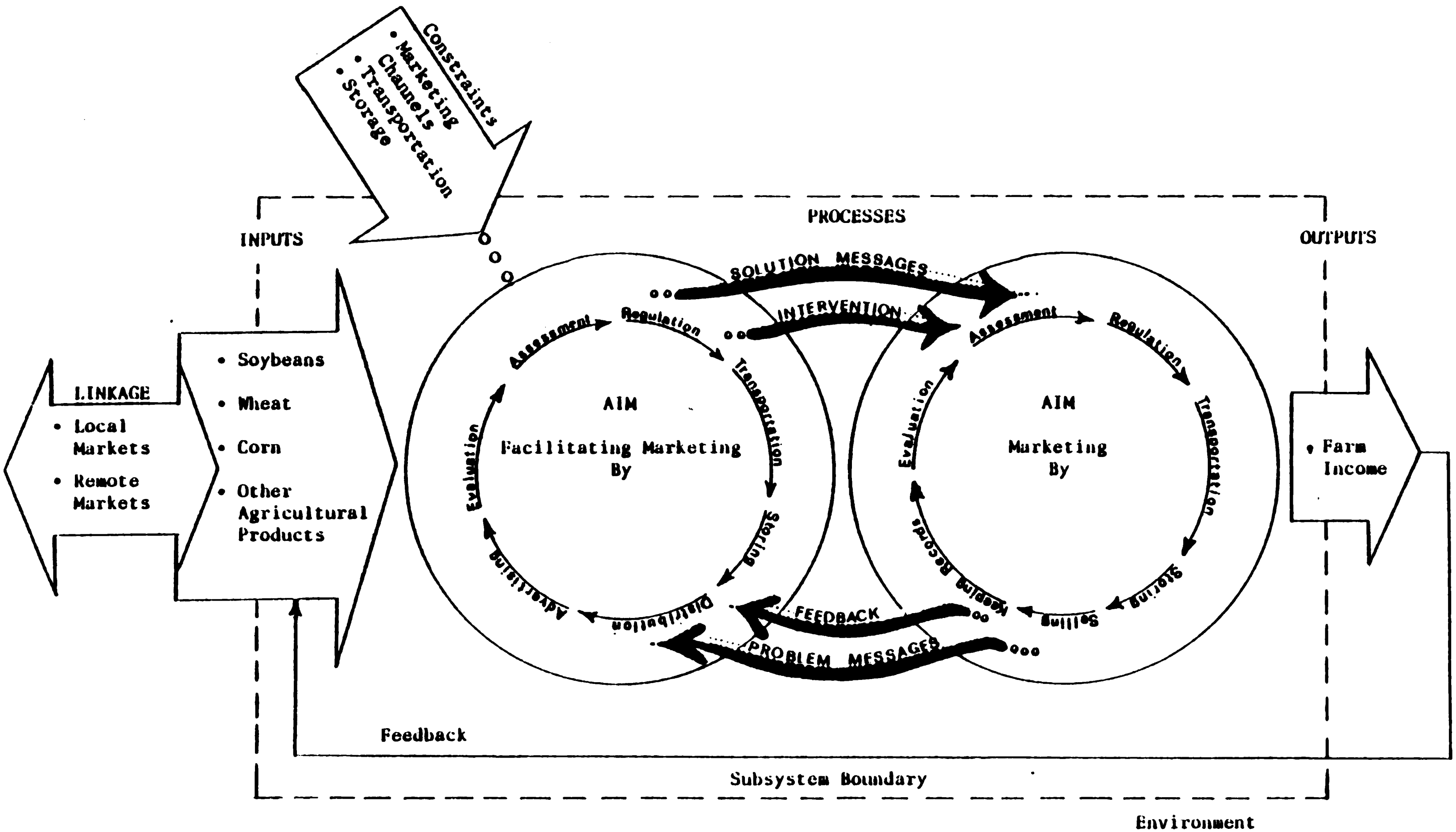

Figure 5.7 Subsystem 6--A Conceptual-Graphical Model of the Subsystem for Marketing.

Throughputs

The throughputs for the marketing subsystem are identified as assessment, regulation, transportation, storing, distribution, advertising, and evaluation. On-the-farm throughputs done by the farmer are identified as the assessment, regulation, transportation, storing, selling, keeping of records, and the evaluation.

Output

The output of the marketing subsystem for the farm manager is the farm income and a marketing network.

Constraints

Constraints in the marketing subsystem may be identified as the lack of marketing channels, the lack of local storage facilities, and an unfavorable environment. The feedback, boundary, and environment are also considered in this subsystem.

Authors, titles, and publishers of some books and publications relevant to the marketing subsystems are given in Appendix B.

Discussion

Theoretical Considerations and Assumptions

The characteristics of change are considered in Chapter II. These characteristics, according to Zaltman and Duncan, are the relative advantage, the impact on social relations, divisibility, reversibility, complexity, compatibility, communicability, time, and the timing.

For further evaluation of a model, one may answer the following questions:

1. What are the relative advantages of the proposed model for change on the status quo ante?

2. What impacts may the proposed model for change have on social relations?

3. To what extent is the proposed model for change divisible?

4. To what extent is the proposed model for change reversible?

5. To what extent is the model complex?

6. To what extent is the model compatible with similar approaches?

7. To what extent is the model communicable?

8. How much time is required and what is the role of timing?

A discussion of each of these questions follows.

1. What are the relative advantages of the proposed model for change on the status quo ante?

This model has many advantages in comparison with the traditional mechanization efforts, because (a) it considers the totality of a system for the Mechanization of Agriculture; (b) it identifies inputs, processes, outputs, and feedback, thereby creating a basis for accountability, and (c) the relationships between the subsystems and the processes within each subsystem and within the system as a whole, are identified. Therefore, it can be used as a frame of reference for decision making and planning judgments.

2. What impacts may the proposed model for change have on social relations?

It seems that the model would have a great impact on social relations, since its aim is to change the traditional system of farming to a mechanized system of farming--with the introduction of new inputs, throughputs, and outputs. These inputs and processes would certainly affect social relations and would also create a wide variety of new occupations.

3. To what extent is the proposed model for change divisible?

Divisibility refers to the extent to which a change can be implemented on a limited scale. Considering the proposed model in this study, one can easily see that this model can be implemented on a limited scale as well as on a large scale. It can be implemented for a single commodity or for a wide variety of agricultural commodities.

4. To what extent is the proposed model for change reversible?

The term reversibility is closely related to divisibility. It refers to the ease with which the status quo ante can be established if a change is introduced but is later rejected. The concept of reversibility also applies to the model proposed in this study since it can be implemented in co-existence with the traditional system of farming--with the final goal of replacing the traditional system of farming with a mechanized system of farming. Therefore, if rejected, the status quo ante can easily be established.

5. To what extent is the model complex?

The proposed model in this study is complex, because the nature of changing from the relatively simple, traditional system of farming to the complex multifactor Mechanization of Agriculture calls for many more inputs and throughputs toward the realization of outputs. General Systems Theory has been applied to identify inputs, throughputs, outputs, linkages, and subsystems, which are represented in the conceptual-graphical models, in order to clarify the complexity of the job to be done. It is worthy to consider that as the degree of complexity rises in a given proposed model of change, there is a higher need for leadership and management for success.

6. To what extent is the model compatible with similar approaches?

There is no doubt that the proposed models in this study are more compatible with similar efforts toward the Mechanization of Agriculture since: (a) standard mechanized farms are established, (b) standard inputs are provided, (c) standard throughputs are provided, (d) on-the-job training prepares the adults as farm managers, and (e) supporting services are provided.

7. To what extent is the model communicable?

Since the models of the system for the Mechanization of Agriculture in this study have been based on the application of General Systems Theory, and inputs, throughputs, outputs, constraints, subsystems, environment, feedback, and relationships have been identified, and are represented in conceptual-graphical models, the model has a high degree of communicability and the relationships between inputs, throughputs, outputs, subsystems, and linkages can easily be seen.

8. How much time is required and what is the role of timing?

A five-year time period would be recommended to implement the proposed system for the Mechanization of Agriculture for adults. This time limit has been chosen arbitrarily. Since a system is a set of interrelated, interdependent elements in interaction, timing is most crucial in order to realize full efficiency.

CHAPTER VI

CONCLUSIONS, IMPLICATIONS, DISCUSSION, AND RECOMMENDATIONS

Of concern in this final chapter of the study are the conclusions, implications, discussion, and recommendations, which are theoretical in nature and are systems oriented.

Conclusions

The main purpose of the study was to design a theoretical isomorphic system for the Mechanization of Agriculture for adults. The second purpose was to identify a method for the design of such a system, and the third purpose was to use the Tel-Plan Computer Program 70 in order to develop a model financial budget based on Michigan prices for the production of soybeans, wheat, and corn as a cropping system.

Systems approach, based on the application of General Systems Theory and model theory, is identified as the methodology for the design of a theoretical isomorphic system for the Mechanization of Agriculture for adults which is represented in seven conceptual-graphical models. These models are: (1) a conceptual-graphical model of a system for the Mechanization of Agriculture for adults in general; (2) a conceptual-graphical model of a subsystem for the Mechanization of Agriculture for the production of soybeans, wheat, and corn, (3) a conceptual-graphical model of a training subsystem for the training of adults on the farm to become farm managers, (4) a conceptual-graphical model of a credit subsystem for providing the necessary credit for each adult, in order to buy a farm with a reasonable monthly payment, (5) a conceptual-graphical model of a maintenance subsystem for supervising the farms in order to extend proper maintenance, (6) a conceptual-graphical model of an extension subsystem for the communication of innovations as a life-long activity to provide the farms and farm managers with the latest research findings, (7) a conceptual-graphical model of a marketing subsystem to facilitate the marketing for agricultural products which have been produced within the context of such a system.

Systems approach is a Gestalt type of approach aiming to see the "whole" at the Macro level with the notion of supersummation, meaning the whole is greater than the sum of its parts. General Systems Theory can be applied in designing a theoretical isomorphic system for the Mechanization of Agriculture for adults. Included in this theory are the following characteristics: (1) interrelationship and interdependence of objects, attributes, events and the like, (2) holism, (3) goal seeking, (4) inputs, (5) throughputs, (6) outputs, (7) entropy, (8) negentropy, (9) regulation, (10) hierarchy, (11) differentiation, (12) equifinality, (13) existence in time and space, (14) boundaries, (15) environment, (16) dynamic interaction, (17) structure, and (18) progressive mechanization.

Model theory can also be applied in designing a theoretical isomorphic system for the Mechanization of Agriculture to be represented in the conceptual-graphical models. Characteristic of model theory are four distinct functions: (1) organizing, (2) heuristic, (3) predictive, and (4) mensurative.

A dimension of evaluation of the models corresponds to each of these four functions of the model: (1) how great is a model's generality or organizing power? (2) what is its fruitfulness, or heuristic value? (3) how important or strategic are the verifiable predictions which it yields? and (4) how accurate are the operations of measurement that can be developed with its aid? Other characteristics of a good model include (1) originality, (2) simplicity, and (3) realism.

Conceptually, a system is defined as a set of interrelated, interdependent elements in continuous action, interaction, and transaction within the system, and with the environment of the system, exchanging matter, energy, and information in the form of inputs, throughputs, outputs, and feedback. The system has both subsystems and a suprasystem, characterized by supersummation, meaning the whole is greater than the sum of its parts.

Linkage is defined as the association of two or more relevant systems, in order to facilitate their functions according to each of the system's goals and objectives. Linkages in this study for a theoretical isomorphic system for the Mechanization of Agriculture for adults are identified as universities, the government, local resources, and remote resources.

Input is defined as matter, energy, and information which are utilized in a given system. In this study, the inputs for the Mechanization of Agriculture are identified as: (1) land, (2) machinery, (3) materials, (4) ideas, (5) adults, (6) fertilizers, (7) equipment, (8) objectives, (9) structure, (10) content, (11) facilities, (12) tools, (13) mechanized farms, (14) seeds, (15) animals, (16) capital, (17) technology, (18) methods, (19) personnel, (20) chemicals, (21) aims, (22) priorities, (23) time schedule, (24) learning aids, (25) buildings, (26) farm managers, and (27) others.

Each system has subsystems and a suprasystem. Subsystems are components of a system, in fact, all systems are subsystems to a larger and more complex system, which is called a suprasystem. Subsystems in a theoretical isomorphic system for the Mechanization of Agriculture are identified as: (1) farm establishment subsystm, (2) training subsystem, (3) financing subsystem, (4) maintenance subsystem, (5) extension subsystem, and (6) marketing subsystem.

Throughputs are processes which transform the inputs according to a plan of operation with specified objectives and goals to outputs. Throughputs, in a system for the Mechanization of Agriculture for adults, are identified as: (1) assessment, (2) diagnosis, (3) intervention, (4) development, (5) selection, (6) evaluation, (7) reporting, (8) recommendation, (9) implementation, (10) refinement, (11) trial, (12) communication, (13) prediction, (14) regulation, (15) preparation, (16) processing, (17) searching, (18) coordination, and (19) accountability.

Outputs are the products of a system where it can be in the form of matter, energy, and information. Outputs, in a theoretical isomorphic system for the Mechanization of Agriculture for adults, are identified as: (1) grain farms, (2) dairy farms, (3) poultry farms, (4) vegetable farms, (5) beef farms, (6) sheep farms, and (7) other farms. Agricultural products, well maintained farms, trained farm managers, farm owners, and farm income were also identified as outputs of the proposed system. The implementation of such a system contributes to rural development; thus, it is conducive to national development.

Constraints are known, sudden and unknown limitations, or restrictions imposed upon a system that affect its normal operations. Constraints, in a theoretical isomorphic system for the Mechanization of Agriculture, are identified as the lack of (1) capital, (2) favorable agricultural policies, (3) resources, (4) proper management, (5) favorable environment, (6) proper skills, (7) time, (8) timing, (9) facilities, (10) machinery and equipment, and (11) also as possible sociocultural resistance to change and to the risk involved in the proper implementation of such a system.

Implications

General Systems Theory can be applied in designing a theoretical isomorphic system for the Mechanization of Agriculture for adults. General systems perspective has provided for the inputs from all segments of the existing knowledge which is relevant to the success of a system for the Mechanization of Agriculture for adults, and has also provided for identifying the linkages with other systems within a specified environment.

This perspective has provided for the development of a goal statement for a system for the Mechanization of Agriculture, and six subgoal statements for each subsystem identified within the context of this system. General systems perspectives makes it possible to make provisions for the evaluation and accountability and problem identification, where they are communicated as problem messages and solution messages. It has provided for the identification of inputs, throughputs, outputs, feedback, constraints, linkages, relationships, boundaries, and environment for the designing of a theoretical isomorphic system for the Mechanization of Agriculture for adults.

This perspective has provided conceptual links between relevant disciplines to the Mechanization of Agriculture by presenting professionals with a common language, thus allowing for a meaningful dialogue in viewing the Mechanization of Agriculture in its totality with the notion of supersummation, meaning the "whole" is greater than the sum of its parts. It has permitted the organization of vast numbers of theories and concepts into a meaningful framework as a basis for the planning judgment.

General systems perspective, with its focus on systems processes, has facilitated a process orientation to the Mechanization of Agriculture along with its supporting subsystems, such as training, maintenance, extension, marketing, financing, which is dynamic and applicable in a wide variety of food production and the Mechanization of Agriculture in developing countries.

This perspective provides the individual with a methodology for seeking directly to design better systems with the following goals: (a) improving the productivity, (b) realizing more efficiency, (c) ensuring subsystems' relevancy, (d) guiding system's growth and development, (e) improving the systems processes and procedures, (f) identifying inputs, throughputs, and outputs of the system, (g) emphasizing feedback toward upgrading the system's performance, (h) providing a basis for accountability, (i) facilitating decision making, (j) maximizing resource allocation and utilization, (k) identifying interrelationships and interdependence of the subsystems, (l) using a Gestalt approach for both visualizing and conceptualizing a system, (m) opening the avenue for further and relevant research, and (n) facilitating national planning and decision making.

By considering the "whole," certain patterns and relationships in the Mechanization of Agriculture for adults have emerged which have not been seen previously because each component of the system has been dealt with in isolation.

From a general systems perspective in this study, agricultural mechanization is a discipline which aims toward mechanized production of agricultural products under the management of an adult individual as a cognitive, dynamic system capable of self-regulation, goal seeking, growth, development and learning. Because man himself is an open system, his boundaries are permeable to inputs of matter, energy, and information. Thus, techniques of intervention can be used to help adults to help themselves by facilitating the establishment of new mechanized farms, facilitating on-the-job learning, providing credit with reasonable monthly payments, supervising for maintenance, communicating innovations, and facilitating marketing.

Discussion

On-the-job training, identified in this system, not only provides the adult individuals with the opportunity to learn by doing, but provides agricultural commodities at the same time. Furthermore, since the adult individual is learning and working with actual machines and equipment, he will be able to operate such machinery and equipment immediately after the training is over.

It seems that the motivation for learning in such a system will be very high, because (1) the adult individual knows that this farm will eventually belong to him, if he can prove he is able to manage it professionally, and (2) he works with machines and equipment, methods and materials which are practical in the local environment, and will be supported by maintenance subsystem when the training is over--which will increase the degree of success.

Because this system is an open system, it is exchanging matter, energy, and information with its environment and with the remote resources. It can therefore become an adaptive system, capable of adjustment within its environment.

Extension has an important part in this system where the communication of innovations as a life-long process is recommended. Extension goals and objectives can easily be identified, since the kinds of farms are known, inputs, throughputs, and outputs are prescribed. Relevant research can be conducted to overcome the local problems within the context of this system for the Mechanization of Agriculture.

Recommendations

This system can be implemented in coexistence with the traditional system of farming where the aim is gradual replacement of the traditional farming with mechanized farms for the production of different agricultural commodities. Before implementing such a system, studies should be conducted to determine the availability of resources, technical know-how, machinery and equipment, qualified personnal, and socio-cultural environmental conditions. This theoretical isomorphic system for the Mechanization of Agriculture for adults will be the most successful where the necessary inputs are available, and also some prerequisites, such as the existence of roads, tillable lands, electricity, fuel and other relevant facilities exist, or can be brought into existence by the government. The use of local coordinators is highly recommended for the implementation of such a system.

Five types of evaluations are recommended when this model is implemented: (1) management goals and objectives, (2) inputs, (3) throughputs, (4) outputs, and (5) attitudes.

Management Goals and Objectives Appraisal

This appraisal helps to determine the degree to which system and subsystem goals and objectives have been achieved. It relates inputs, throughputs, and outputs to the program requirements, problems, and opportunities. Both the internal measure and the external measure can contribute to the appraisal function.

Internal measure. The internal measure is the surveying of the personnel reaction (opinion) about the performance of the system and subsystems as a measure of staff competence.

External measure. The external measure is the auditing by a management consulting firm of the degree to which stated goals and objectives have been met.

Input Analysis

This analysis provides information about the strength, weakness, quality, and availability of inputs specified within the context of this system, in order to provide and determine a set of standards for inputs.

Internal measure. The internal measure is the degree to which money, resources, energy, skills, and information are available, and the degree to which they meet the standard.

External measure. The external measure is the degree to which money, resources, energy, skills, and information are or will be available, according to formal government statistics.

Throughput Analysis

This analysis provides information about the strength, weaknesses, and quality of the processes specified in the system and subsystems of this theoretical isomorphic system for the Mechanization of Agriculture for adults, in order for the system performance, or its future conduct, to be strengthened.

Internal measure. The internal measure is the self-analysis and cognitive testing of the personnel and performance testing of the machinery and equipment.

External measure. The external measure is the standard tests for personnel and performance standard tests for machinery and equipment.

Output Analysis

This analysis provides information for determining whether outputs of the system and subsystems have the desired quality, and whether they are as specified in goals and objectives of the system, and for determining whether the processes employed to achieve them should be continued, modified, or terminated.

Internal measure. The internal measure is the observing of on-the-job performance of adults as farm managers, cognitive testing of basic skills, and comparing the quality and quantity of the agricultural products with desired standards.

External measure. The external measure is the marketability of the products and the selling prices.

Attitude Analysis

This analysis provides information about the attitude of the individuals involved in the processes (personnel, adult farm managers) to determine their attitudes toward the activities of the system.

Internal measure. The internal measure is the personnel response to a questionnaire and the adult farm managers response to a questionnaire.

External measure. The external measure is a public sampling to respond to certain questions about the system performance in general.

It is also recommended that this system be implemented by an independent institute affiliated with both the ministry of agriculture or a similar ministry and the agricultural colleges of the main universities.

Leadership, management, and control are fundamentals for the success of a system. Superior system leaders and system managers can be distinguished by their acceptance of the responsibility for achieving measurable results as it has been and can be identified within the context of a given system. Therefore, one must note that leadership, management, and control are the keys for the successful implementation of the system for the Mechanization of Agriculture for adults proposed in this study. Successful implementation of this system contributes to rural development. Thus, it is conducive to the national development.

APPENDIX A

COST ANALYSIS FOR THE PRODUCTION OF CORN, WHEAT, AND SOYBEANS

APPENDIX A

COST ANALYSIS FOR THE PRODUCTION OF CORN, WHEAT, AND SOYBEANS

Tel-Plan Computer Program 70

For the purpose of developing a theoretical isomorphic cost model for the production of corn, wheat, and soybeans, the following assumptions[1] have been made: (1) there are 360 acres of tillable land; (2) prices on corn, wheat, and soybeans, respectively, are $2.50, $3.00, and $6.50; (3) hired labor is 220 hours, as reflected in the past year's records with similar size operation; and (4) yields of corn, wheat, and soybeans, respectively, are 100 bu/acre, medium yield, 45 bu/acre medium yield, and 30 bu/acre medium yield. Tel-Plan Computer Program 70 has been employed to acquire the following results (Table A.1).

Table A.1 Total Farm Summary--Tel-Plan Computer Program 70

Total sales ($)	69,600
Cash expenses ($)	29,728
Management return ($)	32,272
Rate earned on investment ($)	0
Net farm profit ($)	39,972
Family labor income	39,972
Total acres	360
Labor balance (hours)	649

[1]Assumptions are based on Agricultural Economics Report (Report No. 350, revised, January 1979) revised Michigan crops and livestock estimated 1979 budgets by Sherill B. Nolt, Archibald R. Johnson, Gerald D. Schwab, W. Conrad Search, and Myron P. Kelsey, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan.

Schedule F Summary

Table A.2 is the Schedule F summary for the production of soybeans, wheat, and corn, where crop income, gross income, total cash expenditure, total expenditure, and net profit is estimated.

Table A.2 Schedule F Summary for Soybeans, Wheat, and Corn--360 Acres--1979 Michigan Prices

	($)
Crop income	69,600
Other income	0
Gross income	69,600
Harvest labor	0
Non-harvest labor	663
Repairs, maintenance	2,652
Interest	1,384
Rent	0
Seeds	4,018
Fertilizer	9,792
Insect spray	60
Weed spray	3,144
Fungicide spray	0
Other chemicals	0
Machine hire	0
Crop supply	0
Packages	0
Fuel and oil	1,608
Storage	0
Taxes	0
Insurance	0
Utilities	792
Trucking	2,532
Marketing	2,220
Livestock expense	0
Other	864
Total cash expense	29,728
Depreciation	0
Total expense	29,728
Net profit	39,972

Enterprise Budgets

Table A.3 is the Enterprise Budget for 120 acres of soybeans; Table A.4 is the Enterprise Budget for 120 acres of corn; and Table A.5 is the Enterprise Budget for 120 acres of wheat; all are based on the 1979 Michigan prices.

The soybeans Enterprise Budget is presented in Table A.3, where the income from 120 acres medium yield (30 bushels per acre) soybeans, has been estimated at $23,400, when the selling price for soybeans is $6.50 per bushel and total cash expenditure is $7,369. The net income has been estimated at $16,141.

In Table A.4, income from 120 acres, medium yield (100 bushels per acre) corn has been estimated at $30,000, when the selling price for corn is $3.00 per bushel, and total cash expenditure has been estimated at $14,405; therefore, a net income of $15,595 will be earned.

In Table A.5, income from 120 acres, medium yield (45 bushels per acre) wheat has been estimated at $16,200, when the selling price for wheat is $3.00 per bushel, and total cash expenditure has been estimated at $7,954; therefore, a net income of $8,246 will be earned.

Discussion

Based on average prices in Michigan in 1979, Tel-Plan Computer Program 70 net profit for 360 acres grain production (120 acres soybeans, 120 acres wheat, and 120 acres corn) was estimated at $39,972 (see Tables A.3, A.4, and A.5). In these tables the overhead costs have not been considered.

Table A.3 Enterprise Budget for Soybeans Sold, Medium Yield, 120 Acres (Enterprise 39)[a]

Soybeans (120 Acres)	Total	Per Acre	Per Acre
Yield (bushel)	3,600	30.00	1.00
Price ($)	6.50	6.50	6.50
	($)		
Crop income	23,400	195.00	6.50
Harvest labor	0	0.00	0.00
Non-harvest labor	187	1.56	0.05
Repairs, maintenance	780	6.50	0.22
Interest	342	2.85	0.09
Seeds	1,020	8.50	0.28
Fertilizer	1,716	14.30	0.48
Insect spray	0	0.00	0.00
Weed spray	1,716	14.30	0.48
Fungicide spray	0	0.00	0.00
Other chemicals	0	0.00	0.00
Machine hire	0	0.00	0.00
Crop supply	0	0.00	0.00
Packages	0	0.00	0.00
Fuel and oil	480	4.00	0.13
Storage	0	0.00	0.00
Insurance	0	0.00	0.00
Utilities	276	2.30	0.08
Trucking	564	4.70	0.16
Marketing	0	0.00	0.00
Livestock expenditure	0	0.00	0.00
Other	288	2.40	0.08
Total cash expenditure	7,369	61.41	2.05
Net income	16,141	134.50	4.15
Hired non-harvest labor	62	0.52	0.02
Hired family labor	565	4.71	0.16
Total hired non-harvest labor	627	5.23	0.18

[a]Thirty-nine is a code number (see Agricultural Economics Report, page 11, Report No. 350, January 1979). Revised Michigan crops and livestock estimated 1979 budgets, Michigan State University, Department of Agricultural Economics, East Lansing, Michigan.

Table A.4 Enterprise Budget for Corn Sold, Medium Yield, 120 Acres (Enterprise 33)[a]

Corn (120 acres)	Total	Per Acre	Per Unit
Yield (bushel)	12,000	100.00	1.00
Price ($)	3	2.50	2.50
	($)		
Crop income	30,000	250.00	2.50
Harvest labor	0	0.00	0.00
Non-harvest labor	283	2.36	0.02
Repairs, maintenance	1,176	9.80	0.10
Interest	672	5.60	0.06
Seeds	1,360	11.33	0.11
Fertilizer	4,590	38.25	0.38
Insect spray	60	0.50	0.00
Weed spray	1,428	11.90	0.12
Fungicide spray	0	0.00	0.00
Other chemicals	0	0.00	0.00
Machine hire	0	0.00	0.00
Crop supply	0	0.00	0.00
Packages	0	0.00	0.00
Fuel and oil	708	5.90	0.06
Storage	0	0.00	0.00
Insurance	0	0.00	0.00
Utilities	264	2.20	0.02
Trucking	1,356	11.30	0.11
Marketing	2,220	18.50	0.18
Live stock expenditure	0	0.00	0.00
Other	288	2.40	0.02
Total cash expenditure	14,405	120.04	1.20
Net income	15,595	129,96	1.30
Hired non-harvest labor	94	0.79	0.01
Hired family labor	855	7.12	0.07
Total hired non-harvest labor	949	7.91	0.08

[a]Thirty-three is a code number (see Agricultural Economics Report, page 10, Report No. 350, January 1979). Revised Michigan crops and livestock estimated 1979 budgets, Michigan State University, Department of Agricultural Economics, East Lansing, Michigan.

Table A.5 Enterprise Budget for Wheat Sold, Medium Yield, 120 Acres (Enterprise 45)[a]

Wheat (120 Acres)	Total	Per Acre	Per Unit
Yield (bushel)	5,400	45.00	1.00
Price ($)	3	3.00	3.00
	($)		
Crop income	16,200	135.00	3.00
Harvest labor	0	0.00	0.00
Non-harvest labor	192	1.60	0.04
Repairs, maintenance	696	5.80	0.13
Interest	370	3.08	0.07
Seeds	1,638	13.65	0.30
Fertilizer	3,486	29.05	0.65
Insect spray	0	0.00	0.00
Weed spray	0	0.00	0.00
Fungicide spray	0	0.00	0.00
Other chemicals	0	0.00	0.00
Machine hire	0	0.00	0.00
Crop supply	0	0.00	0.00
Packages	0	0.00	0.00
Fuel and oil	420	3.50	0.08
Storage	0	0.00	0.00
Insurance	0	0.00	0.00
Utilities	252	2.10	0.05
Trucking	612	5.10	0.11
Marketing	0	0.00	0.00
Livestock expenditure	0	0.00	0.00
Other	288	2.40	0.05
Total cash expenditure	7,954	60.28	1.47
Net income	8,246	68.71	1.53
Hired non-harvest labor	64	0.53	0.01
Hired family labor	580	4.84[b]	0.11
Total hired non-harvest labor	644	5.37	0.12

[a]Forty-five is a code number (see Agricultural Economics Report, page 12, Report No. 350, January 1979). Revised Michigan crops and livestock estimated 1979 budgets, Michigan State University, Department of Agricultural Economics, East Lansing, Michigan.

[b]This figure is rounded.

Overhead costs based on the rates for custom work in Michigan (land rented, machinery hired) were estimated at $29,570 (see Tables A.6, A.7, and A.8), reducing the profit to $10,402; but the recommendation here is to invest this amount of money toward the purchase of the land and machinery with lower monthly payments, rather than renting the land and hiring the machinery.

Table A.6 Overhead Costs,[a] Soybeans, 120 Acres

Hired Services	Cost/Acre	Cost/120 Acres
	($)	
1. Tillage		
a. Plowing (four bottom)	8.74	1,048.80
b. Disking	4.39	526.80
c. Fertilizer application	1.99	238.80
2. Planting		
a. Planter (four row)	4.45	534.00
b. Insect, disease control	2.42	290.40
c. Weed control	2.52	302.40
3. Combining		
a. Combine (four row)	13.11	1,573.20
Total	37.62	4,514.40

[a]These estimates are based on rates for custom work in Michigan, February 1978, Extension Bulletin E-458, Michigan State University, East Lansing, Michigan.

Table A.7 Overhead Costs,[a] Wheat, 120 Acres

Hired Services	Cost/Acre	Cost/120 Acres
	($)	
1. Tillage		
a. Plowing (four bottom)	8.74	1,048.80
b. Disking (one time)	4.39	526.80
c. Harrowing (one time)	4.64	556.80
d. Fertilizer application	1.99	238.80
2. Planting		
a. Drilling (one time) (thirteen hole)	3.21	385.20
3. Harvest		
a. Combine (13' header)	11.31	1,357.20
4. Straw Baling		
a. Mowing	3.83	459.60
b. Baling 45 bales (.20¢/bale)	9.00	1,080.00
c. Raking	2.50	300.00
Total	49.61	5,953.20

[a]These estimates are based on rates for custom work in Michigan, February 1978, Extension Bulletin E-458, Michigan State University, East Lansing, Michigan.

Table A.8 Overhead Costs,[a] Corn, 120 Acres

Hired Services	Cost/Acre	Cost/120 Acres
	($)	
1. Tillage		
a. Plowing (four bottom)	8.74	1,048.80
b. Disking	4.39	526.80
c. Fertilizer application	1.99	238.80
2. Planting		
a. Planter (four row)	4.45	534.00
b. Insect disease control	2.42	290.40
c. Weed control	2.52	302.40
3. Combining		
a. Combine (four row)	14.68	1,761.60
Total	39.19	4,702.80

[a]These estimates are based on rates for custom work in Michigan, February 1978, Extension Bulletin E-458, Michigan State University, East Lansing, Michigan.

APPENDIX B

PUBLICATIONS RELEVANT TO A SYSTEM FOR THE MECHANIZATION OF AGRICULTURE FOR ADULTS

APPENDIX B

PUBLICATIONS RELEVANT TO A SYSTEM FOR THE MECHANIZATION OF AGRICULTURE FOR ADULTS

Resources in Education

July-December 1977

1. "Modules in Agricultural Education for Leadership Development." ED 135936.

2. "Modules in Agricultural Education for Agricultural Supplies and Services." ED 135937.

3. "Modules in Agricultural Education for Agricultural Mechanics." ED 135941.

4. "Modules in Agricultural Education for Agricultural Production." ED 135943.

5. "Agricultural Electricity, Electric Controls." Student Manual. Report No. 820/70. ED 134743.

6. "Agricultural Electricity, Electric Motors." Student Manual. ED 134744.

January-June 1977

7. "Farm Crops--Unit Manual." Curriculum Guide. ED 128085.

8. "Sheep Production Occupations, Skills and Competencies." ED 131223.

9. "Electric Motors, An Instructional Unit for High School Teachers of Vocational Agriculture." ED 133418.

10. "Fuels and Lubricants, An Instructional Unit for High School Teachers of Vocational Agriculture." ED 133419.

11. "Determining Adult Agri-Business Training Needs--Final Report." ED 133592.

July-December 1976

12. "A Study of Agricultural Job Tasks and Implications for Curriculum Development in Agriculture and Agriculture-Related Occuptaions." ED 126258.

13. "AGDEX: A System for Classifying, Indexing, and Filing Agriculture Publications." Revised edition. ED 125565.

14. "Transportation Cluster." Vol. 6. Farm and Earth Moving Equipment. ED 120510.

January-June 1976

15. "Determination of a Common Core of Basic Skills for Agri-Business and Natural Resources." Final Report. ED 115791.

16. "Tasks Essential to Successful Performance Within Each of Four Occupational Areas in Agriculture." Determination of a Common Core of Basic Skills in Agri-Business and Natural Resources. ED 115792.

17. "Agricultural Supplies and Services." Program Planning Guide. Vol. 2. ED 116007.

18. "Agriculture, Rural Development and the Use of Land." A Series of Papers Compiled by the Subcommittee on Rural Development of the Committee on Agriculture and Forestry, U.S. Senate, Committee Print, 93rd Congress, Second Session, April 16, 1974. ED 115438.

19. "Communications in Agriculture, The American Farm Press." ED 116194.

20. "Land Use: An Instructional Unit for Teachers of Adult Vocational Education in Agriculture." ED 112246.

21. "Agriculture Production, Program Training Guide." Vol. 1. ED 116006.

22. "Beef Cattle Production, An Instructional Unit for Teachers of Adult Vocational Education in Agriculture." ED 112250.

23. "An Empirical Determination of Tasks Essential to Successful Performance as Beef Farmer." Determination of a Common Core of Basic Skills in Agri-Business and Natural Resources. ED 115796.

24. "An Empirical Determination of Tasks Essential to Successful Performance as a Forage Producer." Determination of a Common Core of Basic Skills in Agri-Business and Natural Resources. ED 115799.

25. "An Empirical Determination of Tasks Essential to Successful Performance as a Commercial Vegetable Producer." Determination of a Common Core of Basic Skills in Agri-Business and Natural Resources. ED 115800.

26. "Planning for Irrigation System." ED 113571.

27. "Tree-Fruit Production." An Instructional Unit for Teachers of Adult Vocational Education in Agriculture. ED 112255.

28. "Shop Projects." ED 112003.

29. "The Tractor Electrical System." A Teaching Reference.

30. "Agricultural Mechanics: Program Planning Guide." Vol. 3.

31. "An Empirical Determination of Tasks Essential to Successful Performance as a Chemical Applicator." Determination of a Common Core of Basic Skills in Agri-Business and Natural Resources. ED 115817.

32. "Agricultural Mechanics." Program Planning Guide. Vol. 3. ED 116008.

33. "Agricultural Production." Program Planning Guide. Vol. 1. ED 116006.

34. "Agricultural Products." Program Planning Guide. Vol. 4. ED 116009.

35. "Agricultural Resources." Program Planning Guide. Vol. 6. ED 116011

36. "Agricultural Supplies and Services." Program Planning Guide. Vol. 2. ED 116007.

37. "A Course of Study in Farm Management." Instructional Series No. 4. ED 112098.

38. "Beef Cattle Production." An Instructional Unit for Teachers of Adult Vocational Education in Agriculture. ED 112250.

39. "Greenhouse Management." An Instructional Unit for Teachers of Adult Vocational Education in Agriculture." ED 112245.

40. "Land Use." An Instructional Unit for Teachers of Adult Vocational Education in Agriculture. ED 112177.

<u>January-June 1975</u>

41. "Staffing Patterns for Programs in Adult Agricultural Education." A Study in Cooperation. ED 095316.

January-December 1975

42. "Rural Land Use, Patterns and Proposals for Reform," ED 106025.

43. "Rural Planning, Ecology and Rural Development." Models based on Dutch and British Experience."

PUBLICATION RELEVANT TO A SUBSYSTEM FOR MECHANIZATION OF AGRICULTURE FOR PRODUCTION OF SOYBEANS, WHEAT, AND CORN

Soybeans

1. "Soil Management for Soybeans." Farm Source. Michigan State University Extension Bulletin E-327.

2. "Controlling Insects in Stored Grain."

3. "Seeding Practices for Michigan Crops." Michigan State University, Extension Bulletin E-830.

4. "Common Root Rots of Soybeans." Michigan State University, Extension Bulletin E-499.

5. "Control of Insects in Dry Beans and Soybeans." Michigan State University, Extension Bulletin E-499.

6. "White Mold of Beans." Michigan State University, Extension Bulletin E-892.

7. "Bean Rust." Michigan State University, Extension Bulletin E-966.

8. "Snap Bean Insect Pests." Michigan State University, Extension Bulletin.

9. "Producing Soybeans Profitably in Michigan." Michigan State University, Extension Bulletin E-362.

10. "Michigan Soybean Performance Report." Michigan State University, Extension Bulletin E-857.

11. "Mechanical Damage to Dry Beans." Michigan State University, Extension Bulletin E-540.

12. "Soybean Production." University of Illinois, College of Agriculture, Vocational Agriculture Service, VAS 4030.

13. "Common Problems of Soybeans." University of Illinois, College of Agriculture, Vocational Agriculture Service, VAS 4057.

Wheat Production

1. "Growing Wheat." University of Illinois, College of Agriculture, Vocational Agriculture Service, Urbana, Illinois, VAS 4027a.

2. "Wheat Diseases." University of Illinois, College of Agriculture, Vocational Agriculture Service, Urbana, Illinois, VAS 4056.

3. "Fertilization of Wheat." Michigan State University, Extension Bulletin E-1067.

4. "Common Bunt Against a Threat to Wheat." Michigan State University, Extension Bulletin E-1178.

5. "Planting Date Affects Disease Development, Crop Vigor, and Yield of Michigan Winter Wheat." Mithigan State University, RR-314.

6. "Wheat Spindle Streak Mosaic." Michigan State University, Extension Bulletin E-808.

Corn Production

1. "High Corn Yields With Irrigation." Michigan State University, Extension Bulletin E-857.

2. "Harvesting, Storing, and Feeding High Moisture Corn." Michigan State University, Extension Bulletin E-1030.

3. "European Corn Borer." Michigan State University, Extension Bulletin E-584.

4. "Sweet Corn Insect Pests." Michigan State University, Extension Bulletin E-967.

5. "Soil Organic Matter Levels in Cornfields." Farm Science 297.

6. "Drying and Storing Shelled Corn." Michigan State University, Extension Bulletin E-799.

7. "Corn Leaf Blights." Michigan State University, Extension Bulletin E-832.

8. "Protecting Field Corn From Insects and Nematodes." Michigan State University, Extension Bulletin E-828.

9. "No Till Corn--1." Michigan State University, Extension Bulletin E-904.

10. "No Till Corn--2." Michigan State University, Extension Bulletin E-905.

11. "No Till Corn--3." Michigan State University. Extension Bulletin E-906.

12. "No Till Corn--4." Michigan State University. Extension Bulletin E-907.

13. "Guidelines for Salvaging Drought-Stressed Corn." Michigan State University, Extension Bulletin E-798.

14. "Michigan Corn Production--Hybrids Compared." 1978 Farm Science Series 630.1.

15. "Corn Molds." Michigan State University, Extension Bulletin.

16. "A Guide for Land Judging in Michigan." Michigan State University, Extension Bulletin E-326, 6th revision.

17. "Tractors Go to 180 HP." John Deere, 1978.

18. "Moldboard Plows." John Deere, 1978.

19. "Grain Drills and Power-Till Seeder." John Deere, 1978.

20. "Drawn and Integral Planters." John Deere, 1978.

PUBLICATIONS RELEVANT TO A TRAINING SUBSYSTEM

Resources in Education

July-December 1977

1. "Course Outlines in Vocational Agriculture." Research Project. ED 140080.

2. "Modules in Agricultural Education for Agricultural Mechanics." ED 135941.

3. "Modules in Agricultural Education for Agricultural Production."

January-June 1977

4. "Farm Crops: Unit Manual 11." Curriculum Guide. ED 128085.

5. "Directory of Resources in Adult Education." 1976. ED 131182.

6. "Comments and Guidelines for Research in Competency Identification, Definition and Measurement."

7. "Adult Learning Issues and Innovations Information." Series No. 8. ED 131197.

8. "Career Education for Persons in Rural Areas." Primary Focus on Adults Sixteen and Over. Final Report. ED 133600.

July-December 1976

9. "A Study of Agricultural Job Tasks and Implications for Curriculum Development in Agriculture and Agriculture-Related Occupations." ED 126258.

10. "A Comparative Analysis of Four Individualized Instructional Delivery Systems with Adult Learners." Final Report. ED 119620.

11. "Teaching One-to-One: A Diagnostic Approach to Beginning Tutoring." Instructional Concept Guide No. 2. ED 120355.

12. "Word Concepts: An Adult Approach to Decoding Skills." Instructional Concept Guide No. 6. ED 120358.

13. "Farmers Functional Literacy Program." ED 123441.

14. "Case Studies of Selected Cooperative Adult Education Programs." ED 122124.

15. "Competency Based Adult Education Research and Innovation Catalog." ED 124872.

16. "An Evaluation Planner: A Guidebook for Developing Evaluation Plans Responsive to a Variety of Contexts. Audiences and Issues Within Adult Basic Education." ED 120533.

17. "Farmers Functional Literacy Program." ED 123441.

18. "Making Individualized Instruction to a Joint Academic-Industrial Venture." ED 119978.

January-June 1976

19. "Shop Projects." ED 112003.

20. "The Tractor Electrical System." A Teaching Reference. ED 112257.

21. "Tractor Hydraulics." A Teaching Reference. ED 112259.

22. "Tractor Operation and Daily Care." ED 113570.

23. "Tractor Transmissions." A Teaching Reference. ED 112258.

24. "Land Use, An Instructional Unit of Teachers of Adult Vocational Education in Agriculture." ED 112246.

25. "Evaluation of the Farm Training Program in Wisconsin." Final Report. ED 113594.

26. "Farm Training in East-Central and Southern Africa." Training for Agriculture. Special Supplement. ED 117547.

27. "In-Service Education of Vocational Agriculture Teachers on Ne Curriculum Materials for Adult Class Instruction." Final Report. ED 114485.

28. "Felt Needs for Training by Adult Basic Education Administrators and Teachers in Texas." ED 117407.

29. "Planning, Conducting, Evaluating Workshops." A Practitioner's Guide to Adult Education. ED 117417.

January-June 1975

30. "A Guide for Developing the Instructional Program in Agricultural Mechanics." ED 099652.

31. "Individualized Study Guide on Agriculture." Instructor's Guide. Curriculum Materials for Agricultural Education.

32. "Individualized Study Guide on Agriculture." Student's Guide. Curriculum Materials for Agricultural Education. ED 097559.

33. "Skill Sheets for Agricultural Machinery." ED 099654.

34. "Skill Sheets for Agricultural Mechanics." ED 099653.

35. "Soil Erosion." Advanced Crop and Soil Science. A Course of Study. ED 098288.

36. "Soil Water." Advanced Crop and Soil Science. A Course of Study. ED 098292.

37. "What Is Soil?" Advanced Crop and Soil Science. A Course of Study. ED 098289.

38. "A Guide for Developing the Instructional Program in Agricultural Mechanics." ED 099652.

39. "Career Preparation in Agricultural Equipment and Mechanics." A Curriculum Guide for High School Vocational Agriculture. Testing Edition. ED 096439.

40. "Teaching Adults." A Handbook for Instructors. ED 095356.

July-December 1975

41. "Adult Education for Farmers in Developing Societies." ED 109422.

42. "Helping Adults to Learn." ED 103670.

43. "Project ACT (Adult Competency Training)." Region VIII, Adult Education Staff Development. ED 106458, ED 106459, ED 106460.

44. "Modular Design Approach for Agricultural Education." ED 105080.

45. "Module Directory of Agricultural Education." ED 105296.

46. "Evaluating the Process of Educational Change." A Model and Its Application. ED 104941.

47. "A Conceptual Model of Individualization." ED 104816.

PUBLICATIONS RELEVANT TO A FINANCING SUBSYSTEM

University of Illinois Extension Publications

1. "Record Keeping in the Farm." University of Illinois, College of Agriculture, VAS 2008b.

2. "Planning to Have an Adequate Size of Business." University of Illinois, College of Agriculture, VAS 2013a.

3. "Using Credits to Increase Farm Earnings." University of Illinois, College of Agriculture, VAS 2024a.

4. "Determining Credit Needs on the Farm." University of Illinois, College of Agriculture, VAS 2025a.

5. "Balancing the Labor Supply and the Farm Business." University of Illinois, College of Agriculture, VAS 2035a.

6. "Using Farm Real Estate Loans." University of Illinois, College of Agriculture, VAS 2073a.

7. "Planning for Repayment of Loans." University of Illinois, College of Agriculture, VAS 2026a.

8. "Sources of Farm Credits." University of Illinois, College of Agriculture, VAS 2027a.

9. "Factors Involved in Borrowing Process." University of Illinois, College of Agriculture, VAS 2028a.

10. "Income Possibilities for Your Farm." University of Illinois, College of Agriculture, VAS 2043.

11. "Planning a Profitable Farm Business." University of Illinois, College of Agriculture, VAS 2001b.

PUBLICATIONS RELEVANT TO A MAINTENANCE SUBSYSTEM

Resources in Education

July-December 1977

1. "Modules in Agricultural Education for Agricultural Supplies and Services." ED 135937.

2. "Modules in Agricultural Education for Agricultural Mechanics."

January-June 1976

3. "Supervised Occupational Experience Programs." Curriculum Material for Agricultural Science and Mechanics 1 and 2. ED 112096.

4. "Fundamentals of Supervision." ED 115901.

January-June 1975

5. "Soil Erosion." Advanced Crop and Soil Science. A Course of Study. ED 098288.

January-December 1970

6. "Agricultural Chemical Safety." A Guide to Safe Handling of Pesticides. Teacher's Handbook. Student Manual and Transparencies. ED 051380.

7. "Competencies in Welding Needed for Agricultural Machinery Maintenance." ED 042922.

<u>Illinois State University Vocation Agriculture Service Publications</u>

8. "Collecting and Preparing Soil Samples for Testing." University of Illinois, College of Agriculture, Urbana, 61801. VAS 4001.

9. "pH Test for Soil Acidity." University of Illinois, College of Agriculture, VAS 4003a.

10. "Determining Available Potassium in Soil." University of Illinois, College of Agriculture, VAS 4003b.

11. "Soil Liming, A Key to Better Farming." University of Illinois, College of Agriculture, VAS 4006a.

12. "Planning the Nitrogen Program." University of Illinois, College of Agriculture, VAS 4009a.

13. "Planning a Fertilizer Program." University of Illinois, College of Agriculture, VAS 4010a.

14. "Hunger Signs in Crops." University of Illinois, College of Agriculture, VAS 4011a.

15. "Farmstead Windbreaks." University of Illinois, College of Agriculture, VAS 4018.

16. "Soil Structure." University of Illinois, College of Agriculture, VAS 4028.

17. "Corn Insects and Their Control." University of Illinois, College of Agriculture, VAS 4040a.

18. "Controlling Weeds." University of Illinois, College of Agriculture, VAS 4042a.

19. "Handling and Using Pesticides Safely." University of Illinois, VAS 4045a.

<u>Michigan State University Cooperative Extension Service Publications</u>

20. "Contol of Insects in Dry Beans and Soybeans." Michigan State University, Cooperative Extension Service, E-499.

21. "European Corn Borer: Controlling It on Corn, Peppers, Potatoes, Snap Beans." Michigan State University, E-736.

22. "Corn Rootworm." Michigan State University, E-736.

23. "Pesticide Manual." Michigan State University, E-751.

24. "Insect Control in Hay, Forage and Pasture Crops." Michigan State University, E-827.

25. "Control of Field Corn Insects." Michigan State University, E-828.

26. "Insect Control in Small Grain Crops." Michigan State University, G-829.

27. "Controlling Insects in Stored Grain." Michigan State University, E-934.

28. "Sweet Corn Insect Pests." Michigan State University, E-967.

29. "High Corn Yields With Irrigation." Michigan State University, E-857.

30. "Weed Control in Field Crops." Michigan State University, E-434.

31. "No-Till Corn and Weed Control." Michigan State University, E-907.[1]

University of Illinois Vocational, Agricultural Service Bulletins

32. "Oxyacetylene Welding and Cutting." University of Illinois, Urbana, VAS 3001a.

33. "Planning for Electrical Wiring." University of Illinois, Urbana, VAS 3003b.

34. "Shielded Metal Arc Welding." University of Illinois, Urbana, VAS 3004a.

35. "Sharpening Hand Tools." University of Illinois, Urbana, VAS 3005.

36. "Concrete Improvements for Farm and Home." University of Illinois, Urbana, VAS 3007a.

37. "Farm Tractor Tune-Up." University of Illinois, Urbana, VAS 3008.

38. "Agricultural Surveying." University of Illinois, Urbana, VAS 3010a.

[1]Cooperative Extension Service Publications, Michigan State University, East Lansing, Michigan 48824.

39. "Lightning and Lightning Protection on the Farm." University of Illinois, Urbana, VAS 3011.

40. "Electrical Hazards in Home, Farm, and Business." University of Illinois, Urbana, VAS 3012a.

41. "Handling and Using Gasoline and LP Gas Safely." University of Illinois, Urbana, VAS 3013.

42. "Small Engines--Principles of Operation. Trouble Shooting and Tune-Up." University of Illinois, Urbana, VAS 3014.

43. "Spray Painting." University of Illinois, Urbana, VAS 3015.

44. "Electrical Wiring Procedures." University of Illinois, Urbana, VAS 3016a.

45. "Appraising Farm Structure." University of Illinois, Urbana, VAS 3017b.

46. "Air Compressors." University of Illinois, Urbana, VAS 3018.

47. "Small Engines Repair and Overhaul." University of Illinois, Urbana, VAS 3019.

48. "The Two-Cycle Engine." University of Illinois, Urbana, VAS 3020.

49. "Safety in the Agricultural Mechanics Shop." University of Illinois, Urbana, VAS 3022.

50. "The Storage Battery." University of Illinois, Urbana, VAS 3024.

51. "Engine Compression and Cylinder Leakage Testing." University of Illinois, Urbana, VAS 3025.

52. "The Spark Plug Operation, Selection and Maintenance." University of Illinois, Urbana, VAS 3026.

53. "Soldering for Home, Farm and Shop Applications." University of Illinois, Urbana, VAS 3027.

54. "The Ignition System--Testing and Analyzing." Test Results. University of Illinois, Urbana, VAS 3028.

55. "Using the Carbon-Arc Torch." University of Illinois, Urbana, VAS 3029.

56. "The Engine Cooling System." University of Illinois, Urbana, VAS 3030.

57. "Tires for Farm Equipment." University of Illinois, Urbana, VAS 3031.

58. "Electrical Fundamentals Useful in Engine Analysis." University of Illinois, Urbana, VAS 3032.

59. "Glazing." University of Illinois, Urbana, VAS 3039.

60. "Preventing Tractor Overturns." University of Illinois, Urbana, VAS 3040.

PUBLICATIONS RELEVANT TO AN EXTENSION SUBSYSTEM

Books

1. Axinn, H. George, et al. Modernizing World Agriculture, A Comparative Study of Agricultural Extension Education Systems. Praeger Publishers, 1972.

2. Bradford, Leland. Making Meetings Work. A Guide for Leaders and Group Members. LaJolla, Calif.: University Associates, 1976.

3. Burke, W. W., and Beckhard, R., eds. Conference Planning. 2nd ed. LaJolla, Calif.: University Associates, 1976.

4. Fiedler, F. G.; Chemers, M. M.; and Mahar, L. Improving Leadership Effectiveness, the Leader Match Concept. New York: John Wiley & Sons, Inc., 1976.

5. Hesburgh, Theodore; Miller, Paul; and Wharton, Clifton. Patterns for Life-Long Learning. San Francisco: Jossey-Bass Publishers, 1973.

6. Lang, Louis Charles. A Historical Review of the Forces that Contributed to the Formation of the Cooperative Extension Service, 1975.

7. The Lifelong University. Task Force on Lifelong Education. Michigan State University.

8. Miller, Paul A. The Cooperative Extension Service. Paradoxical Servant, 1973.

9. Miller, Robert W.; Johnson, Beryl A.; Smith, William J.; and Zoller, Frederick A. Approaches to University Extension Work With the Rural Disadvantaged. Description and Analysis of a Pilot Effort. Office of Research and Development, Appalachian Center, West Virginia University, Morgantown, September 1972.

10. Sanders, H. C. Instruction in the Cooperative Extension Service. Louisiana State University and Agricultural and Mechanical College, 1972.

11. Schindler-Rainman, Eva, and Lippitt, Ronald. The Volunteer Community. Creative Use of Human Resources. NTL Learning Resources Corporation, 1975.

12. Vines, C. A., and Anderson, M. A., eds. Heritage Horizons--Extension's Commitment to People, Madison, Wisconsin, 1976.

Resources in Education

1. "Developing a Continuing Education Office--Two Important Documents." GD 148416.

2. "Evaluation of Cooperative Extension Efforts at the County Level." The University of California. ED 147041.

3. "Heritage Horizons: Extension Commitment to People." ED 142687.

4. "A Project for the Development of Performance Competency Education." ED 148247.

July-December 1978

1. "Strength Through Cooperation: Examples of Cooperation Between Community Education and Cooperative Extension." ED 157139.

2. "A Comparison of Agricultural Extension in Five States." ED 154979.

3. "Cooperative Extension Guide to Community Education Development." Publication 757. ED 151987.

4. "An Evaluation of Community Organization and Leadership Development in Cooperative Extension's Community Development Program." A National Task Force Report. ED 150291.

July-December 1977

5. "Analysis of 4-H Community Development Programs in the Cooperative Extension Service." Summary of Research Series. ED 138783.

6. "Evaluating Extension Work: A Guide for Village Workers." ED 138720.

7. "Instruction for Distant Learners Through Technology." ED 139455.

8. "Extension Agents: A Study of the Congruency of Competencies and Criterion." Referenced Measure. ED 142575.

January-June 1977

9. "Analyzing Impacts of Extension Programs." ED 131240.

10. "A Guide to Educational Project Center Operations." A Manual Based Upon the Model Project Center of Worcester Polytechnic Institute." ED 132899.

July-December 1976

11. "About Distance Education Number Three." ED 126919.

12. "The Extension Service as a Resource in Planning at the Local Level." ED 124351.

13. "Putting the Pieces Together for Examining Results of Several People's Efforts in Several Programs Over Several Years--One Type of Macro Program Evaluation." ED 123393.

14. "Developing Effective Extension Agents." Experience Concerns. ED 127309.

PUBLICATIONS RELEVANT TO A MARKETING SUBSYSTEM

Books

1. Boone, E. Louis, and Kurtz, L. David. Foundations of Marketing. Hinsdale, Ill.: The Dryden Press, 1977.

2. Delozier, M. Wayne, and Woodside, G. A. Marketing Management, Strategies and Cases. Bell and Howell Co., 1978.

3. Kotler, Philip. Marketing Management Analysis, Planning and Control. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1976.

4. McDaniel, Carl Jr. Marketing an Integrated Approach. New York: Harper & Row Publishers, 1979.

5. Stanton, J. William. Fundamentals of Marketing. New York: McGraw-Hill, Inc., 1978.

1978

1. "Marketing and Distributive Education." General Retail Merchandising Curriculum Guide. ED 156857.

2. "Marketing and Distributive Education Curriculum Planning Guide." ED 156859.

3. "Marketing and Distributive Education, Wholesaling Curriculum Guide." ED 156858.

4. "Marketing and Distributive Education, General Marketing Curriculum Guide." ED 156860.

5. "Marketing and Distributive Education, Food Marketing Curriculum Guide." ED 156861.

1977

6. "Advertising Services Module, A Second-Level Option for Distribution and Marketing." ED 135945.

7. "Alternatives in Small Market Research." ED 137857.

8. "Comprehensive Analysis of the Market Survey for Computer Applications Project, Phase 1." ED 139375.

9. "Computer Applications Project, Phase 1." Final Report. Ed 139374.

10. "Conceptual Framework for Curriculum Decisions in Education for Marketing and Distribution Careers." ED 138816.

11. "Making It in Marketing Services, Exploration of Marketing Services Careers." ED 127439.

12. "Orientation to Marketing Careers." ED 127438.

1978

13. "Career Exploration in Marketing and Distribution." ED 122026.

14. "Marketing and Society." Study Guide. ED 126575.

15. "A Planned Approach to Program Development, The Model Marketing Cluster Program." ED 120450.

16. "Public Marketing, An Alternative Policy Decision-Making Idea for Small Cities." Community Development Research Series. ED 125845.

17. "The Selling of a Network." ED 121326.

APPENDIX C

MANAGEMENT PROCESS

APPENDIX C

MANAGEMENT PROCESS

A Model

Figure C.1 is a three-dimensional diagram of the management process developed by Mackenzie. It is a conceptual model representing elements, concepts, and relationships within a frame of reference.

> This diagram shows the different elements, functions, and activities which are part of the management process. At the center are people, ideas, and things, for these are the basic concepts of every organization with which the manager must work. Ideas create the need for conceptual thinking; things, for administration; people, for leadership. Three functions, problem analysis, decision making, and communication, are important at all times and in all aspects of the manager's job; therefore, they are shown to permeate his work process. However, other functions are likely to occur in predictable sequence; thus, planning, organizing, staffing, directing, and controlling are shown in that order on one of the bands. A manager's interest in any of them depends on a variety of factors, including his position and the stage of completion of the projects with which he is most concerned.
>
> He must, at all times, sense the pulse of his organization. The activities that will be most important to him as he concentrates, now on one function, then on another, are shown on the outer bands of the diagram.[1]

The management process for implementation of the models developed in this study is very important. Therefore, the Figure C.1 three-dimensional management process model can be used as an excellent frame of reference for implementation of the system developed in this study.

---

[1]R. Alex Mackenzie, "The Management Process in 3-D," Harvard Business Review, November-December 1969.

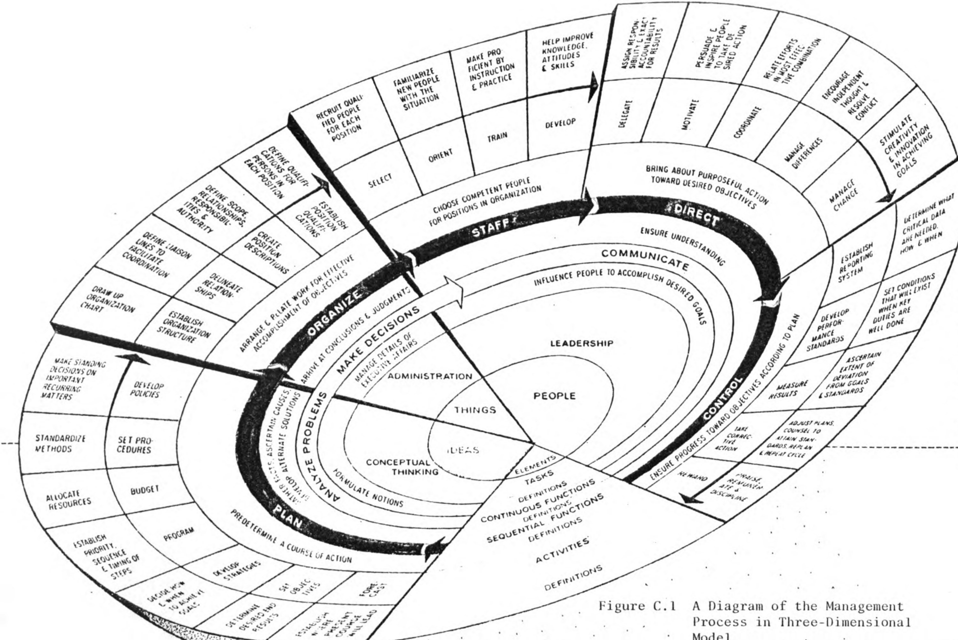

Figure C.1 A Diagram of the Management Process in Three-Dimensional Model.

Source: R. Alex Mackenzie, "The Management Process in 3-D," Harvard Business Review, November-December 1969, p. 83.

Types of Manager Behavior

Sullivan and Gilbert[1] have developed a Conceptual Model of five different types of manager behaviors in performing management functions. Figure C.2 classifies leadership management styles as the Autocrat, the Humanitarian, the Abdicator, the Compromiser, and the Effective Manager.

Instructional Development System--A Model

A functional model of the Instructional Development System, based on the application of General System Theory, is presented in Figure C.3. This model has been developed and tested over a three-year period by the National Special Media Institute's consortium of four universities.

The objective of this model is to provide teachers, administrators, policy makers, and specialists with a model for instructional systems approach to the development of practical solutions to critical teaching and learning problems.[2] This model can become usable within

---

[1]John F. Sullivan and Gilbert H. Skinner, "How Five Different Types of Managers Behave in Performing the Basic Management Functions," unpublished paper, Personnel Management Program Service, Michigan State University, East Lansing, Michigan.

[2]See, for example, M. David Merrill and R. Irwin Goodman, Selecting Instructional Strategies and Media, A Place to Begin (Washington, D.C.: National Special Media Institute, 1972); Frank Nelson, Evaluation for Instructional Development (Washington, D.C.: National Special Media Institute, 1972); Lanny Sparks, Prototypes Specification Manual: A Guide for Instructional Development (Washington, D.C.: National Special Media Institute, 1972); James R. Nord, Tome Bennett, and Dee McEachran, Smith Instructional Development Institute, Morill Hall, Michigan State University, East Lansing, Michigan; and Thomas E. Harries, The Application of General Systems Theory to Instructional Development (Washington, D.C.: National Special Media Institute, 1971).

MANAGEMENT FUNCTIONS	LEADERSHIP/MANAGEMENT STYLE				
	THE AUTOCRAT	THE HUMANITARIAN	THE ABDICATOR	THE COMPROMISER	THE EFFECTIVE MANAGER
SEQUENTIAL FUNCTIONS 1. PLANNING a. Participation by subordinates in goal-setting	Sets work group goals unilaterally. Virtually no participation by subordinates in the setting of work group and individual goals.	Solicits and almost always accepts subordinates' ideas regarding work group and unit goals.	Rarely solicits the ideas of subordinates for goal-setting purposes. Work group goals generally established by superiors.	Solicits and attempts "to the extent possible" to act on subordinates' ideas in goal setting.	Works with subordinates in the establishment of individual and work group goals.
b. Characteristics of work group goals	Sets goals which are demanding and high.	Sets goals which are generally low and at the highest levels likely to be easily accepted by subordinates.	Leads work group members toward goals which are generally low and at the minimal levels likely to be acceptable to higher management.	Sets goals at intermediate levels and at levels which generally gain the approval and acceptance of higher management and which are acceptable to subordinates.	Sets goals which are viewed as realistic but challenging by subordinates and higher management.
2. ORGANIZING a. Emphasis on organizational and/or subordinates' needs.	Organizes work based on the organization's needs only. Subordinates' needs and interests almost never considered.	Organizes work based principally on subordinates' needs and interests.	Attempts to organize work by identifying course of least resistance.	Attempts to balance needs of subordinates and the organization. Sees these as being inherently in conflict.	Organizes the work so as to maximally achieve the needs of the organization and the individuals.
b. Delegation of authority and responsibility.	Delegates as little authority as possible. However, responsibility is often clearly fixed.	Delegates authority and responsibility based primarily on subordinates' willingness to accept same.	Delegates as much as possible to subordinates and other work groups.	Delegates authority and responsibility in a conservative manner. Attempts to minimize the likelihood of failure for self and subordinates.	Delegates as much as possible based on the needs of the organization as well as the needs and the abilities of subordinates.
3. STAFFING a. Selection and retention of subordinates.	Selects and retains subordinates based on their ability to accomplish work group goals.	Selects and retains subordinates based on their ability to be accepted by and work smoothly with other work group members.	Looks for subordinates who will "not rock the boat" — not cause problems or draw attention to the work group.	Selects and retains subordinates who can meet work group goals while working smoothly with other group members.	Selects and retains subordinates who are able to work synergistically with other work group members and accomplish work group goals.

Figure C.2 How Five Different Types of Managers Behave in Performing the Basic Management Functions.

MANAGEMENT FUNCTIONS	LEADERSHIP/MANAGEMENT STYLE				
	THE AUTOCRAT	THE HUMANITARIAN	THE ABDICATOR	THE COMPROMISER	THE EFFECTIVE MANAGER
b. Training and development of subordinates.	Shows no interest in long-term development of subordinates. Supports immediately-useful skills training only. Attempts to minimize expenditures for training and development.	Supports all training and development efforts desired by subordinates. Views the general development of subordinates as legitimate. Does not attempt to closely control training and development expenditures.	Neither supports nor opposes the training/development of subordinates. Shows no interest in the short-term or long-term development of subordinates.	Readily supports the training and development that leads to the acquisition of immediately-useful skills. Approves and engages in long-term employee development efforts in order to placate subordinates.	Supports and shows interest in the short-term and long-term development of subordinates. Views training and development expenditures as investments.
4. DIRECTING a. Giving orders and assigning work.	Issues orders and directives and expects unquestioning obedience from subordinates.	Issues orders and directives reluctantly. When orders are necessary every effort is made to accommodate interests and needs of subordinates. Frequently apologizes for having to issue orders and directives.	Issues orders and directives only when absolutely necessary. In these instances acts as a "carrier pigeon" from upper management.	Attempts to issue orders and directives that will be acceptable to subordinates. Explains the reasons for the orders.	Expects subordinates to direct their own efforts towards the mutually agreed upon goals.
5. CONTROLLING a. Measuring and feeding-back performance evaluation data to subordinates.	Attempts to monitor subordinates' actions and to measure their performance closely and precisely. Emphasis is on feeding-back data on performance which does not meet standards.	Efforts to measure subordinates' performance are sporadic. Emphasis is on feeding-back positive data.	Shows little interest in, and generally avoids, measuring subordinates' performance and feeding-back evaluative data.	Generally attempts to measure subordinates' performance fairly. Feeds back data periodically with negative data softened.	Measures subordinates' progress and expects subordinates to measure their own progress against mutually agreed upon goals and standards. Attempts to ensure that subordinates receive all relevant feedback regarding their performance.
b. Taking corrective actions.	Attempts to Identify and punish the "guilty."	Attempts to protect and comfort subordinates whose behaviors need to be corrected. Attempts to place blame on factors outside of the control of work group members.	Ignores deficiencies to the greatest extent possible. Avoids taking corrective actions.	Takes corrective actions reluctantly. Subordinates always get the benefit of the doubt. Follows the principles of corrective discipline.	Attempts to identify reasons for performance deficiencies. Coaches and works with subordinates in resolving deficiencies. Follows principles of corrective discipline.

Figure C.2--Continued

MANAGEMENT FUNCTIONS	LEADERSHIP/MANAGEMENT STYLE				
	THE AUTOCRAT	THE HUMANITARIAN	THE ABDICATOR	THE COMPROMISER	THE EFFECTIVE MANAGER
b. Training and development of subordinates.	Shows no interest in long-term development of subordinates. Supports immediately-useful skills training only. Attempts to minimize expenditures for training and development.	Supports all training and development efforts desired by subordinates. Views the general development of subordinates as legitimate. Does not attempt to closely control training and development expenditures.	Neither supports nor opposes the training/development of subordinates. Shows no interest in the short-term or long-term development of subordinates.	Readily supports the training and development that leads to the acquisition of immediately-useful skills. Approves and engages in long-term employee development efforts in order to placate subordinates.	Supports and shows interest in the short-term and long-term development of subordinates. Views training and development expenditures as investments.
4. DIRECTING a. Giving orders and assigning work.	Issues orders and directives and expects unquestioning obedience from subordinates.	Issues orders and directives reluctantly. When orders are necessary every effort is made to accommodate interests and needs of subordinates. Frequently apologizes for having to issue orders and directives.	Issues orders and directives only when absolutely necessary. In these instances acts as a "carrier pigeon" from upper management.	Attempts to issue orders and directives that will be acceptable to subordinates. Explains the reasons for the orders.	Expects subordinates to direct their own efforts towards the mutually agreed upon goals.
5. CONTROLLING a. Measuring and feeding-back performance evaluation data to subordinates.	Attempts to monitor subordinates' actions and to measure their performance closely and precisely. Emphasis is on feeding-back data on performance which does not meet standards.	Efforts to measure subordinates' performance are sporadic. Emphasis is on feeding-back positive data.	Shows little interest in, and generally avoids, measuring subordinates' performance and feeding-back evaluative data.	Generally attempts to measure subordinates' performance fairly. Feeds back data periodically with negative data softened.	Measures subordinates' progress and expects subordinates to measure their own progress against mutually agreed upon goals and standards. Attempts to ensure that subordinates receive all relevant feedback regarding their performance.
b. Taking corrective actions.	Attempts to identify and punish the "guilty."	Attempts to protect and comfort subordinates whose behaviors need to be corrected. Attempts to place blame on factors outside of the control of work group members.	Ignores deficiencies to the greatest extent possible. Avoids taking corrective actions.	Takes corrective actions reluctantly. Subordinates always get the benefit of the doubt. Follows the principles of corrective discipline.	Attempts to identify reasons for performance deficiencies. Coaches and works with subordinates in resolving deficiencies. Follows principles of corrective discipline.

Figure C.2--Continued

Source: John F. Sullivan and Gilbert H. Skinner, Personnel Management Program Service, Michigan State University.

training and extension subsystems developed in this study, as a method for problem solving whenever the model is implemented.

DEFINE	Function 1 IDENTIFY PROBLEM Assess Needs Establish Priorities State Problem	Function 2 ANALYZE SETTING Audience Conditions Relevant Resources	Function 3 ORGANIZE MANAGEMENT Tasks Responsibilities Timeliness
DEVELOP	Function 4 IDENTIFY OBJECTIVES Terminal Enabling	Function 5 SPECIFY METHODS Learning Instruction Media	Function 6 CONSTRUCT PROTOTYPES Instructional Material Evaluation Material
EVALUATE	Function 7 TEST PROTOTYPES Conduct Tryouts Collect Evaluation Data	Function 8 ANALYZE RESULTS Objectives Methods Evaluation Techniques	Function 9 IMPLEMENT/RECYCLE Review Decide Act

Figure C.3 The Instructional Development System.

Source: The National Media Institutes.

Definitions of the Functions

Stage 1: Define

Function 1: Identify Problem

Assess needs, establish priorities, identify symptoms, and clearly state a particular problem and tentative solution as agreed upon by all concerned.

Function 2: Analyze Setting

Collect and locate pertinent information on the instructional setting (audience, conditions, and relevant resources) as it relates to the problem statement in Function 1.

Function 3: Organize Management

Plan those activities necessary for management, such as specifying tasks, assigning responsibilities, and developing time schedules.

Stage 2: Develop

Function 4: Identify Objectives

Specify terminal and enabling objectives the learner will be able to demonstrate as a result of instruction.

Function 5: Specify Methods

Determine those instructional strategies, materials, and resources that will maximize learning of a specific objective for a particular content, learner, and type of learning.

Function 6: Construct Prototypes

Select, design, develop, produce, and assemble all materials for the tryout and evaluation of an instructional package or packages.

Stage 3: Evaluate

Function 7: Test Prototypes

Try out instructional prototypes with a representative sample of the student audience and collect and record evaluation data.

Function 8: Analyze Results

Analyze and interpret data from the tryout and all previous Instructional Development functions, such as the objectives, methods, and evaluation techniques.

Function 9: Implement/Recycle

Review the Instructional Development Process, and make a decision to implement on a full scale as designed or to return to previous functions for revision or modification.[1]

Instructional Development here is defined as a systematic, data-based process for analyzing curricular and instructional problems in order to develop tested, feasible solutions. Figure C.4 represents a pictorial view of the functions in this model.

[1]Glossary, Unit 2 Module, Instructional Development Institute, National Special Media Institute, Michigan State University, East Lansing, Michigan.

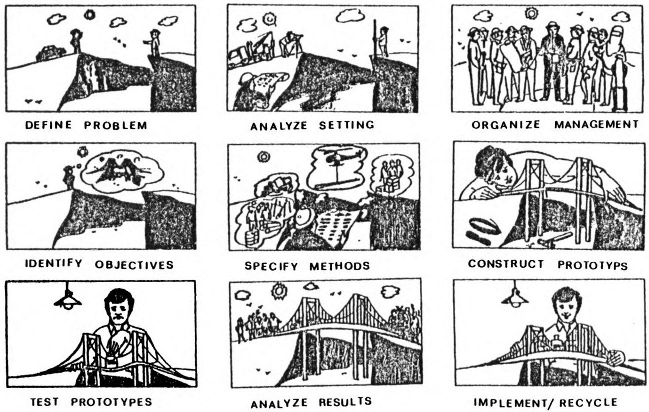

Figure C.3 A Functional Model of Instructional Development.

Source: The National Media Institute, Michigan State University.

BIBLIOGRAPHY

BIBLIOGRAPHY

Albanese, Robert. Management Toward Accountability for Performance. Homewood, Ill.: Richard D. Irwin, Inc., 1975.

Ali, The Imam. The Directive of the Imam Ali to Malik El-Ashlar. Trans. by Mohammad Javed Chirr. The Islamic Center of Detroit.

Alkin, Marvin. C. Accountability, A State, A Process or A Product? Edited by Gephart J. William. New York: Phi Delta Kappa, Inc., 1975.

Anderson, H. H., ed. Creativity and Its Cultivation. New York: Harper & Brothers, 1959.

A People, A Spirit, A Report of the Joint USDA-NASULGC Study Committee on Cooperative Extension. Fort Collins: Colorado State University, November 1968.

Archambault, Reginald D. John Dewey on Education. Selected Writings. New York: The Modern Library, 1964.

Axinn, George H. New Strategies for Rural Development. New York: Rural Life Associates, 1978.

Banathy, Bela H. Developing a Systems View of Education. The Systems Model Approach. Lear Siegler, Inc., 1973.

Barnes, Kenneth C. The Creative Imagination. London: Swathmore College Press, 1960.

Berrion, Kenneth T. General and Social Systems. New Brunswick, N.J.: Rutgers University Press, 1968.

Bertalanffy, Ludwig Von. General System's Theory, Foundations, Development, Applications. New York: George Braziller, 1968.

Bertalanffy, Ludwig Von. Perspectives on General System's Theory. New York: George Braziller, 1975.

Bliss, K. R., et al. The Spirit and Philosophy of Extension Work. Washington, D.C.: USDA and ES, PNHEF, 1952.

Bloom, Benjamin S., et al. Taxonomy of Educational Objections. Handbook I, Cognitive Domain. New York: David McKay Co., 1950.

Borgstrom, George. Harvesting the Earth. New York: Abelard-Schuman, 1973.

Boulding, Kenneth E. General System's Theory, The Skeleton of Science in Management Systems. Edited by P. P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Bross, Irwin D. J. Models in Management Systems. Edited by Peter P. Schoderbek. New York: John Wiley, 1968.

Brown, Lester R. The World Food/Population Problem: An Overview in Alternatives for Balancing World Food Production and Needs. Ames: The Iowa State University Press, 1967.

Bruner, Jerome S. The Process of Education. New York: Random House, 1960.

Buckley, W. Sociology and Modern System's Theory. Englewood Cliffs, N.J.: Prentice-Hall, 1967.

Buffa, Elwood S. Models for Production and Operations Management. New York: John Wiley & Sons, Inc., 1963.

Chin, Robert. The Utility of Systems Models and Development Models for Practitioners in Planning Change. Edited by William G. Bennis, Kenneth Benne and Robert Chin. New York: Holt, Rinehart & Winston, Inc., 1961.

Chinal, Jean P. "The Systems Approach, A French Experience." Interfaces 5 (February 1975): The Institute of Management Sciences.

Chuang, Ying C. Simulation Model and Educational Research. New York: Center for Urban Education, 1971.

Churchman, West C. The Systems Approach. New York: Delacorte Press, 1968.

Cross, Patricia K. Accents on Learning, Improved Instruction and Reshaping the Curriculum. San Francisco: Jossey-Bass, 1976.

Cross, Patricia K.; Tough, Allen; and Weathersby, Rita. Current Issues in Higher Education, the Adult Learner. Washington, D.C.: The American Association for Higher Education, 1978.

Cunningham, Luvern L. "Our Accountability Problems." In Accountability in American Education. Edited by Frank J. Sciara and Richard K. Jantz. Boston: Allyn and Bacon, Inc., 1972.

Deutsch, Karl W. The Evaluation of Models in Management Systems. Edited by Peter P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Dewey, John. Experience and Education. New York: Collier Macmillan Publishers, 1977.

Erikson, Erik H. Adulthood Essays by Erik H. Erikson. Edited by Erik H. Erikson. New York: Norton, 1978.

________. "Identity and the Life Cycle." Selected paper with Historical Introduction by David Rapaport. New York: International Universities Press, 1959.

Frank, Nelson. Evaluation for Instructional Development. Washington, D.C.: National Special Media Institute, 1972.

Freire, Paul. Education for Critical Consciousness. New York: Seabury Press, 1973.

Fuller, B. I Seem a Verb. Management Systems, Business Publications, Inc. New York: Bantam Books, Inc., 1970.

Gagné, Robert M. The Conditions of Learning. New York: Holt, Rinehart & Winston, Inc., 1970.

Good, Carter V., ed. Dictionary of Education. Asst. ed. Winifred R. Merkol. New York: McGraw-Hill Book Co., 1973.

Goode, Harry H., and Machole, Robert E. Systems Engineering. New York: McGraw Hill Book Co., 1957.

Hall, D. A., and Hagen, E. R. "Definition of System." In Organizations, Systems, Control and Adaptation. Edited by Joseph A. Litterer. New York: John Wiley & Sons, Inc., 1969.

Harries, Thomas E. Application of General Systems Theory to Instructional Development. Washington, D.C.: National Special Media Institute, 1971.

Havelock, Ronald G. The Change Agent's Guide to Innovation in Education. Educational Technology Publications, 1978.

Haynes, Warren W., and Massie, Joseph L. Management: Analysis Concepts and Cases. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1975.

Haynes, Warren W., and Henry, William R. Managerial Economics Analysis and Cases. Dallas: Business Publications, 1974.

Hostrop, Richard W. Managing Education for Results. Homewood, Ill.: ETC Publication, 1975.

Hull, John; Mapes, John; and Wheeler, Brian. Model Building Techniques for Management. Saxon House, Cranfield Institute Press, 1976.

Immegart, Glenn L., and Pilecki, Francis J. An Introduction to Systems for Educational Administrator. Reading, Mass.: Addison Wesley Publications, 1973.

Johnson, Alton C., and McCormick, Robert W. Staffing Decisions in the Cooperative Extension Service. National Agricultural Extension Center for Advanced Study, Federal Extension Service. Madison: University of Wisconsin, 1962.

Kaufman, R. A. "A Systems Approach to Education: Derivation and Definition." A. V. Communication Review, 1968.

Kearl, Bryant, and Read, Hardle. Agricultural Communication Service.

Kelsey, Lincoln D., et al. Cooperative Extension Work. New York: Comstock Publishing Co., 1949.

Knowles, Malcolm S. The Modern Practice of Adult Education. New York: Association Press, 1977.

________. Self Directed Learning. A Guide for Learners and Teachers. New York: Association Press, 1975.

Knox, Allan B. Adult Development and Learning. San Francisco: Jossey Bass, 1977.

Kohlberg, Lawrence, et al. Moral Judgement Interview: Assessing Moral Stages. A Manual. Cambridge, Mass.: Harvard University Press, 1977.

________. Continuities in Childhood and Adult Moral Development Revisited. Cambridge, Mass.: Harvard University Press.

Krippendorff, K. Scope of the Information Systems Division. Edited by D. R. Monge. Systems Letter, 1972.

Lanny, Sparks. Prototypes Specification Manual. A Guide for Instructional Development. Washington, D.C.: National Special Media Institute, 1972.

Laszlo, Ervin. The Systems View of the World. New York: Braziller, 1972.

Leadley, M. S., and Pignone, M. M., ed. Systems Analysis for Rural Community Services. Washington, D.C.: Cooperative State Research Service (DOA), ED 110262, 29 July 1972.

Lincoln, K. D., and Cannon, C. H. Cooperative Extension Work. Ithaca, N.Y.: Comstock Publishing Co., 1949.

Litterer, Joseph A. Organizations, Systems, Control and Adaptation. New York: John Wiley & Sons, Inc., 1969.

Loevinger, Jane, et al. Ego Development Conceptions and Theories. San Francisco: Jossey Bass Publishers, 1976.

Lopez, Felix M. Accountability in Education in Emerging Patterns of Administration Accountability. Edited by Lesley H. Browder, Jr. New York: McCutcheon Publishing Co.

Lovett, Robert. "Professional Accountability in Schools." In Accountability in American Education. Edited by J. Frank Sciara and Richard K. Jantz. Boston: Allyn and Bacon, Inc., 1972.

Mann, D. Policy Decision Making in Education. New York: Teachers College Press, 1975.

Maslow, Harold Abraham. The Farthest Reaches of Human Nature. New York: Viking Press, 1972.

Massie, Joseph L., and Douglas, John. Managing: A Contemporary Introduction. Englewood Cliffs, N.J.: Prentice Hall, 1977.

McFarland, Dalton E. Management Principles and Practices. New York: Macmillan Co., 1974.

________. Management Principles and Practices. 2nd ed. New York: The Macmillan Co., 1978.

Mackenzie, Alex R. "The Management Process in 3-D." Harvard Business Review, November-December 1969.

Merill, David M., and Goodman, Irwin R. Selecting Instructional Strategies and Media, A Place to Begin. Washington, D.C.: National Special Media Institutes, 1972.

Miller, James G. "Living Systems, Basic Concepts." Behavioral Science, July 1965, pp. 193-234.

________. "Toward a General Theory for Behavioral Sciences." In Organizations, Systems, Control. Edited by J. A. Litterrer. New York: John Wiley & Sons, Inc., 1969.

Morris, William T. Management Science in Action. Homewood, Ill.: Richard D. Irwin, Inc., 1963.

Muller, Robert E. Inventivity, How Man Creates in Art and Science. New York: The John Day Co., 1963.

Optner, S. Systems Analysis for Industrial and Business Problem Solving. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1965.

Riegel, Klaus F. The Developing Individual in a Changing World. Edited by John A. Meacham. The Hague, Netherlands: Mouton, 1976.

________. Psychology of Development and History. New York: Plenum Press, 1976.

Rodinelli, Denis A. "Why Development Projects Fail, Problems of Project Management in Developing Countries." Project Management Quarterly, March 1976.

Rogers, Everett M., and Shoemaker, Floyd F. Communication of Innovations, A Cross-Cultural Approach. 2nd ed. New York: Collier Macmillan Publishers, 1971.

Rogers, R. C. "Towards a Theory of Creativity." In Creativity and Its Cultivation. Edited by H. H. Anderson. New York: Harper & Brothers, 1959.

Rudner, Richard S. "An Introduction to Simplicity." Philosophy of Science 28 (1961).

Rudwick, Bernard H. Systems Analysis for Effective Planning. Principles and Cases. New York: John Wiley & Sons, Inc.

Schoderbek, Peter P., et al. Management Systems Conceptual Consideration. Business Publications, Inc., 1975.

Sills, Grayce M., and Hall, Jeanne E. "A General Systems Perspective for Nursing." In A Systems Approach to Community Health. Edited by Joanne E. Hall and Barbara R. Weaver. New York: J. D. Lippincott Co., 1977.

Silvern, Leonard C. "A System Language for Flow Chart Modeling." Educational Technology 9 (June 1969).

Skinner, B. F. Beyond Freedom and Dignity. New York: Random House, 1971.

Srinivasan, Lyra. Perspectives on Non-Formal Adult Learning, Functional Education for Individual, Community and National Development. New York: World Education, 1977.

Sullivan, John F., and Skinner, Gilbert H. How Five Different Types of Managers Behave in Performing the Basic Management Functions. Personnel Management Program Service, Michigan State University, East Lansing, Michigan, unpublished paper.

Tough, Allan. Why Adults Learn: A Study of the Major Reasons for Beginning and Continuing a Learning Project. Monographs in Adult Education No. 3. Toronto, Canada: Ontario Institute for Studies in Education, 1968.

Turban and Meredity. Fundamentals of Management Science. Dallas, Texas: Business Publications, Inc., 1977.

Vemuri, V. Modeling of Complex Systems. An Introduction. New York: Academic Press, 1978.

Vines, Austin, and Anderson, Marvin A., eds. "Heritage Horizons, Extension's Commitment to People." Journal of Extension, 1976.

Wadsworth, Barry. Piagot's Theory of Cognitive Development. New York: David McKay Co., Inc., 1971.

Watson, Goodwin. "Resistance to Change." American Behavioral Scientist 14 (May-June 1971).

Webb, Earl S., and Knotts, Clifton Don. Agricultural Mechanical Skills Needed by Farmers in Texas. Texas A & M University College Station, Department of Agricultural Education, ED 084460, September 1970.

Weiner, Norbert. Cybernetics. New York: John Wiley & Sons, Inc., 1948.

Young, Stanley. "Designing a Behavioral System." In Management Systems. Edited by P. P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Zaltman, Gerald, and Duncan, Robert. Strategies for Planned Change. New York: John Wiley & Sons, Inc., 1977.

RELATED BIBLIOGRAPHY

RELATED BIBLIOGRAPHY

Albers, H. Henry. Principles of Management: A Modern Approach. New York: John Wiley & Sons, Inc., 1969.

Ainsworth, W. A. Cybernetic Modelings. Princeton, N.J.: D. Van Nostrand Co., 1967.

Alexander, C. Notes on the Synthesis of Form. Cambridge, Mass.: Harvard University Press, 1964.

Anderson, C. A., and Bowman, M. J. "Theoretical Considerations in Educational Planning." In Educational Planning. Edited by D. Adams. New York: Syracuse University Press, 1964.

Anderson, Ralph, et al. Human Behavior in the Social Environment. A Social Systems Approach. Chicago: Aldine, 1974.

Appley, A. Lawrence. Values in Management. New York: American Management Association, 1969.

Argenti, J. Systematic Corporate Planning. New York: John Wiley & Sons, 1974.

Ashby, R. W. Introduction to Cybernetics. London: Chapman Hall, 1958.

Asimow, Morris. Introduction to Design. Englewood Cliffs, N.J.: Prentice Hall, 1962.

Balogh, T., and Streeten, P. P. "The Planning of Education in Poor Countries." In Economics of Education. Edited by M. Blaug. Baltimore: Penguin Books, Inc., 1968.

Beer, A. E. A Cognitive Model of Problem Formation in Design. Research Report No. 62. Carnegie-Mellon University, Institute of Physical Planning, 1976.

Beer, Stafford. "What Has Cybernetics to Do With Operational Research." In Management Systems. Edited by Peter P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Bertalanfly, L. Von. The Relevance of General Systems Theory. New York: George Braziller, 1972.

Borg, W. R., and Gall, M. D. Education Research: An Introduction. 2nd ed. New York: David McKay Company, Inc., 1974.

Bowles, S. Planning Educational Systems for Economic Growth. Cambridge, Mass.: Harvard University Press, 1969.

Bredemeier, C. Harry. Social Systems Integration and Adaptation. New Brunswick, N.J.: Rutger, The State University, unpublished paper.

Bredemeier, C. Harry, et al. The Analysis of Social Systems. New York: Holt, Rinehart & Winston, 1962.

Bross, D. T. Irwin. Design for Decision. New York: Macmillan Co., 1953.

Brunner, S. Jerome. The Process of Education. New York: Random House, 1960.

Buckley, Walter, ed. Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1966.

Chin, Robert, et al. Planning Change. New York: Holt, Rinehart & Winston, Inc., 1961.

Churchman, C. West. The Systems Approach. New York: Delacorte Press, 1968.

Churchman, C. West, et al. An Introduction to Operation Research. New York: John Wiley & Sons, Inc., 1957.

Churchman, C. West, et al. Measurement: Definitions and Theories. New York: John Wiley & Sons, Inc., 1979.

Collins, Peter. Architectural Judgment. Montreal: McGill-Queen's University Press, 1971.

Combs, Arthur. Educational Accountability Beyond Behavioral Objectives. Association for Supervision and Curriculum Development.

Coombs, P. H. "What Is Educational Planning?" In Fundamentals of Educational Planning. Vol. 1. Edited by C. E. Beeby. Paris: UNESCO Press, 1970.

Crone, Catherine. Research on Innovative Nonformal Education for Rural Women. Phase I. New York: World Education, 1976.

Davis, G., and Scott. Training in Creative Thinking. New York: Holt, Rinehart & Winston, Inc., 1971.

Davis, R. H.; Alexander, L. T.; and Yelon, S. L. Learning System Design. New York: McGraw Hill, 1974.

Dechert, R. Charles. "The Development of Cybernetics." In Management Systems. Edited by P. P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

________. "The Development of Cybernetics." In Management Systems. 2nd ed. Edited by P. P. Schoderbek. New York: John Wylie & Sons, Inc., 1971. Originally printed in the American Behavioral Scientist Journal, June 1965, pp. 15-20.

________, ed. The Social Impact of Cybernetics. Notre Dame: University of Notre Dame Press, 1966.

Deutsch, W. Karl. The Nerves of Government. New York: The Free Press, 1966.

Eastman, C. M. "On the Analysis of Intuitive Design Processes." In Emerging Methods in Environmental Design and Planning. Edited by G. Moore. Cambridge, Mass.: MIT Press, 1970.

________. Problem Solving Strategies in Design. Reprint No. 23. Carnegie-Mellon University, School of Urban and Public Affairs, 1970.

Edwards, Paul, ed. The Encyclopedia of Philosophy. New York: Collier Macmillan. Reprinted edition. 1972.

Emery, F. E., ed. Systems Thinking. Baltimore: Penguin Books, 1969.

English, J.; Morloy, W.; Leighton, Collins; eds. Educating Engineers for World Development. Estes Park, Colo.: International Division, American Society for Engineering Education, 1975.

Etzioni, A. The Active Society: A Theory of Societal and Political Processes. New York: The Free Press, 1968.

Faber, M., and Soars, D., eds. The Crisis in Planning. Vol. 1: The Issues; Vol. 2: The Experience. London: Chattos and Windus for The Sussex University Press, 1972.

Friedman, J. "A Conceptual Model for the Analysis of Planning Behavior." Administrative Science Quarterly 2 (1967): 225-252.

Friedman, J., and Hudson, B. "Knowledge and Action. A Guide to Planning Theory." Journal of the American Institute of Planners 40 (1974): 2-16.

Gagné, R. M. The Analysis of Instructional Objectives for the Design of Instruction. Vol. 1: Teaching Machines and Programmed Learning; Vol. 2: Data and Directions. Edited by R. Glaser. Washington, D.C.: National Education Association, 1965.

Getzels, J. W., and Csickszentmihalyi, M. The Creative Vision: A Longitudinal Study of Problem Finding in Art. New York: John Wiley & Sons, Inc., 1976.

Gordon, William J. M. Synectics--The Development of Creative Capacity. New York: Macmillan, 1971.

Gordon, Hern, ed. The General Systems Approach: Contributions Toward a Holistic Conception of Social Work. New York: Council on Social Work Education, 1969.

Green, T. F., ed. Educational Planning in Perspective. London: International Printing Corporation: Business Press, Ltd., 1971.

Gulband, G. T. What is Cybernetics? New York: Grove, 1960.

Johnson, A. R., et al. The Theory and Management of Systems. 2nd ed. New York: McGraw Hill, 1967.

Joyce, B.; Morine, G.; Weil, M.; and Wold, R.; eds. A Classification of Competency Oriented Tools for Teacher Education. New York: Teachers College, Columbia University Press, 1971.

Hall, A. D., et al. Definition of System, General Systems. General Systems Yearbook. Vol. 1, 1956, pp. 18-28. Reprinted in Walter Buckley, ed. Modern Systems Research for the Behavioral Scientist. Chicago: Aldine, 1966.

Harbison, F. H. "Educational Planning and Human Resource Development." In Fundamentals of Educational Planning. Vol. 3. Edited by C. E. Beeby. Belgium: UNESCO Press, 1971.

________. Education Sector Planning for Development of Nationwide Learning Systems. Princeton: Princeton University, Overseas Liaison Committee, American Council on Education, 1973.

Hartley, H. J. Educational Planning-Programming-Budgeting--A Systems Approach. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1968.

Hoxeng, James. Let George Do It. An Approach to Rural Nonformal Education. Amherst, Mass.: Center for International Education, University of Massachusetts, 1973.

Isaac, S., and Michael, W. B. Handbook in Research and Evaluation. 1st ed. San Diego: Robert R. Knapp, Publisher, 1971.

Kleis, Russell. Non-Formal Education. East Lansing: Michigan State University, 1974.

Klir, J. G. An Approach to General Systems Theory. New York: Van Nostrand Reinhold, 1967.

Krauss, R., and Myer, J. Design: A Case History. Cambridge, Mass.: MIT, Center for Building Research, 1968.

Laszlo, Ervin. Introduction to Systems Philosophy Toward a New Paradigm of Contemporary Thought. New York: Gordon and Breach, Science Publisher, 1972.

________. The Relevance of General Systems Theory. Papers presented to Ludwig Von Bertalanfly on his seventeenth birthday. G. Braziler's Series. The International Library of Systems Theory and Philosophy. New York: George Braziller, 1972.

________. The Systems View of the World. New York: Braziller, 1972.

________, ed. The World System: Models, Norms, Applications. New York: Braziller, 1973.

Mackay, D. "Towards an Information Flow Model of Human Behavior." In Modern Systems Research for Behavioral Scientists. Edited by W. Buckley. Chicago: Aldine Publiching Co., 1968.

Mager, O. Robert. "Preparing Instructional Objectives." In New Patterns of Management. Edited by Rensis Likert. New York: McGraw Hill Book Co., 1961.

Mager, R. F. Preparing Objectives for Programmed Instruction. San Francisco: Fearon, 1902.

Mandler, J. M., and Mandler, G. Thinking: From Association to Gestalt. New York: John Wiley & Sons, 1964.

Manheim, M. L. "A Design Process Model: Theory and Applications to Transportation Planning." In Emerging Methods in Environmental Design and Planning. Edited by G. Moore. Cambridge, Mass.: MIT Press, 1970.

Martin, W. E. "The Systems Concept." Business Horizons, Spring 1966. Reprinted in D. I. Cleland and W. R. King. Systems Organizations, Analysis, Management, A Book of Readings. New York: McGraw Hill Book Co., 1969.

Moore, Franklin G., and Thomas G. Hendrick. Production Operations Management. Homewood, Ill.: Richard D. Irwin, Inc., 1977.

Moravec, A. F. "Basic Concepts for Designing a Fundamental Information System." In Management Systems. Edited by P. P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Nadler, G. "Engineering Research and Design in Socioeconomic Systems." In Emerging Methods in Environmental Design and Planning. Edited by G. Moore. Cambridge, Mass.: MIT Press, 1970.

Niles, Mary Cushing. The Essence of Management. New York: Harper & Brothers Publishing, 1958.

Parnes, H. S., ed. Planning Education for Economic and Social Development. Paris: OCED, 1962.

Parsejig, V. L. This Cybernetic World of Men, Machines and Earth Systems. Garden City, N.Y.: Doubleday & Co., 1972.

Pattec, H. Howard. Hierarchy Theory. The Challenge of Complex Systems. New York: Braziller, 1973.

Pfeiffer, J. New Look at Education Systems Analysis in Our Schools and Colleges. New York: Odessey Press, 1965.

Popham, W. J., and Baker, E. L. Systomatic Instruction. Englewood Cliffs, N.J.: Prentice Hall, Inc., 1970.

Reifman, W. R. "Heuristic Decision's Procedures, Open Constraints, and the Structure of Ill-Defined Problems." In Human Judgment and Optimality. Edited by N. W. Shelly and G. L. Bryan. New York: John Wiley & Sons, 1964.

Rose, J. "Automation," Its Anatomy and Physiology. A contemporary science paperback. London: Oliver & Boyd, Ltd., 1907.

Rowley, C. D. "The Politics of Educational Planning in Developing Countries." In Fundamentals of Educational Planning. Vol. 12. Edited by C. E. Beeby. Paris: UNESCO Press, 1970.

Ruscoe, G. C. "The Conditions for Success in Educational Planning." In Fundamentals of Educational Planning. Vol. 12. Edited by C. E. Beeby. Paris: UNESCO Press, 1970.

Sabine, C. D. Accountability: Systems Planning in Education. Homewood, Ill.: ETC Publishing, 1973.

Sanyal, B. "The Systems Approach to Resource Allocation in Educational Planning." In Economics Analysis for Educational Planning: Resource Allocation in Nonmarket Systems. Edited by K. A. Fox. Baltimore: John Hopkins University Press, 1972.

Scott, G. William. "Organization Theory: An Overview and Appraisal." In Management Systems. 2nd ed. Peter P. Schoderbek. New York: John Wiley & Sons, 1971.

Snow, R. E. "Theory Construction for Research on Teaching." In Second Handbook of Research on Teaching. Edited by R. M. W. Travers. Chicago: Rand McNally, 1973.

Thayer, L. Communication and Communication Systems. Homewood, Ill.: Richard D. Irwin, Inc., 1968.

Thompson, O. James, et al. "Organizational Goals and Environment." In Sociological Reader on Complex Organization. Edited by Amatii Etzioni. New York: Holt, Rinehart & Winston, 1969.

Turban, Efriam, and Meredith. Fundamentals of Management. Dallas: Science Business Publications, 1977.

UNESCO. Educational Planning: A World Survey of Problems and Prospects. Paris: UNESCO Press, 1970.

UNESCO. World Survey of Education; V. Educational Policy, Legislation, and Administration. Paris: UNESCO Press, 1971.

Warren, Bennis, et al. "The Utility of System Models and Developmental Models for Practitioners," pp. 16-26. In Management Systems. Edited by Peter P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

Weiner, Norbert. "Cybernetics or Control and Communication." In The Animal and Machine. New York: John Wiley & Sons, 1948.

Wertheimer, M. Productive Thinking. New York: Tavistock, 1959.

Wilson, John. Thinking With Concepts. London: Cambridge University Press, 1963.

Young, Stanley. "Designing a Behavioral System." In Management Systems. Edited by Peter P. Schoderbek. New York: John Wiley & Sons, Inc., 1967.

PERIODICALS

PERIODICALS

Ackoff, L. Russell. "Towards a System of Systems Concepts." Management Science 17 (July 1971).

Balogun, T. A. "A Systems Approach to Education in Nigeria." West African Journal of Education 16 (1972): 205-219.

Blaug, M. "Approaches to Educational Planning." Economic Journal 77 (1967): 262-287.

________. "Economics and Educational Planning in Developing Countries. Prospects." Quarterly Review of Education 4 (1972): 431-441.

Blendinger, J. "ABC's of the Systems Approach." Education 90 (1969): 56-59.

Cassel, R. N. "Systems Analysis in Our Schools and Colleges." Education 90 (1969): 18-25.

Eisner, E. W. "Educational Objectives: Help or Hinderance." School Review 75 (1967): 250-266.

Fuller, G. "A Framework for Academic Planning." Journal of Higher Education 47 (1976): 65-77.

Hartley, H. J. "Limitations of Systems Analysis." Phi Delta Kappan 50 (1969): 515-519.

Haynan, J. L. "Educational Management Information Systems for the Seventies." Educational Administration Quarterly 10 (1974): 60-71.

Kaufman, K. A. "A Systems Approach to Education--Derivation and Definition." A. V. Communication Review 16 (1968): 415-425.

Martorana, S. V. "Factors Affecting Statewide Planning." New Directions for Higher Education 2 (1974): 7-18.

McGivney, J. H. "The New 'Systems' Approaches to Resource Allocation Decisions: A Second Look." Educational Technology 9 (1969): 31-34.

Miller, J. G. "Living Systems, Basic Concepts." Behavioral Science, July 1965, pp. 193-234.

Morine, G. "Planning Skills: Paradoxes and Parodies." Journal of Teacher Education 19 (1973): 135-143.

Seely, J. R. "What Is Planning? Definition and Strategy." Journal of the American Institute of Planners 28 (1962): 91-97.

Williams, G. "What Educational Planning Is About." Higher Education 1 (1972): 381-390.