SOFT SYSTEMS APPROACH TO INFORMATION PROBLEMS AT THE STRUCTURE LEVEL OF HEALTH CARE

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DECLARATION

ABSTRACT

Different forces are increasing the need for improved methods that measure quality in health care. Elements of structure, process, and outcome need to be identified, defined, and monitored in order to assess quality of health care.

Systems theory and methodology have been applied to a broad spectrum of health care problems. Much of the analytical work has taken place at the process/operational level. Accordingly, the information/decision processes are usually supported at the operational/managerial level. The information bases for decisions and action-taking at the structure and policy level however, require further analysis and research.

In this research, a problem situation regarding information access and use was identified at the structure level of a "health care system". The problem focused on the barriers, values, and impact of scientific and technical information, as assessed by 36 physicians who play the role of regional co-ordinators for conducting activities on health education and research within the "system".

The hypothesis underlying this work is that a Soft Systems approach can be used as a methodology to understand and learn about the information problems that exist at the structure level of a "health care system". It is estimated that through the inquiry process of Soft Systems Methodology, results can contribute to identify a pathway whereby the role of information access and use on quality of health, at the structure-process and process-outcome levels of health care be established.

Soft Systems Methodology was useful both (1) to tackle information problems at the structure level of health care; and (2) to enrich the different concepts of human activity systems that participate in the delivery of health care at the structure, process, and outcome levels. This research provided a model to such approach. Recommendations and further lines of research are also proposed.

ABBREVIATIONS USED IN THE TEXT

CATWOE	Basic elements of a "root definition": Costumers (C); Actors (A); a Transformation process (T); a Weltanschauung (W); Ownership (O); and Environmental constraints (E).
CENIDS	National Health Information and Documentation Centre, Mexico (Centro Nacional de Informacion y Documentacion en Salud).
DIF	Family, Integral Development Organisation, Mexico (Desarrollo Integral de la Familia).
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations).
HSISG	Health Services Information Steering Group (United Kingdom).
HAS	Human Activity System.
IMSS	Social Security Mexican Institute (Instituto Mexicano del Seguro Social).

ISSSTE	State Workers' Social Security Institute, Mexico (Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado).
ITU	International Telecommunication Union.
MEDLARS	Medical Literature Analysis and Retrieval System.
NSOI	Narrower System of Interest.
RCBER	Regional Co-ordinator for Biomedical Education and Research.
SDL	System Decision Level.
SSA	Mexico's Ministry of Health (Secretaria de Salud).
SSM	Soft Systems Methodology.
VSM	Viable System Model.
WHO	World Health Organisation.
WSOI	Wider System of Interest.

INTRODUCTION

The last two decades of the twentieth century will be recognised as a period of extraordinary fertility in biology and biomedical science, promising important developments both, curative and preventive in acute and chronic diseases. Throughout this era of modern medicine, physicians have constantly risen to the challenge of resolving difficult problems. The process of resolution has provided intellectual stimulation and the fundamental satisfaction of improving the human condition.

Medicine has indeed reached new pinnacles in providing benefits to patients, but the care provided today is also highly complex. The concerns now being raised about patient care have been buttressed in part by well-performed studies that suggest that physicians do not consistently apply available knowledge in the care of patients and that uncertainty about the most effective diagnostic and therapeutic approaches is pervasive (Brittain, 1985; Brahams, 1988; O'Leary, 1988).

These observations, as well as the financial incentives to conserve resources, the growth of forprofit hospitals and demands from purchasers, are among the forces today increasing the need for improved methods that measure quality in health care (Hopkins, 1987; Berwick, 1988). This has become a public policy issue.

Quality assessment is a vehicle for reaching the elimination or reduction in aberrancies of care, and the improved provision of care as it is performed today. These objectives, as end-products, can be attained only through the appropriate gathering and use of scientific and technical information.

In developed countries, the increasingly sophisticated databases and managed care procedures for the delivery of care yield new opportunities to observe and correct quality problems; however, research targets of measure and methods of measurement have not yet produced managerial useful applications for quality measurements in real-world settings (Berwick, 1988). Furthermore, in order to measure specific outcomes, much confusion still exists as to what information is needed for specific activities (Balla, et al., 1989; Black, 1989; Shortlife, 1989; Smith, et al., 1989). In developing countries this situation is worsen by political, social, and economic factors.

Clearly, the health care "need-provision" process is not given in isolation but within a "conceptual system" which operates in an environment that imposes boundaries and constraints on its activities. The boundaries and constraints include relationships with patients, with the community or society; with the level of professional knowledge and technology, and with other subsystems within the system, as well as with certain conventions and rules for procedures.

In this context, information plays an important role, not only as an element in a transformation process within the system, but also in decision making and in quality of health care.

According to Donabedian (1988), information needs to be available at all levels of health care. In order to assess the impact of information on quality of health care however, information needs to be not only available, but "used" as a resource. With this rationale, improvements in the use of information at the structure level of health care would lead to improvements at the structure-process, and outcome levels.

This work of research focuses on the information problems that exist at the structure level of a health care system, with an attempt to understand its impact on quality of health.

Two concepts need to be explained at this stage. One is that of a "system"; and the other is related to the "structure" level of health care.

Systems as a subject has been particulalrly prone to controversy and confusion about the meaning of its words. Indeed, the mapping of the abstract concept "system" onto aspects of perceived reality has been an endemic error which has held up the development of systems thinking in the last twenty years (Checkland, 1988).

The word system is used in every-day language in an unreflecting way as if it were a label word for an assumed ontological entity. Thus it is common to speak for example, of the "education system" or the "health care system" as if these were unproblematically systems.

In order to avoid confusion in this work, reference to the label-entity "system" shall be written in quotation marks ("") so as to differentiate it from the use of the real meaning of the word system; that is, ..."an epistemological device, one to be used consciously in the process of trying to understand the complexity of perceived reality" (Checkland, 1988).

On the other hand, the concept of "structure" is used in this work to denote the attributes of the settings in which care occurs. In this particular research, such attributes comprehend human resources education and capacitation (for example, continuing medical and nursing education); scientific and technical information (for example, information sources and channels of communication); and health research (for example, its co-ordination, planning, implementation, and monitoring). The relationships of structure-process-outcome are described in chapter 1, section 1.4.2.

The hypothesis underlying this work is that a Soft Systems approach can be used as a methodology to understand and learn about the information problems that exist at the structure level of a health care system. It is estimated that through the inquiry process of Soft Systems Methodology, results can contribute to identify a pathway whereby the role of information access and use on quality of health at the structure-process and process-outcome levels of health care be established.

The argument put foreward is that before any particular component of structure, process, or outcome can be used to assess quality of health, it is necessary first to establish such relationship (Donabedian, 1988).

The material in this work is presented in six chapters. Chapter 1 reviews the literature on the subject of systems and their application in health care. In separate sections, this chapter reviews the literature on quality of health care, the role of information, and the "environment".

Chapter 2 aims to provide the context in which a problem situation is detected. This chapter therefore provides a wholistic description of the Mexican Health Care System, particularly that of the Social Security Mexican Institute (IMSS). Once the elements of the system are identified, the purpose of this research is described, indicating the limitations and expected contributions of this study.

Chapter 3 examines the methodologies for problem solving, describing their usefulness and limitations.

Soft Systems Methodology is described in-depth for this was the methodology chosen to conduct this research.

Chapter 4 then presents the results of the research. Here, different models and tables illustrate the results.

Chapter 5 provides a discussion about the results obtained from the research, and also about the contribution of systems to health care. The needs, methodologies, and risks of setting-up an information system, as derived from this study, are also discussed and analysed.

Finally, Chapter 6 presents the conclusions and recommendations derived from this research.

CHAPTER 1

REVIEW OF THE LITERATURE

1.1 INTRODUCTION

The purpose of this chapter is to provide a review of the literature that was found relevant in conducting this research. Thus, an overall revision of the concepts of systems and systems thinking is provided in the first section. This section analyses the elements, definitions, and classification schemes of systems, and provides the basis for a systems approach, as complementary to the reductionist approach.

Then, a "Systems Science in Health Care" section explores the different types of "health systems" and models reported in the literature, as well as the decision making processes involved.

Here, the difficult task of measuring the performance of a "health care system" and the recent developments of "systems" in health care are also analysed.

The importance of structure, process, and outcome elements as related to quality of health care are discussed in the next section. Here, special emphasis is placed on the activities of assessment of quality of health and on the difficulties involved in this process.
The following section discusses the importance of information as a resource; its evaluation and its reported impact on health care. A final section then focuses on the "environment" where information use - production, and health care - quality take place.
Eleven conclusions summarize this revision; they are provided at the end of the chapter.

1.2. SYSTEMS AS A SUBJECT

1.2.1. Interpretation of Concepts and Terms.

The concepts of systems have slowly emerged in the present century to assume a central importance in the thinking and approach of many scientists and technologists. The ideas are now having an increasing impact on the approach of social and political scientists and economists.
The impetus towards systems thinking and the systems approach has come partly from a recognition of the complexity of behaviour which arises in both natural and man-made systems, and partly from the need to gain control over the more threatening outcomes of their behaviour (Beishon and Peters, 1981).

The emergence of systems thinking in various forms at different centres and arising from different base disciplines has been one of the main causes for the proliferation of terms, and this has hindered the setting up of an agreed vocabulary.
Indeed, the word "system" has many interpretations depending upon the context in which it is used. It can mean, for example, a procedure, a process or its control, a network, or a computer-based data processing package (Wilson, 1984).

1.2.1.1 Definition of "systems"

A widely quoted definition of systems is the following:

> "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 a whole" (Ackoff, 1960; Bertalanffy, 1956; Boguslaw, 1965; Hall and Fagen, 1956).

In order to explicitly include a subjective aspect, The Open Systems Group (Beishon, 1971; Beishon and Peters, 1981) define a system as an assembly of parts where:

1. The parts or components are connected together in an organaised way.
2. The parts or components are affected by being in the system (and are changed by leaving it).
3. The assembly does something.
4. The assembly has been identified by a

person as being of special interest.

The above mentioned definition is related to the "core meaning" of the word "system". In this context, Jordan (1981) states that the word's core meaning is made up of two aspects: an "out there" aspect which refers to the actual "system", and an "inside-us" aspect which comes from us, from the person doing the defining. Researchers at Lancaster (Checkland, 1971; Wilson, 1984) initially refined a definition to be used as a modelling language by first of all deriving a classification in terms of types of systems and then by developing a set of concepts appropriate to each type (Wilson, 1984). The particular classification may be summarized as follows:

(a) Natural Systems. Physical systems which make up the universe in a hierarchy from subatomic systems through the systems of ecology to galactic systems.

(b) Designed Systems. These can be both physical (tools, bridges, automated complexes) and abstract (mathematics, language, phylosophy).

(c) Human Activity Systems. Generally describing human beings undertaking purposeful activity such as man-machine systems,industrial activity, political systems, etc.

(d) Social and Cultural Systems. Most human activity will exist within a social system where the elements will be human beings and the relationships will be interpersonal. This is different in nature to the other three classes in that it spans the interface between natural and human activity systems. Examples of social systems would be the family, a community, as well as the set of systems formed by groups of human beings getting together to perform some other purposeful activity, such as an industrial concern or a conference.

1.2.1.2 "Elements"

Flood and Carson (1988) provide a systems description of a situation as an assembly of elements related in an organised whole.
In this context, an "element" may be anything that is discernible by a noun or a noun phrase that all informed observers would agree exists. An element must normally be capable of behaviour such that it has some significant property that may change. Thus, a "relationship" is said to exist between A and B if the behaviour of either is influenced by the other (Jones, 1982).
Relationships between elements may be flows of materials, information, or energy.

1.2.1.3 Internal and external relationships.

The concentration of relationships between elements helps us to distinguish a system from its "environment" (input-output relationships with the system).
The demarcation between a system and its environment

is made explicit by defining a "boundary" of the system. So there is always an outside to a system and an inside. This distinction is absolute in the theoretical construct of a "closed system", where there are no relationships between external and internal elements of a system.

An "open system", on the other hand, exchanges material, information, or energy with its environment across a boundary. This important distinction was introduced by Bertalanffy (1950).

Most of the familiar physical and chemical systems are closed systems and the laws of thermodinamics apply to them. These systems are characterized by the way they will always move towards an "equilibrium" state. This is essentially a state where the system is at rest or in a state of internal balance (Beishon, 1971).

Biological, social, and human activity systems are open systems and they exist in a dynamic balance with the environment. They tend towards a "steady" state balance. This concept was initially defined as "Homeostasis", by Cannon (1929), when referred to biological systems.

1.2.1.4 Narrower/Wider system of interest.

Other less influential component parts that indirectly affect a situation under study, via the ability to significantly change the surroundings, are represented as members of a wider environment.

According to Flood and Carson (1988), it is sometimes useful to distinguish a "Narrower System of Interest" (NSOI), from a "Wider System of Interest" (WSOI). This may be necessary where the application domain of a study relates to the NSOI, although there are also some elements that are closely associated and clearly do not belong in the outside environment. These then form a set labeled WSOI.

1.2.1.5 An example.

The fundamental ideas of a system are illustrated in Figure 1-1 (after Flood and Carson, 1988). Here, (a) shows a set of elements devoid of relationships, which is no more than an aggregation of parts; while (b) shows a set of elements with only limited relationships, which does not constitute a system; (c) suggests that identifying the concentrations of relationships between elements helps to identify a boundary of a system, its inputs and outputs; and (d) shows that a system may comprise a number of subsystems, and each subsystem can be thought of as a distinct system with a boundary. Finally, (e) shows that a system (comprised of a narrower and wider system) has an immediate environment with which it directly exchanges, in this abstract sense, material, information, or energy.

Other factors that may influence the system indirectly via an environment are termed the wider environment.

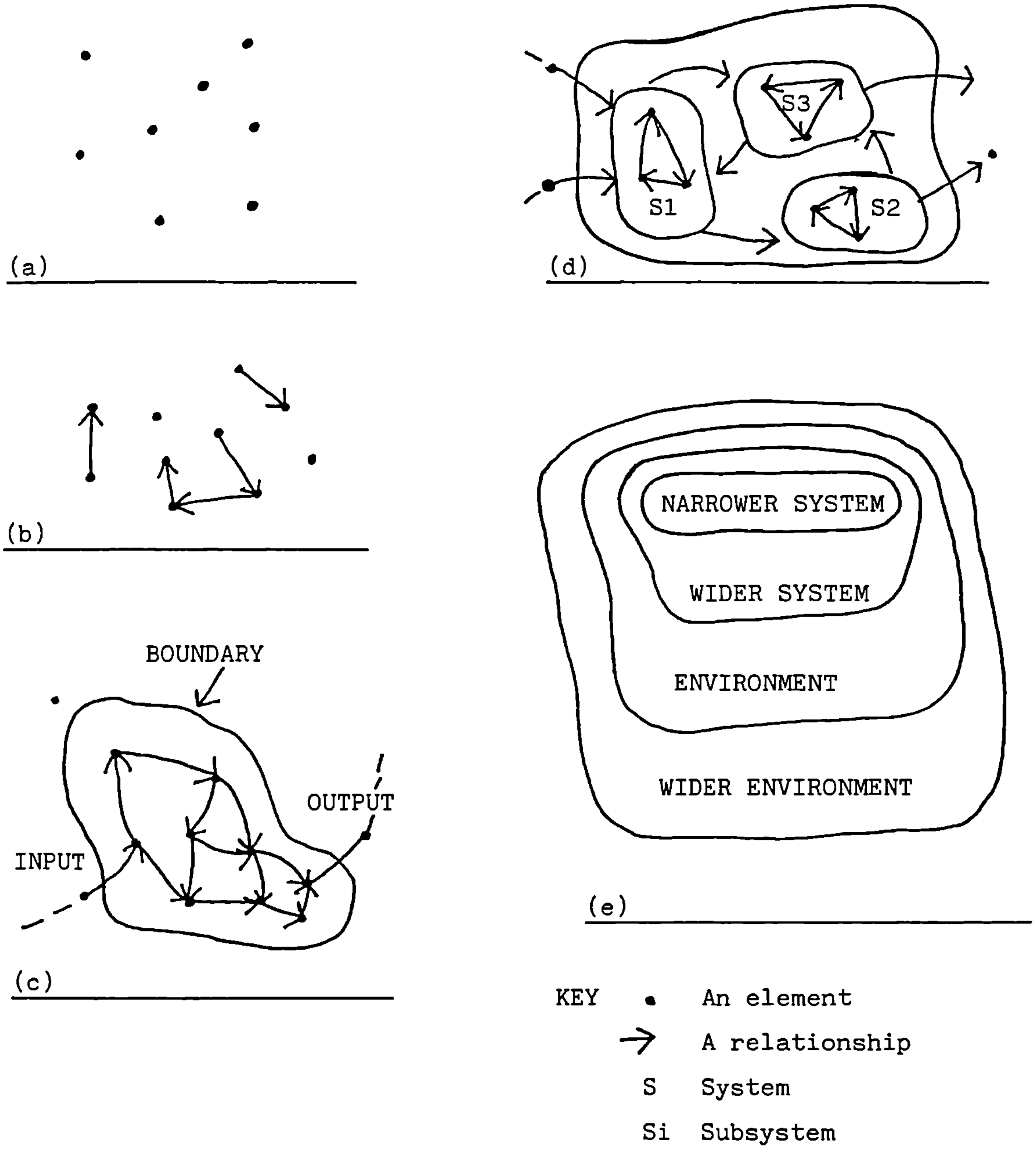


Figure 1-1. Defining a system. (a) Set of elements devoid of relation_ ships; (b) a set of elements with only limited relations; (c) multiple relationships between elements, the boundary of a system, its inputs - and outputs; (d) Subsystems within a System; (e) narrower System, wider System, environment, wider environment. (Flood and Carson, 1988).

1.2.1.6 The "System Universe".

Hearn (1976), described the "System Universe" as illustrated in Figure 1-2. Here, the system is the area within the triangle and has two subdivisions: the area outside the circle (the part of which the system is aware), and the area inside the circle (the part that is unknown to the system).

There are two regions in the environment: the distal environment outside the square, and the proximal environment inside the square. The proximal environment may be defined as the environment of which the system is aware, whereas the distal environment affects the behaviour of the system but is beyond the system's awareness.

1.2.1.7 Structure-process relationship.

The activities of a system are thought of as processes occurring in a structure. "Structure" defines the way in which the elements are related to each other, providing the supporting framework in which the processes occur. Such processes could represent a series of stages in the manufacturing of a product, or more generally, the natural or involuntary operation or series of changes in a situation (Flood and Carson, 1988).

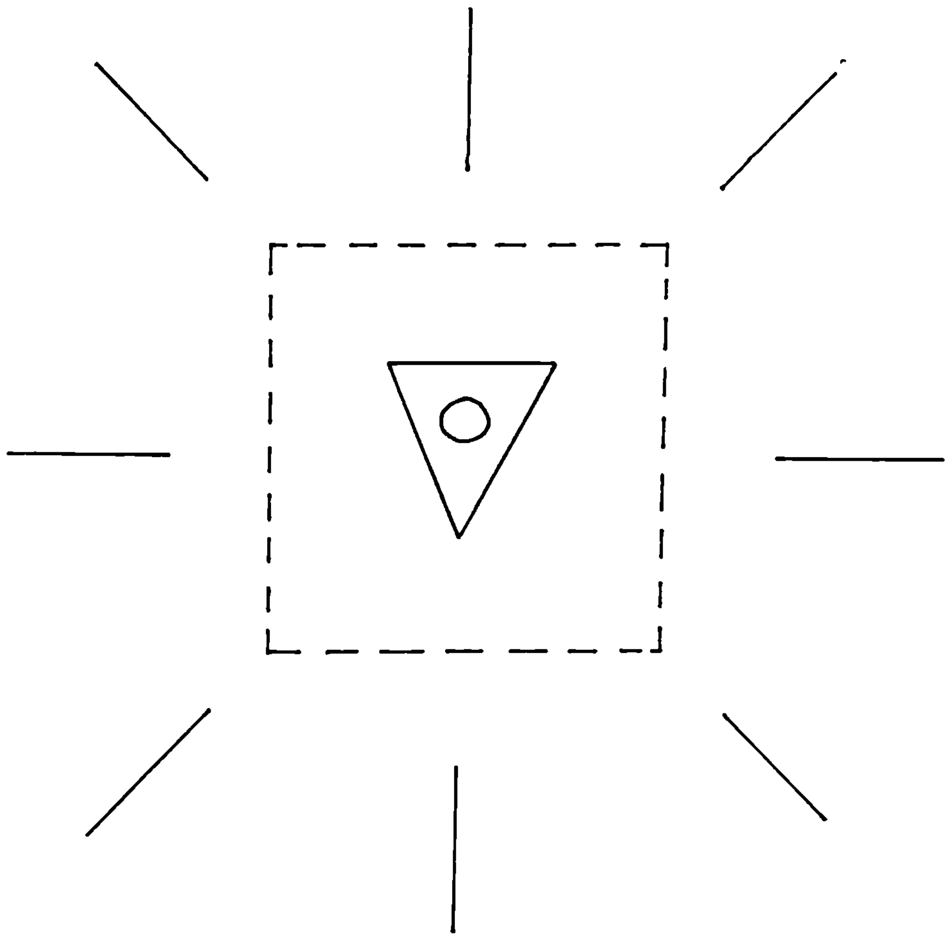


Figure 1-2. The system Universe (Hearn, 1976).

1.2.1.8 Behaviour of systems.

The sequential observations of systems at different times characterize their "situational behaviour", which may be "goal-seeking". A special case of goal-seeking behaviour is "adaptive behaviour" to external changes. In systems terms, this is due to "environmental changes". Thus, if an environment remains constant then a system's survival is not threatened by external forces.

Changes in an environment may be acute or chronic. Such changes are termed "environmental disturbances". These will require short or long-term adaptive behaviour via "regulation" and "control" (Flood and Carson, 1988).

1.2.1.9 Systems laws.

Two systems "laws" have thus emerged: that of "requisite variety" (Ashby, 1956), and Bertalanffy's (1968) principle of equifinality.

Adaptation, regulation, and control lead to "cybernetics", a subject area that describes the natural laws that govern the communication, computation, and control operations of dynamic situations (Wiener, 1948; Ashby, 1956; Robb, 1985; Espejo, 1987; Flood and Carson, 1988).

1.2.1.10 Feedback.

In cybernetics, a system is frequently described as a "black box" whereby the whole of a system's generative mechanisms are lumped into a single "transfer function" (TF). This acts on an input to produce an output.

To ensure that the output is monitored, so that a system may remain homeostatic or attain a new steady state, the output of the TF is brought back into its input where the difference between the desired and actual levels is identified. This is known as "feedback". Figure 1-3 illustrates these concepts.

In "negative feedback", the modification is such as to reduce the difference between actual and desired performance. Thus, negative feedback is usually associated with seeking defined objectives via control parameters. "Positive feedback" on the other hand, induces instability by reinforcing a modification in performance. It may lead to structural changes or death (Checkland, 1981; Flood and Carson, 1988).

1.2.2. A new mode of thought: "Systems Thinking".

In biology during this century there has been a debate about the nature of an organism. This debate has been one version of a wider debate between "reductionism" and "wholism". The terms of that debate have changed, and the change signals the emergence of "systems thinking".

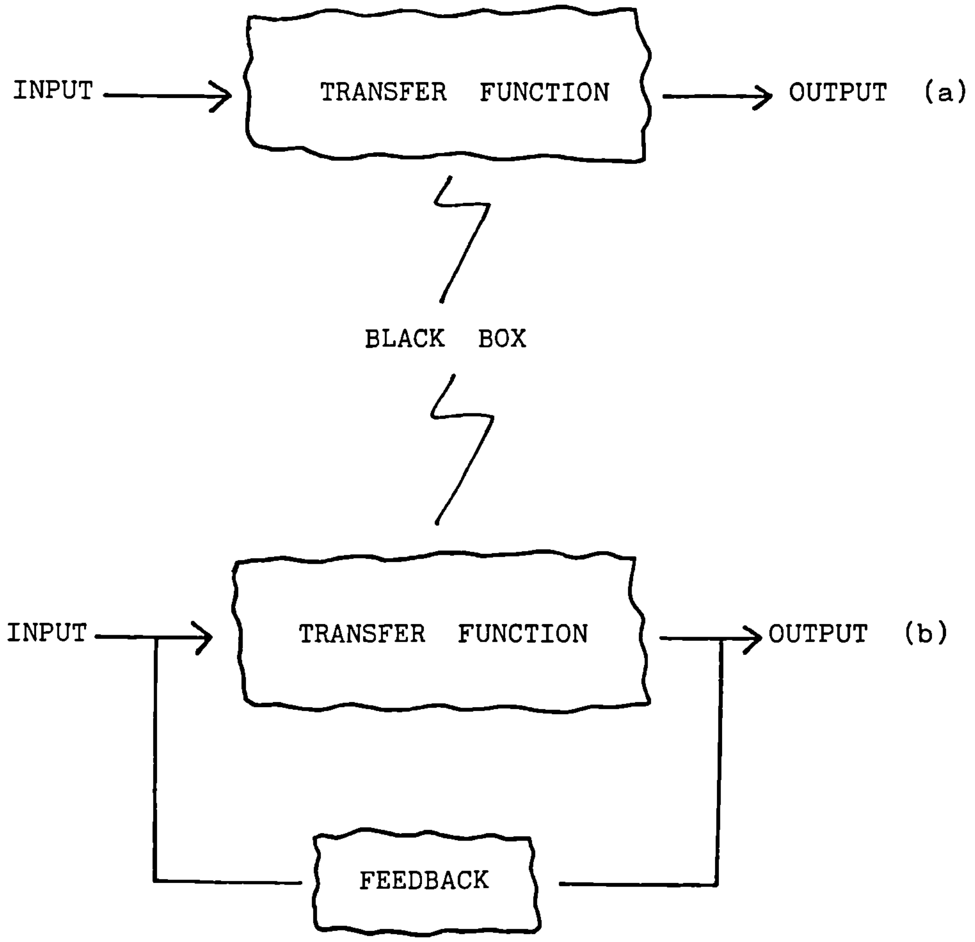


Figure 1-3. Transfer function: (a) without feedback; (b) with feedback (Flood and Carson, 1988).

1.2.2.1 General System Theory.

It was Bertalanffy who in the mid 1940s generalized organismic thinking into thinking concerned with systems in general (Bertalanffy, 1968).
In 1954 he helped to found the Society for General Systems Research, initially the Society for the Advancement of General System Theory (Bertalanffy, 1972). The aims of General System Theory were to be:

1. To investigate the isomorphy of concepts, laws, and models in various fields, and to help in useful transfers from one field to another.

2. To encourage the development of adequate theoretical models in areas which lack them.

3. To eliminate the duplication of theoretical efforts in different fields; and

4. to promote the unity of science through improving the communication between specialists.

Bertalanffy (1968) made the point that the distinguishing feature of living things appeared to be their degree of organisation.
It is the concept of organised complexity which became the subject matter of the new discipline "Systems"; and the general model of organised complexity is that there exists a "hierarchy" of levels of organisation, each more complex than the one below, a level being characterized by "emergent" properties which do not exist at the lower level. Such emergent properties are

meaningless in the language appropriate to the lower level (Checkland, 1981). In this context, the architecture of complexity is one of hierarchical organisation, and the levels of complexity are fundamental to any account of the organism.

1.2.2.2 Systems classifications.

Several classification schemes have emerged. Boulding (1956) for example, presents a preliminary hierarchy of the individual units found in empirical studies of the real world; the position of an item in the hierarchy being determined by its degree of complexity as judged intuitively. This hierarchy is illustrated in Table 1-1.

Jones (1967), on the other hand, has presented a systems classification according to the mode of operation and the physical nature of their components and couplings.

Laszlo (1973), has divided being into terrestrial microhierarchy and an astronomical macrohierarchy. In this scheme, the world is composed of atoms and cells, organisms and "social ecosystems". The world in turn is one of the basic elements of the astronomical macrohierarchy.

More recently, Miller (1975) has presented a "general theory of living systems". He distinguishes two basic notions: first that there is a hierarchy of levels of living systems; and second, that at each level, the same set of critical subsystems are essential to

LEVEL	CHARACTERISTICS
1. Structures, frameworks.	Static.
2. Clock-works.	Predetermined motion (may exhibit equilibrium).
3. Control mechanisms.	Closed-loop control.
4. Open systems.	Structurally self-maintaining.
5. Lower organisms.	Organised whole with functional parts.
6. Animals.	A brain to guide total behaviour, ability to learn.
7. Man.	Self-consciousness, knowledge of knowledge, symbolic language.
8. Socio-cultural systems.	Roles, communication, transmission of values.
9. Transcendental systems.	"Inescapable unknowables".

Table 1-1. Hierarchy of real-world complexity, after Boulding (1956).

function and survival.
Miller names seven major system levels: (1) cell; (2) organ; (3) organism; (4) group; (5) organisation; (6) Society; and (7) supranatural systems. Some of these levels can be subdivided. Nineteen critical subsystems are identified, such as mechanisms for reproduction; a boundary; a set of matter energy processing subsystems; and a set of information processing subsystems.
Among the information processing subsystems are the sensing subsystems, internal mechanisms for transducing, translating, and decoding; a decider or output mechanism which affects matter energy processing subsystems to implement decisions. These critical subsystems are present in all system levels from the cell to the supranatural system.
The strand of wholistic thinking in biology, which began in the second half of the nineteenth century, has continued throughout the twentieth century. The main discussion still being the autonomy of biology (Grene, 1974; Thorpe, 1978).

1.2.2.3 Communication and control.

Hierarchy theory, while still in its infancy (Pattee, 1973), is concerned with the fundamental differences between one level of complexity and another. Its ultimate aim must be to provide both an account of the relationships between different levels, and an account of how observed hierarchies come to be formed. In any hierarchy of open systems, maintenance of the hierarchy will entail a set of processes in which there is "communication" of information for purposes of regulation or control (Checkland, 1981).

The ideas from control theory and from information and communication engineering have made contributions to systems thinking no less important than those from organismic biology (Checkland, 1981).

A link between control mechanisms studied in natural systems and those engineered in man-made systems is provided by the part of systems theory known as cybernitics, as previously discussed.

All control processes depend upon communication, upon flow of information in the form of instructions or constraints, a flow which may be automatic or manual. Thus, while Physics would be a chaotic subject without the idea of energy, defined as the capacity to do work; Systems Thinking similarly, could not do without the idea of information (Checkland, 1981).

Information has indeed emerged as an important scientific concept (Cherry, 1957; Shannon and Weaver, 1949).

1.2.2.4 Communication problems.

The basic conceptualization in communication system engineering is that an information source produces a "message" which is coded to produce a "signal"; this signal is transmitted along a "channel", which will inevitably introduce some unwanted disturbances called "noise".

Signal plus noise then pass to a "decoder" which regenerates the original message, hopefully little distorted, for the receiver.

Three levels of problems have been the suject of discussion: Level A, that of the "technical problem" of signal transmission; level B, the "semantic problem" of how precisely the symbols convey the desired meaning; and level C, the "effectiveness problem" of how the meaning affects the recipient's conduct (Shannon and Weaver, 1949).

1.2.2.5 The core of systems thinking.

Emergence and hierarchy, communication and control constitute the two pairs of ideas which are the core of systems thinking. They provide the basis for a notation or language which can be used to describe the world outside ourselves.

Together these ideas provide an outline both for a systems account of the universe and for a systems approach to tackling its problems, this latter being complementary to the reductionist approach embodied in the method of the natural sciences (Checkland, 1981).

Figure 1-4 provides a historical perspective of the emergence of systems; while Figure 1-5, illustrates the development cycles of Systems Science.

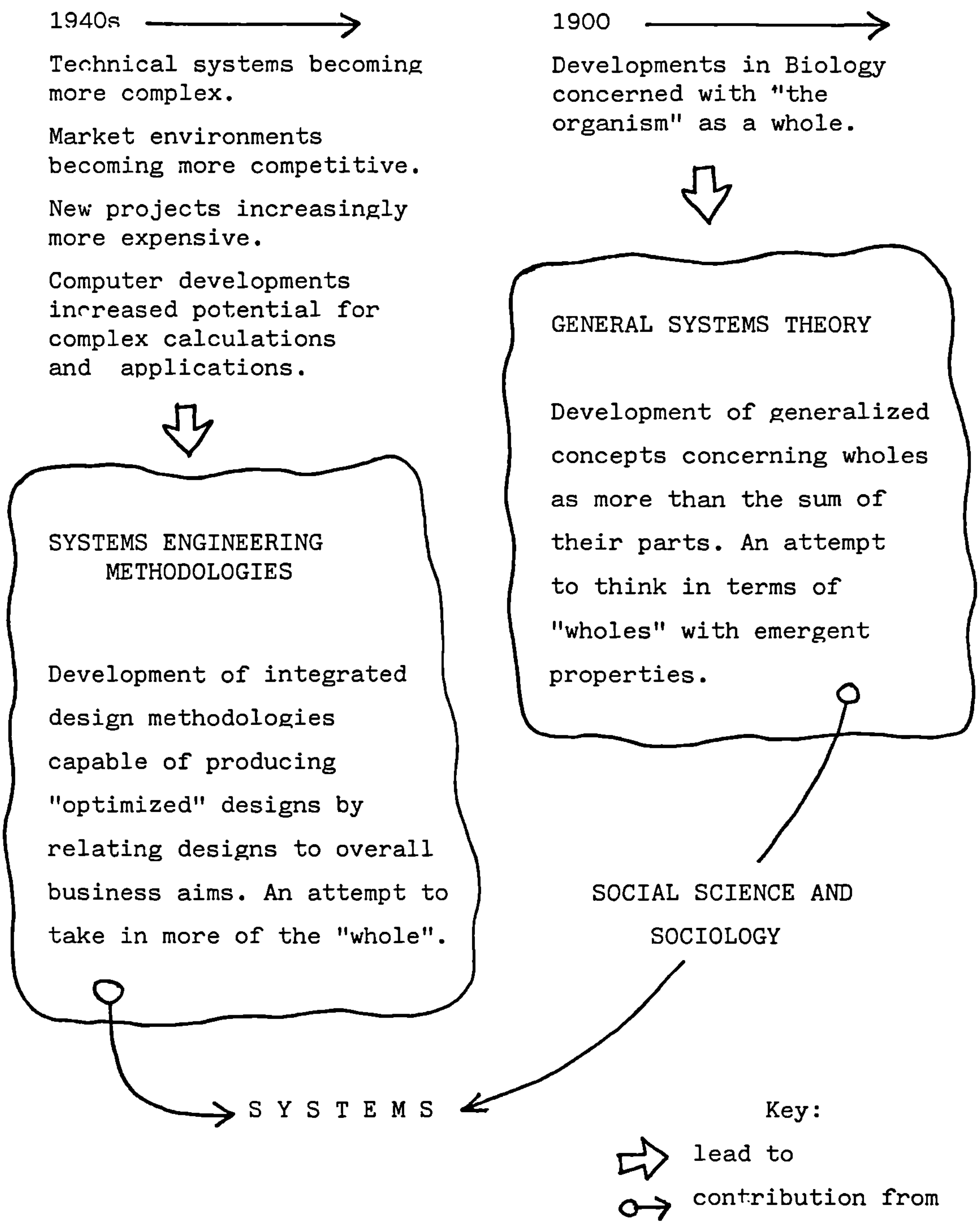


Figure 1-4. Historical perspective of "systems" (Wilson, 1984).

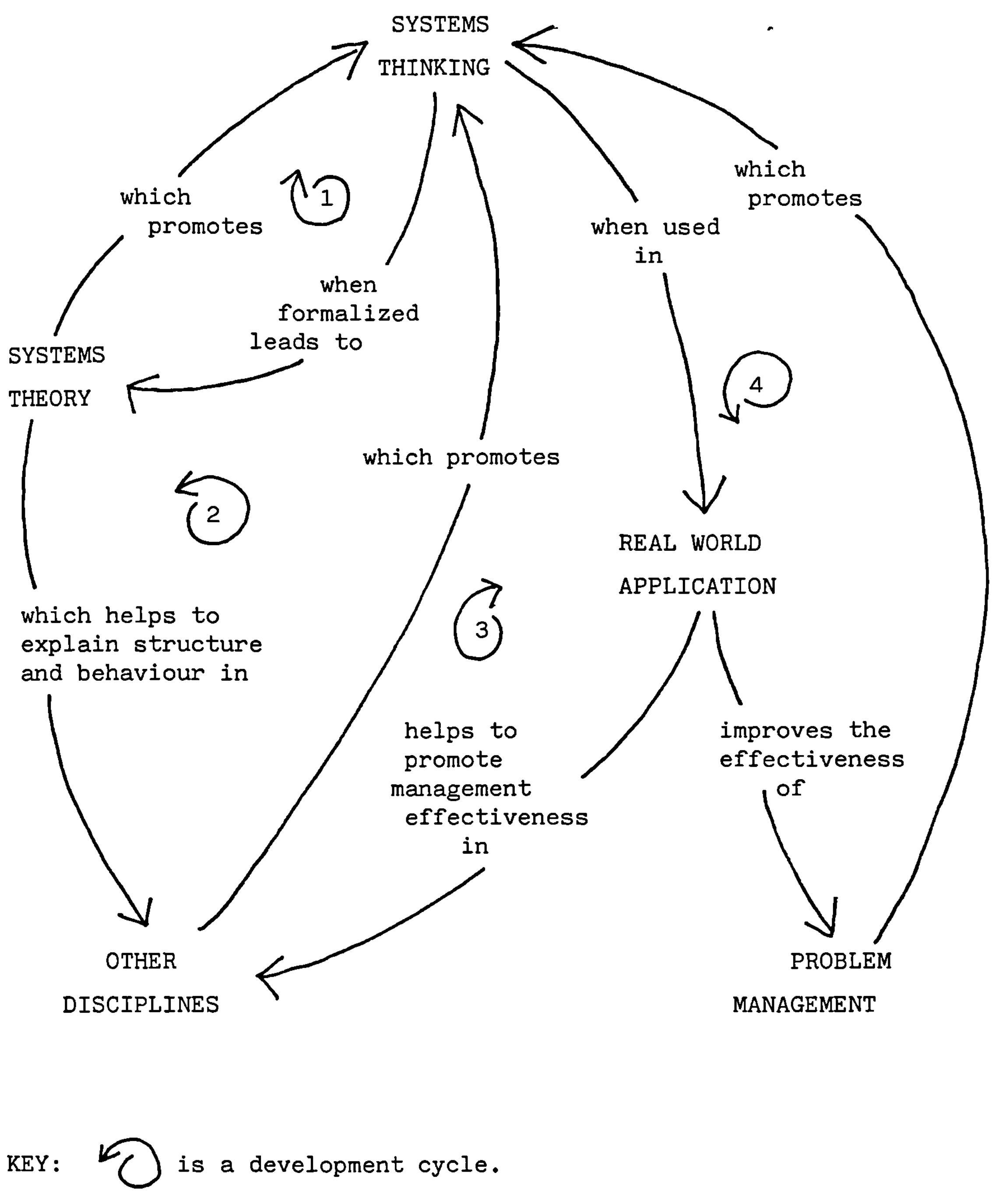


Figure 1-5. Four development cycles of Systems Science (Flood and Carson, 1988).

1.2.2.6 The "systems thinker".

According to Checkland (1981), a systems thinker would be: an observer who gives an account of the world, or part of it, in systems terms; his purpose in so doing; his definition of his system or systems; the principle which makes them coherent entities; the means and mechanism by which they tend to maintain their integrity; their boundaries, inputs, outputs, and components; their structure.
Finally, the observer/describer will be able to describe the behaviour of his system in two ways: he may concentrate only upon the inputs and outputs, in which case the system is treated as a "black box" embodying a transformation process which converts the one into the other; or he may describe the internal "state" of the system in terms of suitable variables, and the trajectory of it from one state to another under the influence of external conditions (Ashby, 1956; Klir, 1969; Checkland, 1981).

1.2.2.7 Map of the systems movement.

A systems account of the observed world and a systems approach to its problems are found in many disciplines; together all these efforts constitute what Checkland (1981) calls "The Systems Movement": the set of attempts in all areas of study to explore the consequences of holistic rather than reductionist thinking.

Although General Systems Theory does not itself provide a means of picturing the totality of work going on in the systems movement, the distinction made between the development of systems thinking as such and the application of systems thinking within other areas, or disciplines can be extended to provide a reasonable map of all the activity of the movement (Checkland, 1979).

According to Checkland, to construct the map, firstly a distinction is made between the development of systems ideas as such (in Cybernetics, for example) and in the application of systems ideas within an existing discipline. This gives two broad areas of systems work.

Secondly, within the work on systems thinking as such, a distinction is made between purely theoretical development of systems ideas and their interrelationships, and work based on the notion of developing the ideas by seeking to "engineer" systems in the real world, using that word in its broad sense. General Systems Theory is an example of the former, the development of systems engineering methodology an example of the latter. "Hard" systems engineering is only one example of the development of systems thinking by attempts at problem-solving.

Others lead to a third distinction: that between (a) engineering hard systems as such; (b) using systems ideas as an aid to decision making (as in Operational

Research); and (c) using systems thinking to tackle "soft", ill-structure problems.

These distinctions are illustrated in Figure 1-6. The internal and external influences to this map are illustrated in Figure 1-7.

1.2.2.8 Checkland's map of the Universe.

In constructing a systems map of the universe, Checkland (1971, 1981) concludes that the absolute minimum number of systems classes needed to describe the whole of reality is five: (1) natural; (2) designed physical; (3) designed abstract; (4) human activity systems; and following Boulding's (1956) classification, (5) transcendental systems, those beyond knowledge. Figure 1-8, summarizes the above mentioned scheme.

Any whole entity which an observer sees as a figure against the background of the rest of reality, may be described either as a system of one of these five classes, or as a combination of systems selected from the five. Thus, pursuing systems thinking becomes a matter of ascertaining the properties of systems of each class, and the way in which they combine and interact to form wider systems showing emergent properties (Checkland, 1981).

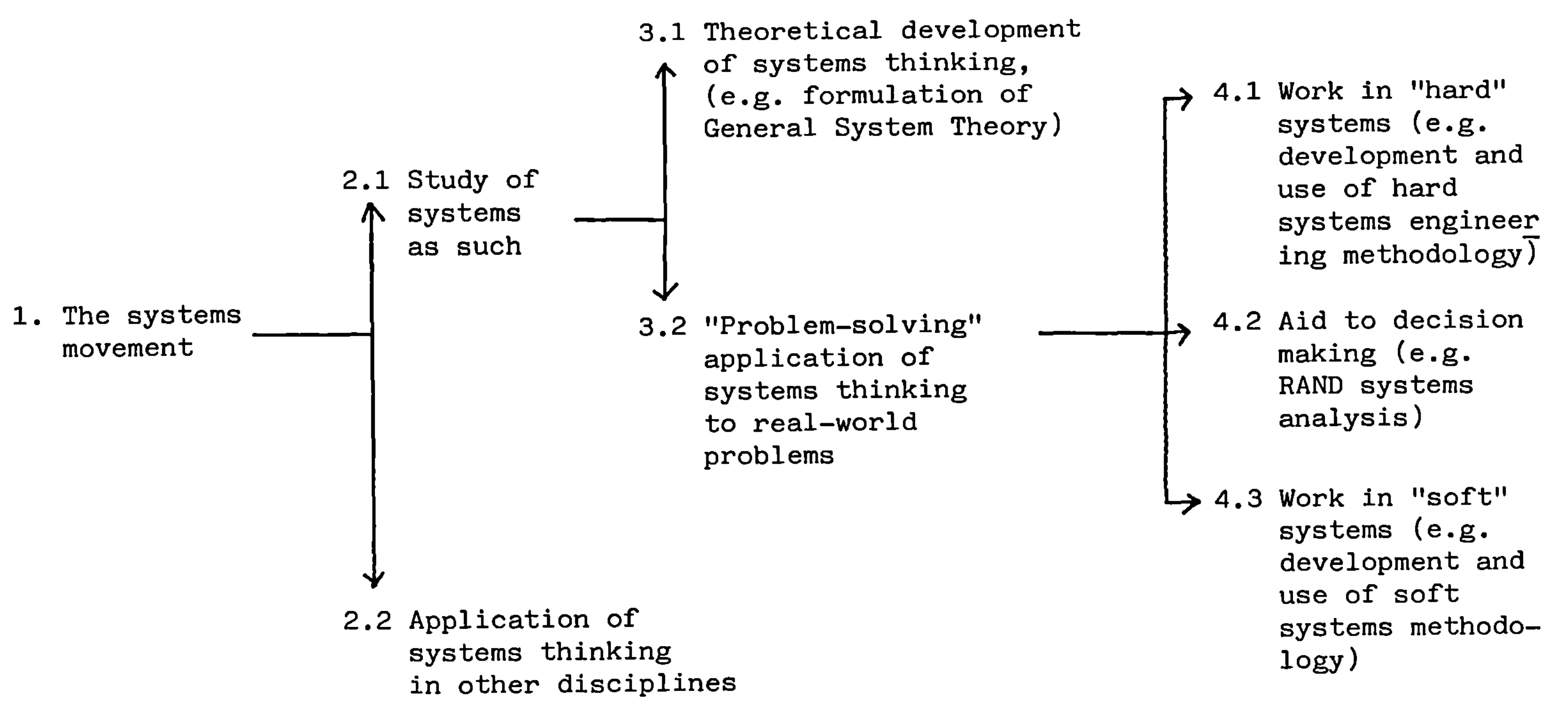


Figure 1-6. Distinction between the development of systems thinking as such, and the application of systems thinking within other areas. (Checkland, 1981).

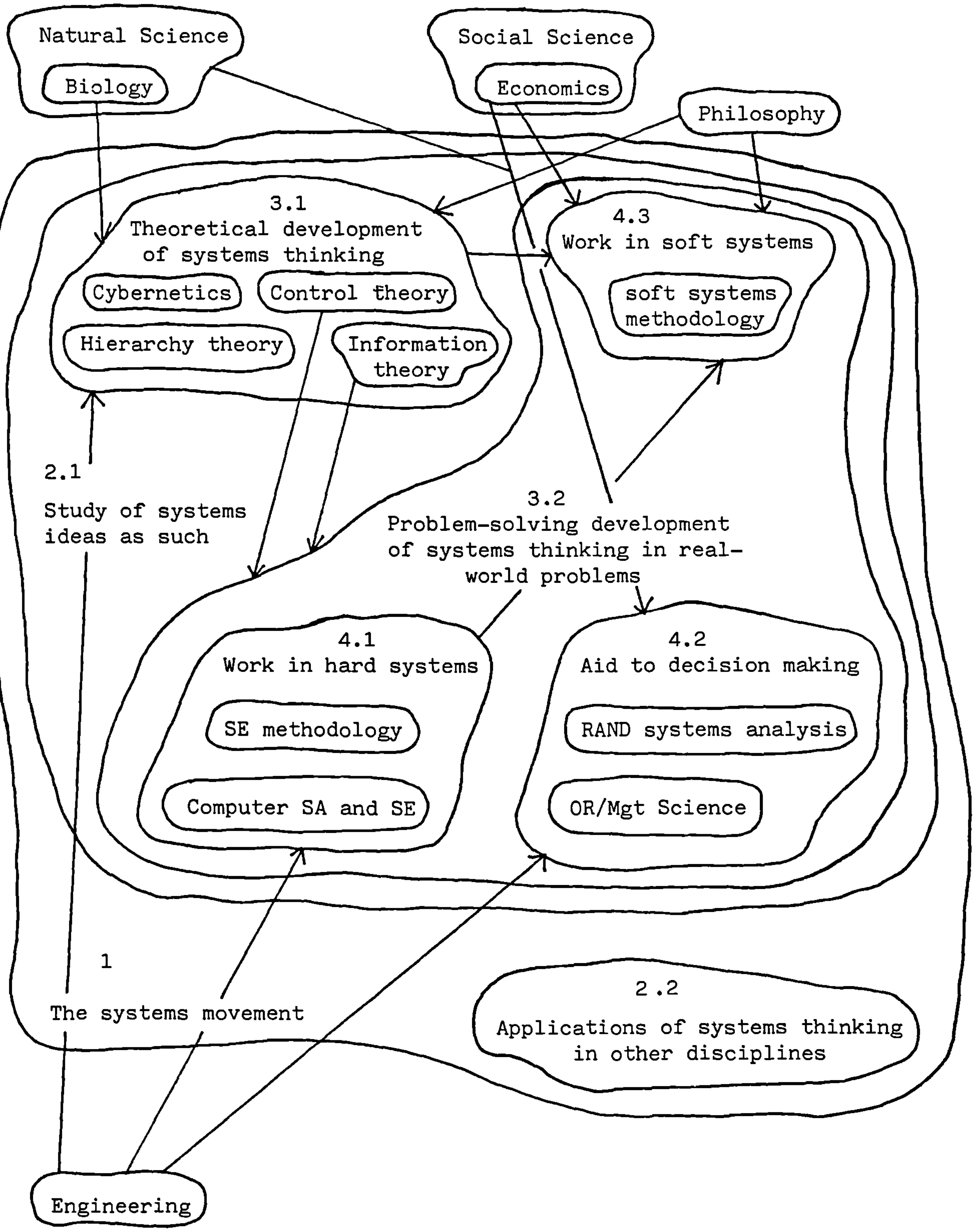


Figure 1-7. The shape of the systems movement indicating major internal and external influences (Checkland, 1981).

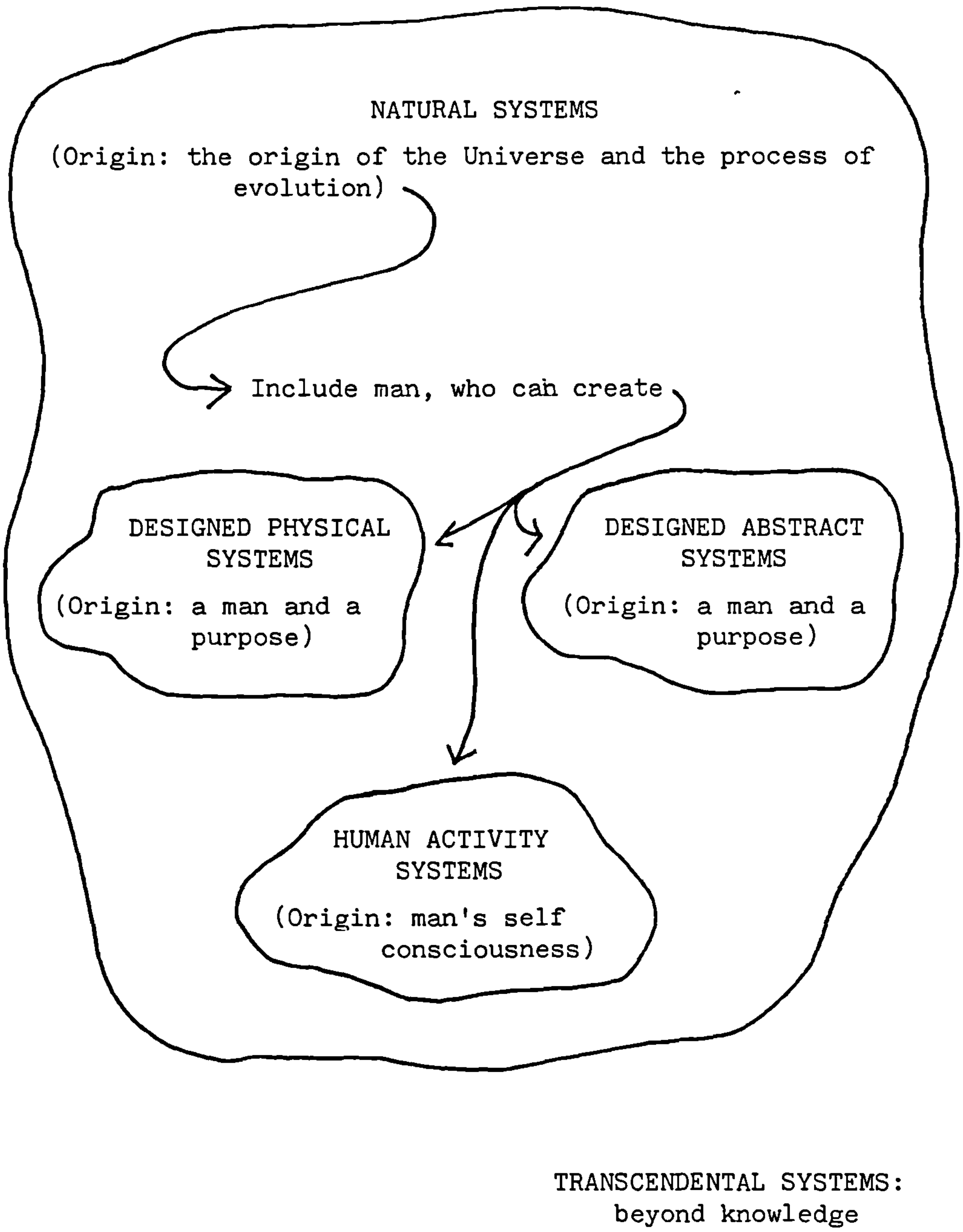


Figure 1-8. Five classes of system which make up a system map of the Universe (Checkland, 1981).

1.2.2.9 Applications of systems thinking.

Systems thinking has had a wide range of applications. It has been used among other fields, in Psychology (De Greene, 1981), Sociology (Buckley, 1981; Emery and Trist, 1981; Forrester, 1981; Vickers, 1981), Organisation Theory (Kast and Rosenzweig, 1981), Politics (Easton, 1981), Ecology (Dale, 1981), man-machine systems (Jenkins, 1981; Parnaby, 1981; Singleton, 1981), Biology (Toates, 1981), and Health Care (Sheldon, et al., 1970; Flagle, 1975; Werley, et al., 1976; Coblentz and Walter, 1977; Tilquin, 1981; Eimeren, et al., 1984; Duru, et al., 1988).

1.3. SYSTEMS SCIENCE IN HEALTH CARE

1.3.1. Conceptual Framework.

Each person participating in the "medical care system", whether as professional or patient, has his own conceptual framework which he employs in working with and moving through the network of organisations, individuals, and technology.
Miller's (1970) distinction for example, between "conceptual systems" that exist in the mind of the observer, and "concrete systems" that are the real, natural objects of scientific study has interesting implications. Depending upon an individual's vantage point and his encounters with the "concrete system" of medical care, he will develop a different "conceptual system" that he will employ to organise his decision-making and future actions.

1.3.1.1 The provider and the consumer of health care.

In "health care systems", two principal components must be differentiated: the provider and the consumer of medical care. Since the provider may not only be an individual physician, but a hospital or a "public health system", just as the consumer may not only be a single patient but a community, or a whole population, it seems more appropriate to distinguish a "subject system" and an "object system" (Hannover, 1977).

The "subject system" corresponds to the provider, the "object system" to the consumer of health care. In this context, the "subject system" acts upon an "object system" with the purpose of influencing its behaviour, for instance by convertińg a state of disease into a state of health. The "subject system" also collects information about the "object system" with the aim of assessing the "object system's" behaviour, in order to select appropriate actions.
It is important to note that health care has in the past directed its attention almost exclusively at the analysis of its "object systems". As a result, we dispose of a great number of techniques for the analysis and description of the behaviour of entire populations, of physical or physical reactions of individuals as well as for analysis of structure and function of single organs or their components down to the microscopic and molecular level. Consideration of the "subject system" has virtually been ignored (Hannover, 1977).

1.3.1.2 The concept of "disease".

Health is a desirable state and disease a perceived objective or subjective difference between an actual state and a desired state. This emphasizes the cybernetic nature of diseases.
The "object system" may be viewed as a complex "system" of mutually interrelated and superimposed control cycles. What we perceive as disease are the

expressions of the derangement of such control cycles. Different kinds of derangements may have the same effects. Single causes may have different effects depending on the state of the "object system" and consequently the appearance of disease varies with time and location.

The perceived effects are further more dependent upon the means applied for observation (Hannover, 1977). Indeed, different medical specialities employing different means of observation will arrive at different results regarding a "diseased system". Also, as the means for observation evolve historically, the picture of disease changes.

An important consequence of these concepts is that we are not dealing with "diseases" corresponding to distinguishable natural entities. Disease is but an expression of the derangement of "systems", and does not exist in isolation of the "object system".

1.3.1.3 Medical model concepts.

Distinctions between different states of the "object system" have the nature of "model" concepts (Bailey, 1980) and are due to artificial delimitations. The ultimate criterion of the value of medical model concepts (the effectiveness in preservation or restoration of what is perceived as "health") is extraneous to the model and itself subject to changes due to the evolution of ideological concepts, social constraints, progress in science, etc., to mention but a few.

Every failure concerning this complex criterion ("health") constitutes an incentive to reconsider the model and to change it.

An example is the continuous refinements of concepts of pathology, which in the past has led to a continuous resolution of the organism into organ-systems, these into cells, these into organelles (Beratalanffy, 1968).

Since all the physical substructures do not suffice, however, to explain the phenomena observed in medicine, contemporary models tend to comprise elements of the environment, such as social environment, climate, geographic characteristics, but also the microbial flora of the body, food, ethnic background, etc..

Further extensions are brought about by inclusion of the emotional and psychic dimensions. These facts account for the great variety of medical model concepts which represent the rules and guidelines for medical action.

Conceptually, medical intervention is considered to be a dual function, consisting of the direct provision of personal health care services and the indirect provision of information and management support services (Tenney, 1976). The first, or clinical task is patient care or problem processing. Its elemental unit is the doctor-patient relationship. Basically, this consists of a two-way transaction of personal expectations, with psychosocial determinants including both parties' personalities, roles reference groups, and subcultures in a socio-cultural environment matrix.

For the patient, antecedents are the multiple factors related to perception of a need for medical intervention, translating it into demand and assuming the patient role; for the physician, they are the acquisition and maintenance of knowledge and skills to analyse and manage patient problems effectively (Donabedian, 1973; Tenney, 1976; Merill and Vallbona, 1984).

The second, or support task is management or information processing. According to Tenney (1976), it is an essential part of medical intervention directed toward patient care but also toward total community health maintenance, health professional education, biomedical and health services research, and social policy direction.

Moore (1970), particularly emphasized information support and described the entire "medical care system" as a predominantly informational one, depending largely on the acquisition, storage, and interpretation of information by both, the patient and the doctor.

1.3.1.4 Levels of health care.

Finally, we can observe the activities and performance of physicians in three levels of health care: primary care, secondary care, and tertiary care.
The medical intervention process is evident at all three levels, but integration and co-ordination are less apparent (Tenney, 1976).
The primary level of patient care is practised by generalists, family physicians, internists, and paediatricians; that is, the doctors to whom patients first turn when they have a health-related problem. Problems at this level are undifferentiated and usually common. Primary medical practice is the level at which the majority of physician visits or medical intervention occurs. It is, as well, the object of public and professional controversy and of interest in health services research to fulfill WHO's goal of "health for all by the year 2000" (Klinger, 1984; Uemura, 1984; Weiss, 1984).
The secondary level of patient care is represented in the practices of specialists, consultants, and general community hospitals. Commonly, patients at this level receive special purpose care that is rendered for already defined problems of diagnosis and treatment; responsability for continuing general care then reverts to a primary physician or to the patient himself when the special purposes have been achieved. Co-ordination with other levels of care, as well as the provisions for adequate supply and distribution of

manpower have contributed to problems in organising the medical intervention function at the secondary level.

The tertiary level of care involves the practices of super-specialists, clinical researchers, and teachers in large medical centres. Here, the professionals and resources are uniquely equipped to tackle technically complex, specialized services for difficult problems. Fry (1973) has depicted the relationship of these three levels of care in a diagram which shows that the number of problems attended to at any level decreases as their complexity increases. Fry's diagram indicates that the majority of problems are self-limited in nature and are handled by the patient and/or his family at what may be termed the self care level.

In Figure 1-9, Vallbona (1983) presents a modification of Fry's diagram and indicates the inverse relationship between the severity of the health problems and the number or volume of health problems attended to at each level of care.

1.3.2. "Health Systems Models".

1.3.2.1 The environment of health care.

Reichertz (1977), in analysing health care delivery as a "system", provides a generalized and simplified model of the environment of health care. Figure 1-10 illustrates the complex environment where a health care "system" is placed. Here, relationships between

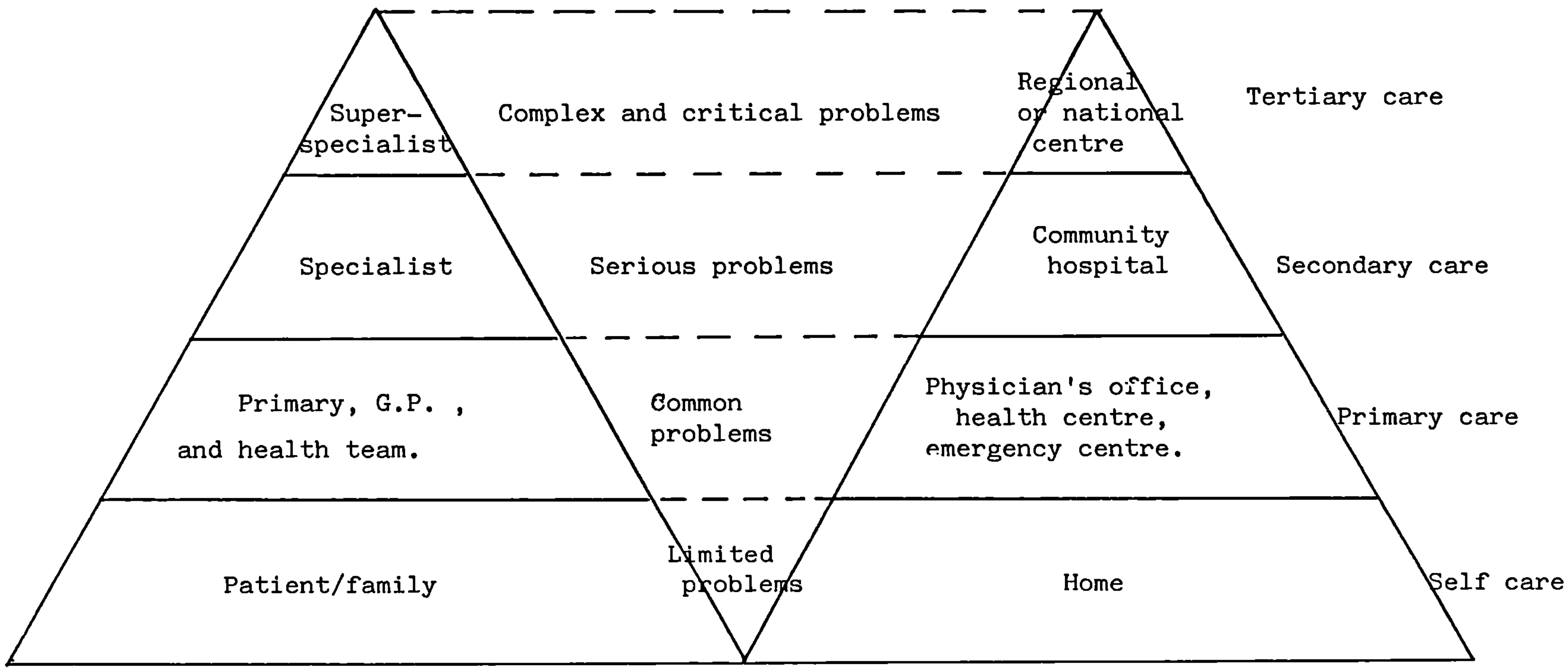


Figure 1-9. Levels of health care, after Fry (1973) and Vallbona (1983).

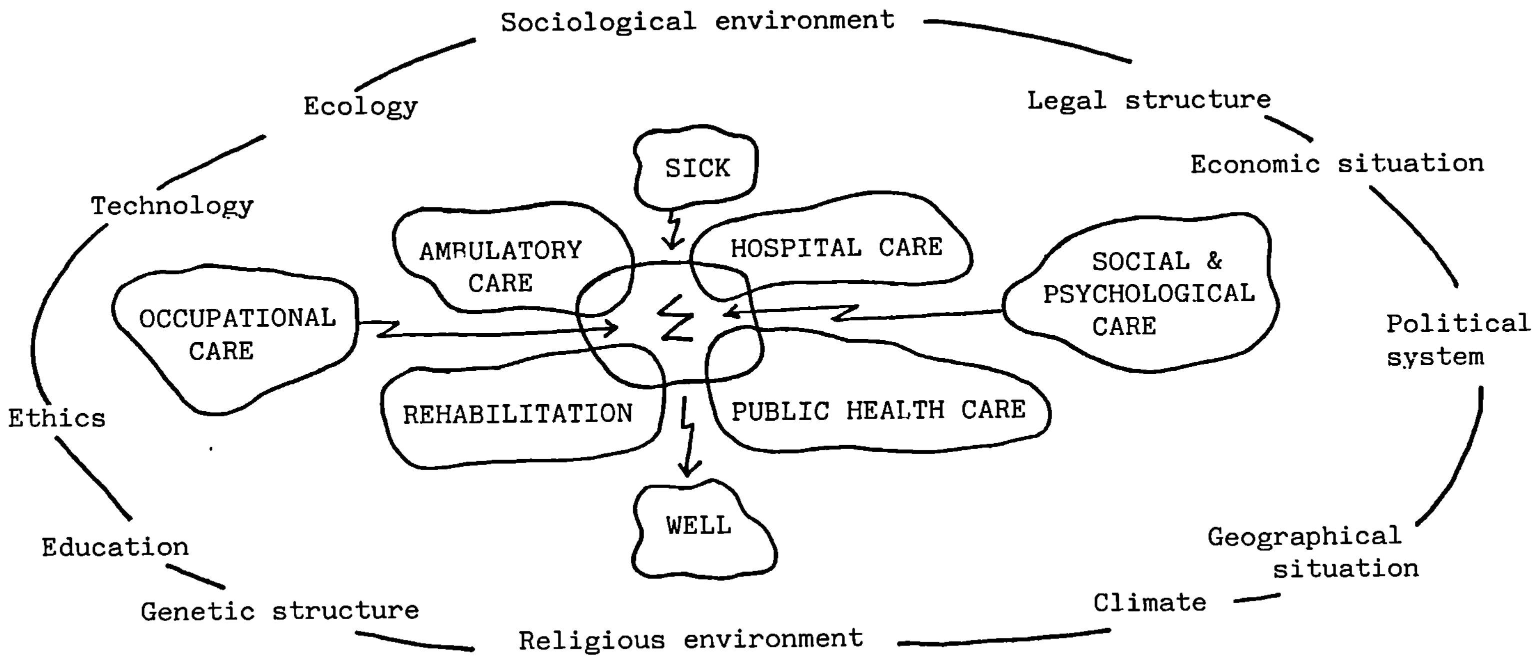


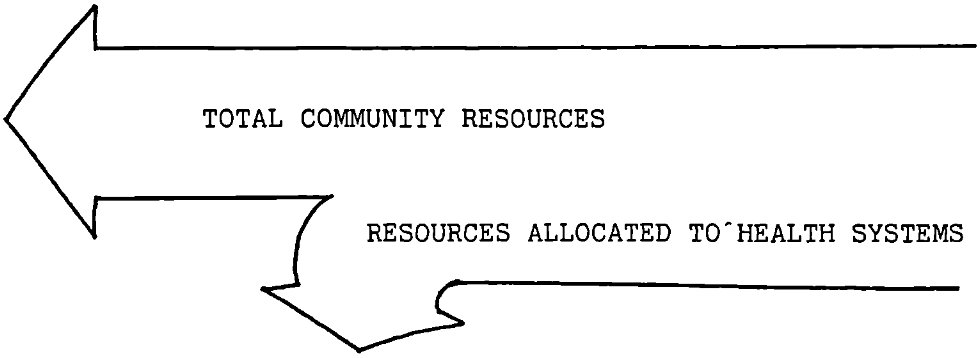
Figure 1-10. Generalized and simplified model of the environment of health care delivery (Reichertz, 1977).

sociological, legal, economic, geographical, biological, political, and psychological factors are clearly emphasized.
A perfect model which is completely identical to a "natural system" or which encompasses the complete chain of cause-effect, does not exist. Such cause-effect relationship may be endless. In modelling building it is therefore necessary to create an artificial limit. It is within these boundaries that a systems approach, after systems thinking, takes place. Usually, not one but many models must be used to analyse a system. Such models have different purposes and are constructed differently. They fall into two general classes, descriptive and predictive, and may be developed by formal, empirical, or combined methods (Flagle, 1962).

1.3.2.2 Howland's model.

In the allocation of resources to "health systems", Howland (1970) distinguishes three levels of approach: strategic, operational, and tactical, as shown in Figure 1-11.

(A) The Tactical level.
At the lowest, tactical level, the decision maker chooses among the resources at hand. He functions in an immediate time frame and can use only the resources which are immediately available. The surgeon for example, must work with the resources provided by the



STRATEGIC LEVEL
SYSTEMS ANALYSIS

Long-range planning of future health facilities:

What future demands are expected?.

What facilities will be required to meet them?.

How will these facilities be financed?.

OPERATIONAL LEVEL
OPERATIONS RESEARCH

Management of groups of patients in an existing health facility:

What demands are expected for groups of patients?.

What data about individual patients are required to develop this information?.

What resources will be required to meet the demands?.

How will these resources be acquired?.

TACTICAL LEVEL
ADAPTIVE SYSTEMS RESEARCH

Management of the individual patient:

How does the system adapt to patient demands?.

How does the use of a specific resource affect a given patient?.

Figure 1-11. The functional level of a health system. (Howland, 1970, 1976).

operating room.

In addition, at the tactical level, the physician is concerned with individual patients. This means that his decisions about medications, therapy, and the like must be based on the individual responses of a specific patient, not on the expected response of patients in general.

It therefore follows that any model used to understand organisational performance at this level must describe individual patient behaviour. This requirement suggests the need for "adaptive system" models (Howland, 1970, 1976).

(B) The operational level.

At the next, or operational level, the planner works with different information and in a different time frame. Resources which are parameters at the tactical level can now be used as variables.

The problem at this level is to organise available resources for the immediate future. The nursing supervisor, for example, must decide how to staff her nursing unit with the personnel at her disposal.

Planning at the operational level may be based on statistical or expected value information, but the numbers from which the statistics are computed must be generated at the tactical level.

The decisions made at the operational level depend on group, rather than individual behaviour. For example the use of X ray facilities in a hospital is based not only on the needs of the individual patient, but also on "system" capabilities and limitations.

The "system management" problem is one of trading off individual demands against "system capabilities". At the operational level, the interaction of the individual and the "system" is a major problem.

Much of the analytical work on "health systems" has taken place at the operational level. Models which describe various aspects of "system behaviour", such as the queue in the doctor's office or outpatient department (Flagle, 1962; Flagle and Young, 1966) have been used to make recommendations regarding various aspects of "system management".

Prescriptive, rather than descriptive models have been used for analysis. The decision criterion is no longer individual, as it was at the tactical level. The relationships between these two levels can be conceptualized in terms of actuarial statistics; mortality curves are developed by aggregating data from individuals. They can be expected to predict, within limits, the probability of death at any age for a group. They cannot, however, be used to predict the death of individuals within the group. This is the concern of the tactical level model.

(C) The strategic level.

At the top, or strategic level, planners work in a more remote frame. Many factors which are parameters at both the operational and tactical levels, such as physical plant, are variables here.

Decisions may be made regarding the construction of new facilities. The size and location of facilities, and the kind of services to be provided are variables. A major decision-making task at this level is to estimate trends in demands and assess the level of community resources which will be allocated to "health systems" (Howland, 1970).

Conceptualizing "health systems" in this way has two advantages: first, it provides for an examination of criteria at the various levels of the "system"; and second, attention is focused on the problem of providing top-level planners with the means of assessing the consequences of their design decisions at the tactical level.

1.3.2.3 Donabedian's model.

Donabedian (1973), in his "health care process" model distinguishes two main branches: (1) the behaviour of the "client" who states a "need" for health care; and (2) the behaviour of the "provider" of a health care service to meet that need.

In this context, both branches lead to the "utilization" of resources and thus to the modification of the initial "need" (outcome). Figure 1-12 illustrates this process.

Donabedian (1973) makes special emphasis on the "structural" aspect of the organisation where the health care process is being provided, and on the

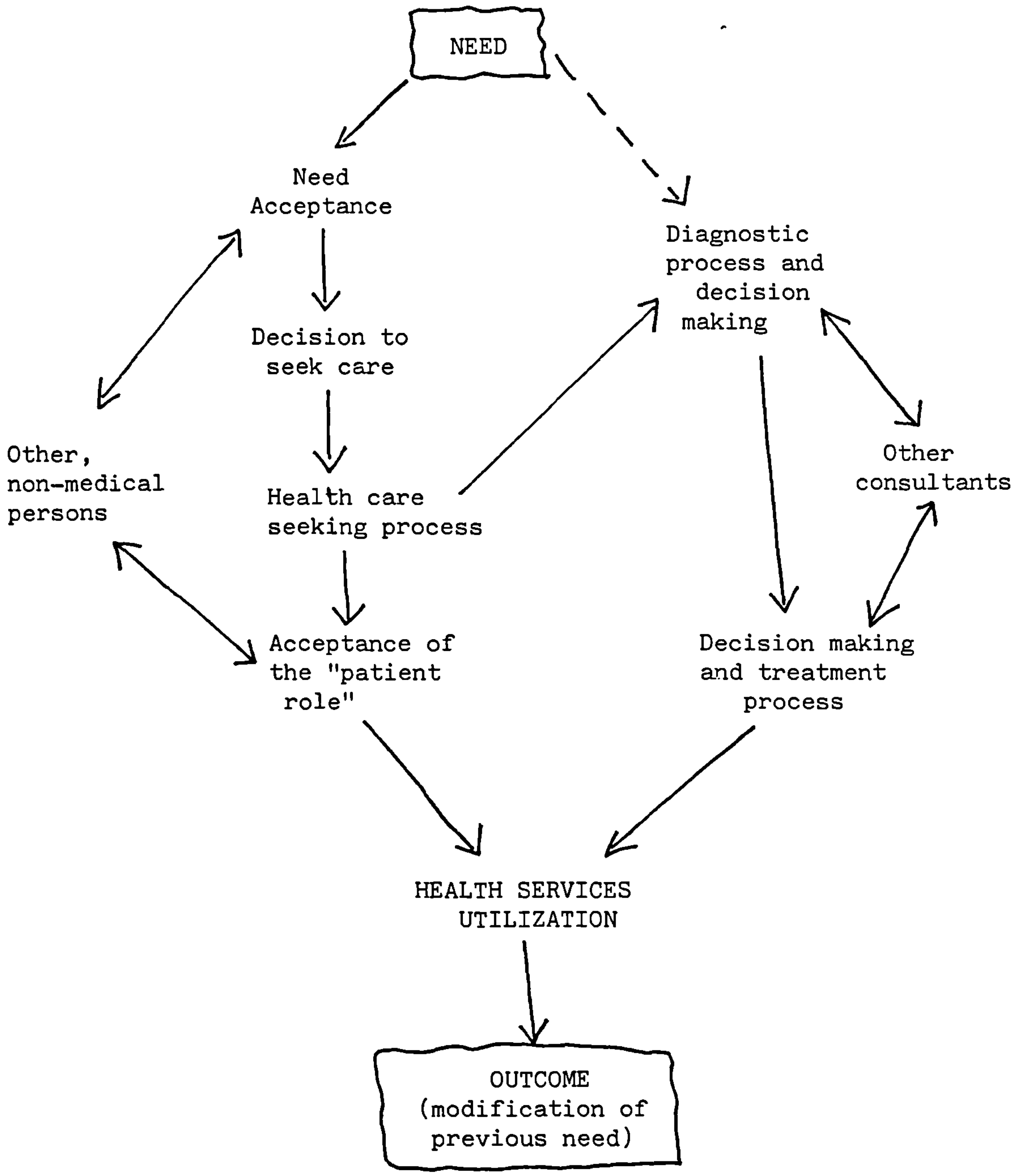


Figure 1-12. A health care process model (Donabedian, 1973).

socio-cultural factors that affect the relationships among those who "need" a health care service, and those who "provide" it, as illustrated in Figure 1-13. This field is a subject of discussion in Medical Sociology (Kasl and Cobb, 1966; Mechanic, 1968; Freeman, et al., 1972).

1.3.2.4 Mayhew's model.

Finally, at the organisational/structural aspect of health care provision, an important distinction must be made between those "health systems" in which there is a higher degree of planning and centralised control, and those in which market forces tend to dominate.

In gravity modeling, as applied to "health systems", Mayhew (1984) developed the basic structure of two hypothetical systems, representing two possible extreme variants. This is illustrated in Figure 1-14. Such a distinction plays a vital role in decision making.

1.3.3. Decision Making.

According to Flagle (1977), an individual human's decisions must be of several kinds, and these may be arranged along some scale, or classified into levels reflecting the time spans over which the decision is effective, the amount of resources involved, and the consideration values and objectives, as shown in Table

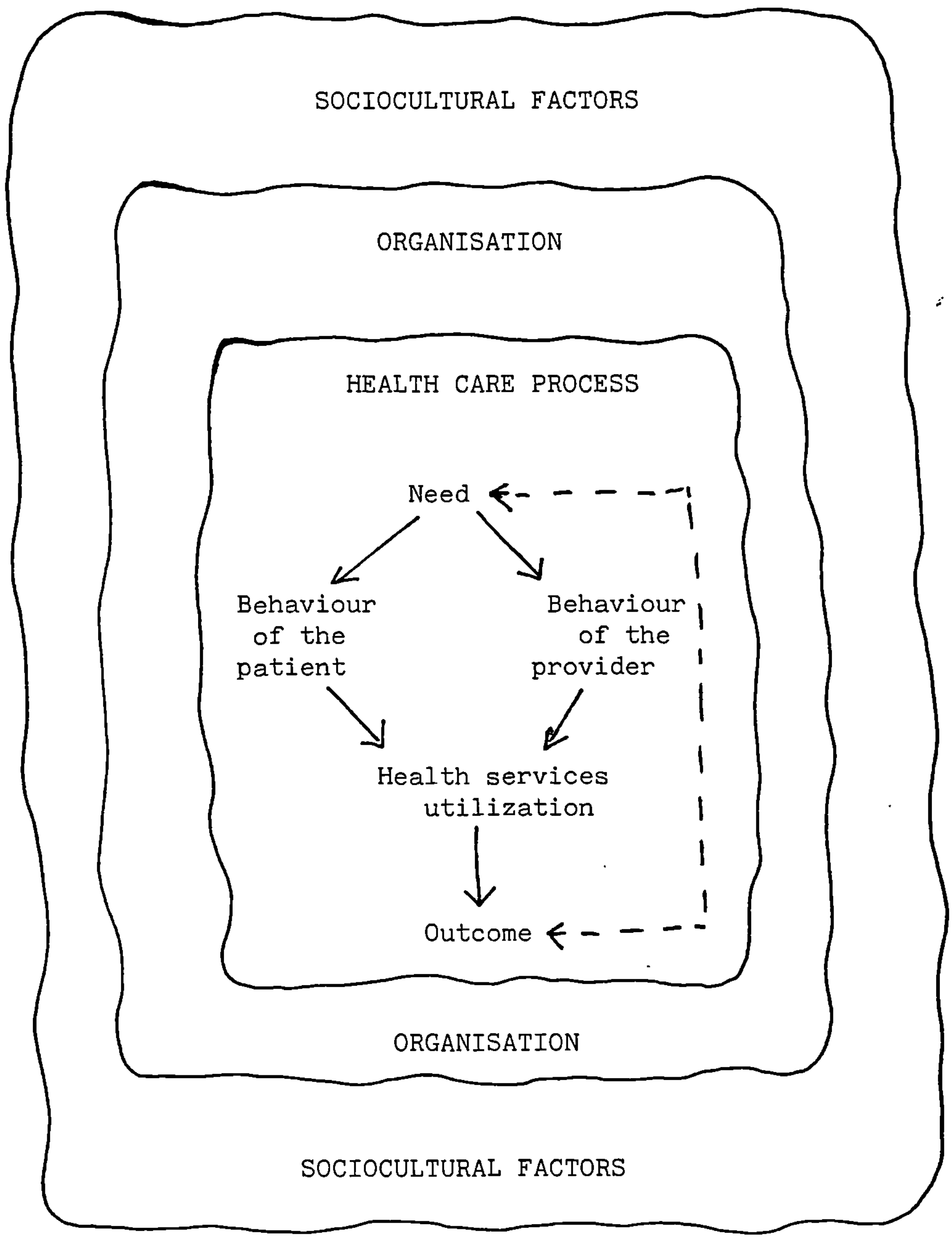
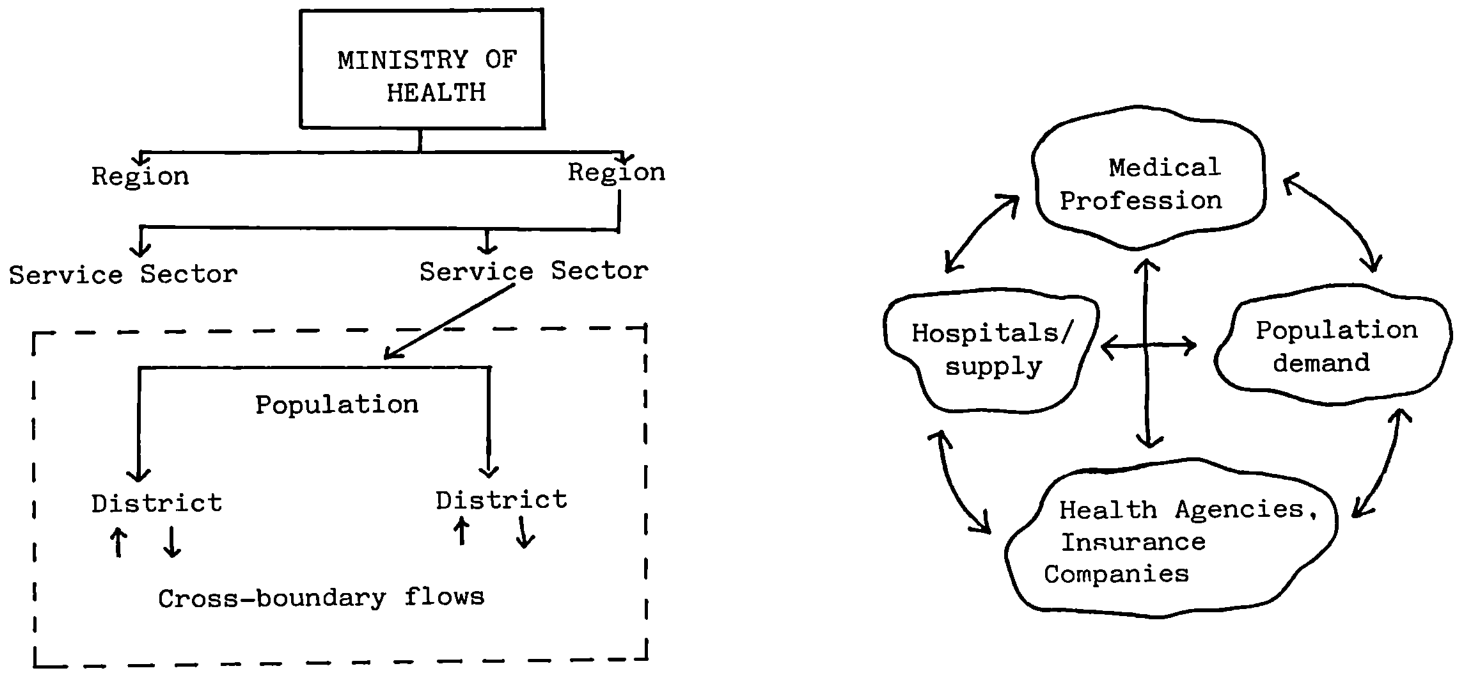


Figure 1-13. A health care process model and its environment (Donabedian, 1973).



(Y)

(Z)

Figure 1-14. Hypothetical idealized decision structures in a (Y) centrally planned, and (Z) market-based health system. (Mayhew, 1984).

1-2. Here, he distinguishes decisions as being operational, managerial, or policy related, thus coinciding with Howland's (1970, 1976) tactical, operational, and strategic levels.

In a usual view, Flagle's (1977) distinction may be seen as a temporal one: short term, intermediate, and long term. In another view, the distinction may be of hierarchical system levels, where operational decisions are relegated to individuals and producing groups; managerial decisions to a managerial class; and policy decisions to a board of trustees or directors.

Flagle's (1975, 1977) point however, is somewhat different. The three decision levels prevail at each of the system levels. He portrays this in a matrix of System Decision Levels (SDL), as shown in table 1-3. Using the table as a check list, it can be asserted that for any system level to be viable, decision processes of all three kinds must be functioning and must be related to, and influenced by, the behaviour and information flow of adjacent system levels. Thus, the viability of a system depends upon the quality of decision at each level.

In health care, SDL 1,2, is exemplified by the diagnostic and therapeutic decision in the physician-patient relationship, or the nurse-patient-physician triad described by Howland and McDowell (1964). SDL 1,4, represents the ongoing regulatory processes by which governments maintain environmental quality. SDL

1. OPERATIONAL DECISIONS

Short term, fixed resources,
fixed goals or norms.

2. MANAGERIAL DECISIONS

Intermediate or long term,
variable resources,
fixed objectives.

3. POLICY DECISIONS

Long term,
variable resources and objectives.
Conflict resolving:
issues of value,
issues of belief.

Table 1-2. Levels of decision (Flagle, 1977).

	OPERATIONAL	MANAGERIAL	POLICY
Human, Individual.	SDL1,1.	SDL2,1.	SDL3,1.
Group.	SDL1,2.	SDL2,2.	SDL3,2.
Organisation.	SDL1,3.	SDL2,3.	SDL3,3.
Social/ Ecological System.	SDL1,4.	SDL2,4.	SDL3,4.
Supranational System.	SDL1,5.	SDL2,5.	SDL3,5.

Table 1-3. Matrix of system decision levels (Flagle, 1977).

2,3, contains the decisions of a hospital administrator to add staff or to purchase new equipment.

Clearly, strong information flows are required at each decision level. The formality and apparent rationality of the information-decision process are relatively strong in the upper left corner of the matrix (in operational and managerial decisions in individuals and organisations).

It is at policy levels that the informational bases for decisions fade away (Flagle, 1977). Such levels represent therefore, an interesting field to conduct further research.

It is argued for example (Flagle, 1980), that for a definitive "information system" to exist (within a "health care system"), there must be further developments to permit consolidation of longitudinal patient histories and ambulatory care; and in long term care, there must be increased collection of patient assessment data at the clinical level.

1.3.4. Measures of Performance.

Both data collection and information use play a vital role in decision making and in assessing the measures of performance of a "health system". In the most general sense, performance measures for any operational "system" are based on the quantity and quality of output for a given quantity and quality of input.

In measuring performance of the patient care service, Jelinek (1967, 1976) describes the elements that make up the patient care function and their relationships to each other. This is illustrated in Figure 1-15. The most important feature of the model is the transformation of inputs into units of output or services. A more specific description of the elements that make up the "patient care system" is described in Table 1-4.

Although measuring performance is multidimensional in that no single, universally acceptable measure exists, there are two basic dimensions to the performance measurement of a "patient care system". The first is the measurement of the "quantity" of output for a given amount of resources used. In the health field this measure has generally been reversed by measuring the resources used to produce some unit of output or service. The second is measurement of the "quality" of the service rendered. This measurement consists of two basic factors: the waiting time for the service, and the standard of performance of the service (Jelinek, 1976).

1.3.4.1 Quantity measures.

The quantity measure relates the input (resources) used to some number of units of an output. This measurement may be in terms of (1) man-hours per unit of output; (2) materials per unit of output; (3)

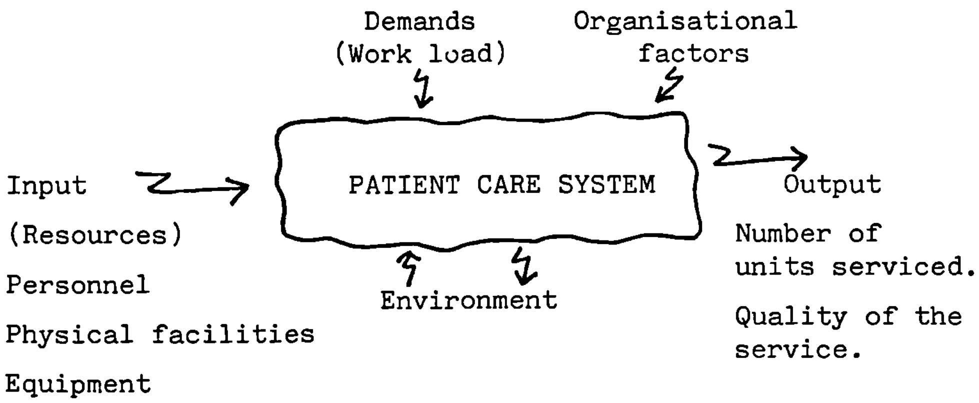


Figure 1-15. The patient care system, after Jelinek (1976).

1. INPUT FACTORS.

Describing the resources used in the patient care operation. Resources include personnel and the physical facilities.

2. ORGANISATIONAL FACTORS.

Describing the form of organisation used in the patient care operation. Factors in this category include the rules and policies used, the degree of work specialization and the type of supervision.

3. WORK LOAD FACTORS.

Determining the work load that any group of patients imposes on the resources, i.e., on the personnel and the physical facilities. These factors are characterized by the number and conditions of the patients to be serviced.

4. ENVIRONMENTAL FACTORS.

Representing elements other than those that are a part of the patient care operation, but which have effects on, or are affected by, patient care. Factors in this category include hospital organisation, medical staff organisation, and other hospital departments or activities.

5. OUTPUT FACTORS.

Describing the outcome of the patient care system in terms of both quantity and quality of the patient care rendered.

Table 1-4. The elements that make up the patient care system (Jelinek, 1967; 1976).

facilities used per unit of output; or (4) cost per unit of output.
The direct cost of nursing service; nursing man-hours, and nursing-service man-hours for example, are considered measures of input; whereas patient-days and beds per day are considered measures of output.

1.3.4.2 Quality measures.

The quality measure concerns itself entirely with the output. Measurements in this area are directed toward quantifying the "goodness" of the output. In the area of patient care this may represent the degree to which needs for care are identified (for example, recognising that a surgical dressing needs changing); or the quality associated with the accomplishment of a particular task (for example, how carefully sterile techniques are practised in the changing of the dressing).

1.3.4.3 The patient care "management control system".

Taking the above mentioned concepts into consideration, Jelinek (1976) constructed a "management control system", as illustrated in Figure 1-16. Here, the major element is the "patient care system" itself, whose output is monitored to determine the level of performance. This measurement is then compared with a preset standard. On the basis of this

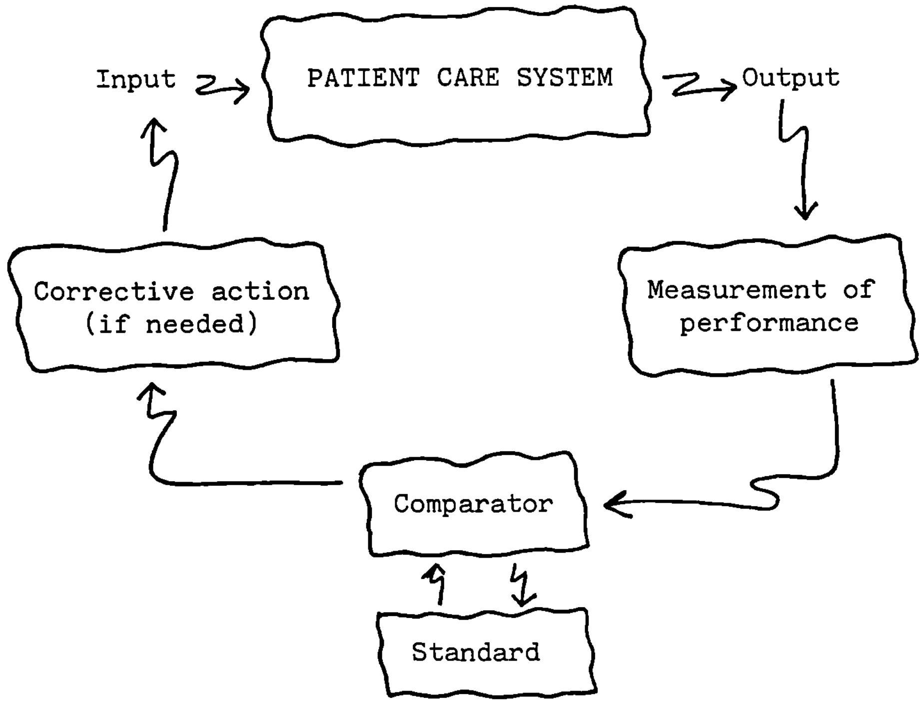


Figure 1-16. The patient care management control system, after Jelinek (1976).

comparison, the inputs to the "patient care system" may be adjusted to correct for any discrepancy.

The first requirement for the "patient care management control system" is the ability to measure the "system's" performance in terms of both, quantity and quality measurements, while also taking into consideration the relationship existing between them. Here, however, the lack of available and satisfactory quality measurements has greatly hindered the development of a truly objective "management control system".

The second requirement for the "patient care management control system" is that of establishing the standards associated with each of the performance measures. However, in the "patient care system", as described previously (Figure 1-15), a multitude of inputs determine the output; furthermore, the "system's" performance can be measured in terms of quantity as well as quality measures.

These characteristics lead to the need for a variable standard, one that can adjust itself to the appropriate level of the input factors (Jelinek, 1976). Clearly, this is a difficult task, considering the constant changes in the environment. Further research needs to be performed in this field.

1.3.5. Developments.

The emergence of systems in the health service is most evident in three kinds of developments:

(1). In the organised response to major health problems, where problems may be classified by a disease entity, such as cardiovascular disease (Michaelis, 1984); substance abuse (McQueen and Celentano, 1984); or by a particular population group such as the elderly (Taylor and Barber, 1984), or workers (Gunderson, 1984).

(2). In the organisation, development and co-ordination of components of the "health care system", such as hospitals, clinics, ancillary services (Anderson, et al., 1984); management processes (Sanderson, 1984); information (Bush, 1984; Willmer, 1984); evaluation (Diggs, 1984; Leathar, 1984); technology assessment (Greer-Lennerson and Greer, 1984); and education (Eisenhardt, et al., 1984; Masek, 1984).

(3). In the development of theory and methodology for study of the "health care system" (Kersell and Milsum, 1984; O'Neill, 1984).

Clearly, the ultimate goal of Systems Science in Health Care is to improve the health care of a given population or society; that is, to improve the quality of health care.

1.4. QUALITY OF HEALTH CARE

There are two elements in the performance of practitioners, as illustrated in Figure 1-17. One is a technical element, and the other, interpersonal. Technical performance depends on the knowledge and judgement used in arriving at the appropriate strategies of care and on skill in implementing those strategies.

The goodness of technical performance is judged in comparison with the best in practice (Donabedian, 1988). Clearly, the interpersonal process is the vehicle by which technical care is implemented and on which its success depends.

The above mentioned elements lead to the health care process model, previously presented by Donabedian (1973) in Figure 1-12, where he distinguishes two main branches: the behaviour of the "client", and that of the "provider". Figure 1-17 however, is also concerned with care received by the community as a whole. Indeed, it should also be judged the social distribution of levels of quality in the community (Donabedian, 1972). This depends, in turn, on who has greater or lesser access to care and who, after gaining access, receives greater or lesser qualities of care.

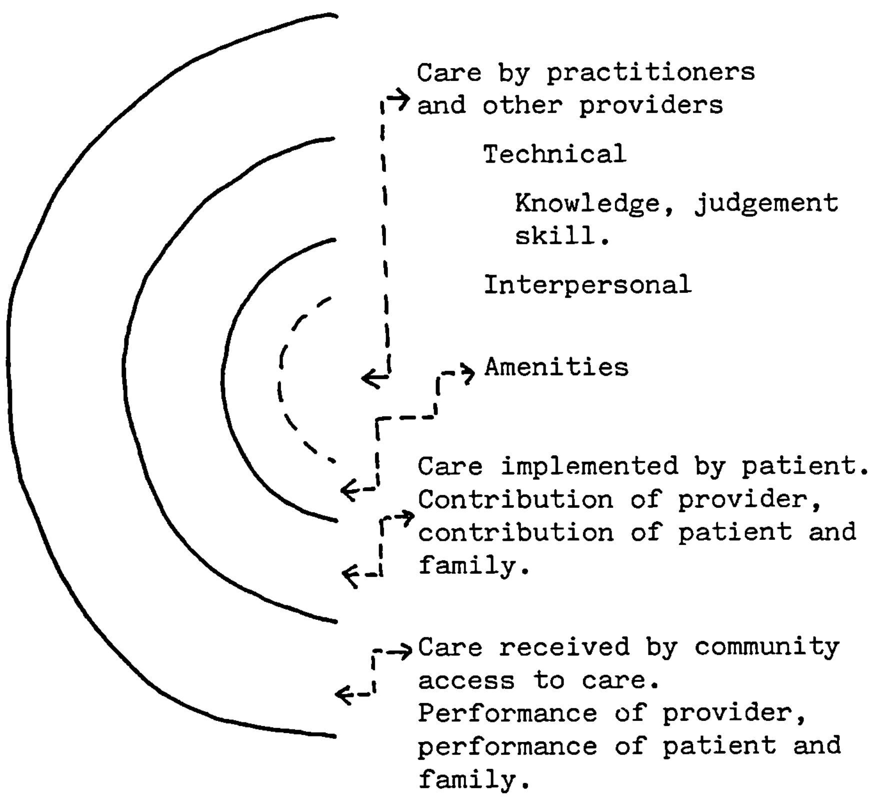


Figure 1-17. Levels at which quality may be assessed (Donabedian, 1988).

1.4.1 Definition of quality medical care.

As we seek to define quality, we soon become aware of the fact that several formulations are both possible and legitimate, depending on where we are located in the "system of care" and on what the nature and extent of our responsabilities are.

Steffen (1988) for example, defines quality itself not as consisting of the properties of an object but rather as the capacity of these properties to achieve goals. Accordingly, quality medical care is the capacity of the elements of that care to achieve legitimate medical and non-medical goals.

1.4.2 Research on quality assurance.

The research on quality assurance has two main divisions (Brook, 1973). One line of research has sought to define the target of measurement; and the other deals with measurement methods through which to assess particlar elements.

1.4.2.1 The target of measurement.

The seminal contribution in this line of research is that of Avedis Donabedian, who suggested that the information from which inferences can be drawn about the quality of care can be classified under three categories: structure, process, and outcome (Donabedian, 1966, 1980, 1988).

"Structure" denotes the attributes of the settings in

which care occurs. This includes the attributes of material resources (such as facilities, equipment, and money), of human resources (such as the number and qualifications of personnel), and of organisational structure (such as medical staff organisation).
Studies of physicians' training or credentials, staffing ratios and job descriptions, "scheduling systems" or access barriers would all be classified as explorations of health care structures. (Palmer and Reilly, 1979).

"Process" denotes what is actually done in giving and receiving care. It includes the patients' activities in seeking care and carrying it out as well as the practitioner's activities in making a diagnosis and recommending or implementing treatment. Thus, process targets include diagnostic strategies, rates of use of tests or procedures, or therapeutic algorithms (Donabedian, 1982).

"Outcome" denotes the effects of care on the health status of patients and populations. Improvements in the patients' knowledge and salutary changes in the patient's behaviour are included under a broad definition of health status, and so is the degree of the patient's satisfaction with care. Indices as mortality, sick-days, symptom scores, or functional status indicators are used under this category (Avery, et al., 1976; Bergner, 1985).

This three-part approach to quality assessment is possible only because good structure increases the likelihood of good process, and good process increases the likelihood of good outcome (Donabedian, 1988). There must be however, preexisting knowledge of the linkage between structure and process, and between process and outcome, before quality assessment can be undertaken.

Knowledge of the effects of structure is rather scanty (Palmer and Reilly, 1979; Donabedian, 1985). This can be explained by the fact that knowledge about the relationship between structure and process or between structure and outcome proceeds from the relatively young organisational sciences. Donabedian himself (1988), states that structural characteristics should be a major preoccupation in systems design.

Knowledge about the the relationship between attributes of the interpersonal process and outcome of care should derive from the behavioural sciences. But so far, these sciences have contributed relatively little to quality assessment (Donabedian, 1988).

The area of major knowledge is that related to technical care and outcome (Rhee, et al., 1984). The reason being that such research is carried out by the health care sciences. Indeed, information about technical care is readily available in a timely manner, so that prompt action to correct defficiencies can be taken.

By contarst, many outcomes, by their nature, are delayed, and if they occur after care is completed, information about them is not easy to obtain.

Furthermore, patient satisfaction plays an important role in outcome evaluation. The patient's judgement on the quality of care in all its aspects, but particularly as concerns the interpersonal process, is important (Steffen, 1988; Donabedian, 1988).

1.4.2.2 Measurement methods.

This line of research deals with measurement methods through which to assess particular structures, processes, or outcomes. These methods fall generally into three categories: implicit methods, explicit methods, and sentinels.

"Implicit" methods use expert opinion as its primary tool. In this method implicit studies help acknowledged experts or groups of peers examine and report their impressions of the quality of elements of structure, process, or outcome through review procedures of varying formidability.

The reviewers are not required to state in advance explicit rules through which they formulate their judgements about quality. "Implicit" assessment methods are most commonly used in peer review programmes organised by the physicians being reviewed (Morehead, 1967; Brook and Appel, 1973; Hulka, et al., 1979; Sanazaro and Worth, 1985).

"Explicit" assessment methods seek to avoid the expense and mystery of implicit methods through establishing less ambiguous lists (Sibley, et al., 1975; Hulka, et al., 1979), or logical "maps" (Greenfield, et al., 1975) specifying appropriate and inappropriate structures, processes, and outcomes. Finally, "sentinel" methods concentrate on unusual structures, processes, or outcomes which, by their nature, directly signal probable quality problems (Rutstein, et al., 1976; Wennberg and Gittelsohn, 1982).

1.4.3 Relationship between quantity of resources and quality of health.

In measuring quantity versus quality relationship, Jelinek (1976) represents in Figure 1-18, the case in which a resource is optimally utilized with respect to quality. He states that in any actual operational situation we would generally not expect to have an optimal utilization of resources; and consequently, an operational point would be expected to fall below the optimal relationship line, at some point, as illustrated in Figure 1-19.

This point indicates that a hospital with a quantity level of R1 attains a quality level of Q1. For this organisation it could be expected that by changing the quantity level, quality would follow some curve similar to that labeled actual relationship. Thus, according to figure 1-19, one possible managerial startegy (as illustarted by arrow A), would be that directed toward increasing quality by simply increasing the quantity of resources while keeping

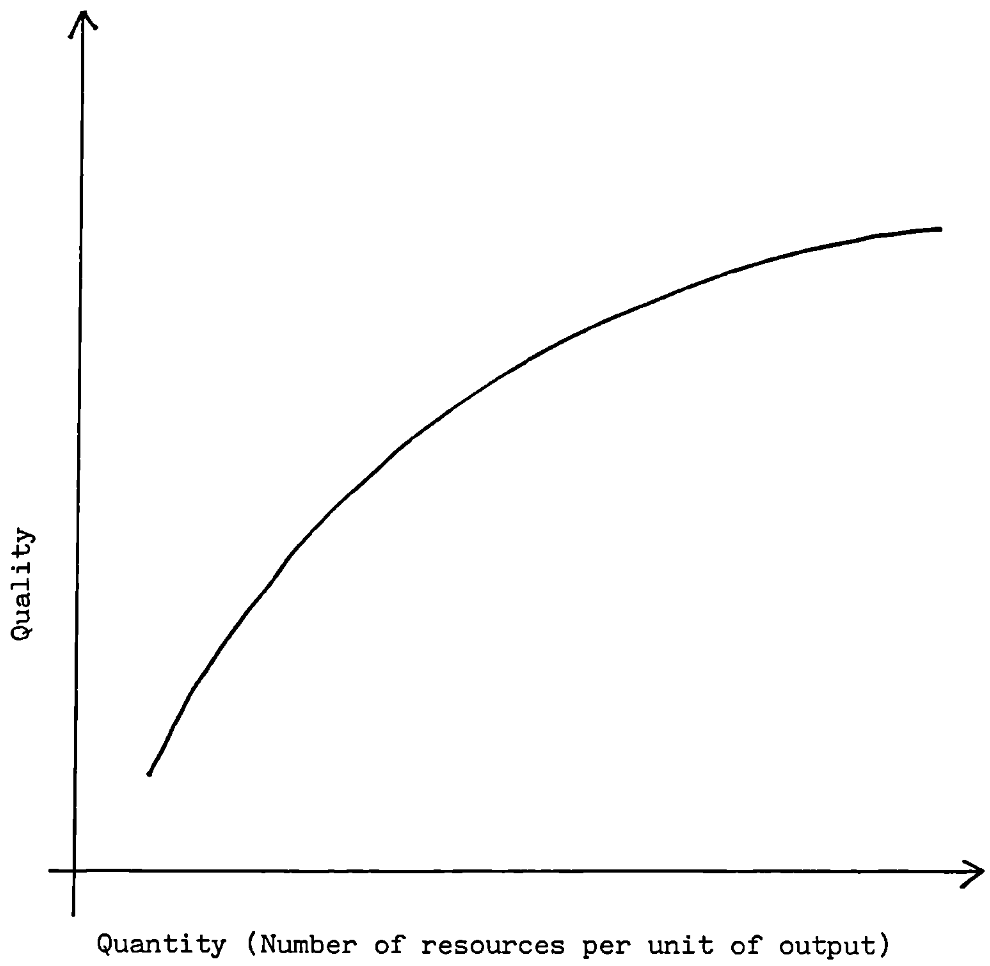


Figure 1-18 Quantity versus quality relationship (Jelinek, et al., 1971).

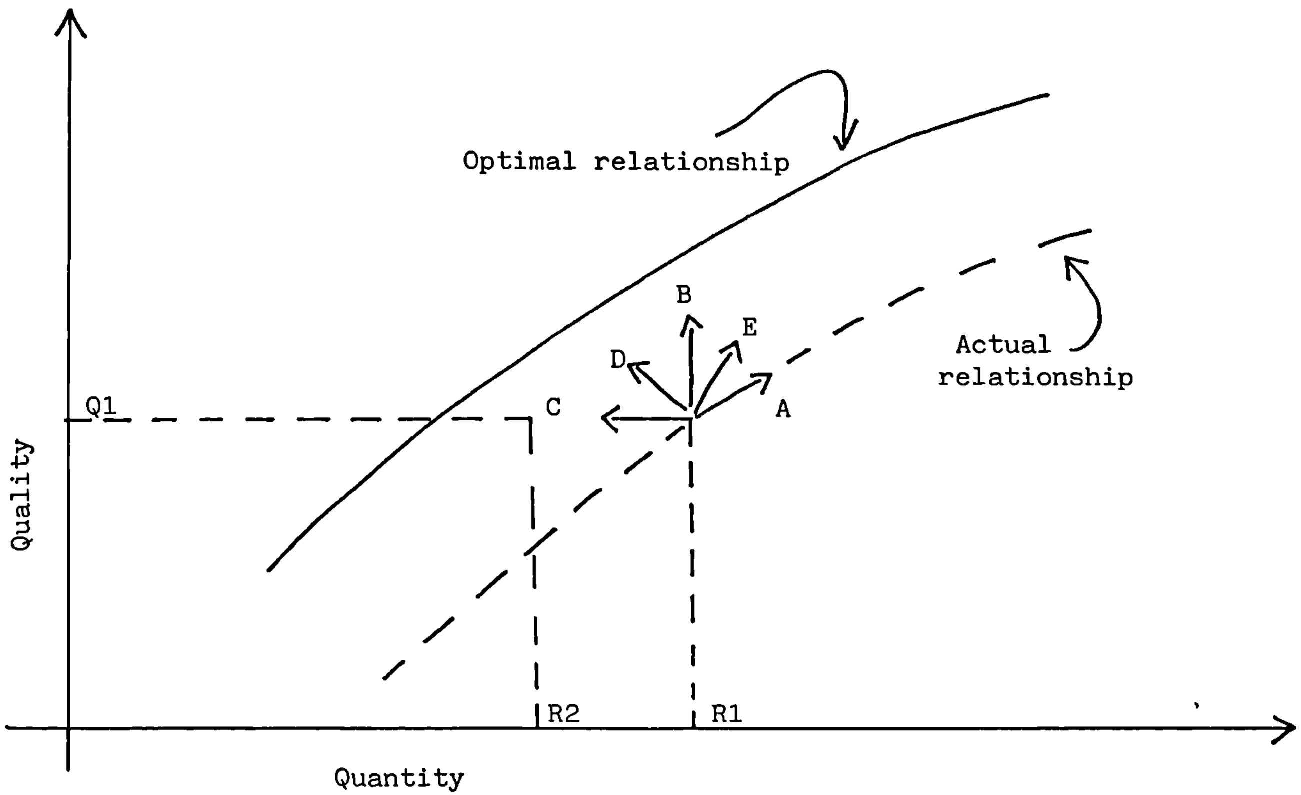


Figure 1-19. Operational interpretation of the quantity versus quality relationships (Jelinek, et al., 1971).

utilization at the level of the existing "system".
An alternative strategy would take the course represented by arrow B. This course better utilizes existing resources to improve the level of quality (this strategy results in a more "efficient system" without, however, any cost savings in terms of resources).
Another startegy could take the course of arrow C. This is a strategy directed toward better utilization of resources so as to keep the quality at its original level Q1, while at the same time reducing the quantity of resources from R1 to R2.
Another possible startegy is one following course D, where utilization of resources is improved and resources are reduced, although not to the same degree as they were in strategy C. This results in a reduction of cost as well as an increase in quality. A strategy following the arrow E is also feasible.

1.4.4 Final considerations.

To increase quality, our concepts of what quality consists of must be translated to more concrete representations that are capable of some degree of quantification. These representations are the criteria and standards of structure, process, and outcome (Donabedian, 1982, 1986, 1988).
Methods for weighting the criteria have been proposed, although we still do not have a method of weighting that is demonstrably related to the degree of impact on health status (Lyons and Payne, 1975).

When outcomes are used to assess the quality of antecedent care, there is the corresponding problem of specifying the several states of dysfunction and of weighting them in importance relative to each other, using some method of preferences.

It is possible to identify specific outcomes, for example, reductions in blood pressure, and to measure the likelihood of attaining it. It is also possible to construct hierarchical scales of physical function so that any position on the scale tells us what functions can be performed and what functions are lost (Stewart, et al., 1981). The greatest difficulty arises when one attempts to represent as a single quantity various aspects of functional capacity over a life span (Donabedian, 1988).

Though several methods of valuation and aggregation are available, there is still much controversy about the validity of the values and, about their ethical implications (Fanshel and Bush, 1970; Patrick, et al., 1973).

Nevertheless, such measures, sometimes called "measures of quality-adjusted life", are being used to assess technological innovations in health care and, as a consequence, play a role in defining what good technical care is (Weinstein and Stason, 1977; Willems, et al., 1980).

All the activities of assessment of quality of health care depend, of course, on the availability of suitable, accurate information.

1.5. INFORMATION

1.5.1. Information as a Resource.

According to Lewis (1985), information is a tradable commodity; essential to effective problem solving, the basis of innovation and new product development. Information is thus a resource which costs money (to create, to store, to retrieve, to disseminate); has a price in the market place, and a value to the end user.

Levitan (1982) however, attempts to show that economic "goods" do not reflect the assumption on which economic models have been built in the past because they involve nonlinear, nonequilibrium, evolutionary processes.

Indeed, the message of the new concepts in science is that change and desequilibria are probably more "natural" than equilibrium and stasis (Allen, 1989). Although some studies have been conducted in this field (Barreto, 1982), more research is needed to disaggregate the economic and institutional infrastructures of information resources.

1.5.1.1 Levitan's model.

Levitan (1982), after reviewing the traditional "models" of information production, as shown in Figure 1-20, concluded that the major weaknesses of the "information transfer model", as with the "channel"

1. CHANNEL:

Creator → $\boxed{}$ → User

2. SYSTEM:

Inputs → $\boxed{}$ → Information products and services

3. INFORMATION TRANSFER:

Organisation → recording → preservation → end-use → transmission

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Figure 1-20. Traditional "models" of information production (Levitan, 1982).

and the "system" models, were lack of time frame or frame dimension in which to view the numerous activities, and absence of a fixed unit of information to observe.

This resulted in a perspective of information production which moves directly from origination or creation of an information source to use and transmission of information products and services. Such a conceptualization totally misses the importance of information resources (Levitan, 1982).

An information resource in a knowledge-based society is defined by Levitan (1982), as a stock of information that has been societally institutionalised for reuse by one or many classes of users.

An information-based society depends on information production for its overall welfare, but information production requires continuous reuse of information, and therein lies the dependence of such a society on its information resources (Carbo Bearman; et al., 1985). Levitan (1982) presents an information life-cycle model integrated by phases of generation, institutionalisation, maintenance, enhancement, and distribution.

An information resource stands at the midpoint of the life-cycle, integrating and co-ordinating the various actors and activities of these phases. Figure 1-21, illustrates this life-cycle.

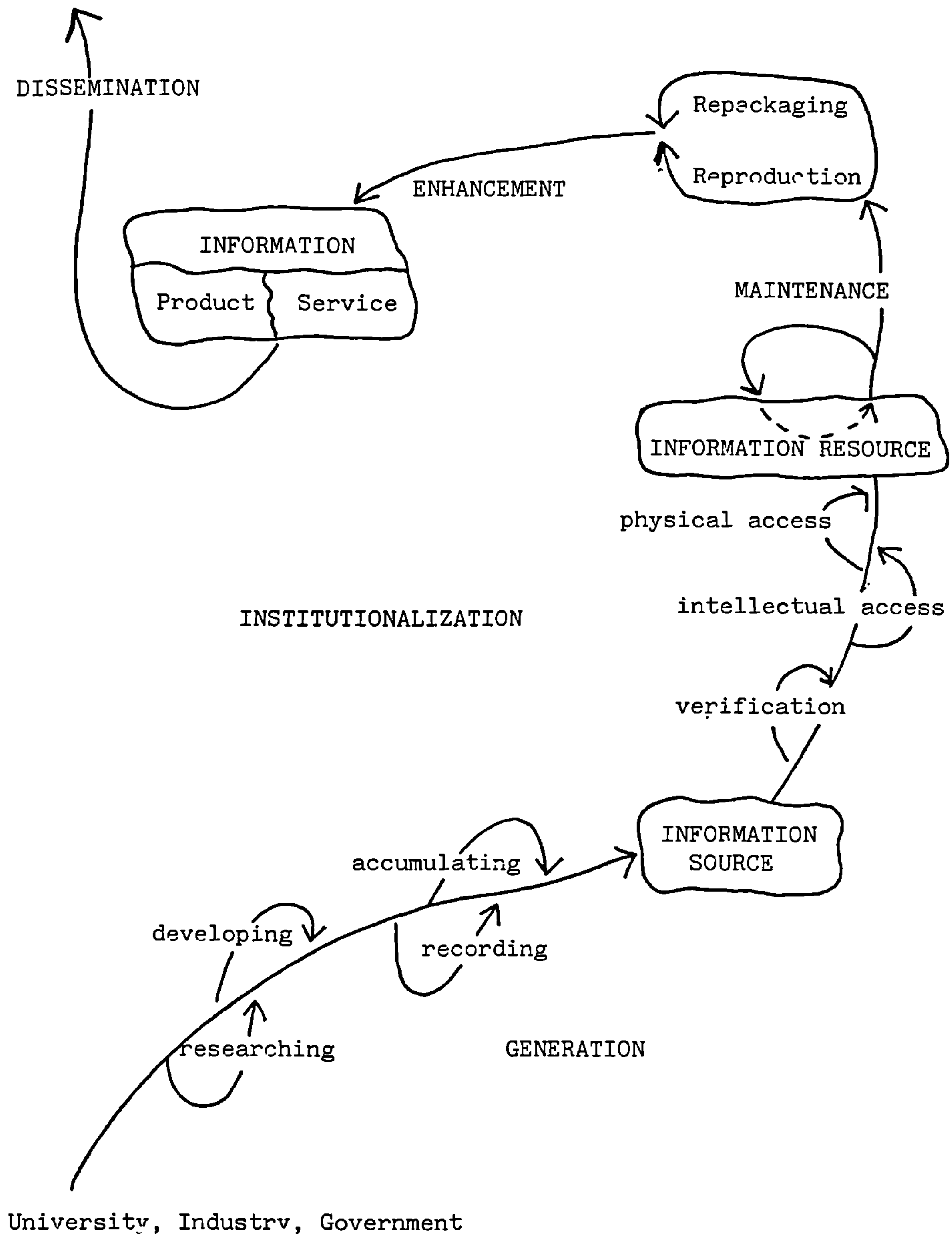

Figure 1-21. Life Cycle of information production (Levitan, 1982).

1.5.1.2 Horton's view.

According to Horton (1982), treating information as a resource, means treating it as (a) something of fundamental value, like money, capital, goods, labour or raw materials; (b) something with specifiable and measurable characteristics, such as method of collection, utilities, and uses, a life-cycle pattern with different attributes at each stage, and interchangeability with other attributes; (c) an input which can be transformed into useful outputs that are beneficial to achieving the organisation's goals; (d) something that can be capitalised, depending on management's purposes; (e) an expense for which standard costs can be developed and cost accounting techniques can be used to monitor and control; and (f) something that presents to top management a variety of development choices; for example, making trade-off decisions between teleprocessing and manual processing activities; or between maintaining an information product or service in-house, or buying it from an external source.

1.5.1.3 Wiggins' concept.

In the context of the management of an organisation, Wiggins (1985) states that the key workers in an organisation are the "knowledge workers", be that knowledge concerned with markets, products, scientific research, or information technology. He sees knowledge as one of the fundamental four resources, along with capital, crucial physical resources, and time, which must be managed for total productivity of the organisation. Furthermore, knowledge work, unlike manual work, cannot be replaced by capital investment. Since energy, time, and money must be invested to change useless data to productive knowledge, a value-added process is involved (Taylor, 1982), thus confirming once again the position of information as a resource.

On the other hand, if information as a resource is so important, then an interesting question is : what studies have been carried out to evaluate it?. More specifically, what is its impact as related to health care or quality of care?.

1.5.2. Evaluation.

Evaluation is a complex process. Appart from information retrieval, there is virtually no other area of information science that has occasioned as much research effort and writing as "user studies" (Wilson, 1981; Craghill and Wilson, 1987).

1.5.2.1 Lancaster's approach.

To evaluate "performance", Lancaster (1977) pointed out that general objectives need to be translated into concrete and meaningful elements that are specific, limited and clearly defined. When the concrete objectives are implemented, the results can then be evaluated.

In evaluating library services, Lancaster (1977) distinguishes three levels of evaluation: effectiveness, cost-effectiveness, and cost-benefit. "Effectiveness" must be measured in terms of how well a service satisfies the demands placed upon it by its users. Such evaluation can be subjective, objective, or a combination of the two.

An evaluation of a "system's cost- effectiveness" is concerned with its internal operating efficiency. Such a study measures how efficiently (in terms of cost) the "system" is satisfying its objectives, that is, meeting the needs of its users.

A "cost-benefit" evaluation is usually the most difficult to conduct. It considers whether the value (worth) of the service is more or less the cost of providing it. In other words, a cost-benefit study attempts to determine whether the expense of providing the service is justified by the benefits derived from it.

Lancaster (1977) discusses the effectiveness of library services and, to a lesser extent, cost-effectiveness. Evaluation is presented within the framework of the connection between bibliographic resources and a given population. The objective of the library being to increase exposure and accessibility of the resources to its users. Lancaster's evaluation focuses on how well the library does this.

He therefore discusses such services as document delivery and providing information requested using measures such as delivery time and ability to supply items needed. He does not discuss the ultimate benefits of library services; that is, the value to users of having these services available, because according to Lancaster (1977), these benefits cannot be measured.

1.5.2.2 Impact of Information on Health Care.

In the medical field, the state of the art suggests that evaluation of the impact of information and of libraries on the quality and cost of health care is reduced to the feedback from users' comments on questions that current literature "directly influenced" the management of specific patients (Greenberg, et al., 1978; Scura and Davidoff, 1981); or that having the "key article" is as important as having the laboratory investigation reports (Marshall and Newfeld, 1981; King, 1987).

Hospitals have tried evaluating services and quality of care through quality assurance procedures (Jacobs, et al., 1976; Greenspan, 1980; Veney and Kaluzny, 1984), but the assessment techniques are either inappropriate when applied to the library or provide little insight into the effect of library services on patient care (Self and Gebhart, 1980; Fredenburg, 1984).

As a result, evaluation of health sciences libraries are uncommon. When undertaken, they typically address inputs, outputs, and operations, with occassional attention to user satisfaction (Evans, et al., 1972; Wilkin, 1982). This information is both necessary and valuable for library decision making and should be a part of library quality assurance assessments. Yet, the measures offer no direct evidence of either quality of service or impact on clinical care.

1.5.3 Problems in keeping up-to-date.

The sources of physician error are multifactorial (Merill and Vallbona, 1984). Ideally, health professionals should be aware of or have ready access to the best published evidence to consider in clinical decision making. Unfortunately, studies have demonstrated a lack of awareness of published findings critical to quality patient care, indicating the problems health professionals have in remaining abreast of the literature (Stross and Harlan, 1979; Brittain, 1985; Covell, et al., 1985).

Obstacles to case-related use of the literature by physicians are well documented (Bowden and Bowden, 1971; Siegel, 1982; Brittain, 1985; Covell, et al., 1985; Haddock, 1985; Tabor, 1985).

The "information explosion" and varying qualities of information complicates the task of remaining aware of and locating useful literature. In the context of the "ethics of knowing", Bernier (1985) for example, states that the only options for the specialist who finds himself unable to keep up to date in his own field are: (a) increased specialization; (b) better surrogation (of information use/access); or (c) unethical "functional obsolescence" caused by skipping relevant material.

The exponential growth trends of science, initially described by Price (1963), underlined the "immediacy of science"; that is to say, that the great majority of scientists who have ever lived are alive today, and the great bulk of published scientific literature has been produced in the last few decades.

The problem is how to cope with this mass of information (Cronin, 1985). Toffler (1983) rightly states that the old idea that knowledge is power is now obsolete: to achieve power today one needs knowledge about knowledge.

Stinson and Mueller (1980), in a survey of the information needs and habits of health professionals found that 19% never used their library and an additional 29% used it less than once a month. Similar results when studying other indicators have been reported (Fazzone and DeSimone, 1984; Kantor, 1984). Garfield (1983) has pointed out much evidence from evaluations of clinical librarian programmes on the value of hospital library service to patient care; he concludes on the need for a definitive study so that we do not have to rely on mainly anecdotal evidence.

1.5.4 Applications of Information Science to health care.

If we relate the existing research and development of information science to the quality of care assessment model, as proposed by Donabedian (1988): structure, process, and outcome; we can clearly see that most of the work is related to the process-outcome elements. This is not a surprising finding, since the key source of information about the process of care and its immediate outcome is, no doubt, the medical record. This has increasingly become a target of research, up to date (Cohen, et al., 1988; Frazer, 1988; Howell, 1988; Small, 1988).

Other major field of research in the "process" element is medical decision making; the work of McNeil, et al. (1971), being the most highly cited in the literature (Pyle, et al., 1988).

The point of departure for quantitative research in medical decision making and the unit of analysis to which it innevitably returns is the process of patient care (Cebul, 1988). This is illustrated in Figure 1-22.

Decision making research has divided naturally into descriptive work, which analyses the process by which decisions are actually made, and prescriptive work, which attempts to define how decisions should be made in an environment of uncertainty and real-world constraints. Thus, social, educational, and political

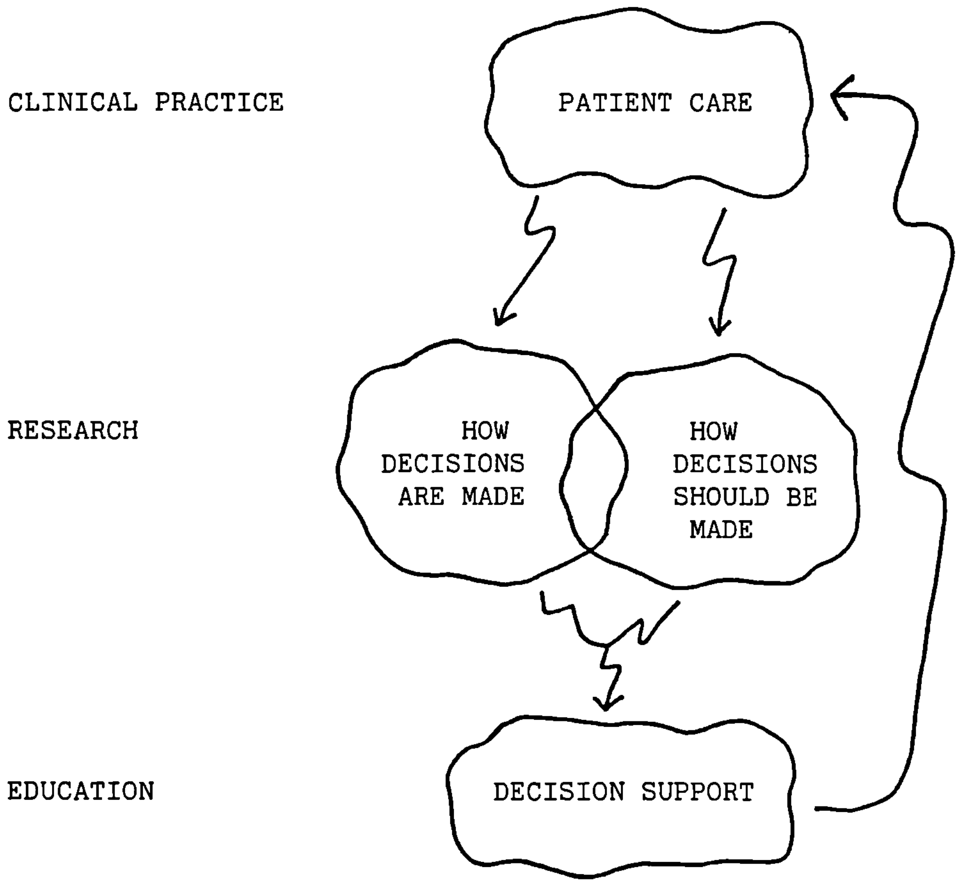

Figure 1-22. A clinician's perspective on quantitative methods in decision making (Cebul, 1988).

factors are frequently related to medical decision making (Eisenberg, 1979; Bordage and Zacks, 1984; McNeil and Pauker, 1984).

Other applications of information at the same level of "process" are those of computer assisted instruction (Weed, 1986); computer simulation (Kelly, et al., 1988); artificial intelligenece (Banks, 1986); and computer assisted diagnosis (Riss, 1988; Carson, 1989). Literature on these topics abounds.

In health care planning and management, several models have placed some interest to the "structure" level; however, major emphasis is more likely placed on the "structure-outcome" level (Atsumy, 1980; Bailey, 1980; Barber and Cundy, 1980; Flagle, 1980).

Donabedian (1988) clearly states that all the activities of assessment, as related to quality of health care, depend on the availability of suitable, accurate information. He fails to mention however, about the risk that although "available", information (or data) does not necessarily lead to its "use".

This is an angular point for research since several factors may affect such information use. In other words, information use and outcome, rather than availability needs to be guaranteed.

1.6. THE ENVIRONMENT

Improvements in health depend on understanding the entire environment and on encouraging all living in that environment to take decisions to change it for better (Rifkin and Walt, 1988). On the other hand, balancing resources with needs for health improvement requires setting priorities.

Furthermore, the status of health services and research, as well as societal, economic and behavioural factors, all affect personal well-being (Walsh, 1988). Indeed, The World Health Organisation's definition of health is not merely the absence of disease, but the complete physical, mental, and social well-being.

Although an ambitious definition of health, it has been accepted by all member countries. A global strategy for health for all by the year 2000 has been agreed (WHO, 1981), based on the WHO declaration of Alma Ata, on primary health care (WHO, 1978).

1.6.1 Health priorities.

Setting health priorities is not an easy task (Warren, 1988). Primary health care recognises however, that priorities must be set to meet local, socio-economic, political conditions, not to respond to the results of clinical trials (Rifkin and Walt, 1988).

Clearly, such priorities and conditioning factors vary according to each country and to each country's level of development. Thus, research on socioeconomic indicators in health care is well defined to specific target populations or countries (Walsh and Warren, 1979; Blake Jr., et al., 1986; Alperstein, et al., 1988; Bush, 1988; Cutting, et al., 1988; House, et al., 1988; Nethercott, et al., 1988).

1.6.2 Socioeconomic factors.

In the information science field, socioeconomic factors have been the subject of research as related for example, to productivity in Science (Braun and Shubert, 1988). Contributions about countries comparisons or regional studies have also been reported in the literature (Tjarks, 1979; Jimenez, et al., 1988).

The study of such factors in developing countries has been well documented in the early work of Admiroah (1976); Gordon (1979); and Saracevic (1980). More recently, Eres (1981), Slamecka (1985), and Dosa (1985) analysed some factors related to information flow and technology transfer to the third world.

Eres (1985) and Eres and Bivins Noerr (1985), continued analysing the access to information sources and the socioeconomic conditions related to economic activity in developing countries. General results have shown for example, that the number of scientific journals, telephones, or telecommunication services are highly correlated to scientific productivity (ITU, 1986; Braun and Shubert, 1988).

1.6.3 Research and development inequalities.

In the industrialized nations where according to Jussawalla (1982), the information sector achieves contribution levels of about one third of the Gross National Product, the productivity of its workers is being taken seriously, as is shown by the current interest in telecommunications (Buckingham, 1987); in computer applications to health care; and general office automation (HSISG, 1982; Black, 1989).
Here, personal attitudes to computer use like the fear of loss of control, suspicion of artificial intelligence, or fear of legal liability may be the target of research (Shortlife, 1989); while in developing countries, most information users face language, organisational, and telecommunication barriers to information access (Michel, 1982; Schwefel, 1984; Thorpe, 1984; ITU, 1986), and most often pay a foreign source for data or information generated in his own country (Rosenberg, 1982).
The important contribution of information to health care in developing countries has been emphasized by the conference convenned in 1982, specifically for this purpose (Fernandez Perez de Talens, 1983).

1.7. CONCLUSIONS

The following conclusions were obtained from analysing the literature:

(A). Emergence and hierarchy; communication and control, constitute the two pairs of ideas which are the core of systems thinking.

(B). In dealing with complexity, a systems approach is complementary to the reductionist approach embodied in the method of the natural sciences.

(C). Much of the analytical work on "health systems" has taken place at the operational level. Accordingly, the information/decision processes in a "health care system" are usually supported at the operational/managerial level. The information bases for decisions at the structure and policy level, however, require further analysis and research.

(D). Information is a resource which, in order to be exploited, requires adequate management.

(E). In order to assess quality of health care, information needs to be "available" at the structure, process, and outcome levels of health care.

(F). In order to assess the impact of information on quality of health, information needs to be not only "available", but also "used" as a resource.

(G). Specific, short-term, rather than general, long-term goals are easier to measure both, in "health" and "information systems".

(H). Plenty of research and development exists on the information needs and use at the "process-outcome" interaction in "health care systems" and models. Very few at the "structure-outcome" level. Research is practically nonexistant at the "structure" level.

(I). Social, economic, and political factors are related to affect both, "health" and "information systems". This is also true for either developed or developing countries.

(J). No studies have been reported on the factors that affect information use and productivity, at the structure or structure-outcome level of health care. An finally,

(K). Since (1) good structure is likely to lead to good process, and good process to good outcome in health care; and (2) most of the research on information as applied to health care models has been oriented to the process-outcome level, then, research at the structure level is needed. This is particularly important when systems analysis, previous to health information systems design is required.

CHAPTER 2

PURPOSE OF THIS RESEARCH

2.1 INTRODUCTION

In this chapter, a general review on the organisation, structure, funding, and services of the Mexican health care sector is provided. This is complemented by the provision of the information flows and developments that exist within the different institutions.

In a separate section, the structure, resources, and status of the Social Security Mexican Institute (IMSS) is presented. This analysis provides a framework to describe the functions of the IMSS' Education and Research Office, and to establish the role of the Regional Co-ordinators for Biomedical Education and Research (RCBER). Then, their relationships and activities are described and illustrated, so as to state the "problem-situation".

Finally, the purpose and objectives of this research are described, indicating the limitations and expected contributions of this study.

2.2 THE MEXICAN "HEALTH CARE SYSTEM"

2.2.1 Organisation.

With a population of approximately ninety million, Mexico ranks a significant place among the highly populated countries in the world.

Nearly 130 000 physicians provide both, public and private health care services throughout the country (Tapia, et al., 1986; Frenk, et al., 1988). In 1987, approximately 90% of the population was covered by the National Health Service (Valdes, 1988).

Being a Republic, Mexico is divided into 31 States and one Federal District, set up in the capital, Mexico City. The National Health Service is mainly provided by (1) the Ministry of Health (SSA); (2) the Social Security Mexican Institute (IMSS); (3) the State Worker's Social Security Institute (ISSSTE); and (4) the Family, Integral Development Organisation (DIF).

Other minor institutions provide health services to more specific target users; for example, Mexico's Oil Company (PEMEX), and the Naval and Armed Forces.

All institutions although independent from each other, must implement the "General Health Law Act" and the "National Health Programme Act", as well as any other official statements published by SSA, who functions as head of the health sector (Soberon Acevedo, 1987).

An approach to integrate the main four health institutions started in the early eighties (Gonzalez-

Block, 1988); a new trend however to co-ordinate and descentralise services was seen under the last administration (Soberon Acevedo, 1987a; Ortega Lomelin, 1988). Figure 2-1., illustrates this co-ordination.

Descentralised from SSA, Mexico has nine National Institutes of Health which have become centres of excellence in their respective fields; these include paediatrics, cardiology, nutrition and internal medicine, oncology, neurology and neurosurgery, pneumology, perinatology, psychiatry, and public health.

The latter was recently established in 1987, through the integration of the Centre for Public Health Research; the Centre for Research on Infectious Diseases; and the School of Public Health of Mexico.

2.2.2 Services.

SSA and DIF offer comprehensive services free to the whole population, while IMSS and ISSSTE serve only the affiliated population. All four institutions are represented in each of the 31 States and the Federal District (Soberon Acevedo, 1987; Soberon Acevedo, et al., 1988b).

A recent health survey (SSA, 1988) showed that health services demands by the population, corresponded to a high extent to IMSS (33.5%) and the private sector (36.7%); and in a lower scale to SSA (12.6%) and ISSSTE (6.9%).

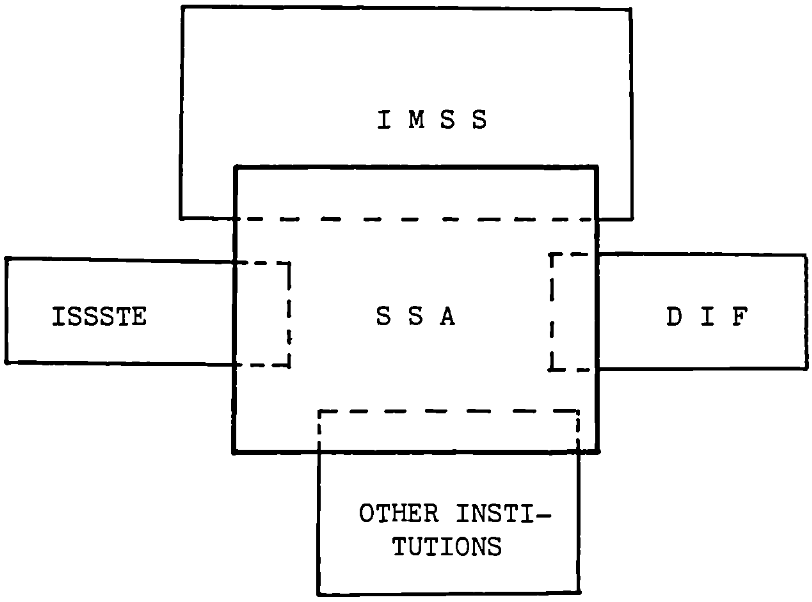

Figure 2-1. Mexico's National Health System, as co-ordinated by the Ministry of Health (SSA).

2.2.3 Funding.

The major sources of funding for the health sector are general taxation and insurance contributions (Soberon Acevedo, 1987b). According to previous planning and programming proposals, the Ministry of Planning and Budgeting allocates a sum to SSA, who then distributes the money to local health authorities.

Health expenditure as related to Gross National Product has decreased from 2.24% in 1978, to 1.63% in 1987 (Valdes, et al., 1988). During the period 1978-1986, SSA spent 70% of its budget on curative medicine; 6% on preventive medicine and human resources capacitation; and only 1% was spent on research-for-development activities (Soberon Acevedo, 1987b).

2.2.4 Health Status.

The health status of the Mexican population obeys to different social, cultural, ecologic, economic, and ethnic factors. Throughout the years, a transition from parasitic and infectious diseases to chronic pathologies has been seen.

Thus, while in the fifties the parasitic and infectious diseases were predominant with over 30% of death rates, by 1982, they represented only 12.2%. On the other hand, an increase in cardiovascular diseases and accidents was noted after the seventies, as illustrated in Table 2-1.

		1950	1960	1970	1980
General Mortality Rate.	A	418	403	486	434
	B	16.22	11.53	10.07	6.21
Parasitic & Infectious.	A	145	103	112	72
	B	34.61	25.54	23.11	16.46
Cardiovascular System.	A	26	34	51	71
	B	6.20	8.52	10.52	16.43
Respiratory System.	A	87	78	106	59
	B	20.72	19.34	21.78	13.48
Gastrointestinal System.	A	21	21	27	31
	B	5.08	5.29	5.59	7.12
Tumours.	A	8	13	19	28
	B	2.00	3.35	3.98	6.47
Accidents.	A	25	26	35	67
	B	5.89	6.54	7.16	15.51
Other causes.	A	107	126	135	118
	B	25.50	31.42	27.86	27.27

A = ciphers in thousands.
B = total %.

Table 2-1. Mexico. Mortality rates by causes (Valdes, et al., 1988).

This change may be related to the significant migration of the population from rural to urban settlements, particularly after the sixties, as shown in Figure 2-2.

The national immunization and family planning programmes as set up by the health sector have helped both, decrease infant mortality rates and population growth. The latter, from 3.32% in the seventies, to 2.53% in the eighties, as illustrated in Table 2-2. Thus, by 1986, Mexican life expectancy was 65 years; the overall mortality 5.9 and the infant mortality 33 (Soberon Acevedo and Valdes, 1986).

In meeting national priorities, Mexico's health strategy of health for all, is primary care. (Soberon Acevedo, et al., 1988; Soberon Acevedo, et al., 1988a; Kumate and Isibasi, 1988).

2.2.5 Scientific and Technical Information.

Control and monitoring of the health activities is mainly performed by local authorities, who in turn report to the central SSA office in Mexico City. The Ministry of Health on the other hand, provides with the "National Vital Statistics", which are published and disseminated on a yearly basis throughout the country. Accordingly, every health institution within the sector, collects, processes, manages, and disseminates its own information.

An official decree published by SSA in 1982,

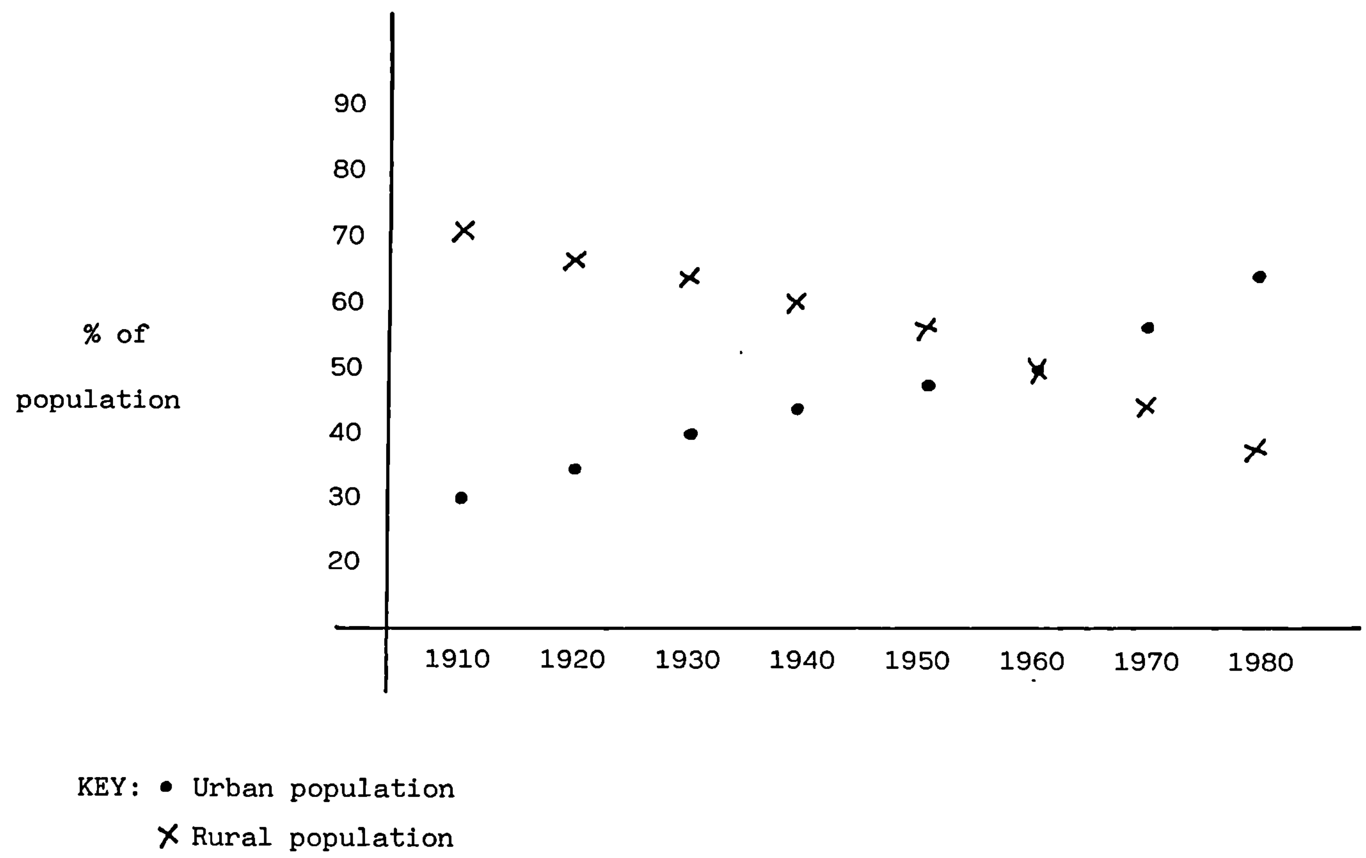

Figure 2-2. Population distribution in Mexico (Valdes, et al., 1988).

YEAR	TOTAL (000)	GROWTH RATE	DENSITY per Km2
1895	12632	1.50	6.45
1900	13607	1.09	6.95
1910	15160	0.51	7.74
1921	14335	1.61	7.32
1930	16553	1.73	8.45
1940	19654	2.75	10.04
1950	25791	3.08	13.17
1960	34923	3.28	17.83
1970	48225	3.32	24.63
1980	66847	2.53	34.14

Table 2-2. Population growth rate in Mexico (Valdes, et al., 1988).

established the need to create an integral "basic frame" to use drugs, medical equipment, and scientific and technical information within the health sector. The basic frames for drugs and medical equipment were developed and applied. That of scientific and technical information however, has not yet been produced. This has prevented the health sector from an integrated "information system".

Over fifty schools and faculties of medicine exist in Mexico (Tapia, et al., 1986), and approximately three hundred biomedical libraries provide services at different levels of development both, in the health and education sectors. No national co-ordination however exists to produce union lists of serials or interlibrary loan facilities among institutions. This has led to duplication of acquisitions and waste of resources (Macias-Chapula, 1987).

A recent study (Macias-Chapula, 1990) reported 67 Mexican biomedical journals; 36 of which (53.73%) are disseminated through six major secondary services (Index Medicus; Excerpta Medica; Index Medicus Latinoamericano; Biological Abstracts; Chemical Abstracts; and Science Citation Index). Under the SSA administration, the National, Health Information and Documentation Centre (CENIDS) functions as the MEDLARS centre in Mexico, and provides services to 23 regional centres and other private and institutional users (Macias-Chapula, 1980, 1988).

Three important national programmes regarding health information are currently being conducted in Mexico: (1) the National Health Survey (Gutierrez, et al, 1988); (2) the National Health Research and Development Registry System; and the National Biomedical Information Database (Mácias-Chapula, 1986).

2.3 THE SOCIAL SECURITY MEXICAN INSTITUTE (IMSS)

2.3.1 Structure.

Founded by official decree in 1943, the IMSS functions as a health and welfare insurance institution, covering a population of 34 330 540 (Garcia Sainz, 1988).

A General Assembly determines the amount of resources to be used by IMSS every year. Among other functions, the Assembly also designates the members of the Technical Council and the Auditing Commission, thus decides on the approval or modification of yearly budgets and general programmes.

The Technical Council decides on the Institute's investments; opening or closure of IMSS Jurisdictions in the Mexican States; and discusses on the approval of the budget and the general programmes, as proposed by the General Director.

The General Director then implements the agreements discussed by the Technical Council and the General Assembly. He represents the institution before other authorities and organisations; and is responsible both, for the presentation of a yearly "inform of activities", and a proposal for the following fiscal year's programming and budgeting plan. He also proposes to the Technical Council the appointments of the General Secretary; heads of subdivisions, different offices, and IMSS Jurisdictions. Figure 2-3, illustrates a simplified version of the IMSS structure.

The Medical Subdivision comprehends the Offices of family medicine, primary, secondary, and tertiary care; education and research, preventive medicine, family medicine, and occupational medicine, as illustrated in Figure 2-4.

In order to provide national coverage, the IMSS descentralised its services into ten regions and 36 jurisdictions throughout Mexico as described in Table 2-3. A "Delegate" to each jurisdiction is proposed by the IMSS General Director to the Technical Council. Accordingly, each Delegate functions as a General Director within his jurisdiction, reproducing the structure, organisation, and general activities of IMSS at his own, local level.

2.3.2 Resources.

Health services are provided by nearly twelve thousand family practitioners and over nine thousand medical specialists. Nursing staff accounted for nearly sixty

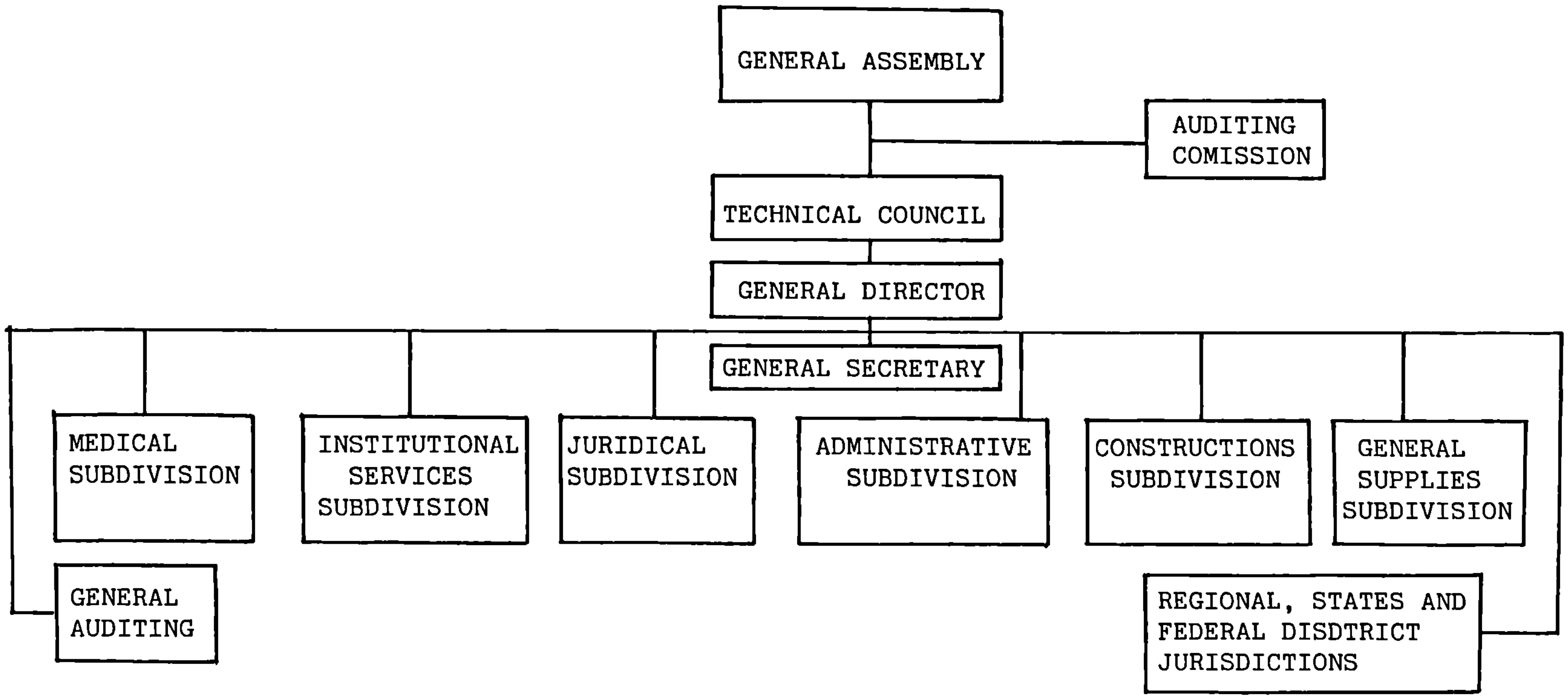

Figure 2-3. Simplified structure of the Social Security Mexican Institute (IMSS) (Garcia Sainz, 1984).

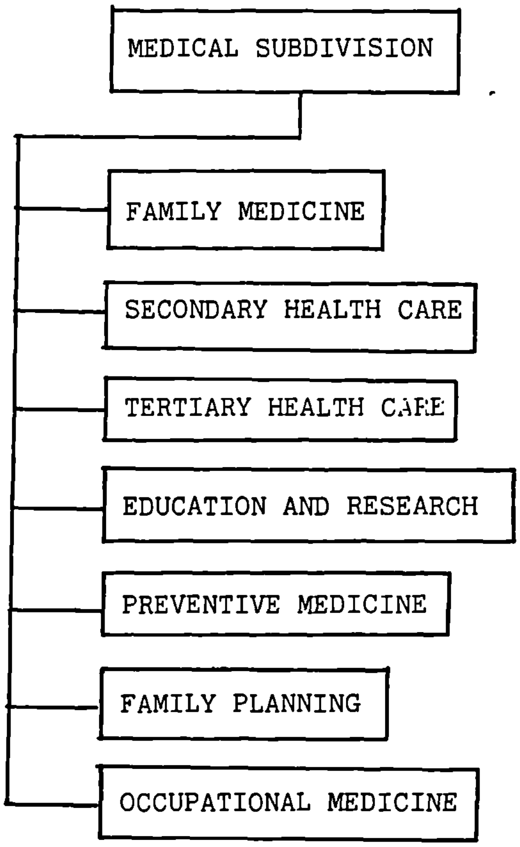

Figure 2-4. Structure of IMSS' Medical Subdivision (Garcia Sainz, 1984).

REGION	GEOGRAPHICAL COVERAGE (Jurisdictions)
1. C.M. XXI Distrito Federal.	Chiapas, Guerrero, Morelos, D.F. 37, D.F. 38.
2. C.M. LA RAZA Distrito Federal.	Hidalgo, Mex-Naucalpan/ Toluca, D.F. 35; D.F. 36. Queretaro.
3. C.M. OCCIDENTE Guadalajara, Jal.	Colima, Jalisco, Michoacan, Nayarit.
4. C.M. MONTERREY Monterrey, N.L.	Nuevo Leon, Tamaulipas, San Luis P.
5. C.M. CD. OBREGON Cd. Obregon, Son.	Baja California Norte, Baja California Sur, Sinaloa, Sonora.
6. C.M. MERIDA Merida, Yuc.	Campeche, Quintana Roo, Yucatan.
7. C.M. VERACRUZ Veracruz, Ver.	Tabasco, Veracruz Norte, Veracruz Sur.
8. C.M. PUEBLA Puebla, Pue.	Oaxaca, Puebla, Tlaxcala.
9. C.M. TORREON Torreon, Coah.	Coahuila, Chihuahua, Durango, Zacatecas.
10. C.M. LEON Leon, Guanajuato.	Aguascalientes, Guanajuato.

Table 2-3. IMSS Regions (IMSS, 1989).

thousand in 1988; and other biomedical technicians numbered over five thousand. As for physical resources, by 1988 the IMSS had 1266 primary health care units; 218 secondary level units; and 33 tertiary care units. All three levels accounted for a total of 27 248 hospital beds and 765 operating rooms (Garcia Sainz, et al., 1988).

Health care services are descentralised and co-ordinated through the ten regions and 36 jurisdictions mentioned in Table 2-3. Thus, a patient may be referred from one jurisdiction to another, or from primary to secondary and tertiary care, according to his health status and the resources available within each jurisdiction and within each region.

An example is illustrated in Figure 2-5. Here, outpatients from Tlaxcala or Oaxaca, can be referred to local secondary level hospitals, either at their own or diffrent jurisdiction. In case of need, they can be referred to Puebla's medical centre, where tertiary health care is available.

2.3.3 Health Services.

At the first level of health care, outpatient visits to a family unit can vary according to the user's age. Thus, while infants and new-borns demand 3.5 visits per year, the middle-aged and the aged demand 1.8 and 1.6 visits per year, accordingly. On average, a couple demands three outpatient visits per year (IMSS, 1989). Causes for health services demands at this level are

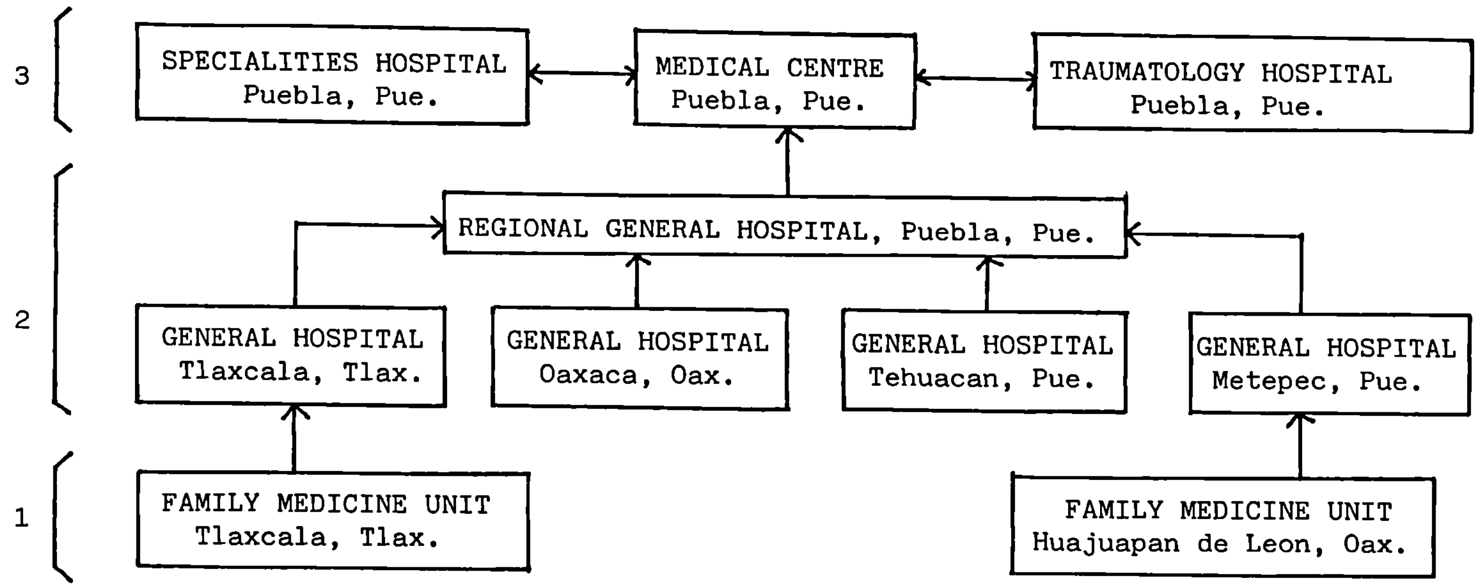

Figure 2-5. IMSS Puebla Region, illustrating three levels of health care (IMSS, 1989).

mainly related to acute respiratory tract infections (18.2%); teeth and oral-related diseases (7.8%); intestinal infectious diseases (5.7%); arterial hypertension (4.2%); and diabetes mellitus (3.7%).

On the other hand, four, out of every hundred IMSS users require hospitalisation. At this secondary and tertiary level of health care, hospitalisation demands are mainly due to obstetric affections (32,8%); traumatisms and poisoning (7.1%); urinary tract infections (3.8%); perinatal affections (3.6%); and acute respiratory tract infections (3.1%) (IMSS, 1989).

IMSS mortality rate is 2.6 per 1000. The main causes of death are: malignant tumours (14.3%); diabetes mellitus (12.1%); heart diseases (12.1%); perinatal affections (10.5%); and cerebrovascular diseases (7.4%) (IMSS, 1989).

A recent diagnostic analysis of the IMSS hospital services showed the following (Garcia Sainz, et al., 1988):

1. Heterogeneity on health services demands;
2. Irregular distribution of resources;
3. Arbitrariness on the physical capacity of the units;
4. Inconsistency between real/ideal levels of resolution;
5. Partial unaccessibility to the user population;
6. Over-demand on emergency services;

7. Over-abundance of super-specialities, as related to basic specialities;
8. Obsolescence or non-existence of technical norms;
9. Jurisdictional policies limiting health services;
10. Inadequate services supply;
11. Inadequate health resources utilization; and
12. Significant differences between metropolitan Mexico City and rural health services provision.

This situation led to a national plan of action which, by focusing on the optimization and equal distribution of resources had the aim of increasing IMSS productivity. Such plan was supported by specific evaluation and control activities; as well as by those activities related to the training and continuing medical education of the personnel. (Garcia Sainz, et al., 1988).

2.3.4 The Education and Research Office.

This Office is responsible for the planning, organisation, implementation, supervision, and evaluation of the IMSS programmes on health research and education. Thus, plenty of co-ordination with other IMSS Offices and departments is expected; as well as with other health and educational institutions in Mexico.

Furthermore, training, research, and continuing medical education programmes are to be designed not only in accordance to local and national health status indicators of the population, but also in accordance with the different educational and research trends of the related sectors.

2.3.4.1 Medical specialities.

A total of 38 medical specialities are provided at the post-graduate level and at the ten medical centres described in Table 2-3.

From 1954 to 1987, a total of 24 187 specialists had been trained (Garcia Sainz, et al., 1988). The fields corresponded as follows: 41% to family medicine; 27% to the broad fields of general surgery, paediatrics, internal medicine, and obstetrics and gynaecology; 20% to the so-called medico-surgical specialities (ophthalmology, othorrhinolaryngology, etc.); and the rest, corresponded to sub-specialities.

2.3.4.2 Nursing.

As for nursing, over 800 nurses per year are trained at the undergraduate level, in the six IMSS nursing schools. At the post-graduate level, 8169 nurses were trained during the period 1971-1987. Such courses included nursing services administration, public health, paediatrics, and surgery.

IMSS also offers its units for the training of nurses from other 109 nursing schools that exist in the country.

2.3.4.3 Co-ordination with medical schools.

A co-ordination with 49 medical schools and faculties takes place every year in order to provide both, medical internship training, and social service facilities to medical students. On average, 5000 interns and social service doctors are allocated on a yearly basis, at primary and secondary level units (IMSS, 1989).
Continuing education to the medical and paramedical staff is provided by different types of courses, sessions, and meetings at the three levels of health care.

2.3.4.4 Publications.

Three journals are published by IMSS' Education and Research Office: "Revista Medica de Enfermeria" (Nursing Journal); "Revista Medica del IMSS" (General Medicine Journal); and "Archivos de Investigacion Medica" (Medical Research Journal), the latter is indexed by major secondary services such as Index Medicus, Biological Abstracts, Excerpta Medica, Chemical Abstracts, and Science Citation Index (Macias-Chapula, 1990).

2.3.4.5 Libraries.

The Education and Research Office co-ordinates 119 biomedical libraries located at secondary and tertiary levels of health care; and 126 "reading units", as located at primary care units. A total of 11 768 journal subscriptions to 1 269 journal titles was obtained in 1989. This accounted for an approximate expenditure of one million sterling pounds, as paid to seventy different publishers.

A recent diagnostic analysis to IMSS libraries (Macias-Chapula, 1990a) showed general defficiencies in the organisation and administration of resources and services; as well as in the equipment, technical processes of material, and continuing education of librarians.

2.3.4.6 Research.

Biomedical research started at IMSS in the late sixties; by the seventies, several units had been developed in Mexico City, Guadalajara, and Monterrey. More recently in 1981, a research unit on traditional medicine had been set-up in the State of Morelos.

The fields of research at IMSS are those mainly concerned with reproduction, nutrition, oncology, neurology, infectious/parasitic diseases; and genetics (Garcia Sainz, 1988). As for 1989, 112 researchers had registered 71 projects and published 207 documents (IMSS, 1989).

2.3.4.7 Training centre.

Finally, the Education and Research Office has set-up a Centre for the training of those qualifying doctors who are to be appointed at managerial levels in different units. This centre is also responsible for the training of teaching doctors, who in turn function either as heads of teaching units in general hospitals; teaching consultants; or as Regional Co-ordinators for Biomedical Education and Research in a given IMSS jurisdiction.

2.3.5 Role of the Regional Co-ordinator for Biomedical Education and Research (RCBER).

A RCBER is appointed by the head of the Education and Research Office, to each one of the 36 IMSS jurisdictions in the country. While at the operational level he is to report to the head of the Medical Services Jursidictional Division, at the normative level he is expected to liaise and report to the head of the Education and Research Office, at Mexico City. Figure 2-6 illustrates these relationships. Here, it is shown how RCBER have normative authority over the heads of the teaching units, who work in a given hospital, within their jurisdiction.

RCBER are therefore responsible for the planning, co-ordination, and supervision of all educational and research activities within their jursidictions. They are expected both, to co-ordinate the application of central norms, as produced by the Education and Research Office, and to design and implement

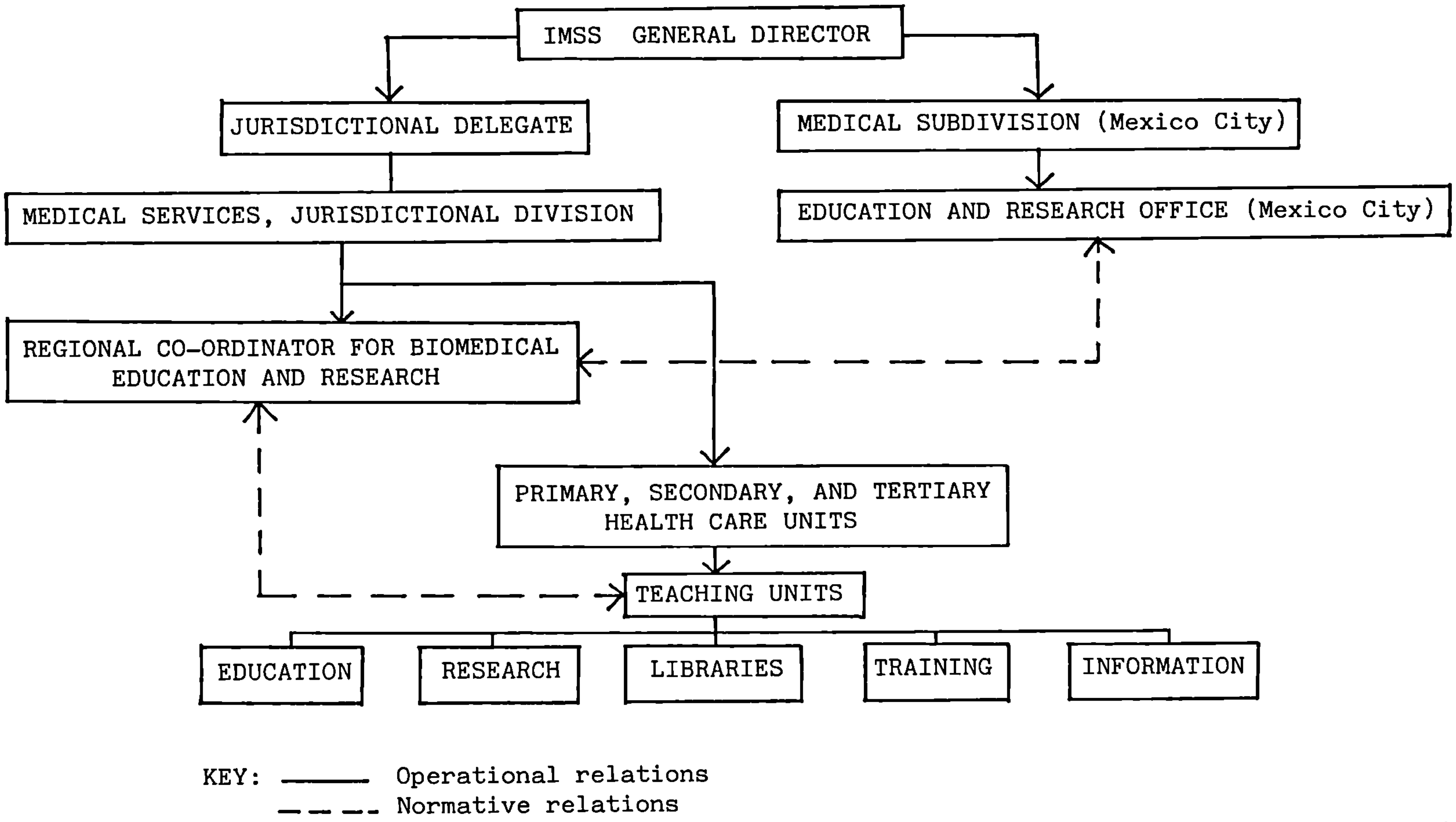

Figure 2-6. IMSS. Normative and operational relationships on education and research activities at the central and jurisdictional levels.

jurisdictional plans on education and research, based on local needs.

The main activities of the RCBER are described in the specific instruction manual, produced by IMSS for this purpose (IMSS, 1981). Table 2-4, provides a six programme summary of such activities.

2.4 THE PROBLEM

2.4.1 General framework.

Mexico produces and consumes biomedical information according to its degree of development, sustaining a second place, after Brazil, in the Latinamerican/Caribbean region (Macias-Chapula, 1990). Manual and computerised sources of scientific and technical information are easily available throughout the country. Thus, a significant amount of resources is being invested to collect, analyse, retrieve, and disseminate biomedical information among health workers (Molino, 1986; Brito, 1987; Macias-Chapula, 1986, 1988); yet, it remains unknown how all this information is being used. What benefits, if any, are gained from using it. Is productivity increased?; is health care delivery or quality of health improved?. This represents an important problem to study since on the one hand, the "value" of information to health care may be understood and recognised; and on the other, the planned information programmes and services

PROGRAMMES	
1.	UNDERGRADUATE STUDIES.
1.1	Internship.
1.2	Social Service.
1.3	Clinical Rounds.
2.	POSTGRADUATE STUDIES.
2.1	Specialities Courses.
2.2	Administration Activities.
3.	CONTINUING EDUCATION AND CAPACITATION OF HEALTH STAFF, TEACHERS, AND DECISION MAKERS.
4.	LIBRARIES AND DISSEMINATION OF INFORMATION.
5.	RESEARCH.
6.	INFORMATION GATHERING.

Table 2-4. Summary of the activities performed by IMSS' Regional Co-ordinators for Biomedical Education and Research (RCBER).

of the health sector shall find helpful data where to base their design models.

2.4.2 Detection of the problem situation.

In this context, information needs to be analysed at the structure, process, and outcome levels of health care. As previously discussed in Chapter 1, while some research has been performed at the process and outcome levels, practically no research has been carried out at the structure level. It is at this level that a problem situation was detected regarding the activities of the IMSS' RCBER.
The IMSS Education and Research Office was facing a situation where:

a). IMSS norms, vital statistics, technical reports, manuals, etc. were being produced and sent to all potential users at each IMSS jurisdiction, including the RCBER.

b). Statistical reports, annual plans and programmes, etc., were being produced by RCBER and sent to the Education and Research Office in Mexico City.

c). A cycle of "mandatory" information production and dissemination was being carried out on a reciprocal basis.
d). No knowledge existed as to what information was useful for the RCBER to perform their every day activities.

e). No knowledge existed about the "value" of information, as assigned by RCBER.

f). No knowledge existed of the personal experience or behaviour towards information use by RCBER.

g). No knowledge existed regarding the factors involved in information access and use.

h). It was unknown whether scientific and technical information was playing an important role to carry out the activities of the RCBER.

i). No knowledge existed about the information sources used by the RCBER.

2.4.3 Summary.

In summary, it was felt that there was a situation where information was playing "some role" at some stage in the performing of the RCBER' activities. The extent or implications of information use at that level however, were not clearly defined. Furthermore, the impact of information production and use at this level, as related to health care or quality of care, was less clear.
This was an important situation to be understood because plenty of human, material, and budgetary resources were being used to create, acquire, and disseminate information sources throughout all, 36 IMSS jurisdictions.

To understand the problem situation, the "real-world" environment where RCBER conduct their every day activities needed to be explored and analysed. From an understanding of this environment, we can develop a better sensitivity to the end-user's perceptions of their benefits and products as they use information.

2.4.4 Previous studies.

Previous studies on Mexican biomedical information are related to the information structure; selective dissemination of information services; and statistical analysis of online training courses and services (Macias-Chapula, 1980, 1984, 1986, 1986a, 1986b, 1987, 1988, 1990; Macias-Chapula and Hernandez Vera, 1987, 1988; Macias Chapula, et al., 1988). No research however, has been carried out on (1) the role of information at the structure level of health care, especially involving educational and research activities; nor (2) on the factors that affect information use at that level.

2.5 THE PURPOSE

It is the purpose of this research to conduct an analytical study on the information problems that exist among RCBER. These problems are to be analysed within the structural framework of the educational and research activities, as performed at IMSS.

2.5.1 Objectives.

The objectives of this research are:

1. To understand and learn about the information problems that exist among RCBER.
2. To obtain a descriptive diagnosis of the role of scientific and technical information among RCBER.

3. To provide a plan of action to improve the existing situation.

4. To provide the rationale where a systems approach to the problems encountered be applied.

5. To obtain insights for the design and implementation of information systems and services, within IMSS' Education and Research Office; and
6. To provide the basis where further research can be conducted at the structure, process, and outcome levels of health care.

It is not the purpose of this research to measure variables, or conclude on prescriptive criteria; the rationale being that in this study there is not a problem as such, but a "soft", problem situation, where human activity systems are related to the problem situation.
Thus, a wholistic, rather than a reductionist approach has been selected to analyse the problem of study. This is discussed in the next chapter.

CHAPTER 3

METHODOLOGY

3.1. INTRODUCTION.

The purpose of this chapter is to describe the methodology that was chosen to be applied in this research, and to provide the rationale where this choice was based.

First, a distinction between "hard" and "soft" problems is made. This helps to identify as "soft" the problem analysed in this research.

Then, the difference between a systems approach and a scientific approach is clearly delineated. Thus, while it is recognised that this research faces a soft type of problem where a systems approach is more likely to be applied, the question: which methodology should be used?, arises.

One section then emphasises on the existing systems methodologies, describing their usefulness and limitations, as well as the emergence of Soft Systems Methodology (SSM). SSM is then described in-depth, for this was the methodology applied to this research.

Applications of the methodology by other authors and disciplines are also mentioned.
A final section describes the seven stages involved in the use of the methodology.

3.2 DISTINCTION BETWEEN "HARD" AND "SOFT" PROBLEMS.

In selecting a methodology for problem solving, a distinction between "hard" and "soft" problems is necessary. A "hard", or structured problem is one which is exclusively concerned with a "how" type of question. This kind of problem is the domain of the design engineer who seeks effective and economic answers on "how" for example, can we transport X from A to B, at minimum cost?.
A "soft", or unstructured problem is one which is typified by being mixtures of both "what" and "how" questions. This kind of problem is manifest in a feeling of unease but which cannot be explicitly stated without this appearing to oversimplify the situation.
Clearly, structured problems are what "hard" systems thinking and most operational research are concerned with (Checkland, 1981; Wilson, 1984).

3.2.1 The concept of "problem".

The concept of "problem" is also one that has been found to be inappropriate. The notion that a problem can be defined suggests that a solution can be found which removes the problem. This is not unreasonable at the "hard" end of the problem spectrum, but at the "soft" end, problems do not occur in a way which enables them to be readily isolated. It is more usual to find sets of problems which are highly interactive and it has been found to be more useful to examine, not a problem, but a "problem situation"; i.e., a situation in which there are perceived to be problems (Wilson, 1984).

The ways of describing the problem situations (modelling languages) need to be appropriate to the nature of the problem under investigation. Since the "hard"/"soft" distinction refers to the extremes of a possible problem spectrum, the modelling languages can also be viewed in relation to these extremes.

Mathematics provides a general language which has been widely applied to "hard" problems. When the elements of a "soft" problem include such factors as conflicting objectives, unclear or complex information flows, people with different perceptions and attitudes, etc., it is difficult to see how a mathematically-based language can be appropriate.

Clearly, the present research is to be concerned not with "hard" problems or problems as such, but with a problem situation in which there are "soft", unstructured problems.

3.3 THE SYSTEMS APPROACH.

Science provides us with the phrase "a scientific approach" just as systems provides a "systems approach". Both are disciplines and both embody a particular way of regarding the world. An approach is a way of going about tackling a problem, and obviously a particular approach may be relevant to more than one subject.

A systems approach tends to be an approach to a problem which takes a broad view, which tries to take all aspects into account, which concentrates on interactions between the different parts of the problem (Checkland, 1981).

The scientific outlook assumes that the world is characterized by natural phenomena which are ordered and regular, not capricious, and this has led to an effective way of finding out about the regularities, the so-called "laws of nature" (Checkland, 1981).

The systems outlook, accepting the basic propositions of science, assumes that the world contains structured wholes which can maintain their identity under a certain range of conditions and which exhibit certain general principles of "wholeness", as previously described in chapter 1.

Systems thinkers are interested in elucidating these principles, believing that this will contribute usefully to our knowledge of the world (Bertalanffy, 1968; Ackoff, 1974; Waddington, 1977; Checkland, 1981).

According to Checkland (1981), there is a cycle of interaction between the formulation of theory relevant to serious problems or concerns, and the testing of that theory by the application of methodology appropriate to the subject matter.

In Figure 3-1, Checkland (1981) illustrates the relationships between activities and results in a developing subject: a "systems model" of any developing discipline. Here, it is assumed that the focus of interest is a set of concerns, issues or problems perceived in the real world, or something there about which we have aspirations. Whatever the focus, it will lead to ideas from which we can formulate two kinds of theory: "substantive" theories about the subject matter (for example a theory concerning catalysis in chemistry), and "methodological" theories concerning how to go about investigating the subject matter. Once such theories exist, it is possible to state problems, not merely as problems existing in the world, but as problems within the discipline.

All the resources of the discipline (previous results within it, its paradigms, models, and techniques) can then be used in an appropriate methodology to test the theory. The results from this test, which will itself involve action in the real world (intervention, influence, observation) will provide what in Figure 3-1 are called "case records", records of happenings

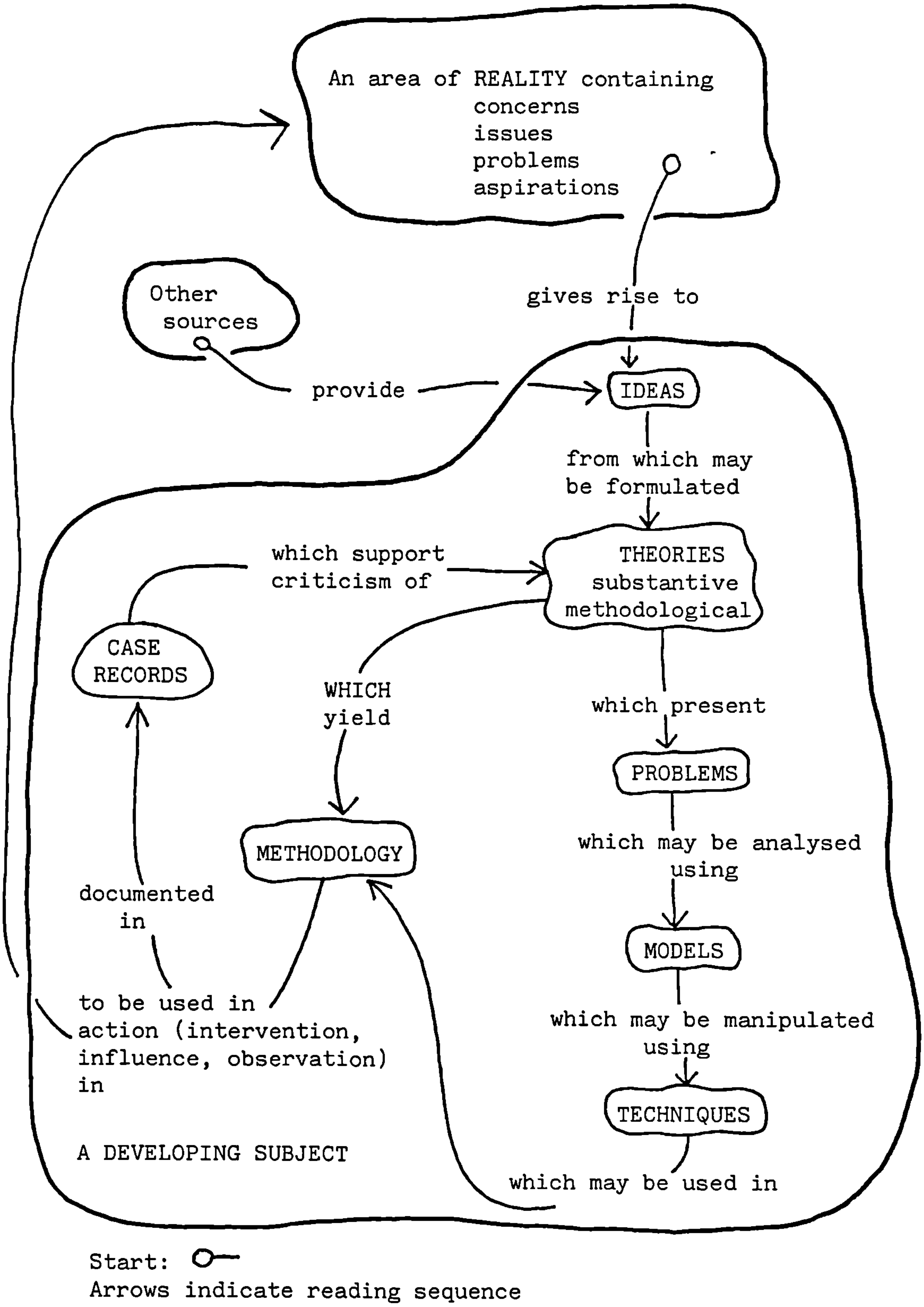

Figure 3-1. Relationships between activities and results in a developing subject (Checkland, 1981).

under certain conditions. These provide the crucial source of "criticism" which enables better theories to be formulated, better models, techniques, and methodology to be developed (Checkland, 1981).

3.4 WHICH METHODOLOGY?.

Substantial efforts have been dedicated to the analysis, development, and refinement of methodologies for problematic situations (Flood and Carson, 1988). "Reductionist" efforts have investigated specific methodologies (Rhodes, 1985; Woodburn, 1985). Of equal importance is the consideration of a wholistic approach to methodology, whereby various methodological approaches are linked or integrated into a system that reflects the wide variety of situational classes that may exist.

The benefit of such an approach is to marry appropriate methodological approaches to types of problematic situations. If feasible, ideally this would give some real directions as to which methodology should be used (Flood and Carson, 1988). Efforts in this area include "Towards a System of Systems Methodologies" (Jackson and Keys, 1984), and Klir's Architecture of Systems Problem Solving (Klir, 1985). The former work is conceptually based in social systems theory, whereas the latter has a strong relation to general systems theory and its associated mathematical foundations (Flood and Carson, 1988).

Other attempts at wholistic classification are found in Boulding (1956), Checkland (1971, 1981), and Jordan (1981).

3.4.1 System Design Methodologies.

The motivation to undertake the development of system design methodologies arose because of the four characteristics that affected the post-war industry (Wilson, 1984):

(a) technical systems were becoming more complex;

(b) market environments were becoming highly competitive;

(c) new projects were increasingly more expensive;

(d) computer developments made complex calculations more feasible.

These features gave rise to the need for integrated design methodologies that were capable of producing "optimized" designs and the need to see design as part of business development planning. Thus there was a realization that technical system design was part of a wider environment which had to be accomodated in the design process (Wilson, 1984). Plant design methodologies were developed (Williams, 1961).

As well as being concerned with design, systems engineering as a discipline was directed towards the development of methodologies for problem solving in general (Wilson, 1984). Examples of these are the methodology described by Hall (1962), developed as a result of the experience with Bell Telephone

Laboratories, and that of the RAND Systems Analysis (Quade and Boucher, 1968).

Both of these methodologies emphasize a "systemic" approach to problem investigation, though neither of them take the basic definition of a system to be more than the general definition; i.e., an interconnected set of entities. They both place considerable emphasis on the definition of the problem and on the need for consensus over objectives.

The methodologies detail the stages involved in a complex analysis but give no guide as to how each stage should be taken (Wilson, 1984).

3.4.2 The Viable System Model.

Another systems approach to complexity is Beer's (1979, 1981, 1985) "Viable System Model" (VSM). For Beer, a system is viable if it is capable of responding to environmental changes, even if those changes could not have been foreseen at the time the system was designed.

In order to become or remain vaible and effective, an organisation has to achieve "requisite variety" with the complex environment it faces. It must be able to respond appropriately to various threats and opportunities presented by the environment (Beer, 1985).

Of course, the potential variety of the environment always threatens to overwhelm that of the system.

Complexity, therefore has to be "managed".
VSM sets out the necessary relationships which must obtain between essential organisational elements and information channels, so that the variety equations can be balanced in a satisfactory way, the ultimate key to the correct balance being the purpose the organisation is pursuing.
According to Jackson (1989), Beer's VSM encapsulates the most important features of organisational cybernetics. Indeed, VSM is best employed as a "diagnostic tool"; it provides specifications for the design of goal-seeking, adaptive systems.

3.4.3 Jenkins' Methodology.

The Jenkins' (1981) methodology consists of the following four major stages: (1) systems analysis; (2) systems design; (3) implementation; and (4) operation. This methodology attempts to be both systematic and systemic, though the systems concepts are only a small subset of what is now known as the formal systems model. It still made the assumption that systems exist in the real world; i.e., the distinction had not been made between designed physical systems and human activity systems. Because of the inclusion of an analysis of both the system and its wider system and their respective objectives, there is an emphasis on the consistency of hierarchical objectives.
The measure of performance is expressed solely in economic terms. This stems from the concern that the

systems should function efficiently. Furthermore, this methodology was based on the idea that engineering the system within which the problem lies would solve the problem (Wilson, 1984).

3.4.4 Need of a "soft" Methodology.

As the kind of problems encountered became "softer", modifications to the Jenkin's methodology were found to be necessary. For example, it was found to be useful to derive measures of performance that were not economic and to consider system boundaries that were not co-incidental with organisational boundaries (Wilson, 1984). However, real difficulties were encountered when it was realized that, in general, objectives could not be taken as given.

There is usually no basis for assuming at any level in an organisation, that published objectives really represent what is being aimed for, or that there is anything like a consensus about them. What was needed therefore, was a methodology which explicitly faced this problem and attempted to expose and counterpose the various "world views" in order to reach some valid consensus concerning possible changes based on an appreciation, by the actors involved, of their own and others' values and beliefs (Mingers, 1980).

Based on a programme of action research within real-world situations, Checkland (1981) has developed such methodology, now known as Checkland methodology or

Soft Systems Methodology (SSM).

Given a set of methodologies, the question "which methodology should be used?", arises. Flood and Carson (1988) were not able to find universal acceptance with either of the approaches reviewed. On the other hand, Wilson (1984) states that the assembly of systems concepts (i.e., methodology) needs to be appropriate to the situation and to the particular personality of the analyst himself.

Thus the analyst should choose that methodology which "works" for him and which of course, produces results which the organisation will agree are useful. To carry out this research, Soft Systems Methodology was chosen.

3.5 SOFT SYSTEMS METHODOLOGY.

3.5.1 Description.

Soft Systems Methodology can be described as a seven-stage process of analysis which uses the concept of a human activity system as a means of getting from "finding out" about the situation, to "taking action" to improve the situation. Figure 3-2, illustrates this process. Here, a chronological sequence is to be read from 1 to 7, a logical sequence which is most suitable for describing it but which does not have to be followed using it.

In reality it represents a pattern of activities. The analyst may start with any activity, progress in any

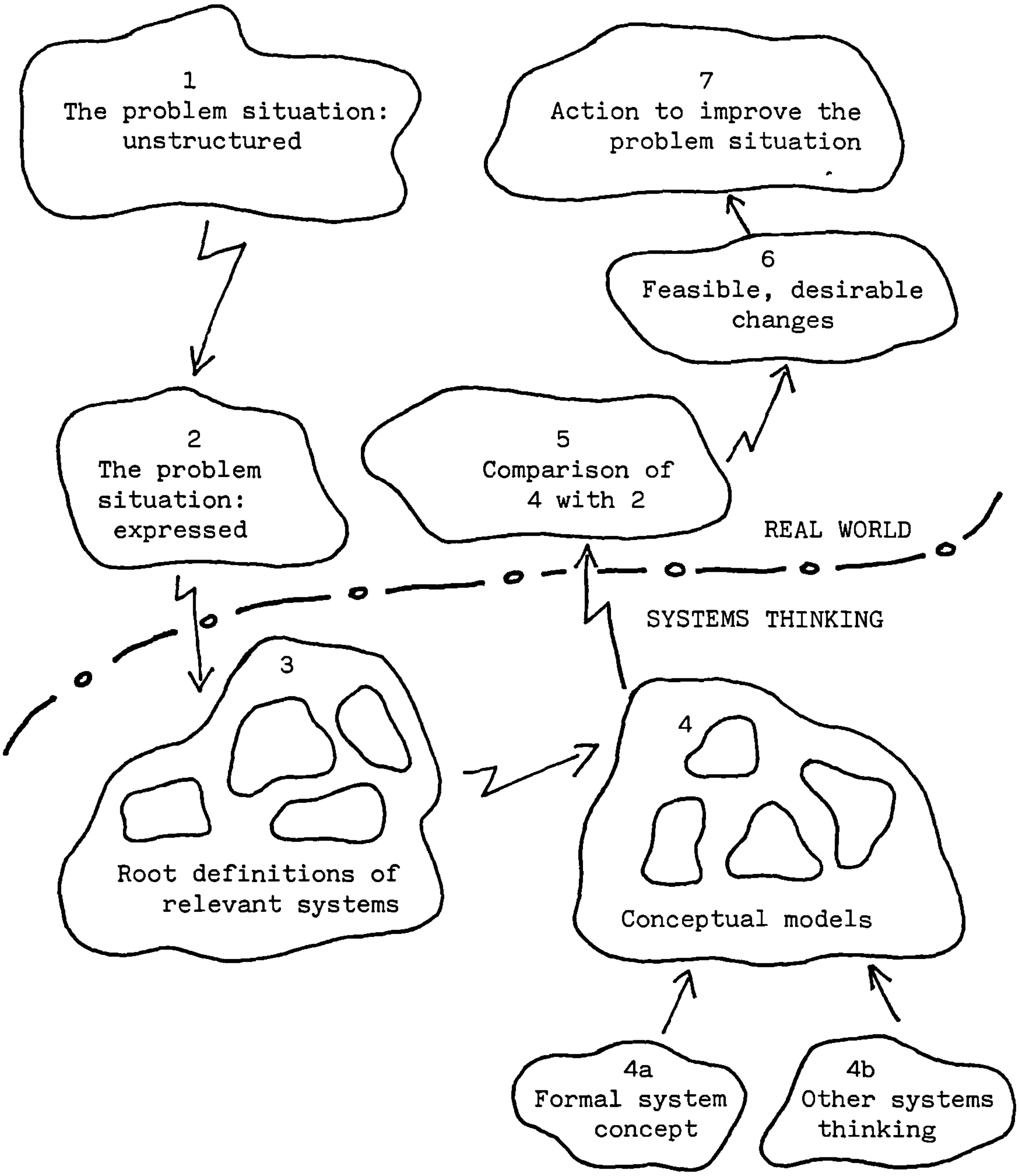

Figure 3-2. The Soft Systems Methodology in summary (Checkland, 1981).

direction, and use significant iteration at any stage. In an actual study the most effective systems thinker will be working simultaneously at different levels of detail, on several stages (Checkland, 1981). This has to be so because the methodology is itself a system and a change in any one stage affects all the others. The methodology contains two kinds of activity. Stages 1, 2, 5, 6, and 7 are "real world" activities necessarily involving people in the problem situation. Stages 3, 4, 4a, and 4b, are "systems thinking" activities which may or may not involve those in the problem situation, depending upon the individual circumstances of the study.

In general, the language of the former stages will be whatever is the normal language of the problem situation; that of 3, 4, 4a, and 4b, will be the language of systems, for it is in these stages that the real-world complexity is unravelled and understood as a result of translation into the higher level language of systems (Checkland, 1981).

3.5.2 Basic Elements.

For the purpose of this work, the main outcomes of the action research in using the methodology, as reported by Checkland (1981), can be summarized as follows:

3.5.2.1 Primary task/issue-based root definitions.

A helpful distinction to bear in mind when selecting the systems to model is that between "primary task" and "issue-based" root definitions (Checkland and Wilson, 1980). Previous reference to this relationship is found in Merton's (1957) distinction between "manifest" and "latent" functions.

3.5.2.2 CATWOE Elements.

Because conceptual models of systems described in root definitions are checked against the characteristics of the formal model of any human activity system, there ought to be characteristics in any root definition which is "well-formed", which relate to the formal system model and make that checking process possible. Smyth and Checkland (1976) concluded that an adequate root definition should contain five elements explicitly; if it does not, then omission of any of these elements should be conscious and for good reason.

The five elements are: the core of the root definition of a system will be a "transformation" process (T); the means by which defined inputs are transformed into defined outputs. The transformation will include the direct object of the main activity verbs subsequently required to describe the system.

There will be "ownership" (O) of the system, some agency having a prime concern for the system and the ultimate power to cease it to exist. The owner can discourse about the system.

Within the system itself will be "actors" (A), the agents who carry out or cause to be carried out the main activities of the system, especially its main transformation.

Wthin and/or without the system will be "customers" (C) of the system, beneficiaries or victims affected by the system's activities. Customers will be indirect objects of the main verbs used to describe the system.

Fifthly, there will be "environmental constraints" (E) on the system, features of the system's environment and/or wider system which it has to take as given.

To these five elements a sixth element is added, which, by its nature is seldom explicit in a root definition but which cannot be excluded: there will be a "Weltanschauung" (W), an outlook, framework or image which makes a particular root definition meaningful.

These six elements are known by the mnemonic CATWOE.

3.5.2.3 Laws of procedure.

Two laws of procedure are to be taken into consideration: (a) the "law of conceptualization", which states that a system which serves another cannot be defined and modelled until a definition and a model of the system served are available; and (b) the "law of model building", which states that models of human activity systems must consist of structured sets of verbs specifying activities which actors could directly carry out.

3.5.2.4 Wilson's Maltese Cross.

A tool for information systems analysis and design may be used at the "primary task" model, to identify activity-to-activity information flows. Such a device, known as the "Maltese Cross", was developed by Wilson (1980, 1984) and is applied at stage 4 of the methodology.
In essence, the Maltese Cross is a four part matrix. The upper half contains the activities taken from the activity model together with an indication of the activity-to-activity information flows. The lower half contains a statement of the existing formal information processing procedures.

3.5.3 Applications.

Soft Systems Methodology has been applied to different kinds of studies pursuing different aims, such as system design, historical analysis, and clarification of concepts (Checkland, 1981, Wilson, 1984).
More recently, it has had practical applications in organisational analysis (Atkinson, 1989; Patching, 1990), and the industry sector (Youssef and Jackson, 1989; Checkland and Scholes, 1990).
In the medical field, Eggington (1988) used the methodology to examine, at a conceptual level, the

information requirements of health care systems throughout Europe. Checkland and Scholes (1990) applied the methodology at the community level, within the National Health Service in the United Kingdom. Smallwood (1990), on the other hand, used a soft systems approach to the problems concerning the transfer of patient information and communication patterns amongst nurses.

No studies however, were found regarding the use of the methodology in solving information problems at the structure level of health care.

3.6 USE OF THE METHODOLOGY.

According to Checkland (1981), in every problem situation, no matter what particular perceptions or mix of perceptions seem obvious to particular individuals or groups, a fixed element will be the existence of the role "problem-owner", occupied by those who perceive the problem.

A second fixed element will be the role, the would-be "problem-solver", the occupants of which wish to tackle the perceived problem. It is important to emphasize however, that these are "roles", not individuals.

In a systems context, there is a "problem-content" system, containing the role of problem-owner, and there is a "problem-solving" system, containing the role of problem-solver.

In this research, Soft Systems Methodology is used to take action to improve aspects of the problem-content situation. The outline in Figure 3-3, illustrates the use of the methodology.

Before a description of the methodology is given, it is important to mention that in order to approach the problem situation, it was helpful to limit our study to the IMSS' RCBER. This provided both (1) the basis where to analyse the problem-content i.e., the respective boundaries, relationships, etc. so as to develop the methodology in the "systems thinking world"; and (2) the defined target population where to apply the methodology so as to validate a consensus model and propose alternatives to improve the situation in the "real world".

3.6.1 Stages 1-2.

Stages 1 and 2 of the methodology (Figure 3-2) are an expression phase during which an attempt is made to build up the richest possible picture, not of the problem but of the "situation" in which there is perceived to be a problem.

The most useful guideline here has been found to be that this analysis should be done by recording elements of slow-to-change structure within the situation and elements of continuously changing process, and forming a view of how structure and process relate to each other within the situation being investigated. Checkland (1981) calls this

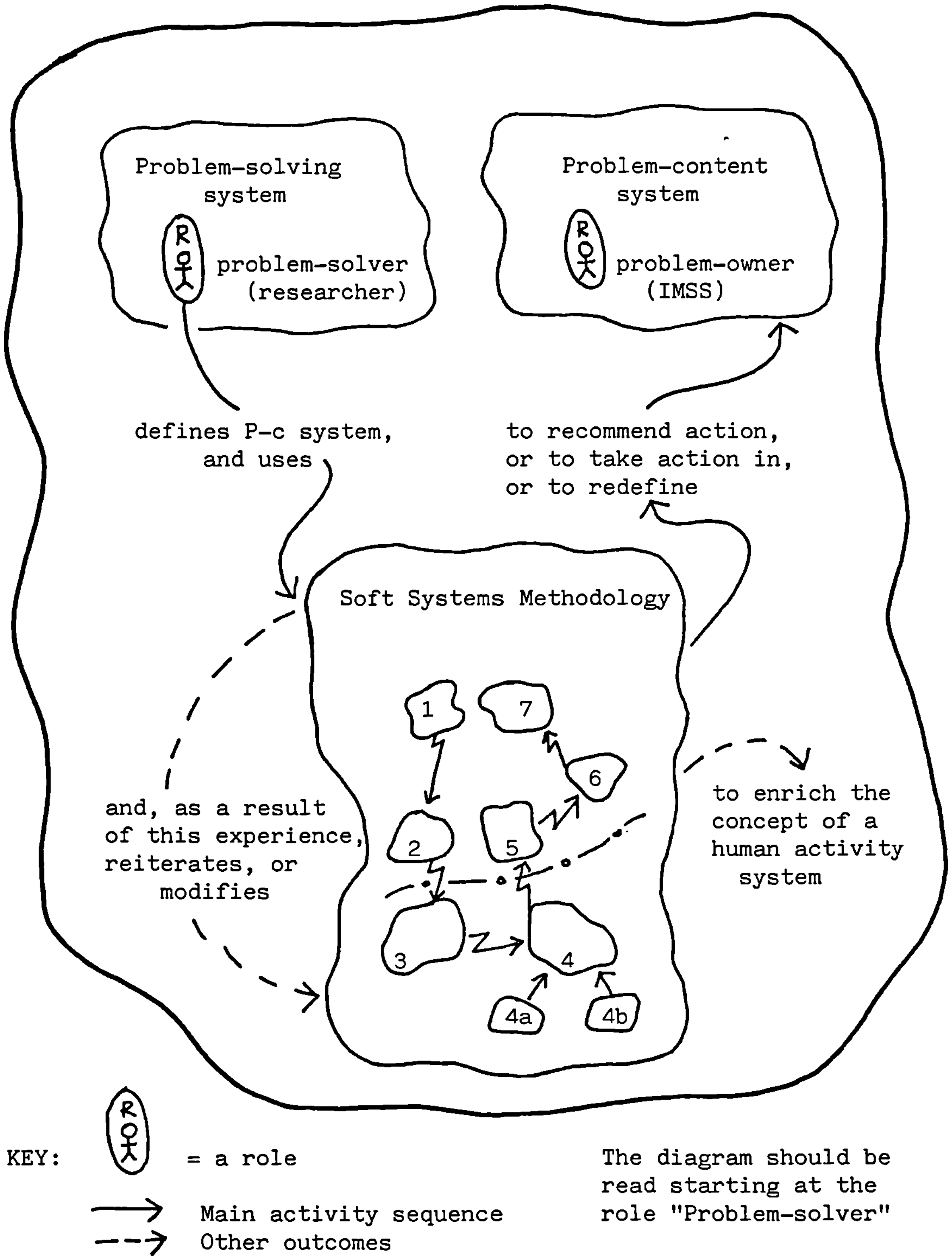

Figure 3-3. An outline of a system to use Soft Systems Methodology, modified after Checkland (1981).

relationship "climate".

Elements of structure are defined as those features related to physical layout, power hierarchy, reporting structure, and the pattern of formal and informal communications. Process is related to the on-going activities of conversion of raw material into products, monitoring, decision-making, and controlling (Checkland, 1981).

In soft systems there will always be many possible versions of the soft system to be engineered or improved, and system boundaries and objectives may well be impossible to define. In this context, Vickers (1968, 1970) has argued against taking social systems to be goal-seeking, pointing out that "relationship-maintaining" is often a better description of their purpose ; Checkland's (1981) approach endorses that view.

It has been found most useful to make the initial expression a building up of the "richest possible picture" of the situation being studied. Such a picture then enables selection to be made of a viewpoint from which to study further the problem situation. Once that selection is made, one or more particular systems which will be part of a hierarchy of systems, are being defined as "relevant" to problem solving.

Stages 1 and 2 were thus identified and defined accordingly. They are described in the following chapter.

3.6.2 Stage 3.

Stage 3 involves naming some systems which look as though they might be relevant to the problem and preparing concise definitions of what these systems are. The object is to get a carefully phrased explicit statement of the nature of some systems which will subsequently be seen to be relevant to improving the problem situation.

This cannot be guaranteed, but the formulation can always be modified in later iterations as understanding and familiarity deepens. These definitions in stage 3 are termed "root definitions". Thus, the intention is to indicate that they encapsulate the fundamental nature of the systems chosen. (specified-task-carrying-out).

In other words, to propose a particular definition is to assert that, in the view of the analyst, taking "this" to be a relevant system, making a conceptual model of the system, and comparing it with present realities is likely to lead to illumination of the problems and hence to their solution or alleviation (Checkland, 1981).

The selected root definitions considered as relevant for this research were:

(1) The "Education System".

(2) The "Research and Development System".

(3) The "Library System"; and

(4) The "Information System".

A complete description of these root definitions is given in the next chapter.

3.6.3 Stage 4.

What is further done in stage 4, is to make a model of the activity system needed to achieve the transformation described in the definition. A conceptual model is built, which will accomplish what is defined in the root definition.

The definition is an account of what the system "is"; the conceptual model is an account of the activities which the system must "do" in order to "be" the system named in the definition (Checkland, 1981).

Definitions are formulated without thinking: "this system ought to be engineered". The resulting model, when complete, is not a state description of any actual human activity system. It is in no sense a description of any part of the real world; it is simply the structured set of activities which logic requires in a notional system which is to be that defined in the root definition.

At this stage, modelling becomes a question of asking: what activities, in what sequence, have to occur in order to do the transfer? (Checkland, 1981).

3.6.3.1 The technique of modelling.

Due to the fact that the conceptual model is a model of an activity system, its elements will be "verbs". The technique of modelling is to assemble the minimum list of verbs covering the activities which are necessary in a system defined in the root definition, and to structure the verbs in a sequence, according to logic.

Checkland (1981) has found best always to complete a model at a low level of resolution and then to expand each major activity at a higher level of resolution.

3.6.3.2 Stage 4a.

Once a conceptual model has been built, it would be reassuring to be able to establish its validity. In this context, there are not valid models and invalid ones, only defensible conceptual models and ones which are less defensible (Checkland, 1981).

In Figure 3-2, stage 4a represents what Checkland (1981) calls the formal system model. This model is not descriptive nor prescriptive of actual real world manifestations of human activity systems, rather, it is a formal construct, aimed at helping the building of conceptual models which are themselves formal. The model is a compilation of "management" components which arguably have to be present if a set of activities is to comprise a system capable of purposeful activity. The model extends Jenkins' summary of properties of systems (Jenkins, 1981), and Churchman's (1971) anatomy of systems teleology. The components of the model are summarized as follows (after Checkland, 1981):

S is a "formal system" if, and only if,

(1) S has an on-going purpose or mission;

(2) S has a measure of performance;

(3) S contains a decision-taking process;

(4) S has components which are themselves systems having all the properties of S;

(5) S has components which interact;

(6) S exists in wider systems and/or environments with which it interacts;

(7) S has resources, physical and through human participants, abstract which are at the disposal of the decision-taking process; and

(8) S has some guarantee of continuity.

From the above it can be noted that if the analysis is pressed to lower levels in greater detail, then below sub-systems and sub-sub-systems, etc., will eventually be found. From the analyst point of view, they may not be systems, but systems components.
Similarly, analysis in the other direction will eventually reach larger entities which in the analyst judgement have to be taken as environments rather than systems, the distinction being that an environment may hopefully be influenced but cannot be "engineered", whereas a wider system can at least in principle, be

engineered (Checkland, 1981).

The value of the formal system model is that it enables questions to be framed which, when asked of the conceptual model, reveal inadequacies either in it or in the root definition which underlies it.

3.6.3.3 Stage 4b.

In stage 4b, the models are examined for validity in terms of any other systems thinking which the analyst reveres. This is the point at which the conceptual models may be inspected alongside any systems theory which is relevant to human activity systems; for example Emery and Trist (1981); Beer (1981, 1985); Ackoff (1971); Churchman (1971); or Vickers (1968, 1973).

A consensus, "primary task" model was then built and also tested against Checkland's formal system concept, and other systems thinking, as described in chapter 4. After the validation of the consensus model was made in the "systems thinking" world, the next step was to identify the information needed to perform the activities in the model. Thus, using Wilson's (1984) Maltese Cross as a tool (Figure 3-4), the northern matrix of the cross was built by identifying the information needs to carry out each of the activities in the model. Since the west axis (representing inputs) is the mirror image of the east axis (representing outputs), the productivity, i.e., the information production was easily identified.

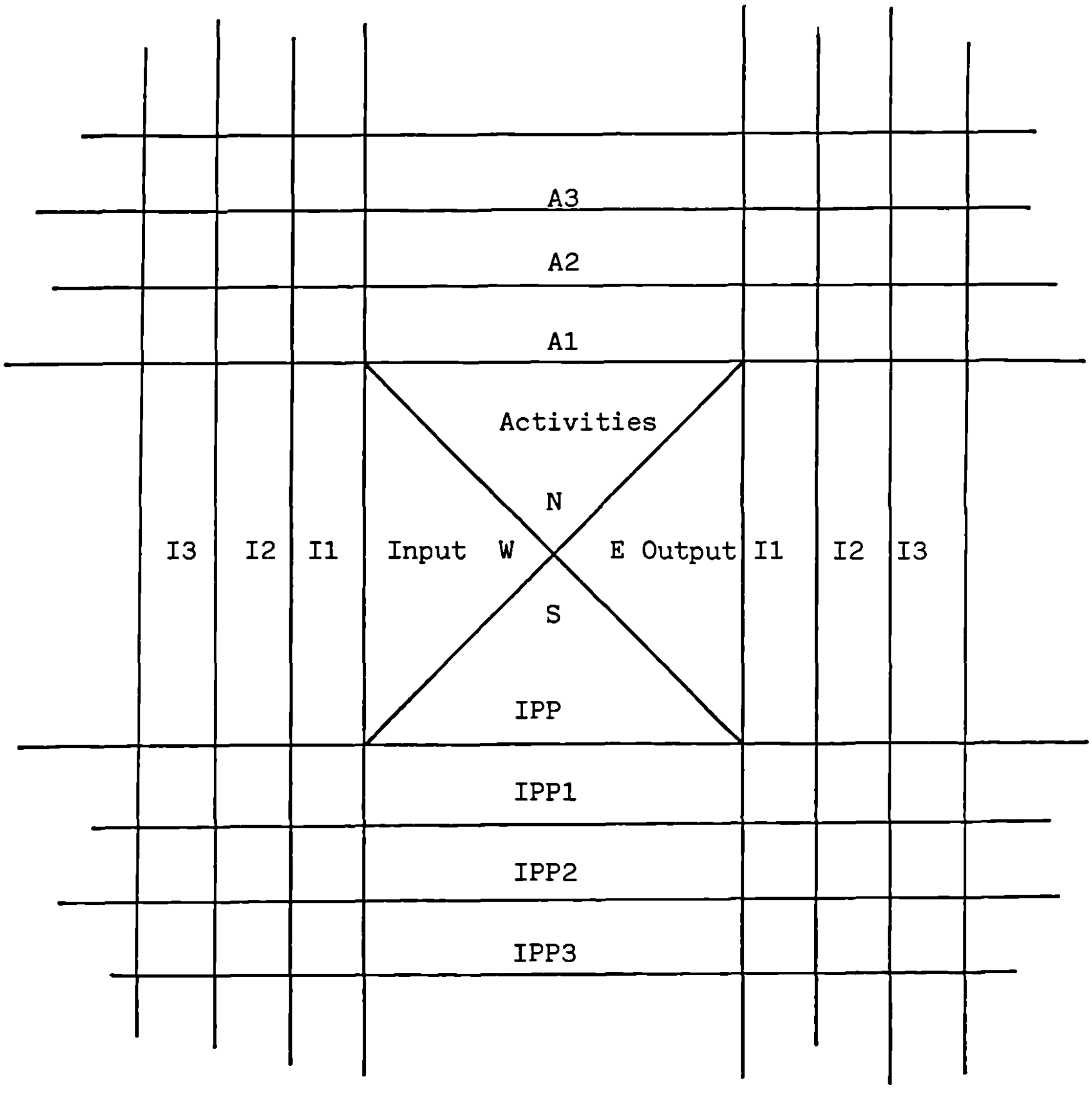

Figure 3-4. Structure of a Maltese Cross (Wilson, 1984).

The north axis is a listing of the set of activities making up the consensus "primary task" model relevant. The south axis should represent a listing of the information processing procedures (IPP) currently performed in the "real world"; thus, in this case, this axis was left blank for considering it an entire "green-field" situation at this stage.

3.6.4 Stage 5.

At stage 5, parts of the problem situation analysed in stage 2 are examined alongside the conceptual models. This should be done together with concerned participants in the problem situation, with the object of generating a debate about possible changes which might be introduced in order to alleviate the problem condition.

According to Checkland (1981), it is the comparison stage which embodies the basic systems hypothesis that systems concepts provide a means of teasing out the complexities of "reality".

3.6.4.1 Use of the questionnaire.

In order to perform such comparison, structured interviews with the 36 IMSS' RCBER were conducted by the researcher. A questionnaire was used as a tool to obtain the following information:

1. The validation, refutation, or similarities found of the conceptual, "primary task" model.

2. The information "used" by the interviewed to perform the activities in the model.

3. The information "produced" by the interviewed from performing the activities in the model.

4. The "value" assigned to information by the interviewed in his real-world environment.

5. The "impact", as measured by the interviewed, of information use; and finally,

6. The factors (at the user, source, or environment level) which are referred to affect such information use.

Appendix 1 describes the questionnaire in detail. Before it was applied, the questionnaire was tested among health workers in the Mexico City area.

3.6.4.2 Interview procedure.

RCBER were notified by letter, two months in advance about the visit of the researcher. An average of two working days per region, was spent on each visit. Appendix 2 provides the itinerary followed.
The procedure of the interview was as follows:
First, an introduction and general background about the research, as well as the overall structure of the questionnaire was commented by the researcher.
Then, the questionnaire was handed to the RCBER, who

proceeded to answer it. The researcher remained nearby the interviewed while the questionnaire was being answered; this technique allowed for explanations, comments, or discussions either about the questionnaire or the problem situation.

Through observation, the researcher could take note of (1) the relevant activities carried out at the RCBER's office; (2) adopted attitude towards the researcher's visit; (3) the available scientific and technical information nearby the RCBER; and (4) the general knowledge of information sources, as used by the RCBER, among other.

This approach helped to corroborate the answers given by the interviewed and to have a "real world" image of the RCBER's role within the system.

On average, each interview lasted approximately three hours. The rest of the time was spent visiting health care units and having meetings with the unit's directors, heads of the teaching units, researchers, and librarians. Throughout these meetings, discussions on information use, flows, production, and availability, took place.

This provided insights to the problem situation from different viewpoints, generating a debate among RCBER, other actors involved, and the researcher.

3.6.4.3 Analysis and interpretation of data.

All the information was manually analysed and interpreted. Basic statistical analysis was applied to the data in order to present it in an explanatory manner. The results are provided in the following chapter.

3.6.5 Stage 6.

At stage 6, debate about change is carried out in the real world of the problem with "concerned actors". This stage aims at defining changes which meet two criteria (Checkland, 1981): they must be arguably systemically "desirable", as a result of the insight gained from selection of root definitions and conceptual model building; and they must also be culturally "feasible" given the characteristics of the situation, the people in it, their shared experiences, and their prejudices.

3.6.6 Stage 7.

Finally, stage 7 involves taking action based on stage 6, to improve the problem situation. A plan of action to improve the problem situation is one of the results of this research. This is discussed in chapter 4.

CHAPTER 4

RESULTS

4.1 INTRODUCTION.

This chapter presents the results of the research. The order of presentation is according to the methodology used. Thus, a first section describes the unstructured problem situation. This is followed by the "expressed" problem.

A third section describes the root definitions of relevant systems. Here, the CATWOE elements to each root definition are identified.

Then, a section on conceptual models describes the activities selected for each root definition at several levels of resolution. A consensus, "primary task" model is then developed and tested against Checkland's formal system concept and other systems thinking.

A section on the comparison of the conceptual model with the expressed problem situation presents the results obtained from the structured interviews with 36 RCBER. Here, statistical analysis was applied to

the responses so as to obtain a situational diagnosis, and to obtain a "debate". Such debate leads to identify the feasible, desirable changes proposed to the problem owner. Changes in structure, processes and attitudes are described.
Finally, a plan of action is proposed to overcome the existing problem situation. The results are illustrated with different figures, tables, and appendixes.

4.2 THE PROBLEM SITUATION, UNSTRUCTURED.

The initial, unstructured problem situation was expressed as follows:

Scientific and technical information, both national and international, exists in Mexico. Its presentation and dissemination is made through different forms and channels. Its use however, among the health community; and more important, the benefits derived from using it are not known.
At the institutional level, IMSS' RCBER are expected to use and produce information according to their education, research, or library related activities within their jurisdictions. Thus, while efforts are being placed on the institutional production of norms, instruction manuals, statistical data, and reports, etc., no knowledge exists in relation to the "value" of such information, as assigned by the RCBER

themselves, nor to the difficulties they face to access and use the information needed to support their activities.
Less clear is the impact of information on quality of health.

4.3 THE PROBLEM SITUATION: EXPRESSED.

The "expressed" problem situation was as follows:

Do IMSS' RCBER value scientific and technical information so as to use it as a resource to conduct their activities; increase their productivity; i.e., impact the structure level of health care?. Which are the factors affecting such information use?.
Figure 4-1 illustrates the resulting stages 1 and 2, when applying the methodology.

4.4 ROOT DEFINITIONS OF RELEVANT SYSTEMS.

The selected root definitions were the following:

1. The Education System.
2. The Research and Development System.
3. The Library System.
4. The Information System.

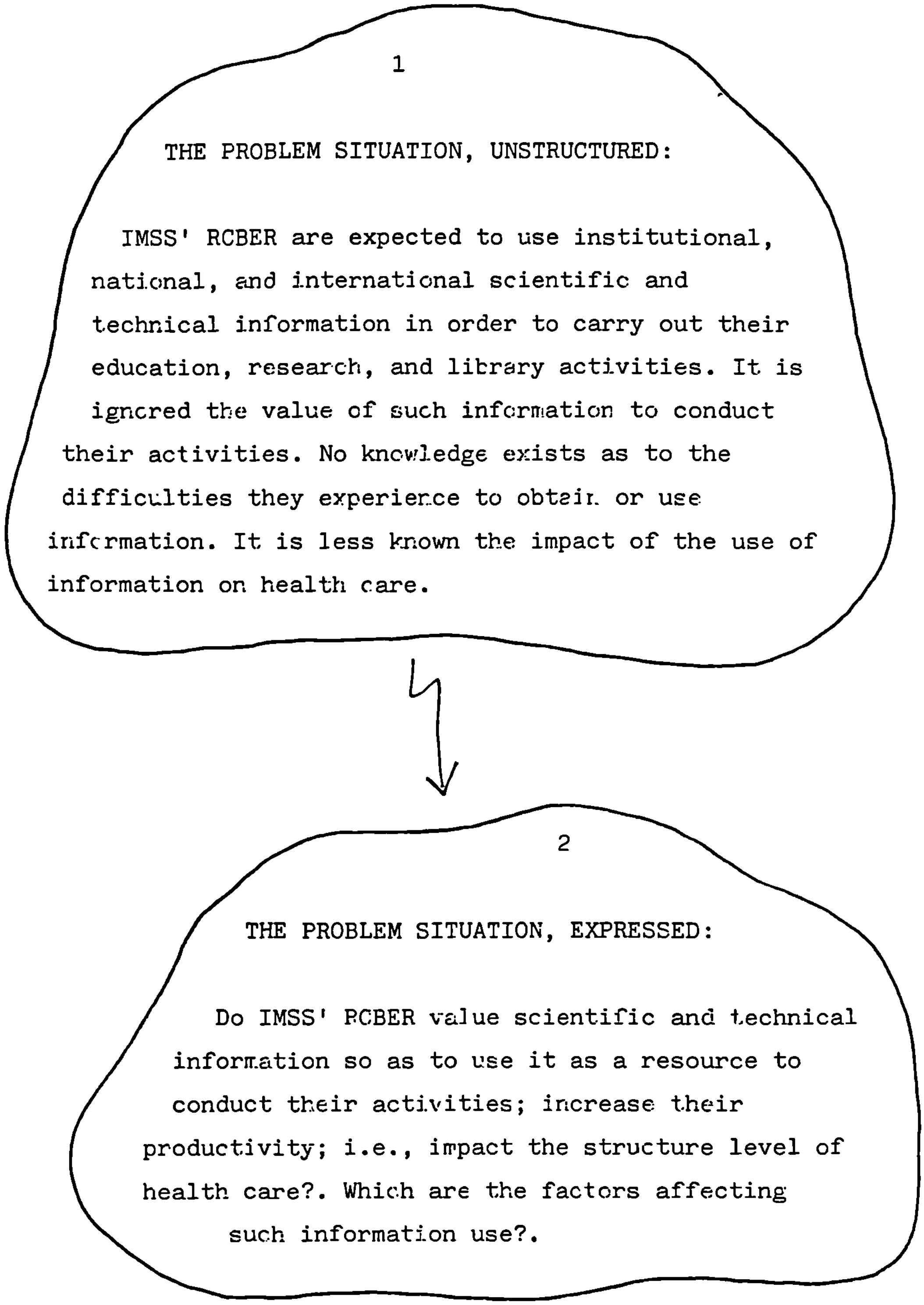

Figure 4-1. The unstructured and expressed problem situation.

4.4.1 The Education System.

This was defined as an IMSS owned system where RCBER use scientific and technical information in order to co-ordinate the planning, implementation, and evaluation of their activities on education within their jurisdiction. The CATWOE elements identified were the following:

(C) The end-users of the programmes; the students, both, medical and paramedical.

(A) The RCBER; the teachers.

(T) Co-ordination in one level of awareness or consciousness on the use of scientific and technical information for educational activities, to co-ordinators applying information resources as a tool in educational activities.

(W) Scientific and technical information can be used as a resource in the planning and implementation of educational activities.

(O) IMSS.

(E) The current structure of information services at IMSS; the availability of human, material, and financial resources. The structure of the courses at IMSS in general, and at each jurisdiction in particular. Other systems related to educational activities in the jurisdiction.

4.4.2 The Research and Development System.

This was defined as an IMSS owned system where RCBER use scientific and technical information in order to plan, implement, monitor, and evaluate their jurisdictional research programmes.
The CATWOE elements identified were as follows:

(C) The health workers, either institutional, national, or international. The affiliated population; the researchers.

(A) The RCBER; the researchers.

(T) Co-ordinators that rely on informal sources to plan research activities, to co-ordinators that use scientific and technical information to plan and implement research-for-development activities.

(W) Scientific and technical information can be used to plan and implement research activities.

(O) IMSS.

(E) The availability of information sources and resources. The availability of researchers within the jurisdictions.

The local policy structure and development to conduct research.
The attitudes of health workers towards research. The efficiency of library services within the jurisdictions.

4.4.3 The Library System.

This was defined as an IMSS owned system where RCBER use scientific and technical information in order to co-ordinate the planning, implementation, and supervision of library services within their jurisdiction.
The CATWOE elements identified were as follows:

(C) The librarians; the real and potential users.

(A) The RCBER; the heads of teaching units; the librarians.

(T) Co-ordinators without knowledge as to "how to" co-ordinate library services within a jurisdiction, to co-ordinators using scientific and technical information to plan and implement a library services programme.

(W) Scientific and technical information may be used to co-ordinate activities, plan, and implement library programmes.

(O) IMSS.

(E) The availability of human, material and financial resources. The integration of library committees in the jurisdictions; the existence of other libraries in the jurisdictions. The institutional policies to provide services, acquire materials, and retrieve information. The existing liaison between the librarians and heads of teaching units.

4.4.4 The Information System.

This was defined as an IMSS owned system where RCBER use data and information to monitor their education, research, and library programmes within their jurisdiction.
The CATWOE elements identified were the following:

(C) The RCBER; the directors of medical units; the head of the Education and Research Office in Mexico City.

(A) The RCBER. Heads of teaching units in hospitals; the researchers, the librarians.

(T) Co-ordinators informally collecting data and information derived from their activities, to co-ordinators systematically collecting and analysing data and information derived from their activities, to make decisions about the planning and implementation of their programmes.

(W) Data and information may be used to monitor and control the development of education, research, and library activities.

(O) IMSS.

(E) The institutional policies to monitor activities. The available indicators to measure performance and productivity. Other related information systems, such as the IMSS' health services demands.

Figure 4-2 illustrates the root definitions of the above mentioned relevant systems, at stage 3 of the methodology.

4.5 CONCEPTUAL MODELS.

4.5.1 First level of resolution.

The activities selected for each root definition at a first level of resolution were the following:

Root Definition No. 1. The Education System (Figure 4-3):

Activity No. 1. Identify the staff' needs on training

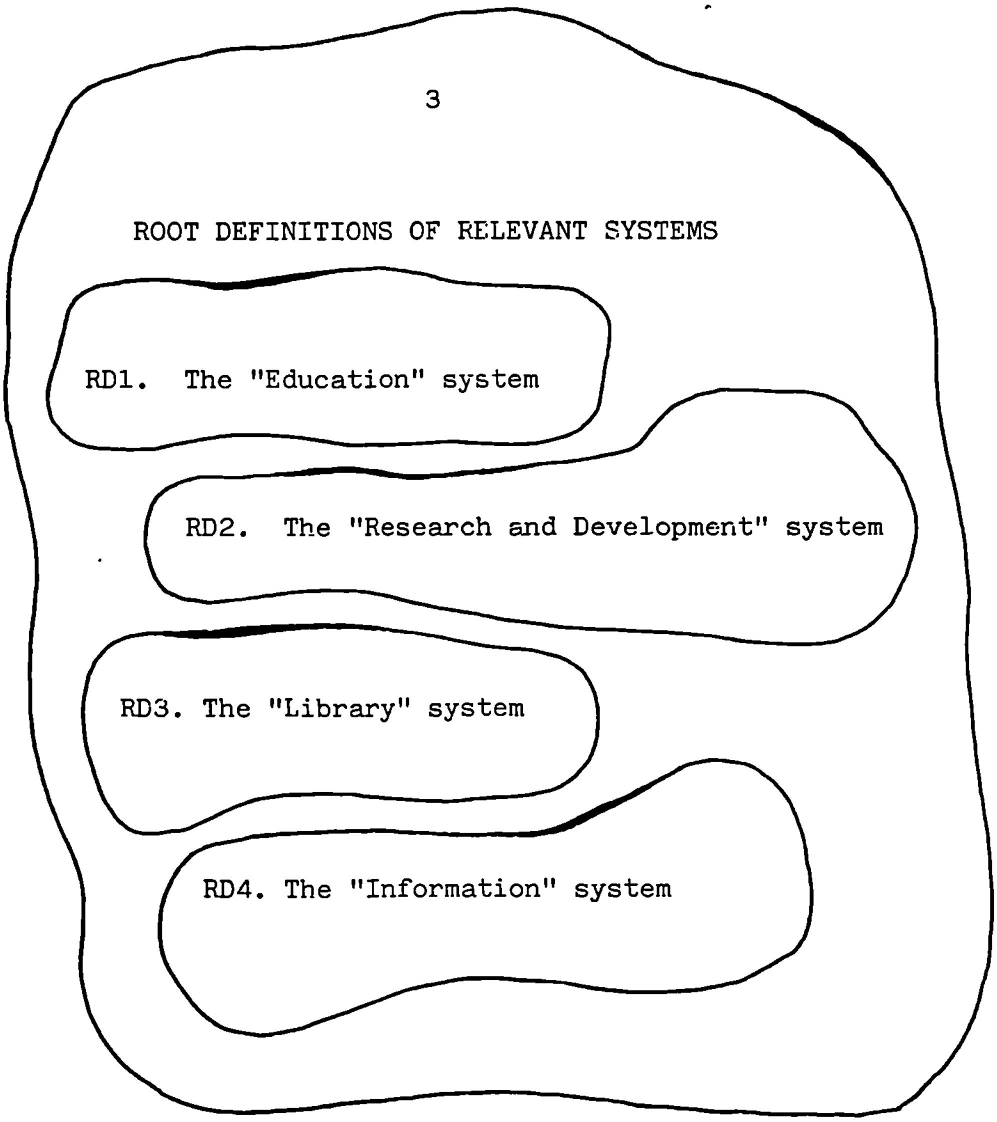

Figure 4-2. Root definitions of relevant systems.

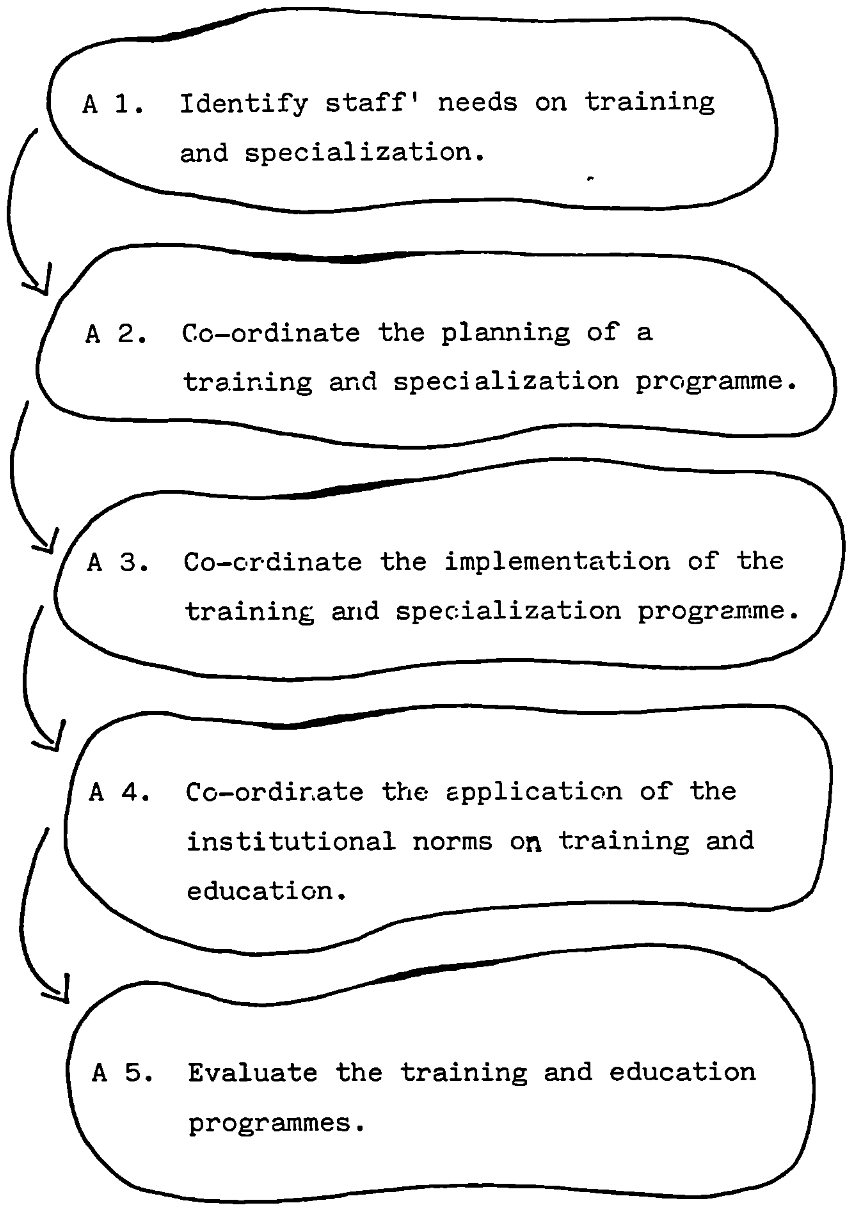

Figure 4-3. The "Education" system model at first level of resolution.

and specialization.

Activity No. 2. Co-ordinate the planning of a training and specialization programme.

Activity No. 3. Co-ordinate the implementation of the training and specialization programme.

Activity No. 4. Co-ordinate the application of the institutional norms on training and education.

Activity No. 5. Evaluate the training and education programmes.

Root Definition No. 2. The Research and Development System (Figure 4-4):

Activity No. 1. Identify local research needs within the jurisdiction.

Activity No. 2. Plan and promote a jurisdictional research programme.

Activity No. 3. Co-ordinate the implementation of the research programme.

Activity No. 4. Monitor the application of IMSS' research norms.

Activity No. 5. Evaluate the results of the research programme in the jurisdiction.

Root Definition No. 3. The Library System (Figure 4-5):

Activity No. 1. Co-ordinate the planning and design of library services in the jurisdiction.

Activity No. 2. Monitor the application of the IMSS' norms and procedures on library services.

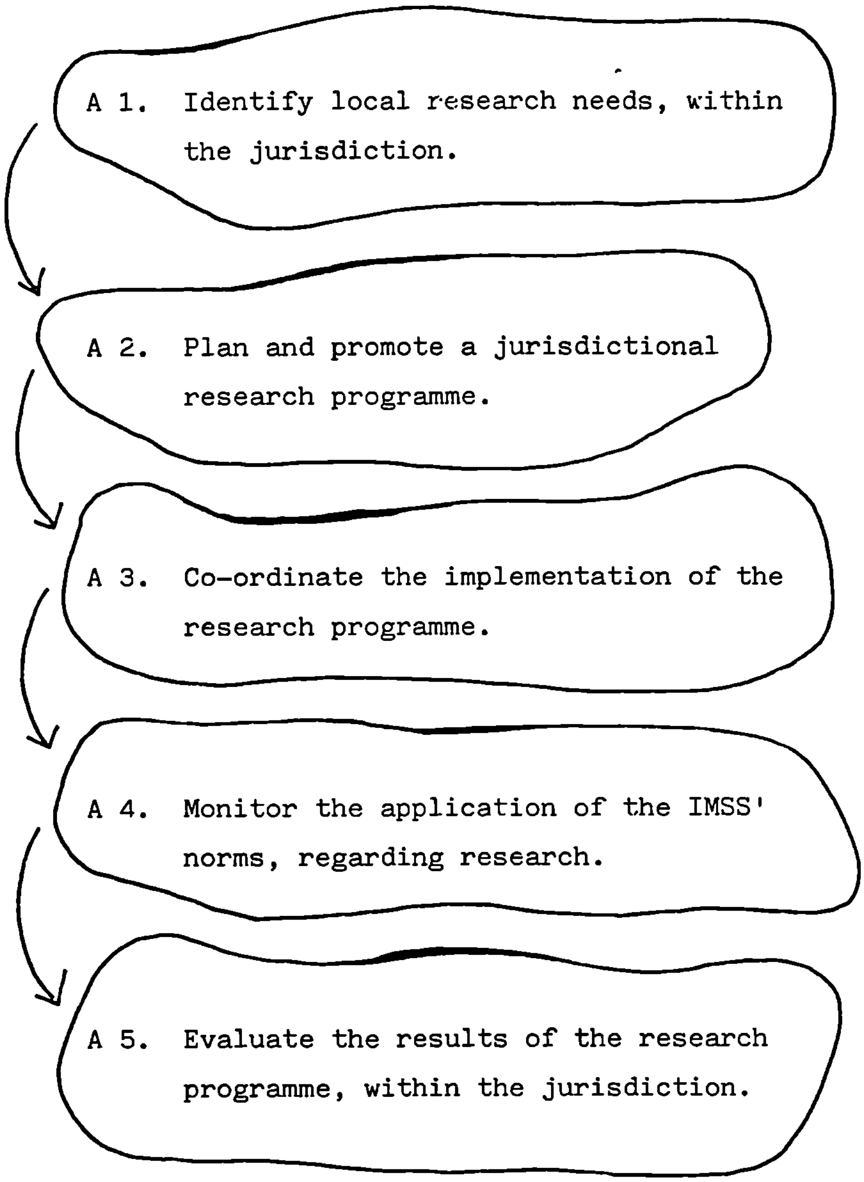

Figure 4-4. The "Research and Development" system model at first level of resolution.

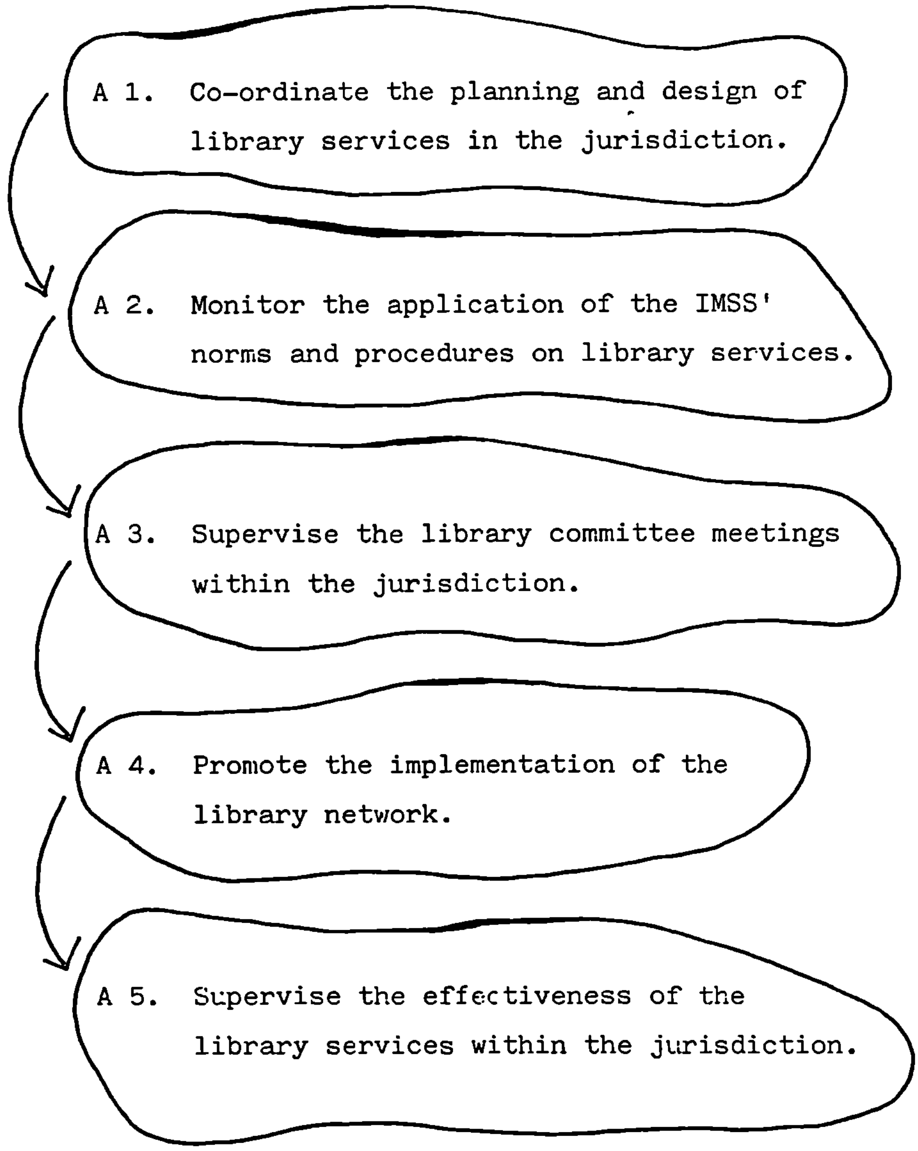

Figure 4-5. The "Library" system model at first level of resolution.

Activity No. 3. Supervise the library committee meetings within the jurisdiction.
Activity No. 4. Promote the implementation of the library network.
Activity No. 5. Supervise the effectiveness of the library services within the jurisdiction.

Root Definition No. 4. The Information System (Figure 4-6):

Activity No. 1. Co-ordinate the setting-up of a registry on education, research, and library activities.
Activity No. 2. Co-ordinate the collection of information derived from the education, research, and library programmes.
Activity No. 3. Analyse and process the collected information.
Activity No. 4. Co-ordinate the exchange and dissemination of information.
Activity No. 5. Assess programmes; detect new needs, and elaborate future plans.

4.5.2 Second level of resolution.

A higher level of resolution was applied to each root definition; i.e., to each activity within a root definition. Since the emerging activities derived from the first level of resolution, a definition for each subsequent root was omitted. The models obtained after a process of iteration are illustrated in Figures 4-7,

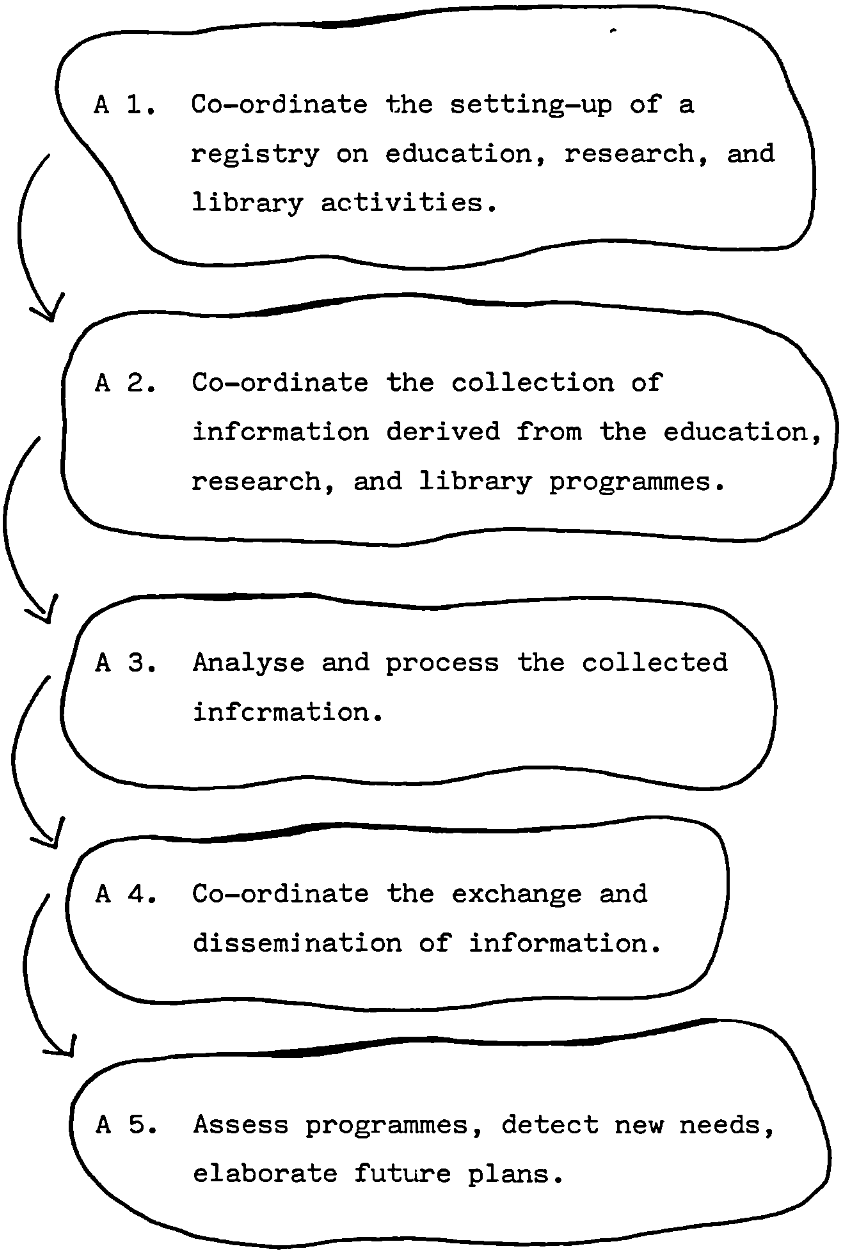

Figure 4-6. The "Information" system model at first level of resolution.

4-8, 4-9, and 4-10, for each root definition, accordingly. This analysis provided four conceptual models, one for each root definition at higher levels of resolution, as illustrated in Figure 4-11.

4.5.3 The consensus model.

A total of nine activities were initially selected from the four conceptual models; however, after reiteration, only six activities were found to be "indispensable" to make the model coherent. They were either found at different levels of resolution or named under different terms in the previous models. Figure 4-12 illustrates the consensus, "primary task" model developed. This was defined as an "education, research, library, and information system based on the co-ordination of these activities by the IMSS' RCBER, at each jurisdiction; and where scientific and technical information is used as a resource to perform the activities".

4.5.3.1 Validation of the Consensus Model.

The consensus, "primary task" model was tested against Checkland's (1981) formal system concept as follows:

(A). Objective/Mission/Purpose:
To use information as a resource to perform the co-ordination activities on education, research, libraries, and information, at the structure level of

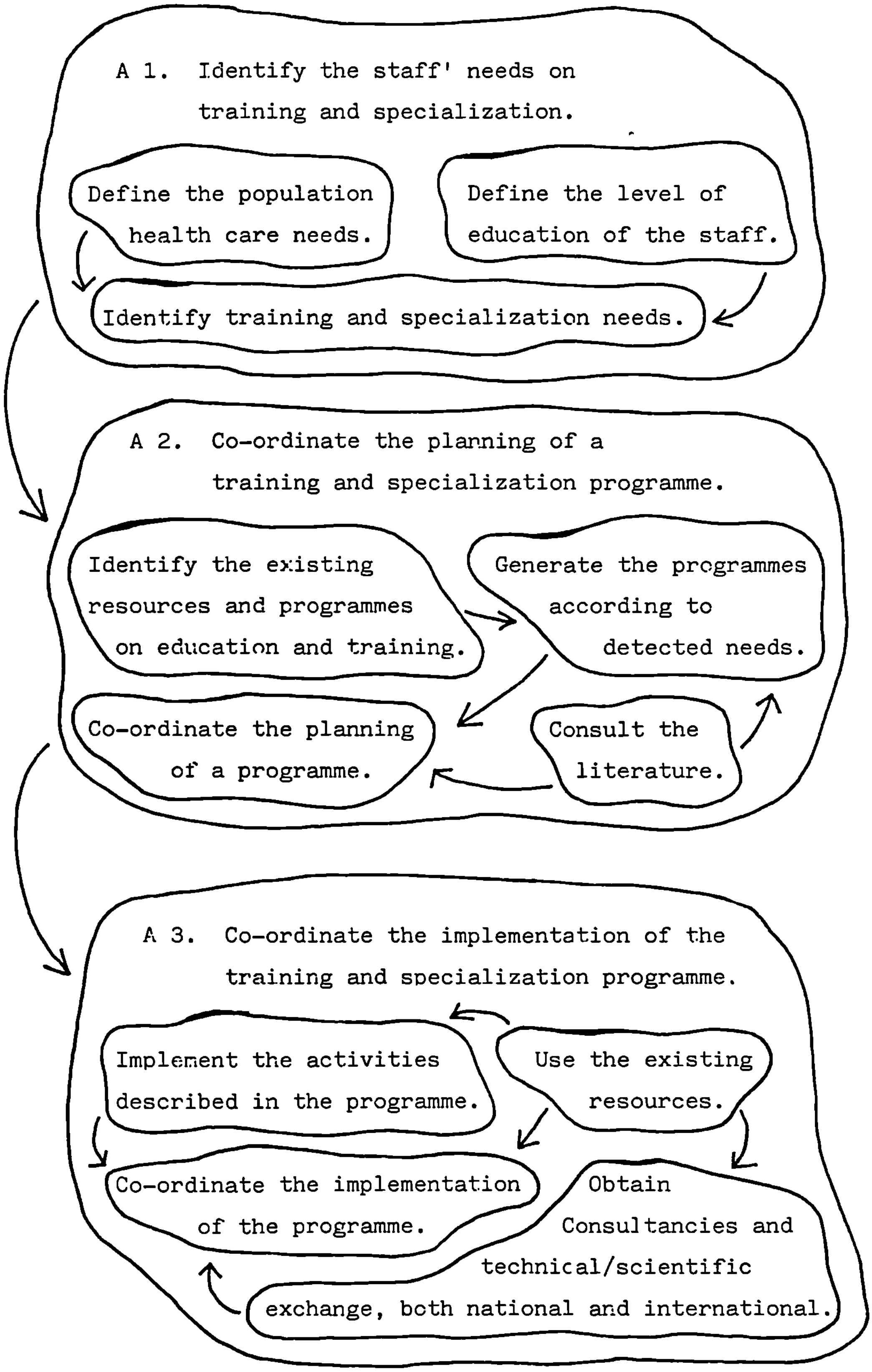

Figure 4-7. The "Education" system model at second level of resolution.

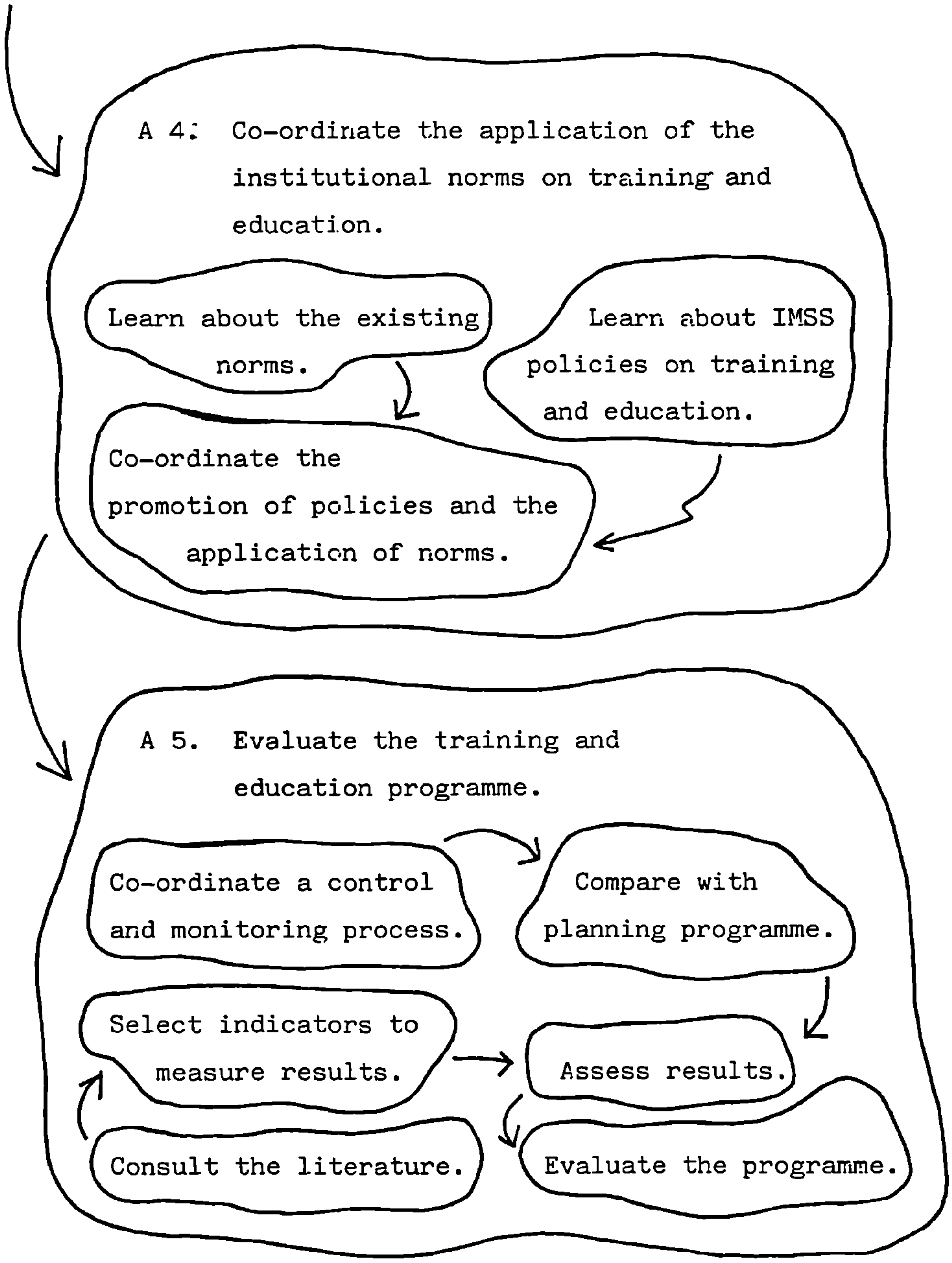

Figure 4-7 (cont.) The "Education" system model at second level of resolution.

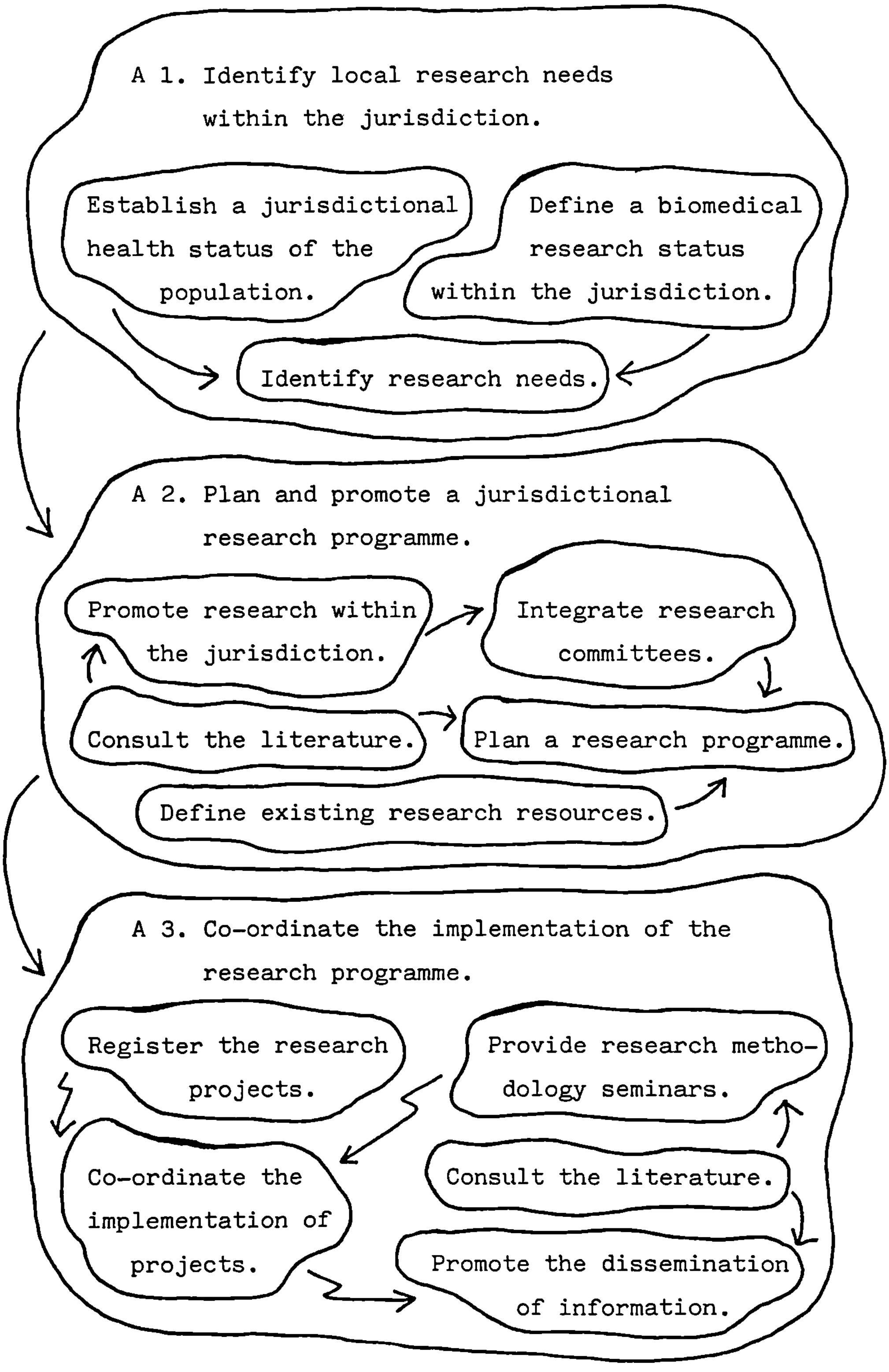

Figure 4-8. The "Research and development" system model at second level of resolution.

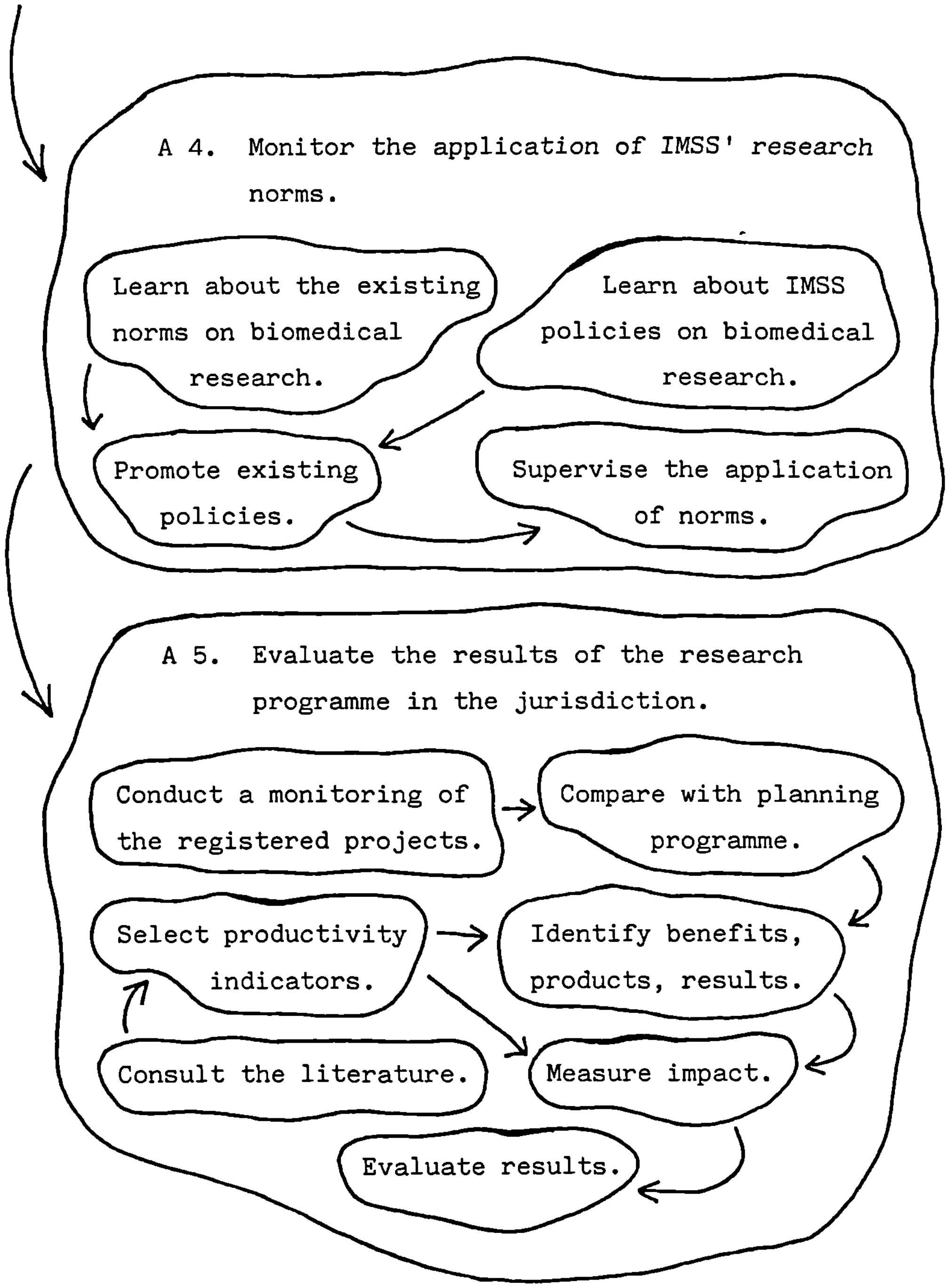

Figure 4-8 (cont.) The "Research and development" system model at second level of resolution.

Figure 4-9. The "Library" system model at second level of resolution.

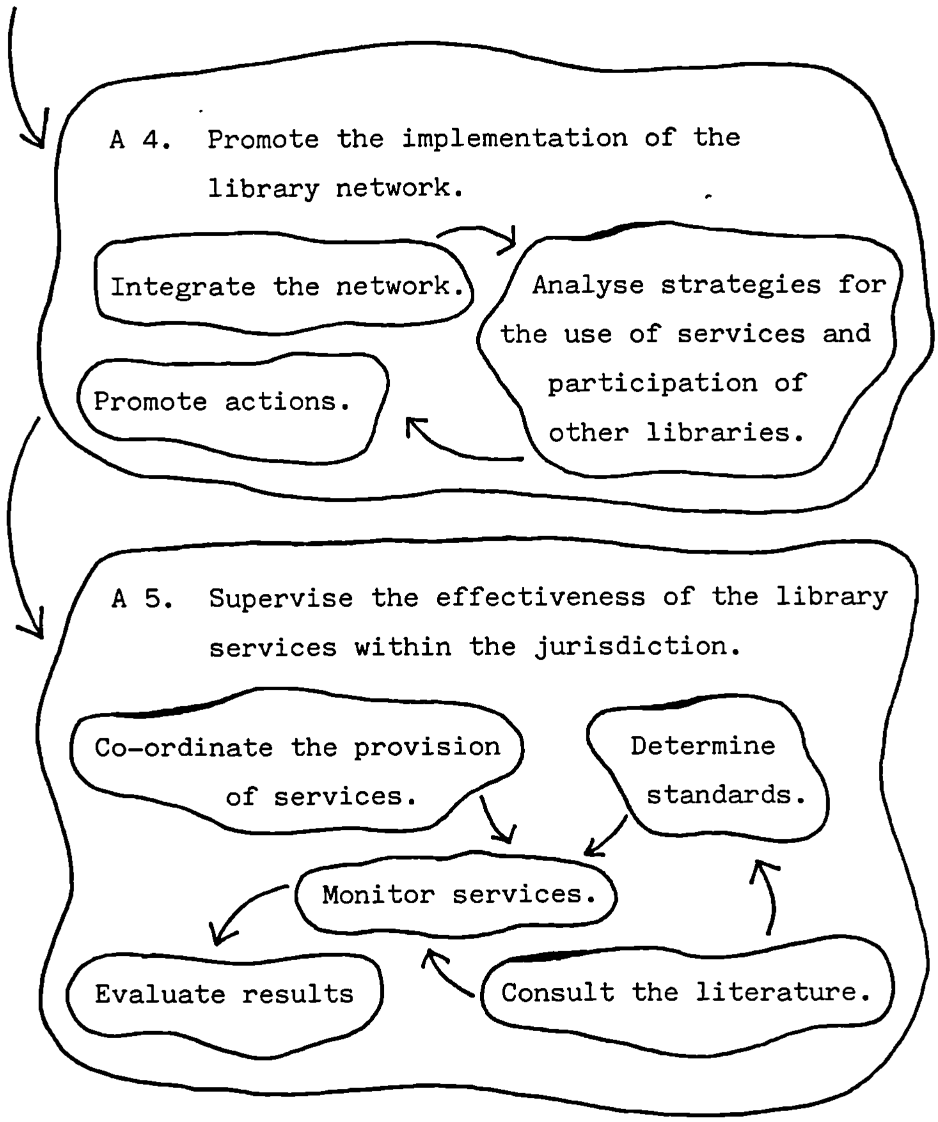

Figure 4-9 (cont.) The "Library" system model at second level of resolution.

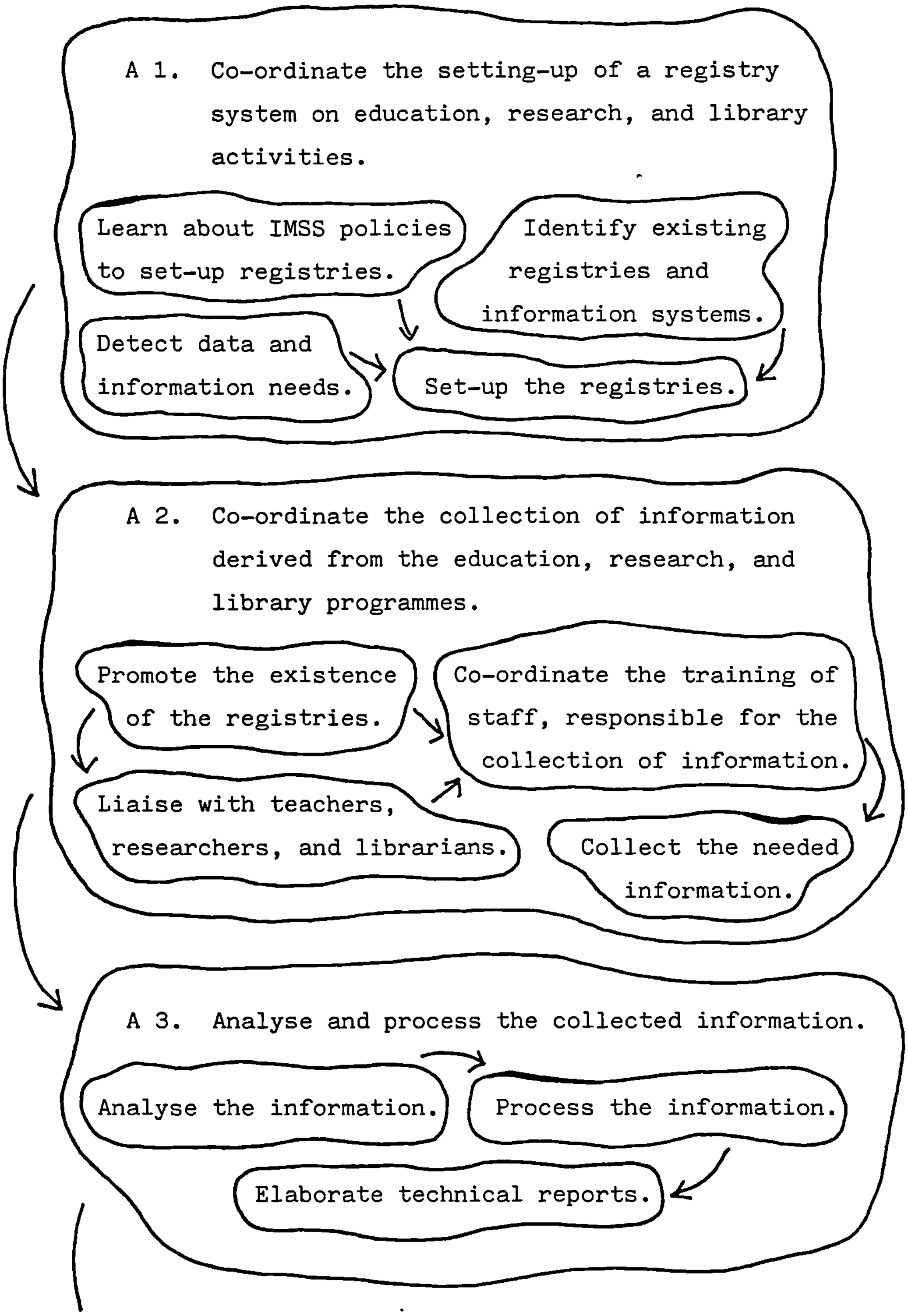

Figure 4-10. The "Information" system model at second level of resolution.

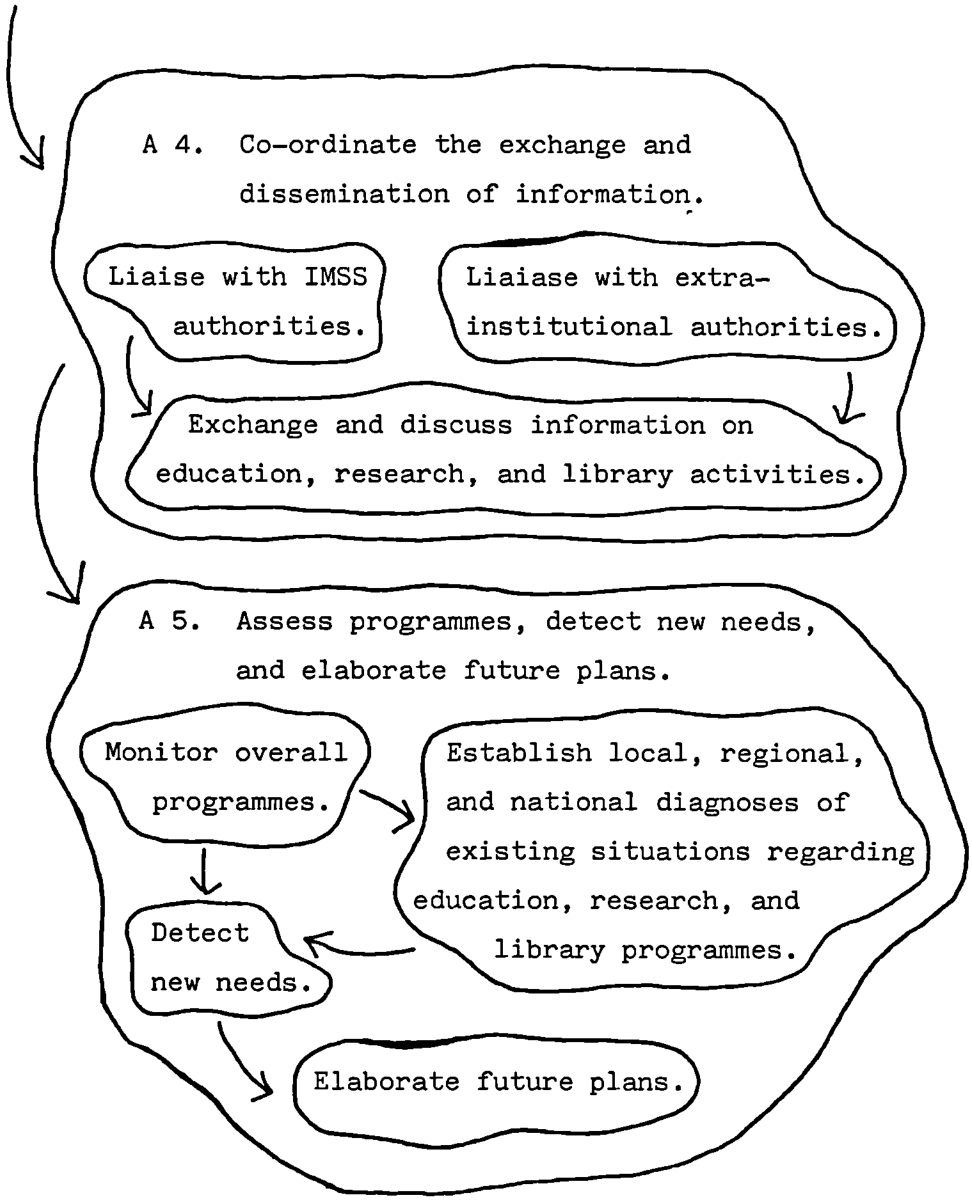

Figure 4-10 (cont.). The "Information" system model at second level of resolution.

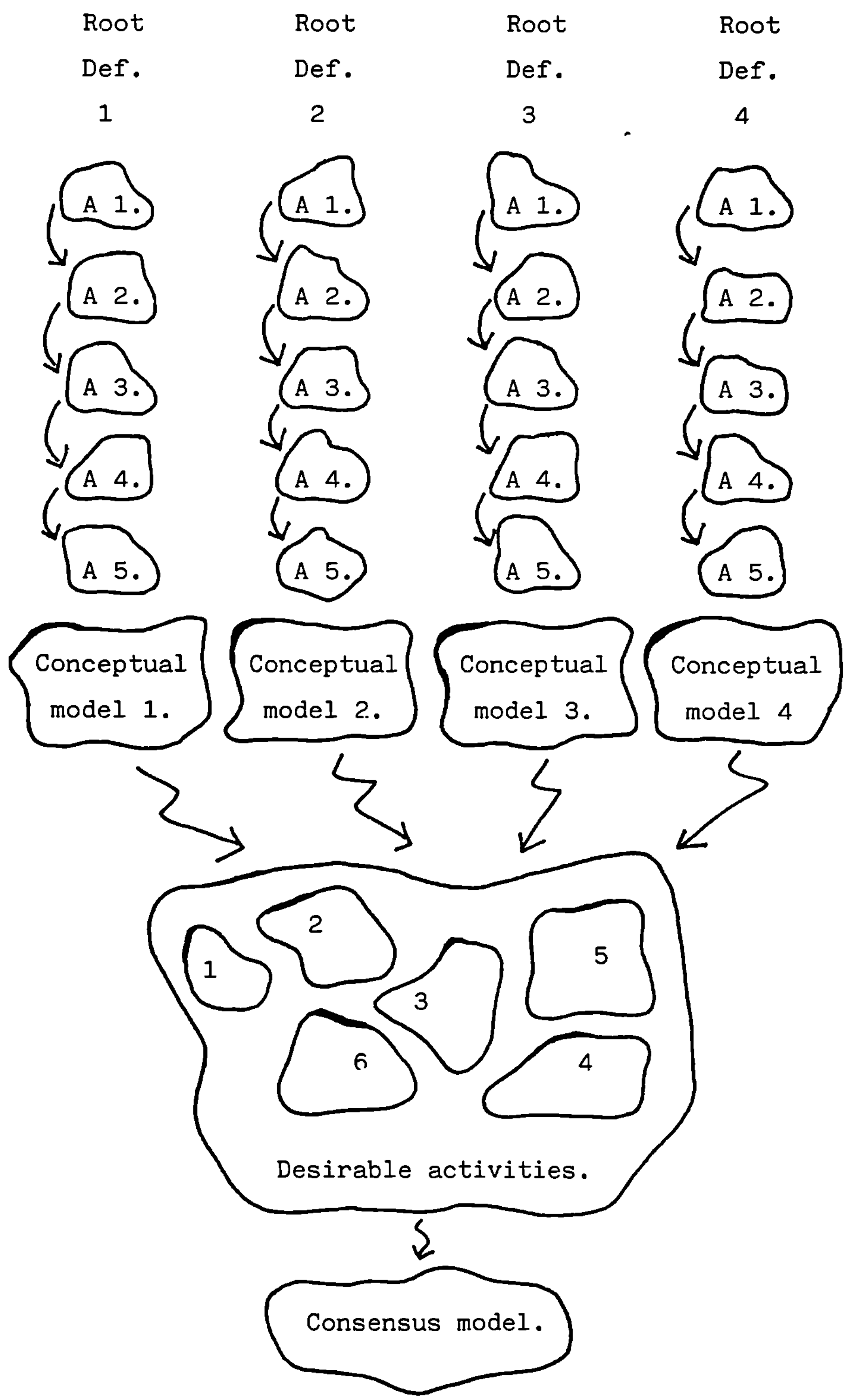

Figure 4-11. Development of the consensus model.

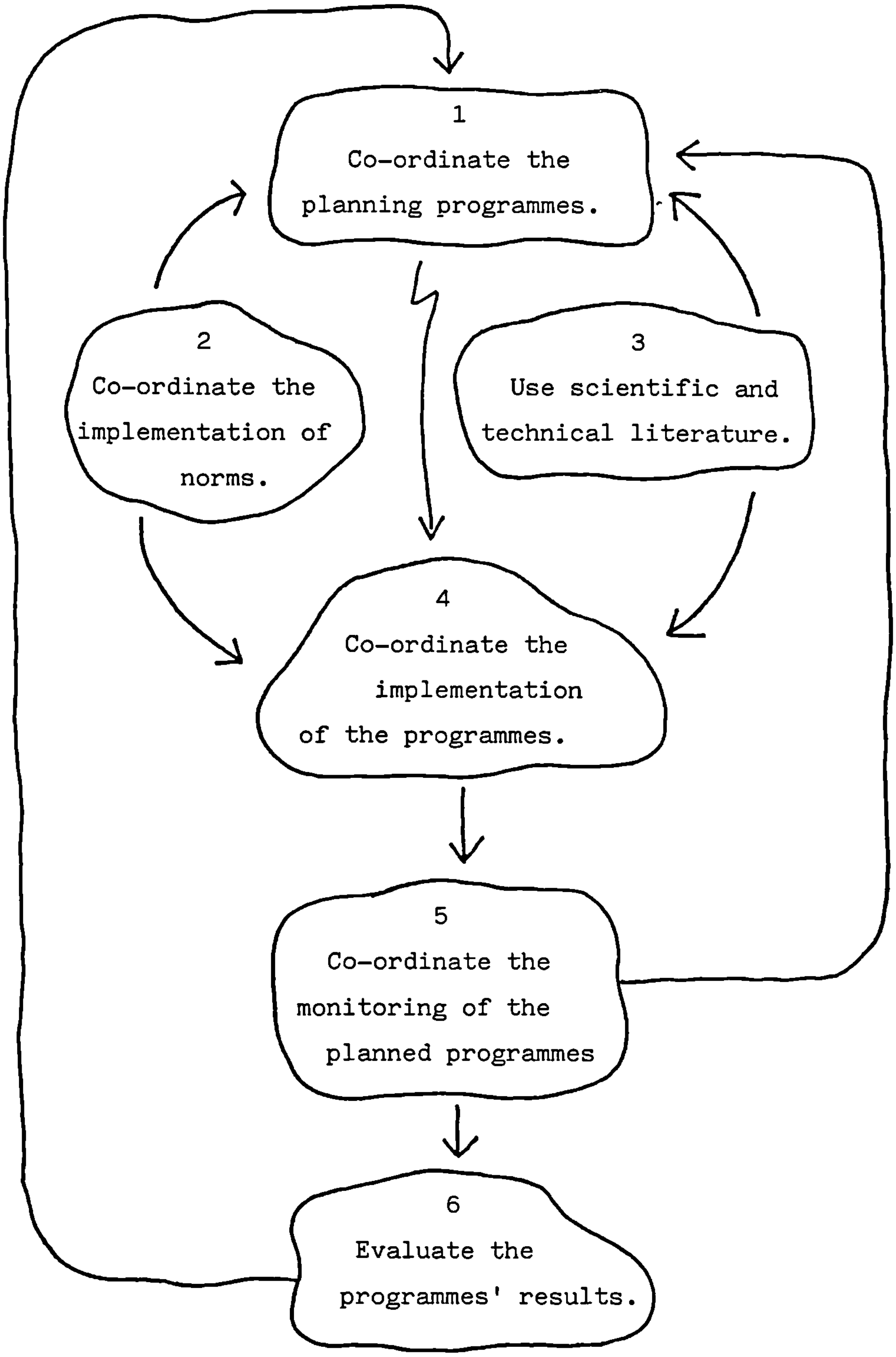

Figure 4-12. The consensus, "primary task" model.

health care thus improving the process and outcome of health care.

(B). Measure of performance:
Monitor and impact activities; productivity; information.

(C). Sub-components which interact:
The identification of needs are used to plan programmes. The identification of resources are used to generate programmes and implement plans. Learning about the existing norms is useful to co-ordinate their promotion and develop registries. Consulting the literature is useful to plan, implement, and evaluate the programmes.

(D). Wider system or environment with which it interacts:
The National Health System. The National System on Education. The Science and Technology System. The Ministry of Health (SSA). ISSSTE. DIF. The National Council for Science and Technology. Public and State Universities. Professional Associations.

(E). Resources:
Money, staff, equipment. libraries, books, scientific journals, space, time, information.

(F). A decision-taker and a decision-taking process:
Those performing the programmes on education, research, libraries, and information; and those operating the programmes and conducting the

activities.

(G). Guarantee of stability/continuity:
Permanence of willingness to improve the quality of health care.

Validation was also made against other systems thinking. Relevant models of health care systems were those reported by DeGeynd (1970); Starfield (1973); Gilchrist (1985); Donabedian (1988); and Frenk and Pena (1988).
It was particularly useful the validation obtained when tested against the models reported by the Economic and Social Commission for Asia and the Pacific (ESCAP, 1983); Cedillo, et al (1984); and Cordera (1986). Figures 4-13, 4-14, and 4-15, illustrate these latter models.

4.5.3.2 Information inputs and outputs.

Following Wilson's (1984) approach to information requirements analysis, after the consensus model was developed, information inputs and outputs were identified from the activities in the model. Wilson's Maltese Cross was used as a tool, as explained in chapter 3.
Appendix 3 describes the activities in the model, the input requirements, and the information products or outputs.

A	B		C
INPUT →	PROCESS	→	OUTCOME
Human resources	STRUCTURAL	FUNCTIONAL	Health programmes
Physical resources	Action	Support	Health activities
Equipment	Central level	Planning	Healthy population
Financial Resources	Zones	Supplies	Actions
Information:	Areas	Communica-tions.	Improvement in the health status of the population.
Statistical	Hospitals	Construct.	↑
Administrative	Health centres	etc.	Attitudes of the population. Income, agriculture, etc.
Scientific	etc.		
Politic			
Behavioural			

Figure 4-13. Health services model, after ESCAP (1983).

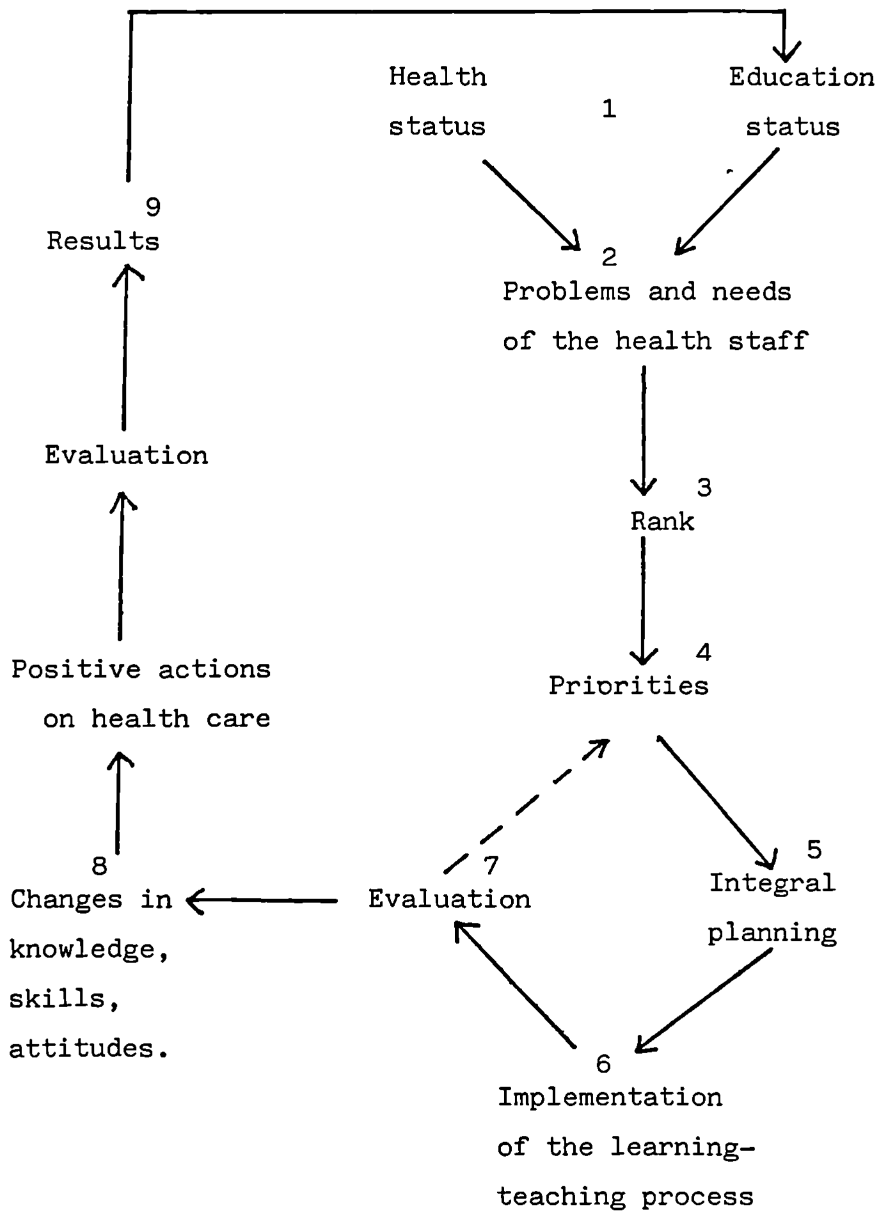

Figure 4-14. The learning - teaching process in relation to medical practice (Cedillo, et al., 1984).

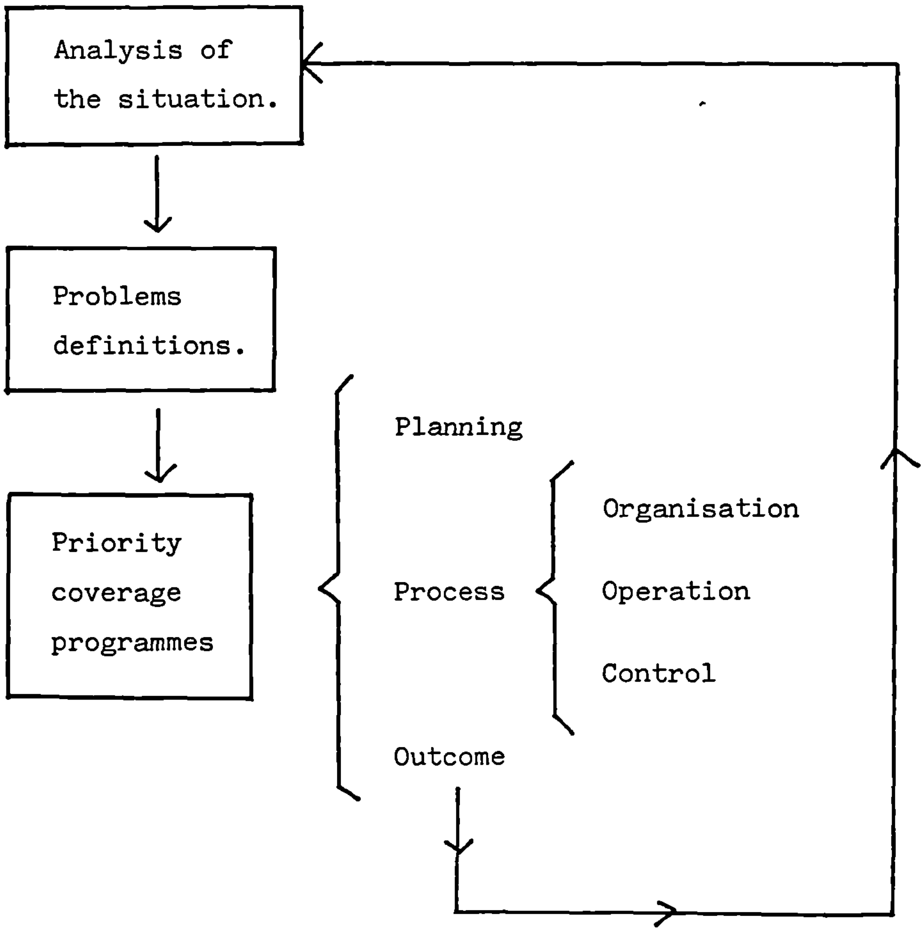

Figure 4-15. The health system model, as proposed by Cordera (1986).

4.6 COMPARISON OF THE CONCEPTUAL MODEL WITH THE EXPRESSED PROBLEM SITUATION.

The results obtained at the comparison stage were as follows (percentages rounded, except when stated otherwise):

4.6.1 Agreement on activities performed.

All, 36 RCBER agreed that their activities conform a system model integrated by:

(a) the training and continuing education of medical and paramedical staff;

(b) research;

(c) library services; and

(d) information organisation and management of (a), (b), and (c).

The reasons provided for such agreement are described in Table 4-1.

4.6.2 Importance of scientific and technical information.

While 100% of RCBER regarded scientific and technical information as important to perform their activities, 17 (47%) interviewed made a highly positive emphasis on this matter. Table 4-2 describes the type of answers provided.

REASONS	No.	%
Coherent with real activities/ structure	17	47
Good control/organisation	12	33
Coherent with systems theory	6	17
Coherent with the "health care system".	1	3
TOTAL	36	100

Table 4-1. Reasons for agreeing on a system model integrated by activities related to (a) training, continuing education of medical and paramedical staff; (b) research; (c) library services; and (d) information organisation and management of (a), (b), and (c).

ANSWERS	No.	%
YES (with highly positive emphasis)	17	47
YES (explaining the answer)	11	31
YES (No further explanation)	8	22
TOTAL	36	100

Table 4-2. Type of answers provided to the question: Do you regard it as important to have access and to use scientific and technical information in order to perform the activities in the model?.

4.6.3 Agreement on the consensus model.

Regarding the conceptual, "primary task" model, 100% of RCBER agreed with the model. However, 9 (25%) stated that they do not follow it completely in practice.

Table 4-3 summarizes the type of answers provided.

4.6.4 Activity No. 1.

In order to carry out activity No. 1 in the consensus model (to co-ordinate the planning programme of research and education within the jurisdiction), only 3 (8%) RCBER reported no barriers or difficulties to obtain or use the information needed.

The remaining 33 (92%) reported 157 barriers, which were summarized as follows:

(a). 44 (28%) belonged to "personal factors" (category A, in the questionnaire).

(b). 54 (34%) classified under the "information source factors" (category B, in the questionnaire); and

(c). 59 (38%) belonged to "environmental factors" (category C, in the questionnaire).

The main "personal" barrier reported was "lack of time to be spent on searching for information" (factor No. 5, in this category).

The main "information source" barrier reported was

ANSWERS	No.	%
YES (explaining the answer)	16	44
YES (although in practice, it is not completely followed)	9	25
YES (no further explanation)	5	14
YES (although lacking a model of their own)	5	14
YES (although the model lacks some activities)	1	3
TOTAL	36	100

Table 4-3. Type of answers regarding the agreement/disagreement of the consensus, "primary task" model.

"accessibility" (factor No. 2, in this category).
The main "environmental" barrier reported was "lack of a communication channel between the information source and the user" (factor No. 1, in this category).

While personal, source, or environmental factors were reported individually, they were more likely to be reported in combination. Indeed, 21 (58%) RCBER reported the simultaneous appearance of factors corresponding to categories A, B, and C. Thus, most of the RCBER (83%) reported more than one barrier to carry out Activity No. 1., in the model.
Finally, 34 (94%) RCBER reported to have a product derived from carrying out Activity No.1; They had a "plan", describing the co-ordination programmes for education, research, libraries, and information, within their jurisdictions. 2(6%) did not have such plan.
Tables 4-4, 4-5, and 4-6, summarize the results concerning Activity No. 1 of the consensus model.

4.6.5 Activity No. 2.

To carry out Activity No. 2 in the consensus model (to co-ordinate the implementation of IMSS norms, as related to education, research, and libraries), only 5 (14%) RCBER did not report any barriers or difficulties to obtain or use the information needed. The rest 31 (86%) RCBER reported 125 barriers, difficulties, or problems, which were summarized as

FACTORS (*) (problems, barriers, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1	12	27	9	17	21	36
2	4	9	12	22	5	8
3	5	12	2	4	1	2
4	3	7	5	9	6	10
5	19	43	9	17	4	7
6	1	2	5	9	16	27
7			4	7	6	10
8			8	15		
TOTAL	44	100	54	100	59	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-4. Barriers reported to affect information use at Activity No. 1 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	3	0
1	3	3
2	3	6
3	4	12
4	6	24
5	5	25
6	3	18
7	4	28
8	4	32
9	1	9
TOTAL	36	157

Table 4-5. Total barriers per No. of RCBER at Activity No. 1 of the consensus model.

CATEGORIES	No. of RCBER	%
A	2	6
B	1	3
C	1	3
AB	0	0
AC	4	11
BC	4	11
ABC	21	58
none	3	8

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-6. Independent and combined categories of barriers, as reported by RCBER at Activity No. 1 of the consensus model.

follows:

(a) 37 (30%) belonged to "personal factors" (category A, in the questionnaire).

(b) 45 (36%) classified under the "information source factors" (category B, in the questionnaire); and

(c) 43 (34%) belonged to "environmental factors" (category C, in the questionnaire).

The main "personal" barrier reported was "awareness of the existence of the source" (factor No. 2 in the category).
The main "information source" barrier was the "existence of the source" (factor No. 1 in this category).
The main "environmental" barrier was "lack of a communication channel between the information source and the user" (factor No. 1 in this category).
15 (42%) RCBER reported barriers from categories A, B, and C, simultaneously; and most of the RCBER (81%) reported more than one barrier to carry out Activity No. 2 of the model.
Finally, while 29 (81%) RCBER do co-ordinate the implementation of IMSS' norms on education, research, and libraries (product derived from carrying out Activity No. 2), 13 (36%) reported to have problems (other than information-related) in performing this activity. 7 (19%) do not co-ordinate the

implementation of norms.

Tables 4-7, 4-8, and 4-9 summarize the results related to Activity No. 2 of the consensus model.

4.6.6 Activity No. 3.

To carry out Activity No. 3 of the consensus model (to use scientific and technical information), only 2 (6%) RCBER did not report any barriers, problems, or difficulties to obtain or use information.

On the other hand, 34 (94%) RCBER reported 164 barriers, which were summarized as follows:

(a) 43 (26%) belonged to "personal" factors (category A, in the questionnaire).

(b) 70 (43%) classified under the "information source" factors (category B, in the questionnaire); and

(c) 51 (31%) belonged to "environmental" factors (category C, in the questionnaire).

The main "personal" barrier reported was "lack of time to be spent on searching for information" (factor No. 5 in category A).

The main "information source" barrier reported was "accessibility" (factor No. 2 in category B).

The main "environmental" barrier reported was "lack of a communication channel between the information source and the user" (factor No. 1 in category C).

FACTORS (*) (problems, barriers, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1.	6	16	14	31	14	32
2	10	27	13	29	2	5
3	8	22	7	16	3	7
4	5	13	0	0	7	16
5	7	19	3	7	3	7
6	1	3	6	13	11	26
7			0	0	3	7
8			2	4		
TOTAL	37	100	45	100	43	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-7. Barriers reported to affect information use at Activity No. 2 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	5	0
1	2	2
2	7	14
3	4	12
4	6	24
5	5	25
6	3	18
7	2	14
8	2	16
TOTAL	36	125

Table 4-8. Total barriers per No. of RCBER at Activity No. 2 of the consensus model.

CATEGORIES	No. of RCBER	%
A	0	0
B	3	8
C	2	6
AB	2	6
AC	2	6
BC	7	19
ABC	15	42
none	5	14

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-9. Independent and combined categories of barriers, as reported by RCBER at Activity No. 2 of the consensus model.

Most of the RCBER reported combined barriers to categories B and C (28%), and A, B, and C (50%). Thus, most RCBER (86%) reported more than one barrier to carry out Activity No. 3 of the model.

15 (42%) RCBER do not have a product derived from Activity No. 3 (inventory of resources, directories, catalogues, research registries, etc.). On the other hand, while 21 (58%) do have a product, 8 (22%) reported problems to obtain it.

Tables 4-10, 4-11, and 4-12, summarize the results concerning Activity No. 3 of the consenus model.

4.6.7 Activity No. 4.

To carry out Activity No. 4 of the consensus model (to co-ordinate the implementation of the education, research, and library programmes), only 5 (14%) RCBER did not report any barriers to obtain or use information.

31 (86%) reported 122 barriers, which were summarized as follows:

(a) 36 (30%) belonged to "personal" factors (category A in the questionnaire).

(b) 49 (40%) belonged to "information source" factors (category B in the questionnaire); and

(c) 37 (30%) belonged to "environmental" factors (category C in the questionnaire).

The main "personal" barrier was "awareness of the

FACTORS (*) (problems, barriers, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1	8	19	17	24	19	37
2	6	14	20	29	4	8
3	9	21	7	10	0	0
4	4	9	4	6	5	10
5	14	32	3	4	3	6
6	2	5	8	11	14	27
7			4	6	6	12
8			7	10		
TOTAL	43	100	70	100	51	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-10. Barriers reported to affect information use at Activity No. 3 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	2	0
1	3	3
2	3	6
3	7	21
4	5	20
5	6	30
6	4	24
7	1	7
8	2	16
10	1	10
12	1	12
15	1	15
TOTAL	36	164

Table 4-11. Total barriers per No. of RCBER at Activity No. 3 of the consensus model.

CATEGORIES	No. of RCBER	%
A	0	0
B	4	11
C	0	0
AB	1	3
AC	1	3
BC	10	28
ABC	18	50
none	2	6

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-12. Independent and combined categories of barriers, as reported by RCBER at Activity No. 3 of the consensus model.

existence of the source" (factor No. 2 in category A).
The main "information source" barrier was "accessibility" (factor No. 2 in category B).
The main "environmental" barrier was "lack of a communication channel between the information source and the user" (factor No. 1 in category C).

Most of the RCBER reported combined barriers to Categories B and C (17%), and A, B, and C (36%). Thus, most of the RCBER (64%) reported more than one barrier to carry out Activity No. 4 in the model.
Only one (3%) RCBER did not have a product derived from this cativity. On the other hand, while 35 (97%) RCBER reported several products to this activity, 15 (42%) reported problems to obtain them.
Tables 4-13, 4-14, and 4-15, summarize the results concerning Activity No. 4 of the consensus model.

4.6.8 Activity No. 5.

To carry out Activity No. 5 of the consensus model (to co-ordinate a monitoring of the planned programmes), only 3 (8%) RCBER did not report any barriers to obtain or use information.
On the other hand, 33 (92%) RCBER reported 110 barriers, which were summarized as follows:

(a) 23 (21%) belonged to "personal" factors (category A in the questionnaire).

(b) 32 (29%) belonged to "information source"

FACTORS (*) (problems, barriers, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1	7	19	10	21	12	33
2	9	25	12	25	3	8
3	7	19	6	12	2	5
4	6	17	4	8	6	16
5	7	19	5	10	4	11
6	0	0	8	16	7	19
7			0	0	3	8
8			4	8		
TOTAL	36	100	49	100	37	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-13. Barriers reported to affect information use at Activity No. 4 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	5	0
1	8	8
2	1	2
3	10	30
4	3	12
5	3	15
6	1	6
7	1	7
9	3	27
15	1	15
TOTAL	36	122

Table 4-14. Total barriers per No. of RCBER at Activity No. 4 of the consensus model.

CATEGORIES	No. of RCBER	%
A	1	3
B	5	14
C	4	11
AB	1	3
AC	1	3
BC	6	17
ABC	13	36
none	5	14

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-15. Independent and combined categories of barriers, as reported by RCBER at Activity No. 4 of the consensus model.

factors (category B in the questionnaire); and

(c) 55 (50%) belonged to "environmental" factors (category C in the questionnaire).

The main "personal" barrier reported was "lack of time to be spent on searching for information" (factor No. 5 in this category).
The main "information source" barrier reported was "organisation" (factor No. 6 in this category).
The main "environmental" barrier reported was "bureaucracy" (factor No. 6 in this category).

Most of the barriers corresponded either to Category C (25%); or to the combination of categories B,C (19%) and A, B, C (31%).
26 (72%) RCBER reported more than one barrier to carry out Activity No. 5 of the model.
33 (92%) RCBER reported to have a product derived from this activity. 8 (22%) however, reported problems to obtain such products. Only 3 (8%) RCBER stated to have no products derived from Activity No. 5.
Tables 4-16, 4-17, and 4-18, summarize the results concerning Activity No. 5 of the consensus model.

4.6.9 Activity No. 6.

To carry out Activity No. 6 of the consensus model (to evaluate the programmes' results), only 5 (14%) RCBER did not report any barriers to obtain or use information.

FACTORS (*) (barriers, problems, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1	4	17	3	9	8	15
2	2	9	5	16	7	13
3	2	9	4	13	4	7
4	4	17	2	6	9	16
5	11	48	7	22	5	9
6	0	0	8	25	13	24
7			1	3	9	16
8			2	6		
TOTAL	23	100	32	100	55	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-16. Barriers reported to affect information use at Activity No. 5 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	3	0
1	7	7
2	7	14
3	7	21
4	5	20
5	3	15
6	3	18
15	1	15
TOTAL	36	110

Table 4-17. Total barriers per No. of RCBER at Activity No. 5 of the consensus model.

CATEGORIES	No. of RCBER	%
A	0	0
B	1	3
C	9	25
AB	2	6
AC	3	8
BC	7	19
ABC	11	31
none	3	8

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-18. Independent and combined categories of barriers, as reported by RCBER at Activity No. 5 of the consensus model.

On the other hand, 31 (86%) RCBER reported 103 barriers, which were summarized as follows:

(a) 27 (26%) belonged to "personal" factors (category A in the questionnaire).

(b) 44 (43%) belonged to "information source" factors (category B in the questionnaire); and

(c) 32 (31%) belonged to "environmental" factors (category C in the questionnaire).

The main "personal" barrier reported was "lack of time to be spent on searching for information" (factor No. 5 in category A).
The main "information source" barrier reprted was "existence of the source" (factor No. 1 in category B).
The main "environmental" barriers reported were (equally): "existence of a communication channel between the information source and the user", and "bureaucracy" (factors No. 1 and 6 in category C).

Most of the barriers corresponded either to Category B (25%), or to the combined categories A, B, C (38%). 22 (61%) RCBER reported more than one barrier to carry out Activity No. 6 of the model.
20 (56%) RCBER did not have a product derived from this activity. On the other hand, while 16 (44%) RCBER reported several products, 13 (36%) stated problems to obtain them. Tables 4-19 , 4-20, and 4-21, summarize

the results concerning Activity No. 6 of the consensus model.

4.6.10 Barriers per category.

An analysis of barriers per category, as affecting all (six) activities in the consensus model showed the following:

(a) Within Category A (personal factors), it was found that factor No. 5 (lack of time to be spent on searching for information) was the most frequently referred barrier (33%), while "other" factors (not mentioned under the classification) were less referred (2%). Table 4-22 provides this distribution.

(b) Within Category B (information source factors), it was found that factor No. 2 (Accessibility) and factor No. 1 (existence of the source) were the most frequently referred barriers (23%). Factor No. 7 (language) was the less referred barrier (3%). Table 4-23 provides this distribution.

(c) Within Category C (environmental factors), factor No. 1 (existence of a communication channel between the information source and the user) was the most frequently referred barrier (30%). On the other hand, factor No. 3 (inter-personal relations) was the less referred barrier (4%). Table 4-24 provides this distribution.

FACTORS (*) (barriers, problems, difficulties)	CATEGORIES A No. (RCBER)	%	B No. (RCBER)	%	C No. (RCBER)	%
1	5	19	14	32	9	28
2	1	3	6	14	1	3
3	5	19	6	14	2	7
4	5	19	0	0	3	9
5	10	37	9	20	5	16
6	1	3	7	16	9	28
7			0	0	3	9
8			2	4		
TOTAL	27	100	44	100	32	100

(*) Specific factors are described in the questionnaire (Appendix 1).
A = Personal factors.
B = Inormation source factors.
C = Environmental factors.

Table 4-19. Barriers reported to affect information use at Activity No. 6 of the consensus model.

A (No. of barriers)	B (No. of RCBER)	A X B
0	5	0
1	9	9
2	3	6
3	9	27
4	4	16
5	3	15
6	1	6
9	1	9
15	1	15
TOTAL	36	103

Table 4-20. Total barriers per No. of RCBER at Activity No. 6 of the consensus model.

CATEGORIES	No. of RCBER	%
A	1	3
B	9	25
C	1	3
AB	0	0
AC	2	6
BC	4	11
ABC	14	38
none	5	14

A = Personal factors.
B = Information source factors.
C = Environmental factors.

Table 4-21. Independent and combined categories of barriers, as reported by RCBER at Activity No. 6 of the consenus model.

F	CATEGORY A ACTIVITIES (*) A1	A2	A3	A4	A5	A6	TOTAL
1	12(27)	6(16)	8(19)	7(19)	4(17)	5(19)	42(20)
2	4(09)	10(27)	6(14)	9(25)	2(09)	1(03)	32(15)
3	5(12)	8(22)	9(21)	7(19)	2(09)	5(19)	36(17)
4	3(07)	5(13)	4(09)	6(17)	4(17)	5(19)	27(13)
5	19(43)	7(19)	14(32)	7(19)	11(48)	10(37)	68(33)
6	1(02)	1(03)	2(05)	0(00)	0(00)	1(03)	5(02)
T	44	37	43	36	23	27	210(100)

(*) Percentages in parenthesis.
F = Factors. Specific activities and factors are described in the questionnaire (Appendix 1).
T = Total.

Table 4-22. Distribution of the personal factors (Category A), affecting information use on the performance of Activities 1-6 of the consensus model.

F	CATEGORY B ACTIVITIES (*) A1	A2	A3	A4	A5	A6	TOTAL
1	9(17)	14(31)	17(24)	10(21)	3(09)	14(32)	67(23)
2	12(22)	13(29)	20(29)	12(25)	5(16)	6(14)	68(23)
3	2(04)	7(16)	7(10)	6(12)	4(13)	6(14)	32(11)
4	5(09)	0(00)	4(06)	4(08)	2(06)	0(00)	15(05)
5	9(17)	3(07)	3(04)	5(10)	7(22)	9(20)	36(12)
6	5(09)	6(13)	8(11)	8(16)	8(25)	7(16)	42(14)
7	4(07)	0(00)	4(06)	0(00)	1(03)	0(00)	9(03)
8	8(15)	2(04)	7(10)	4(08)	2(06)	2(04)	25(09)
T	54	45	70	49	32	44	294(100)

(*) Percentages in parenthesis.
F = Factors. Specific factors and activities are described in the questionnaire (Appendix 1).
T = Total.

Table 4-23. Distribution of the information source factors (Category B), affecting information use on the performance of Activities 1-6 of the consensus model.

F	CATEGORY C ACTIVITIES (*) A1	A2	A3	A4	A5	A6	TOTAL
1	21(36)	14(32)	19(37)	12(33)	8(15)	9(28)	83(30)
2	5(08)	2(05)	4(08)	3(08)	7(13)	1(03)	22(08)
3	1(02)	3(07)	0(00)	2(05)	4(07)	2(07)	12(04)
4	6(10)	7(16)	5(10)	6(16)	9(16)	3(09)	36(13)
5	4(07)	3(07)	3(06)	4(11)	5(09)	5(16)	24(09)
6	16(27)	11(26)	14(27)	7(19)	13(24)	9(28)	70(25)
7	6(10)	3(07)	6(12)	3(08)	9(16)	3(09)	30(11)
T	59	43	51	37	55	32	277(100)

(*) Percentages in parenthesis.
F = Factors. Specific factors and activities are described in the questionnaire (Appendix 1).
T = Total.

Table 4-24. Distribution of the environmental factors (Category C), affecting information use on the performance of Activities 1-6 of the consensus model.

4.6.11 General analysis of barriers.

A general analysis of all the barriers to information use as found in all the activities of the model, indicated that the highest referred barriers were the following (in descending order):

(a) Lack of a communication channel between the information source and the user (Category C.1).

(b) Bureaucracy (Category C.6).

(c) Lack of time to be spent on searching for information (Category A.5).

(d) Accessibility of information (Category B.2); and

(e) Existence of the information source (Category B.1).

On the other hand, less referred barriers were those related to:

(a) External influences (Category C.5).

(b) Work role (Category C.2).

(c) Cost of information (Category B.4).

(d) Inter-personal relations (Category C.3); and

(e) Language of publication (Category B.7).

Table 4-25 describes a rank distribution of the barriers reported by all, 36 RCBER, as referred to affect information use i.e., to perform the activities

RANK	FACTOR	CATEGORY	No.
1	Existence of a communication channel between the information source and the user.	C1	83
2	Bureaucracy.	C6	70
3	Lack of time to be spent on searching for information.	A5	68
3	Accessibility (of information).	B2	68
4	Existence of the (information) source.	B1	67
5	Education/training on "how to" use information sources.	A1	42
5	Organisation (of information).	B6	42
6	Personal experience/familiarity (with information sources).	A3	36
6	Technical quality/credibility (of information sources).	B5	36
6	Existing policies/politics.	C4	36
7	Awareness of the existence of the (information) sources.	A2	32
7	Ease of use (of information sources).	B3	32
8	Other environmental factors.	C7	30
9	Lack of value, as assigned to information.	A4	27
10	Other information source factors.	B8	25
11	External influences.	C5	24
12	Work role.	C2	22
13	Cost (of information).	B4	15
14	Inter-personal relations.	C3	12
15	Language (of information sources).	B7	9
16	Other personal factors.	A6	5
	TOTAL		781

Category A = Personal factors.
Category B = Information source factors.
Category C = Environmental factors.

Table 4-25. Rank distribution of the barriers, problems, or difficulties reported by RCBER, as referred to affect information use in carrying out the activities of the consensus model.

in the consensus model.

4.6.12 Products.

24 (66%) RCBER reported from two to five products, as derived from their daily activities. In general, a total of 105 products were referred. These were classified and ranked according to their referral distribution. Here, it was found that "training courses", "information", and "planning", ranked high in the distribution. Tables 4-26 and 4-27 describe these findings.

On the other hand, the "lack of products", as derived from performing the activities in the model was particularly significant at Activity No. 3 (use scientific and technical information), and No. 6 (evaluate the programmes' results). No correlation with information access or use, however, was possible at this stage.

4.6.13 "Value" of information.

35 (97%) RCBER regarded scientific and technical information as a product. However, when asked about its value or means for measuring it, the answers varied significantly. Table 4-28 provides the types of answers given by RCBER.

When a scale of "values" was provided (5-10, minor to major), RCBER valued the impact of information use on productivity as follows:

A No. of products	B No. of RCBER(*)	A X B
1	10 (28)	10
2	7 (19)	14
3	7 (19)	21
4	6 (17)	24
5	4 (11)	20
7	1 (03)	7
9	1 (03)	9
TOTAL	36 (100)	105

(*) Percentages in parenthesis.

Table 4-26. Amount of products derived from daily activities, as reported by RCBER.

RANK	PRODUCT	No.
1	Training courses.	28
2	Information.	11
3	Planning.	8
4	Programmes.	7
4	Research projects.	7
5	Improve quality of health care.	6
5	Evaluation.	6
6	Publications.	5
6	Consultancies.	5
6	Implementation activities.	5
7	Co-ordination activities.	4
7	Improve quality of information sources.	4
8	Control of activities.	3
9	Production of norms.	2
10	Changes in attitudes.	1
10	Improvement of communication.	1
10	Dissemination of information.	1
10	Technical procedures.	1

Table 4-27. Rank distribution by type of products, as referred by RCBER.

RANK	TYPE OF VALUE/MEASUREMENT	No.(*)
1	Improvement in the quality of health care.	9
2	Useful in problem solving.	8
3	Useful in the satisfaction of needs.	7
3	As a resource, it is an "intake".	7
4	"Very high".	6
5	There are no measurement indicators.	5
6	Useful in increasing knowledge/updateness.	4
6	Good for the efficient performance of activities.	4
7	Good for decision making.	3
8	Useful in the dissemination of results.	2
8	Helpful for conducting research.	2
9	Does not know.	1

(*) 14(39%) RCBER provided more than one answer.

Table 4-28. Type of value/measurement assigned to scientific and technical information by RCBER.

9 (25%) RCBER assigned a "10" value; 11 (30%) assigned a "9" value; 15 (42%) an "8" value; and only 1 (3%) assigned a value of "6". This is described in Table 4-29.

4.6.14 Information sources.

In general, the type of information sources that RCBER valued as most useful to carry out their activities were, in descending order:

(a) Working manuals.

(b) Journal articles.

(c) Research projects.

(d) Index Medicus.

(e) Librarians.

(f) Official documents.

(g) Internal reports.

(h) Courses.

(i) Books, and

(j) IMSS colleagues.

Lower values were assigned to:

(k) Theses.

(l) Own notebooks.

(m) External reports.

(n) Conferences.

(o) Collegues outside IMSS; and

(p) News papers.

VALUE (*)	No. of RCBER	%
10	9	25
9	11	30
8	15	42
7	0	00
6	1	03
5	0	00
TOTAL	36	100

(*) Value scale was 5 - 10 (minor to major).

Table 4-29. Value assigned to the impact of information use on productivity by RCBER.

Table 4-30 provides a rank distribution of these sources with their respective values.

When analysed independently, the values to information sources so as to carry out education activities for example, ranked differently. Here, "courses" were above "working manuals"; and "books" were above "internal reports", "research projects", and "official documents", as described in Table 4-31.
Values to information sources, as used to carry out research activities also ranked differently: "research projects", and "journal articles" ranked first, followed by "Index Medicus", and "working manuals", as illustrated in Table 4-32.
Again, a different pattern was found when analysing values to information sources as used to conduct library-related activities. Here, "librarians" were regarded of higher value than "working manuals", "official documents", or any other information source, as described in Table 4-33.
Appendix 4 provides specific values assigned by RCBER to each information source and to each activity.

4.6.15 Regularly used information sources.

When asked directly about the information sources that RCBER use or read regularly, they ranked "journal articles", "books", and "working manuals", as heavily used. Table 4-34 provides this distribution. These results corroborate the findings regarding the "value"

RANK	INFORMATION SOURCE	VALUES (*)			TOTAL	MEAN
		E	R	L		
1	Working manuals.	9.00	8.58	8.94	26.52	8.84
2	Journal articles.	8.91	9.44	8.08	26.43	8.81
3	Research projects.	8.47	9.44	8.19	26.10	8.70
4	Index Medicus.	8.27	9.11	8.22	25.60	8.53
4	Librarians.	7.88	8.30	9.41	25.59	8.53
5	Official documents.	8.38	8.50	8.50	25.38	8.46
6	Internal reports.	8.72	8.36	8.27	25.35	8.45
7	Courses.	9.13	8.19	7.91	25.23	8.41
8	Books.	8.80	7.88	8.16	24.84	8.28
9	IMSS colleagues.	8.25	8.08	7.80	24.13	8.04
10	Theses.	7.91	8.38	7.63	23.92	7.97
11	Own notebooks.	8.11	8.00	7.72	23.83	7.94
12	External reports.	7.75	7.66	7.13	22.54	7.51
12	Conferences.	7.58	7.19	6.75	21.52	7.17
14	Colleagues outside IMSS.	6.80	6.75	6.61	20.16	6.72
15	News papers.	6.50	6.19	6.11	18.80	6.26

(*) The scale value was 5 - 10 (minor to major).
E = Education.
R = Research.
L = Libraries.

Table 4-30. Ranking values to information sources, as used by RCBER to conduct activities on education, research, and library services.

RANK	INFORMATION SOURCE	VÂLUE (*)
1	Courses.	9.13
2	Working manuals.	9.00
3	Journal articles.	8.91
4	Books.	8.80
5	Internal reports.	8.72
6	Research projects.	8.47
7	Official documents.	8.38
8	Index Medicus.	8.27
9	IMSS colleagues.	8.25
10	Own notebooks.	8.11
11	Theses.	7.91
12	Librarians.	7.88
13	External reports.	7.75
14	Conferences.	7.58
15	Colleagues outside IMSS.	6.88
16	News papers.	6.50

(*) The scale value was 5 - 10 (minor to major).

Table 4-31. Ranking values to information sources, as used by RCBER to conduct activities on education.

RANK	INFORMATION SOURCE	VALUE(*)
1	Research projects.	9.44
1	Journal articles.	9.44
2	Index Medicus.	9.11
3	Working manuals.	8.58
4	Official documents.	8.50
5	Theses.	8.38
6	Internal reports.	8.36
7	Librarians.	8.30
8	Courses.	8.19
9	IMSS Colleagues.	8.08
10	Own notebooks.	8.00
11	Books.	7.88
12	External reports.	7.66
13	Conferences.	7.19
14	Colleagues outside IMSS.	6.75
15	News papers.	6.19

(*) The scale value was 5 - 10 (minor to major).

Table 4-32. Ranking values to information sources, as used by RCBER to conduct research activities.

RANK	INFORMATION SOURCE	VALUE (*)
1	Librarians.	9.41
2	Working manuals.	8.94
3	Official documents.	8.50
4	Internal reports.	8.27
5	Index Medicus.	8.22
6	Research projects.	8.19
7	Books.	8.16
8	Journal articles.	8.08
9	Courses.	7.91
10	IMSS Colleagues.	7.80
11	Own notebooks.	7.72
12	Theses.	7.63
13	External reports.	7.13
14	Conferences.	6.75
15	Colleagues outside IMSS.	6.61
16	News papers.	6.11

(*) The scale value was 5 - 10 (minor to major).

Table 4-33. Ranking values to information sources, as used by RCBER to conduct library-related activities.

RANK	INFORMATION SOURCE	No.(*)	%
1	Journal articles.	26	30
2	Books.	17	20
3	Working manuals.	16	18
4	Official documents.	8	9
5	Internal reports.	5	6
6	Index Medicus.	4	5
7	IMSS colleagues.	3	3
7	Own notebooks.	3	3
8	News papers.	2	2
9	Theses.	1	1
9	Research projects.	1	1
9	Librarians.	1	1
TOTAL		88	100

(*) RCBER referred more than one source.

Table 4-34. Rank distribution of the information sources that are regularly read or used (3-5 times a week), by RCBER.

assigned to information sources, as previously described in Table 4-30.

4.6.16 Professional profile of RCBER.

Regarding the "profile" of RCBER, the following was found:

(a) 27 (75%) belonged to 54 different professional associations. Only 2 (6%) are members to the same association; and 7 (19%) were not memebers of any association.
While 27 RCBER belonged to more than one association, as described in Table 4-35, the 54 reported associations were either local or national; none was international, and most of them were clinical rather than related to education, research, or libraries. Table 4-36 provides a subject classification of these associations.

(b) 26 (72%) RCBER participated in 78 professional meetings (seminars, courses, congresses, or work meetings) in the previous twelve months to the interview. It was found that most RCBER (61%) participated in 1 - 3 meetings per year. On the other hand, 10 (28%) RCBER did not participate at any meeting, at all. This distribution is described in Table 4-37.
The type of participation of 26 RCBER was mainly attending to work meetings (49%), or as a lecturer (37%) in different courses. Participation with a paper

No. of MEMBERSHIPS	No. of RCBER (*)	TOTAL ASSOCIATIONS
0	7	0
1	15	15
2	7	14
3	3	9
4	2	8
5	2	10
TOTAL	36	56

(*) Only two RCBER are members of the same association.

Table 4-35. Memberships to professional associations, as reported by RCBER.

SUBJECT	No. of ASSOCIATIONS
General Practice	18
Paediatrics	9
Family Practice	7
Obstetrics/Gynaecology	6
Internal Medicine	3
Anaesthesiology	3
Psychiatry/Neurology	3
Public Health	1
Occupational Medicine	1
Sterility/Infertility	1
Demography	1
University (Academic)	1

Table 4-36. Subject classification of professional associations, to which RCBER are reported to be members.

No. of EVENTS (*)	No. of RCBER	%
0	10	28
1	10	28
2	5	14
3	7	19
5	1	03
+5	3	08

(*) Congresses, seminars, conferences, or work meetings.

Table 4-37. Distribution of professional meetings, where RCBER participated in the last twelve months.

accounted for only 9%. These results are described in Table 4-38.

(c) Only 8 (22%) RCBER published scientific or technical literature in the last twelve months (previous to the interview). While 16 publications were referred as products, only 2 (13%) were related to their activities as RCBER. The rest were mainly clinical publications. Table 4-39 describes these findings.

(d) Most RCBER (95%) have been working at IMSS for over six years. Regarding their position as RCBER in IMSS, 10 (28%) had less than a year in that position; 24 (66%) from two to ten years; and 2 (6%) had been working as RCBER for more than ten years. Tables 4-40, and 4-41 describe these results.

(e) Regarding their highest academic degree, 31 (86%) RCBER had a medical speciality; 4 (11%) had a Master degree, and one (3%) was a general practitioner. Specialities ranged from family medicine and internal medicine, to psychiatry, haematology, and cardiology.

(f) 24 (67%) RCBER use a library on a regular basis. 58% uses it from one to five times a month; the rest (42%) from 6 to 20 times a month. Their information needs are generally satisfied through the use of scientific journals and books.

EVENT	TYPE OF PARTICIPATION				TOTAL	%
	A	B	C	D		
SEMINAR	5	3		1	9	12
COURSE	1		29		30	38
CONGRESS	4	1		2	7	09
WORK MEETING	28	3		1	32	41
TOTAL	38	7	29	4	78	100

A = as attendee.
B = with a paper.
C = as lecturer.
D = as reviewer.

Table 4-38. Professional activities of RCBER.

No. of RCBER	TYPE OF PRODUCT	No.
5	Papers in scientific, national journals.	4
4	Working manuals.	2
4	Books.	3
2	Chapter in a book.	2
1	Paper in a scientific, international journal.	1

Table 4-39. Type of publications produced by RCBER in the last twelve months.

YEARS	No. of RCBER	%
0 - 5	2	05
6 - 10	10	28
11 - 15	6	17
16 - 20	8	22
+ 20	10	28
TOTAL	36	100

Table 4-40. No. of years working at IMSS, as referred by RCBER.

YEARS	No. of RCBER	%
0 - 1	10	28
2 - 3	10	28
4 - 5	7	19
6 - 7	4	11
8 - 9	3	08
+ 10	2	06
TOTAL	36	100

Table 4-41. No. of years working as RCBER, within IMSS.

4.6.17 Benefits of information use.

The benefits derived from using scientific and technical information as referred by RCBER were mainly:

(a) An increase in the quality of health care.

(b) Helpful in decision making.

(c) Helpful in the planning and design of programmes.

(d) As a resource, it generates other resources; and

(e) Helpful in keeping up to date.

Table 4-42 provides a rank distribution of these benefits.

4.7 DEBATE.

A comparison of the conceptual model with the expressed problem situation generated a "debate", which was summarized as follows:

(A). 36 (100%) RCBER regarded scientific and technical information as an important resource to perform the activities in the model; however, there were barriers to its use. While personal, source, and environmental barriers were likely to appear in combination, the most referred barriers to affect the "access" and "use" of information

RANK	BENEFITS	No. of RESPONSES (*)	%
1	Increases quality of health care.	18	19
2	Helpful in decision making.	17	18
3	Helps to plan and design programmes.	15	16
4	As a resource, it generates other resources.	14	15
5	Helps to keep up to date.	13	14
6	Provides the "know how" for procedures.	5	06
7	Provides consensus in knowledge.	4	04
7	Encourrages the use of technology.	4	04
7	Motivates continuing education and research.	4	04
TOTAL		94	100

(*) RCBER provided more than one answer.

Table 4-42. Rank distribution of the benefits derived from using scientific and technical information, as referred by RCBER.

were the following (in descending order):

(a) Lack of a communication channel between the information source and the user; (b) bureaucracy; (c) lack of time to be spent on searching for information; (d) accessibility of the source; (e) existence of the source; and (f) training on "how to" use information sources.

(B). Intrainstitutional information sources are highly used, as compared to extrainstitutional sources.

(C). Limiting the analysis to the consensus model, the barriers to information access and use are related to affect productivity, particularly at using scientific and technical information (Activity No. 3 in the model); and at evaluating the programme's results (Activity No. 6 in the model). However, other factors need to be analysed before any conclusions can be derived from these results.

(D). The overall "value" assigned to the impact of information use on productivity was either "medium" (42%), or "high" (55%). Its impact however, as related to quality of health care was explicitly recognized by 18 (50%) RCBER. Further research is needed in order to conclude on the impact of information use on quality of health care, at the structure level.

4.8 FEASIBLE, DESIRABLE CHANGES.

The feasible and desirable changes identified were classified according to structure, procedures, and attitudes.

4.8.1 Changes in Structure.

(a) The existing information structure needs to be changed. Instructive manuals need to be revised and modified in order to provide an adequate channel of communication between the information source and the user. Activities at lower levels of resolution need to be identified and analysed.

(b) Organisational hierarchies need to be revised and simplified in order to diminish the existing bureaucracy.

(c) The allocation of qualified human resources at the hierarchical structure, needs to be assessed and changed, according to local, jurisdictional needs.

(d) Institutional policies to the access and use of scientific and technical information need to be changed in order to promote its use at the jurisdictional, national, and international levels.

4.8.2 Changes in Procedures.

(a) The allocation of resources needs to be performed according to "existing needs", rather than to prescriptive norms.

(b) Accordingly, primary and secondary sources of information need to be produced, acquired, and disseminated.

(c) Training on "how to" use information sources needs to be provided to RCBER.

(d) Relevant, extrainstitutional sources of information must be identified and disseminated among RCBER.

(e) RCBER are to have an active participation in academic, research, and library meetings through structured participation.

(f) RCBER are to liaise among them and among extrainstitutional colleagues.

(g) Existing manuals should be changed, accordingly.

4.8.3 Changes in Attitudes.

(a) RCBER ought to liaise with colleagues.

(b) RCBER ought to organise their information sources.

(c) RCBER ought to propose changes in policies and procedures.

(d) RCBER ought to be aware of the impact of information on quality of health.

The above mentioned changes were integrated in an "action plan".

4.9 ACTION.

An action plan to overcome the problem situation was thus designed. This included four main programmes: (1) diagnosis of the existing situation at lower levels of resolution; (2) structure development; (3) training and continuing education of RCBER; and (4) changes to instruction manuals and procedures.
It was understood that "attitude" changes could be obtained through the changes at the structure and process levels.

4.9.1 Diagnosis of the Existing Situation at Lower Levels of Resolution.

The activities in this programme include:

(a) Further research on activity-to-activity analysis. Soft Systems Methodology can be applied at lower levels of resolution, for example, "how do RCBER consult the literature?"; "how do they identify training and specialization needs?"; "how do they co-ordinate the implementation programmes on education, research, and libraries?".

(b) Extrainstitutional activities need also to be explored in order to co-ordinate jurisdictional programmes.

(c) Allocation of resources needs to be conducted according to existing diagnoses.

4.9.2 Structure Development.

The activities in this programme include:

(a) The identification of existing communication channels within the structure;

(b) The revision of institutional, national, and international policies on scientific and technical information.

(c) The allocation of human resources according to local needs and demands; and

(d) The revision and modification of the organisational structure.

4.9.3 Training and Continuing Education of RCBER.

The activities in this programme include:

(a) The provision of training courses on the use of scientific and technical information.

(b) Continuing education on "how to" do research, publish literature, organise information, and participate in academic, research, and library meetings; and

(c) Training courses on "how to" teach; "how to" promote/co-ordinate research, and "how to" organise a library.

4.9.4 Changes to Instruction Manuals and Procedures.

The activities in this programme include:

(a) The revision of existing manuals and procedures.

(b) Comparison with results from situational diagnoses.

(c) Modification of procedures.

(d) Promotion and Dissemination of new norms and procedures; and

(e) Implementation of actions.

Figure 4-16 Illustrates the support of these programmes in action taking.

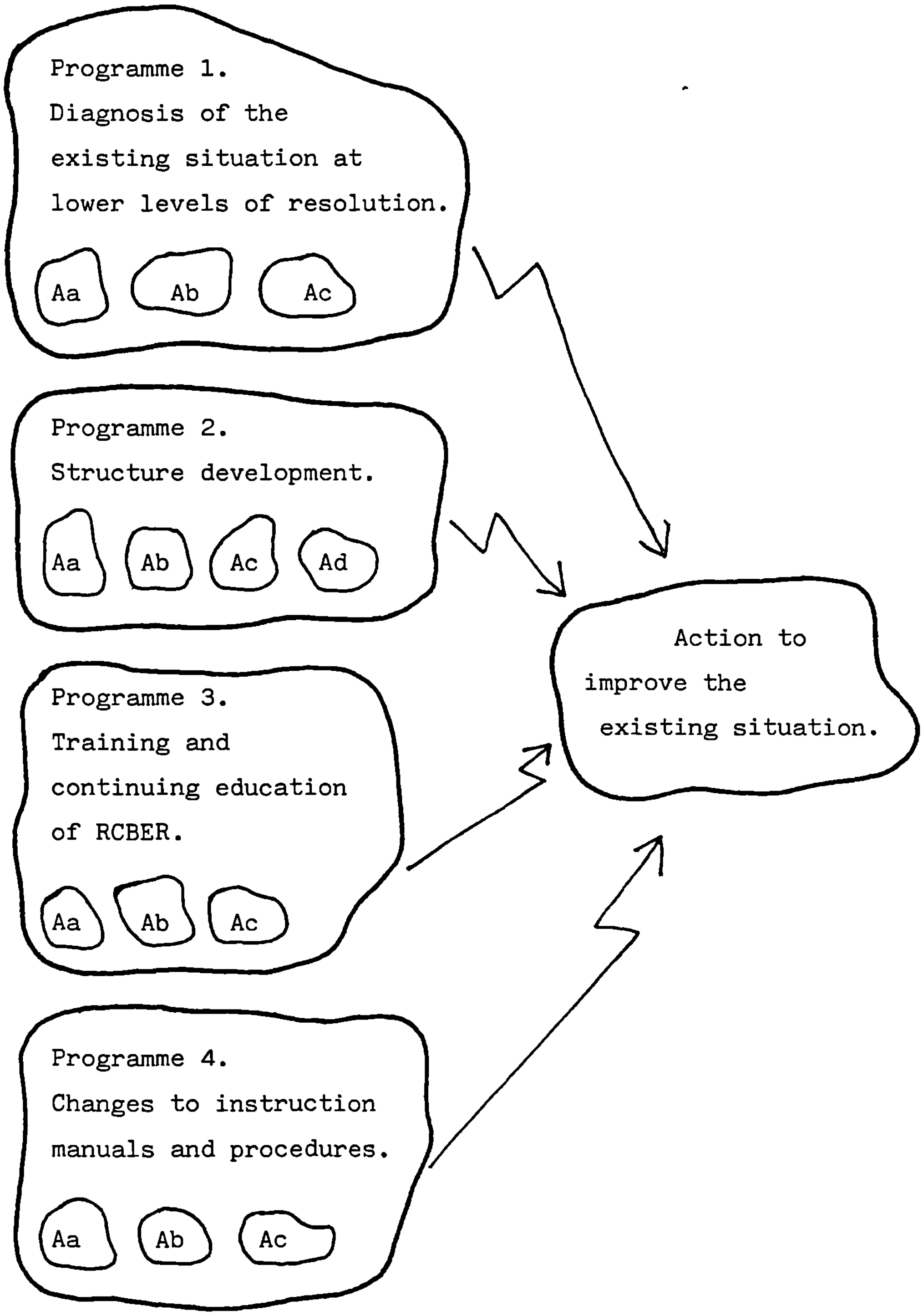

Figure 4-16. Supporting programmes in taking action to improve the problem situation.

CHAPTER 5

DISCUSSION

5.1 INTRODUCTION.

This chapter comprehends four sections. The first section discusses about systems prospects and their relation to health care. The second section discusses about the results obtained in this research. Since the results provided insights where to base further research in the design and implementation of information systems and services, a third section discusses the needs, methodologies, and risks of setting-up such "information systems".
Finally, the fourth section describes the contributions of this research both, to the field and to the health care system analysed.

New lines of research are highlighted throughout the chapter.

5.2 THE CONTRIBUTION OF SYSTEMS.

The world is full of constraints. The "laws of science" express our description of general classes of natural constraints. Other kinds of constraint are added when machines are constructed or rules and procedures are accepted by human actors. Systems ideas can help us understand how order can emerge from particular structures of relationships, notably those exhibiting closed sequences or loops. A system of elements linked in such ways can demonstrate interesting "emergent" properties: theories can be developed for their study (Anderton, 1989).

5.2.1 The systems movement.

The proper theorising of the relationships between tendencies that make up the systems movement is certainly one of the most important challenges that the systems community faces in the decade to come. According to Flood, et al.(1989), its future growth and prosperity, and the realisation of its potential for massively increased influence in the affairs of organisations and societies, crucially depend upon the resolution of this problem.

Flood, et al. (1989) present two possible solutions to the problem:

The first position sees the recent history of systems thinking in terms of the replacement of the old "hard" paradigm (operational research, systems engineering, general systems theory, cybernetics, etc.), with a new and vigorous "soft" paradigm. The hard paradigm, unable to deal with the anomalies arising when it is applied in complex, human-centred organisational and societal situations has given way to a soft paradigm, which both preserves the achievements of the hard in its specialized domain of application and extends the area of successful operation of systems ideas to the behavioural and social arena.

The second possible resolution is the "pluralist" position, which seeks to recognise the complementary strenghts of the different systems tendencies and to align each of them with the sort of problem situation for which it should, in theory, provide the most suitable approach (Jackson, 1989).

5.2.2 The strength of systems thinking.

One indicator of the strength of systems thinking is the range of areas in which it has been found to be useful in practice. The different shades of systems thinking and theory support and suggest their use in different contexts. The design and construction of physical artefacts for example, can benefit from the involvement of systems ideas to guide and facilitate progress.

The diagnosis and improvement of difficulties faced by individuals and groups on the other hand, can be aided by approaching the situation with a systemic attitude. Systems practice also implies that systems ideas may be brought to bear upon the practice itself. Benefits come not only from systems ideas in practice, but also by using systems ideas to study practice.

In focussing upon practice, one is confronting a situation containing several related elements, such as: (1) the issue of concern; (2) the individuals and groups involved; (3) the method of inquiry; and (4) the theoretical base of this method.

To understand the complex relationships which are implied by practice requires a body of theory to be developed which can operate over various types of situation and be transferable between these situations. Systems ideas offer one possible basis for such a theory as they are intended to be relevant to situations common to many disciplines rather than specific to one (Flood, et al., 1989).

In this context, Checkland (1988) recognises the status of "systems" as a meta-discipline; a subject which can discourse about the content of other subject areas.

5.2.3 Systems approach to health problems.

Systems science in health care has been the focus of research and development in four international conferences held since 1976 (Coblentz and Walter, 1977; Tilquin, 1981; Eimeren, et al., 1984; Duru, et al., 1988). These conferences have been the arena where a variety of specialists has discussed that health problems have not been solved by medicine or organisational management, or politics, alone; but have yielded to a total systems approach in which the clinical, institutional, and social aspects are considered simultaneously.

Attacks on the infectious diseases, such as smallpox and on cardiovascular disease mortality are examples. It is the hope that in time, with expanding biomedical knowledge, increasing capabilities in informatics and management, that real inroads can be made on other problems that threaten health and limit the quality of life (Flagle, 1984).

Several factors have been reported to influence the delivery of health care over the last three decades. Summarizing Vallbona's (1983) view, these factors are the following:

(a) Accelerated growth of new knowledge in the basic and clinical sciences of medicine.

(b) Increased demand for health care by a growing population.

(c) Proliferation of health care facilities and increased supply of health care professionals.

(d) Sudden development of new technologies which have application in the delivery of health care.

(e) Fragmentation and discontinuity of the patient-physician relationships.

(f) Accelerated rise in the cost of health care.

(g) Complex interaction between the physiological, psychological, and sociological dimensions of health and illness.

(h) Inadequate integration of preventive and curative services.

On the other hand, dramatic developments have been seen: regionalization of health care services; progress in the struggles toward the goals of health for all by the year 2000; the near universal striving for equity of access to care; the impact of new diagnostic and therapeutic technologies; and a slow, but inexorable and often chaotic trend toward increasingly integrated and co-ordinated forms of service (Moriski, et al., 1981; Flagle, 1988; Gibbs and Hogan, 1988; Rogers, 1988; Royston, et al., 1988). Clearly, the problems of managing "health systems" can no longer be dealt with piecemeal by components within the system suboptimizing without regard to performance of the overall system. Integartion and co-ordination can only be acquired by looking at system components in interaction. Likewise, elements of structure, process, and outcome need to be identified, defined, and monitored in order to assess quality of health care.

During the coming decades, measuring the quality of health care will become increasingly common (Goldschimdt, 1988), the result of:

(a) The desire of the population that health care be delivered according to accepted practice standards.

(b) Concern that cost-containment efforts do not affect quality of care adversely.

(c) Advances in knowledge and technology that produce the potential for increased variability in provider performance.

(d) Competition among providers.

(e) A surplus of providers, permitting choice among them based on the quality of care they deliver; and

(f) Development of the computer, information and knowledge technology required to measure quality of care.

5.3 THE RESULTS.

In this work, a framework of concern was identified at the structure level of health care regarding the use of scientific and technical information by IMSS' RCBER. Following Checkland's (1981, 1981a) approach to problem solving, Soft Systems Methodology was used to (1) define a problem situation; (2) build up conceptual models; (3) generate a debate about feasible, desirable changes; and (4) produce a plan of action to tackle the identified problem situation.

The actors involved in this study provided with sufficient information to "understand" the problem situation. Soft Systems Methodology on the other hand, helped to "learn" about the problem and how to approach it.

The results regarding the role of scientific and technical information among RCBER can be analysed under three broad sections: (1) the value assigned to information sources by RCBER; (2) the impact of information on productivity; and (3) the existing barriers, problems, or difficulties to information access and use, within the system.

5.3.1 Value to information sources.

RCBER value information as an important resource that is needed to carry out their every day activities. They also regard information as a product. However, there exists confusion as to how to value it.

This study showed that "working manuals" was valued as the most useful information source to carry out their activities. On the other hand, they do not value as useful "external reports", "conferences", nor "colleagues outside IMSS". This reflects a strong intra-institutional reliance on information sources. Further research needs to be performed both (1) at lower levels of resolution to identify values as assigned to specific sections of information sources; and (2) at extra-institutional information sources to know about their accessibility and relevance to RCBER.

5.3.2 Impact on productivity.

While it was found that information had an impact on productivity in general, this was not particularly true when using scientific and technical information, nor when evaluating the programmes' results. This implied, on the one hand, that the inventory of resources, directories, library catalogues, and research registries, among other, were not being constantly produced by RCBER; and on the other, that the impact/effectiveness of the RCBER' programmes, as such, were not being "measured" by over half (56%) RCBER.

These results have interesting implications at the structure level of health care, and constitute the basis where further research can be conducted.

Taking into consideration the results of this research, information processing procedures for example, need to be identified at lower levels of resolution, as well as relationships with external components from other systems.

5.3.3 Problems to information access and use.

Two "environmental" factors were the most frequently referred barriers to information access and use: (1) the "existence of a communication channel between the information source and the user"; and (2) "bureaucracy". If we add the following referred barriers, in descending order, "lack of time to be spent on searching for information"; "accessibility"; "existence of the source"; "education/training on how to use information sources"; and "organisation of information", we find a mixture of barriers to information, as related to the source, the environment, or the end-user.

Some barriers may be inter-dependent; for example, "bureaucracy" with "lack of time to be spent on searching for information", and "existing policies/politics; however, further research needs to be done at lower levels of resolution in order to conclude on these findings.

While some factors are attitudinal in nature, such as "lack of a value as assigned to information", and "inter-personal relations", most of the barriers involve processes or procedures. These are feasible to change more rapidly.

5.3.4 Improving the existing situation through the plan of action.

The training and education of RCBER on how to use information sources plays an important role to produce the desirable changes. This will allow them to have not only the "knowledge" about the information sources, but also shall provide the means to demand, organise, and produce information sources, thus affecting the structure, processes, or attitudes of the existing system components.

The proposed changes, integrated in the action plan have the aim of improving the existing situation. It is through the implementation and monitoring of these changes, that new problems are going to emerge, further research is going to be conducted at higher or lower levels of resolution; and a deeper understanding of the role of information at the structure level of health care is going to be assessed. Here, organisational power for instance, has an important effect upon decision-making and consequently, upon the way that change takes place (Stowell, 1989).

Organisational power, through the decision-making procedures, affects the way that a proposed change is developed and implemented. Yet, further investigation on power in and around the development process is required. The power an individual or group holds is perceived differently by different actors within a system. Some are unaware of "covert" activities, while others are fully cognizant of what is happening, but may not be in a position to express dissent.

In other cases what is perceived as unreasonable coercion by some may be seen as a legitimate action by others, including perhaps the actor exercising his power (Thomas, 1989).

5.3.5 Basis for further research.

Regarding current criteria available by which to judge research on Soft Systems Methodology, Checkland (1989) reports its use, transferability, and teachability.

From using the methodology in this research it was learned that Soft Systems Methodology can be used both (1) to solve information problems at the structure level of health care; and (2) to enrich the different concepts of human activity systems that participate in the delivery of health care.

A model was constructed where to base this approach. Figure 5-1 illustrates such model; here, the approach to its use can be systemic and its flow, multidirectional.

Based on this model, information sources can be investigated at the structure, process, and outcome levels of health care; as well as at primary, secondary, or tertiary levels of care. This model thus becomes a circular task which, through assessment, intervention, evaluation and re-assessment, becomes a continuous monitor of changes.

The model developed in Figure 5-1 can also be used to analyse extra-institutional sources of information; or else, relationships with other disciplines.

The "new process" of SSM, as recently published by Checkland and Scholes (1990) is particulalrly relevant at lower levels of resolution, where roles, norms, values, and power need to be analysed as part of the "cultural" stream of the process, along with relevant systems.

On the other hand, in measuring the impact of information on quality of health care, the criteria

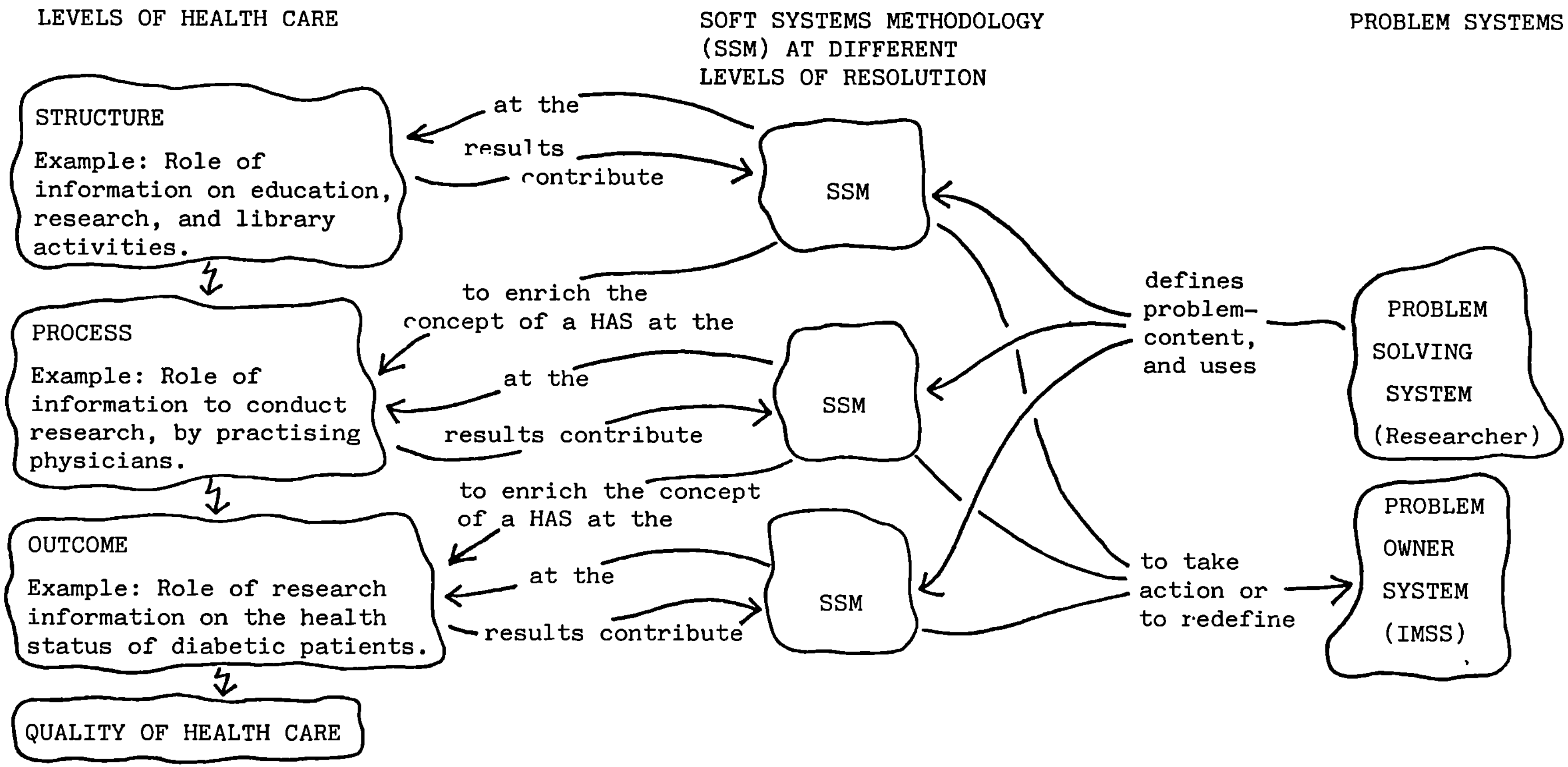

Figure 5-1. Application of Soft Systems Methodology (SSM) at the structure, process, and outcome levels of health care, in information-problem-situations.

for efficacy, efficiency, and effectiveness in model building, plays a vital role in the later comparison between the model and the perceptions of the real world.

5.3.6 **Other considerations.**

Clearly, other factors besides information need to be considered. In any "health care system", both provider and consumer behaviour are related to the characteristics of each group, because psychosocial, power, cultural, and economic attributes influence attitudes and behaviours.

The traditional approach to continuing education for example, has been a simple one: one or several "experts" decide what should be taught and the learners are identified on the basis of personal interest or their own perception of need (Hess, 1976). Very little attention is given to the more fundamental question of educational need determined on the basis of the care actually being given to patients as compared with a defined standard of care. Furthermore, continuing education should be interrelated with basic professional education and health care research (Johnston, 1981).

If we accept the view that patient care is the most important output of a "health care system", then at least part of the basis for determining the educational needs of practicing health professionals should be the quality of care their patients receive. In taking a systems approach to identify educational needs, it is then useful to define continuing medical education as any planned intervention that beneficially alters the patient output of the "health care system".

5.4 THE "INFORMATION SYSTEM".

Adequate information is indispensable for the efficient operation of all health "system" components, from the top management level down to individual, even small establishments and their structural units.
Information is essential for the planning and implementation of activities; for evaluating the efficiency of medical institutions; for determining to what degree the avilable services are used by the population; and for organising the day to day operation of physicians, allied health personnel, and institutions.
The "health system" thus needs detailed information not only regarding public health indicators, but also, that information supplied from other "systems", such as the social, demographic, or economic "systems". The input of this kind of information to the "health system", as well as to other "systems" (social insurance, and social security services for example) should be regular and timely; and it is important that the data from other "systems" be compatible and

comparable with those of the health services.
This can be ensured through a team of experts engaged in information support activities, especially when a systems approach is used to consider all relevant aspects of the information and to select the most pertinent information.

5.4.1 Insights for the design and implementation of information "systems" and services.

An important outcome of this research was a situational diagnosis concerning the role of information among RCBER. Information regarding values, impact, sources, and production has been collected. These results provide valuable insights where to base further research in the design and implementation of "information systems" and services; as well as for the development of policies for the fair use of information.

5.4.2 The conventional approach to set-up "information systems".

A generic view of an "information system" is highly problematical. There are philosophical and pragmatic problems when attempting to develop a generic view of an "information system" for the purpose of analysis, design, or management (Davies, 1989). Indeed, an "information system", as a human activity (social) system emphasises its organisational and societal

impact (Buckingham, et al., 1987).
On the other hand, "information systems" have not always been implemented with an explicit methodology (Avison, 1989). Caution must be taken in this process. The conventional approach to "information systems development" consisted of the phases feasibility study, systems investigation, analysis, design, implementation, and review and maintenance (Daniels and Yeates, 1971). These phases and their sub-phases, led to increased control, because it was easier for systems analysts to assess both the time and people resources required.
The methodology also emphasised the importance of documentation, and this helped to improve the communications between the various actors: analysts, programmers, and users.
Finally, the methodology was capable of being taught, and training courses helped to improve the level of expertise of computer systems analysts.
But there are weaknesses to this approach. According to Avison (1989), firstly it emphasised the computer aspects of "information systems development"; secondly, it concentrated on unambitious and "small information systems" at the operations level of organisations; and thirdly, its use led to user disatisfaction.
There were several reasons for this: the computer orientation of the documentation; the difficulty users had in being able to see the likely form of reports;

and the long time-scale required to develop "systems". The conventional approach to "information systems" development has been atacked on a number of fronts, and the alternative approaches tend to address one or more of these weaknesses (Avison and Fitzgerald, 1988).

5.4.3 Current methodologies.

The methodologies that draw on the systems approach in the present day include Soft Systems Methodology (Checkland, 1981, 1985; Wilson, 1984; Checkland and Scholes, 1990; Patching, 1990), and Viable Systems Model (Beer, 1985). These stress the human and organisational components of information systems, as against the computer component in the conventional approach.

There is a recognition in these approaches that organisations are complex and unclear.

The philosophy of these approaches lies in their attempt to understand the organisation holistically, analysing the structure of organisations as a whole and from many viewpoints.

In this context, an information system can be considered as a two-way process of inquiry or knowledge generation in which a systems analyst with a user attempts to develop an understanding of the content of the situation prior to intervention.

This understanding and intervention methodology connects two abstract entities which Checkland (1984) calls "complementarity". This means that a methodology transfers "thinking about the content of the situation", which is relevant to the "content of the situation". These entities, therefore, are not separate but interconnected.

In using this connectivity an information system can be understood as the problem-solving team conducting an inquiry which is intervening in the real world.

In this process two linked sets of assumptions complement a methodology (Wood-Harper, 1989). The first are those which relate to reality, and the second are those which are associated assumptions in which knowledge is embedded when the team uses the methodology.

Figure 5-2 illustrates an intellectual context for an inquiry of how the systems analyst with a user, utilises the methodology for intervention in a real world information situation.

5.4.4 Role of the "systems" analyst.

The role of the systems analyst is very important. Historically, there has been a work role progression within data processing departments; this is usually the route from computer programmer to "systems" analyst.

Many organisations, particularly in developing countries, employ analyst/programmers to undertake their "system" development. This often results in the

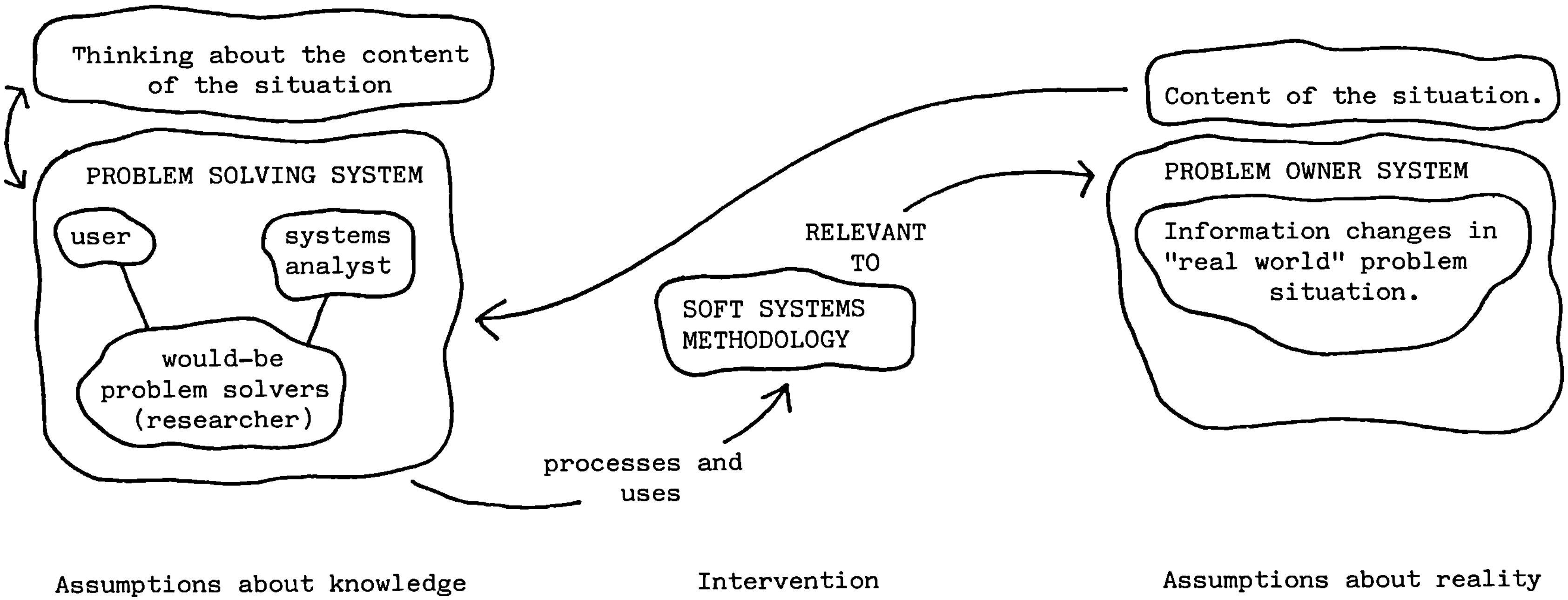

Figure 5-2. Intellectual context for an inquiry of how the systems analyst with a user utilises Soft Systems Methodology for intervention in a real world information situation. (Adapted from Checkland, 1984; and Wood-Harper, 1989).

same person undertaking problem identification, "systems" analysis, "systems" design, and programming. It is difficult to contemplate that within most "systems" development the analyst's role is underpinned by two distinct complementing activities: analysis and design (Maguire and Hammond, 1989).

The argument put foreward is that there are different thinking mechanisms taking place at each stage of the "systems" life cycle, that is systemic, versus reductionist.

The specialist role of the "systems analyst" requires more than just technical skills. Managerial and organisational training is also needed.

In many instances, no cognizance is taken of how a particular "system" will have repercussions in other functional areas within the organisation. It is these particular failures which are expensive to organisations in terms of time and resources. Very often the result is that "systems" are technical sucesses but organisational failures.

On the other hand, if we do not differentiate between the stages, we are locked into a "hard systems" approach to implementing "information systems". This may be a dangerous strategy as this approach adheres closely to a means-end schema (Maguire and Hammond, 1989).

Finally, "system evaluation" and review should be undertaken at regular intervals in order to ensure that "the system" is not only performing well from a technical point of view, but is providing the organisation with the relevant information for effective decision-making to take place.

5.5 CONTRIBUTION OF THIS RESEARCH.

Figure 5-3 provides a summary of the contributions of this research. Three main directions can be easily identified as a result of the use of Soft Systems Methodology.

The first direction is related to the improvement of an information-problem situation through the implementation of a plan of action, within the context of the IMSS' RCBER health care system. Here, a closed cycle is obtained, indicating both the learning-process of the methodology and the "exposure" of human activity systems to environmental constraints.

The second direction is related to the contribution with insights for the design/creation of an "information system" for IMSS' RCBER. Enriched with other methodologies/procedures, such "system" leads to the use of relevant data/information by its users; again leading to a closed cycle in the model.

The third, long-term direction is related to the conformation of the basis where further research can be conducted on the impact of information on quality of health, at the structure, process, and outcome levels. It is the aim that the results of such

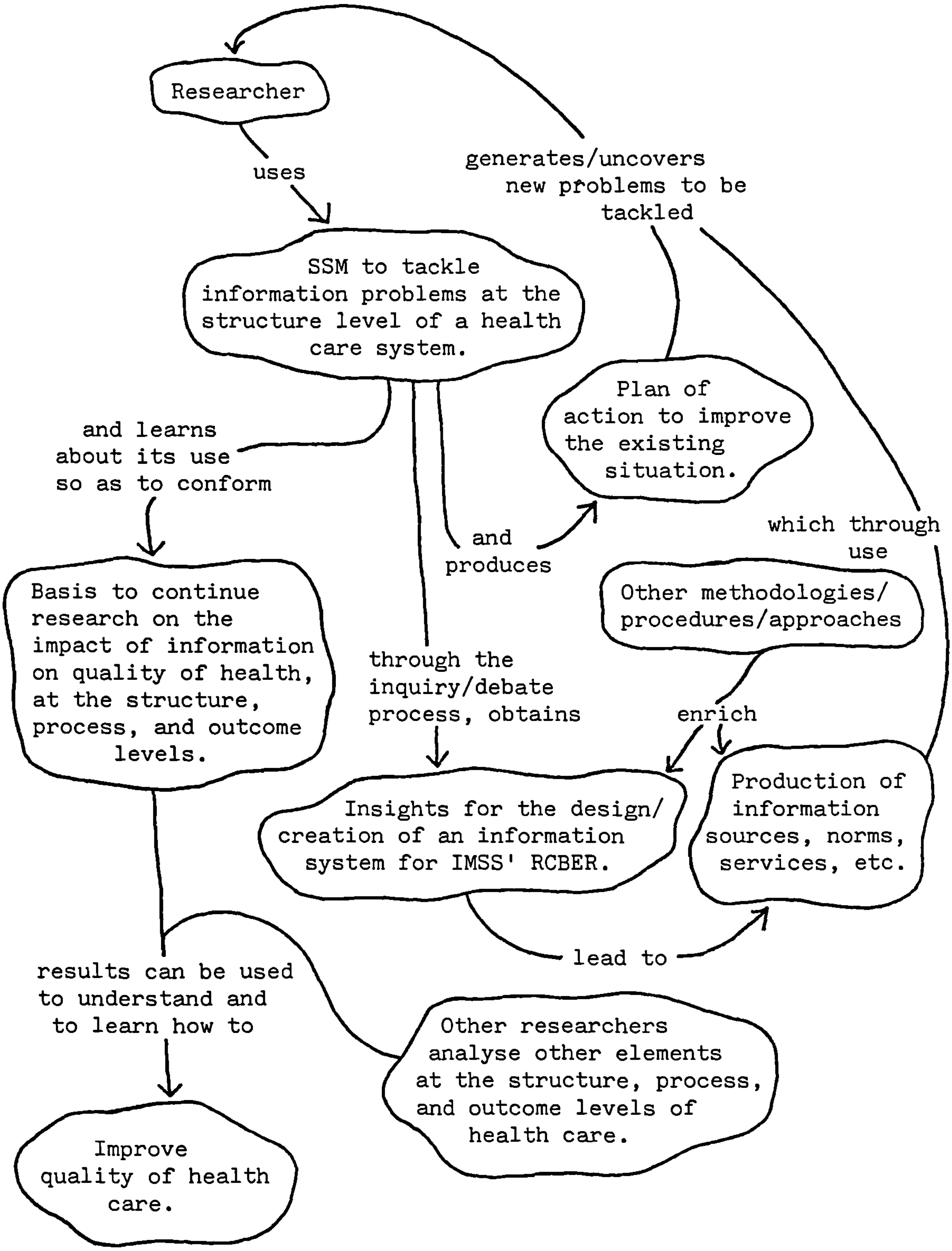

Figure 5-3. Contributions of this research.

research, as well as the contributions of other researchers analysing different elements, would lead to improvements in the quality of health care.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION.

This chapter presents the conclusions and recommendations derived from the research. The conclusions reflect not only the interpretation of the results as found in this study, but also, the interpretation of the literature that was reviewed for this purpose.
A total of 22 conclusions are described. In a separate section, the general recommendations and the lines for further research, as proposed by the author, are described.

6.2 CONCLUSIONS.

1. In dealing with complexity, a systems approach is complementary to the reductionist approach. The problems of managing "health systems" can no longer be dealt with piecemeal by components within the "system" suboptimizing without regard to the performance of the

overall "system". Likewise, Integration and co-ordination can only be acquired by looking at different components in interaction.

2. Elements of structure, process, and outcome need to be identified, defined, and monitored in order to assess quality of health care. In order to assess the impact of information on quality of health, information needs to be not only "available", but also "used" as a resource. In this context, specific, short-term, rather than general, long-term goals are easier to measure both, in health and information "systems".

3. Much of the analytical work in the so-called "health systems" has taken place at the operational level. Accordingly, the information/decision processes are usually supported at the operational/managerial level. The information bases for decisions at the structure and policy level however, require further analysis and research.
Indeed, plenty of research and development exists on the "information needs" and "use" at the process-outcome interaction in "health care systems" and models. Research at the structure level is practically nonexistent.

4. Social, economic, and political factors have been reported to affect both, health and information

"systems". This applies to either developed or developing countries. Before this work was carried out, no studies had been reported on the problems that affect information use and productivity at the structure level of health care.

5. Substantial efforts have been dedicated to the analysis, development, and refinement of methodologies for problematic situations. Reductionist efforts have investigated specific methodologies. Of equal importance is the consideration of a wholistic approach to methodology, whereby various methodological approaches are linked or integrated into a system that reflects the wide variety of situational classes that may exist.

6. The methodologies that draw on the systems approach in the present day include Soft Systems Methodology and Viable System Model. These stress the human and organisational components of human activity systems. There is a recognition in these approaches that organisations are complex and unclear. Their philosophy lies in their attempt to understand the organisation wholistically, analysing the structure of organisations as a whole and from many viewpoints.

7. Given a set of methodologies, there is no "universal" acceptance for their approaches. Rather, the assembly of the methodology needs to be

appropriate to the situation and to the particular personality of the analyst. Thus, the analyst should choose that methodology which "works" for him and which of course, produces results which the organisation will agree are useful.

8. In this research, a problem situation regarding information access and use was identified at the structure level of a health care system. More specifically, the problem focussed on the value and impact of scientific and technical information, as assessed by IMSS' RCBER to perform their daily activities on the co-ordination of education, training, research, and library services. Factors affecting information use needed to be also identified.

9. Soft Systems Methodology was chosen to carry out this research. This allowed not only to "understand" and "learn" about the problem, but also to produce a plan of action to improve the existing situation.

10. The "expressed" problem situation was the following: Do IMSS' RCBER value scientific and technical information so as to use it as a resource to conduct their activities; increase their productivity; i.e., impact the structure level of health care?. Which are the factors affecting such information use?.

11. The selected root definitions of relevant systems were: (1) the "education system"; (2) the "research and development system"; (3) the "library system"; and (4) the "information system". CATWOE elements were identified for each root definition, and different models were constructed at different levels of resolution.

12. A consensus, "primary task" model was built. The following six activities were found indispensable to make the model coherent: (1) co-ordinate the planning programmes; (2) co-ordinate the implementation of norms; (3) use scientific and technical information; (4) co-ordinate the implementation of the programmes; (5) co-ordinate the monitoring of the planned programmes; and (6) evaluate the programmes' results.

13. Validation of the consensus model was performed against Checkland's formal system concept and other systems thinking.
Wilson's Maltese Cross was used as a tool to identify information inputs and outputs, as derived from the activities in the consensus model.
This technique helped to design a questionnaire through which information inputs and outputs could be collected. The technique was also helpful in identifying the existing barriers to information

access and use, as experienced by RCBER.

14. A comparison of the conceptual model with the expressed problem situation was performed through structured interviews. A questionnaire was personally applied to 36 RCBER throughout Mexico.

15. In general, it was found that while 100% RCBER agreed with the consensus model, 25% do not follow it completely in practice. This was particularly manifest when (1) using scientific and technical information; and (2) evaluating the programmes' results. These findings provided insights to carry out further research.

16. A descriptive diagnosis of the role of scientific and technical information among RCBER was obtained. RCBER value information as an important resource to carry out their every day activities. They also regard information as a product. However, confusion still exists as to "how" to value information. On the other hand, a pattern of strong reliance on intra-institutional information sources was found.

17. While personal, source, and environmental factors were found to affect information access and use, the most frequently referred barriers were: (1) the lack of a communication channel between the

information source and the user; (2) bureaucracy; (3) lack of time to be spent on searching for information; (4) accessibility of the source; (5) existence of the source; and (6) education on "how to" use information sources.

Since most of these barriers involve processes or procedures, it was concluded that they were likely to undergo changes more rapidly.

18. A comparison of the consensus model with the expressed problem situation generated a debate which led to feasible, desirable changes in the structure, processes and attitudes of the system and its components. These in turn contributed to elaborate a "plan of action" so as to improve the existing situation. Such plan comprised four programmes: (1) diagnosis of the existing situation at lower levels of resolution; (2) structure development; (3) training and continuing education of RCBER; and (4) changes to instruction manuals and procedures.

19. While it was found that information had a positive impact on short-term goals, a conclusion of its impact at the structure level of health care was not possible at this stage. Other factors besides information use and access need to be explored and correlated; information needs and organisational power, for instance.

20. The hypothesis underlying this work was confirmed. The learning obtained in the use of Soft Systems Methodology provided insights to conclude that this methodology is useful both (1) to tackle information problems at the structure level of health care; and (2) to enrich the different concepts of human activity systems that participate in the delivery of health care at the structure, process, or outcome levels. This research provided a model to such approach.

21. The results of this work provided valuable insights where to base further research in the design and implementation of "information systems" and services, as well as for the development of policies for the fair use of information.

22. In hypothesis-testing, it was learned that this research produced a novel contribution of the application of systems ideas in the following two areas:

(1) as an inquiry process, or methodology; that is, using SSM simultaneously to (a) tackle information problems at the structure level of health care; (b) obtain a diagnosis of the existing "information situation", as a previous step to "information system design"; and (c) de-institutionalise the inquiry process through the analysis of models in quality of health care; and

(2) In an "area of application"; that is, using SSM to understand and learn about the impact of information use on quality of health.

6.3. RECOMMENDATIONS.

6.3.1 General Recommendations.

1. Soft Systems Methodology can be used to tackle information-problem situations that may arise at any level of a "health care system". Its use at the structure level is highly recommended.

2. The proposed "action plan", as derived from this work should be monitored and subject to future changes according to the impact of new actions and to the development of the system, wholistically.

3. When designing an "information system", a previous diagnosis of the existing situation needs to be performed. It is necessary first to ascertain how people in the organisation perceive their world. This will legitimise certain activity systems as being meaningful to the people concerned.
Soft Systems Methodology can be used to understand and learn about the problems within the organisation. The Maltese Cross can be used as tool to detect information inputs and outputs.

4. Soft Systems Methodology needs to be more "usable" and "transferable" among researchers, managers and practitioners in the health sector. Its dissemination through conferences, meetings and papers is recommended.

6.3.2 Further Research.

1. A new problem emerged from this study: 56% of RCBER are not measuring the impact/effectiveness of their programmes. The immediate question is, why?; then, a problem situation arises: do they know how to measure such impact?; are there standard measurement scales within IMSS?; how does this affect the planning of new programmes? does it affect the process and outcome of health care?. It is recommended that this new problem situation be approached through Soft Systems Methodology.

2. This research explored the role of information on education, research, and library activities at the structure level of health care. The results can be used to enrich the concept of a human activity system both, at the process and outcome levels of health care. A soft Systems Approach is recommended for this purpose.

3. Further research needs to be conducted at lower levels of resolution to identify values as assigned by

RCBER to specific sections of information sources. This is highly recommended to identify information processing procedures. Linkages to factors other than information and to external components of systems at these lower levels of resolution also need to be explored.

APPENDIX 1

QUESTIONNAIRE

SURVEY ON INFORMATION USE AMONG

IMSS' RCBER

NAME ______________________________ DATE _________________

ADDRESS __________________________ TEL. _________________

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____

Please answer the following questions according to the specific instructions. The data gathered through this questionnaire is confidential and personal names wont be disclosed. The results of this survey will be used to establish a diagnosis of the existing situation on the use of information resources, and to present the corresponding proposals to IMSS authorities. The answers should reflect your own personal opinion.

Thank you.

1. In your own view as RCBER, do you agree that your main activities are based on a system model integrated by areas of (a) training, continuing education of the medical and paramedical staff; (b) research; (c) library services; and (d) information organisation and management of (a), (b), and (c) ?.

YES ( ) NO ( )

Please, explain why?.

2. Do you regard it as important to have access and to use scientific and technical information in order to perform the above mentioned activities in the model?.

3. In the figure displayed (here, a figure of the consensus, "primary task" model is displayed throughout the interview), you find six activities that are regarded as relevant to a co-ordinated system of biomedical education and research, where scientific and technical information is used as a resource to increase productivity. Please analyse the model and answer whether you agree or disagree with it. Furthermore, please indicate how similar is this model to the one you are currently using (if any).

There may (or may not) be difficulties, problems, or barriers that affect the use of information to carry out the activities displayed in the model. For explanatory purposes such factors have been classified as follows:

(A) PERSONAL FACTORS, such as (1) education/training on how to use information sources; (2) awareness of the existence of the sources; (3) personal experience/familiarity; (4) lack of a value, as assigned to information; (5) lack of time to be spent on searching for information; or (6) other (not mentioned above).

(B) INFORMATION SOURCE FACTORS, such as (1) existence of the source; (2) accessibility; (3) ease of use; (4) cost; (5) technical quality/credibility; (6) organisation; (7) language; or (8) other (not mentioned above).

(C) ENVIRONMENTAL FACTORS, such as (1) existence of a communication channel between the information source and the user; (2) work role; (3) inter-personal relations; (4) existing policies/politics; (5) external influences; (6) bureaucracy; or (7) other (not mentioned above).

Although not exhaustive, these factors may be used as a guideline to answer questions 4 to 9 below. Should you wish to mention other factors, please do not hesitate to do so.

4. In order to co-ordinate the planning programme on research and education within your jurisdiction (Activity No. 1 in the model), one requires, among other, information regarding the vital statistics, population trends, health status indicators, socio-economic indicators, human resources available, medical equipment available, scientific and technical information sources avilable, and research resources. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Do you have a plan which describes the co-ordination programmes for education, research, libraries, and information, within your jusrisdiction?. If not, please explain, why?

5. In order to co-ordinate the implementation of norms, as related to education, research, and libraries (Activity No. 2 in the model), one requires, among other, information regarding the "General Health Law Act"; the instruction manuals on education and research; the national, international, and institutional norms; and the corresponding IMSS manuals. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Do you co-ordinate the implementation of norms on education, research, and libraries?. If not, please explain, why?.

6. In order to use scientific and technical information (Activity No. 3 in the model), one requires among other, access to secondary sources of information; documents, and statistical data on national and international activities on biomedical research and education. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Do you have an inventory of the resources that support your programmes; such as directories, catalogues, research registries, publications produced, conferences attended, technical reports, etc. ?. If not, please explain, why?.

7. In order to co-ordinate the implementation of the programmes on education, research, and libraries (Activity No. 4 in the model), one requires both, the national and institutional "Health Programme Act", and those specifically related to education, research, and libraries. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Do you co-ordinate the implementation of courses?; research projects?; library services?. Do you provide consultancies?. Are research projects being registered?. Are library committees meeting regularly?. If not, please explain, why?.

8. In order to co-ordinate the monitoring of the planned programmes (Activity No. 5 in the model), one requires, among other, data obtained through the monitoring of courses, research projects, and library services. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Do you have an information system on courses, research projects, and library services?. If not, please explain, why?.

9. In order to evaluate the programmes' results (Activity No. 6 in the model), one requires, among other, information regarding standards, indicators, variables to be measured, bibliographic information; and a confrontation between the real and planned results. Please specify for each factor (A, B, or C), the problems, barriers, or difficulties you experience to obtain or use the information needed to carry out this activity.

FACTORS	PROBLEMS, BARRIERS, DIFFICULTIES.
A	
B	
C	

Is there a measurement of the impact/effectiveness of the programmes?. Are there technical reports, conferences, or situational diagnosis?. Are decisions taken, affecting the programmes?. Are proposals for changes submitted?. Are research fields being opened?. Are new problems defined and expressed?. Are there cost-benefit analyses?, etc.. If not, please explain, why?.

10. In your own view, what/which are considered the "products" of your work as RCBER?.

11. Is scientific and technical information a product?. If not, why?. If yes, what is its value?. How do you (would you) measure it?.

12. Within the scale 5 to 10 (minor to major), assign a value to the impact of information use on productivity in your work.

13. PLease rank the information sources that follow, according to their "value" or "usefulness" in decision or action making for each category (Education, Research, and Libraries). Assign a "10" to the source you find most useful; a "5" to the one least useful. You may assign the same rank to more than one source and to more than one category; for example, the source "books" can be ranked "8" to all three categories, or six sources can be ranked "8" under the "Research" category.

	CATEGORIES		
INFORMATION SOURCE	EDUCATION	RESEARCH	LIBRARIES
JOURNAL ARTICLES			
BOOKS			
INTERNAL REPORTS			
EXTERNAL REPORTS			
OFFICIAL DOCUMENTS			
IMSS COLLEAGUES			
COLLEAGUES OUTSIDE IMSS			
LIBRARIANS			
INDEX MEDICUS			
OWN NOTEBOOKS			
NEWSPAPERS			
CONFERENCES			
COURSES			
THESES			
RESEARCH PROJECTS			
WORKING MANUALS			
OTHER (SPECIFY)			

14. Is there an information source which you regularly (3 to 5 times a week) read or use?. If yes, please specify.

15. Do you belong to a local, national, or international association?. If yes, please specify.

16. Have you attended to any local, national, or international meeting, conference, or congress in the last 12 months?. If yes, please explain which, and type of participation (presenting papers, reviewing, attending, etc.).

17. Have you published any papers, books, etc., in the last 12 months ?. Please specify.

18. How long have you been working (a) at IMSS, and (b) as RCBER ?.

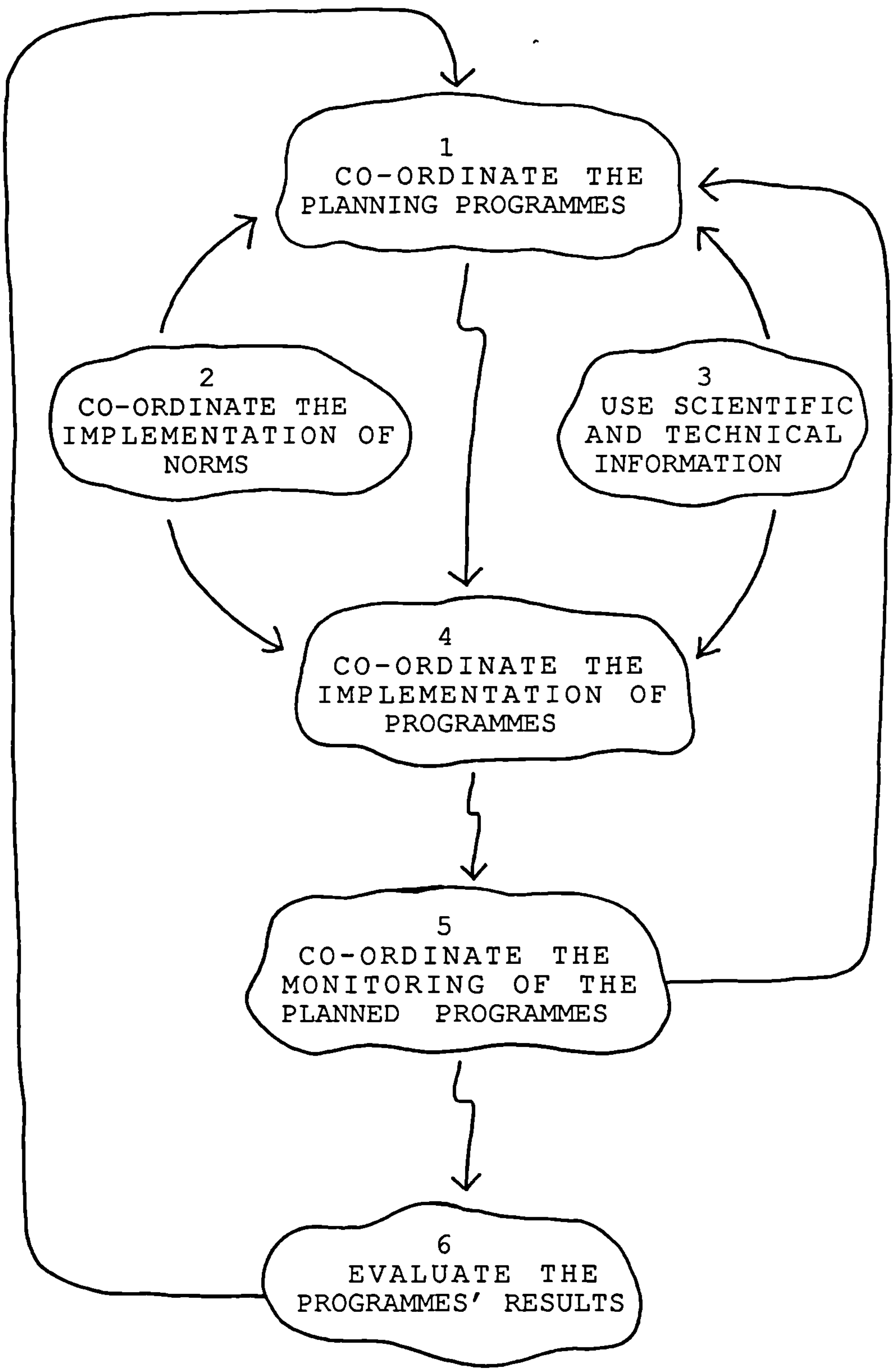
19. What is your highest academic degree or area of speciality, if any ?.

20. How do you satisfy your information needs?.

21. Is there a library or information unit in your organisation?. If yes, how frequently do you use it?.

22. In your own view, what benefits to the health care system are derived from using scientific and technical information ?.

CONSENSUS MODEL



APPENDIX 2

DATES AND PLACES VISITED TO INTERVIEW RCBER

JURISDICTION	DATE (1990)
DDF 1.	19 - 20 April
DDF 4.	27 - 30 April
DDF 2.	3 - 4 May
Leon, Guanajuato.	9 - 11 May
Guadalajara, Jal.	14 - 16 May
Tepic, Nayarit.	17 - 18 May
Colima, Col.	21 - 22 May
DDF 3.	24 - 25 May
Mexicali, B. California.	28 - 29 May
Cd. Obregon, Sonora.	30 May - 1 June
Culiacan, Sinaloa.	4 - 5 June
La Paz, B. California Sur.	6 - 7 June
Villahermosa, Tabasco.	14 - 15 June
Campeche, Campeche.	18 - 19 June
Merida, Yucatan.	20 - 22 June
Chetumal, Quintana Roo.	25 - 27 June
Cd. Victoria, Tamaulipas.	2 - 3 July
Monterrey, Nuevo Leon.	4 - 6 July
Saltillo, Coahuila.	9 - 10 July
Chihuahua, Chihuahua.	15 - 18 July
Durango, Durango.	19 - 20 July
Zacatecas, Zacatecas.	23 - 25 July
Oaxaca, Oaxaca.	30 - 31 July
Tapachula, Chiapas.	1 - 3 August
Jalapa, Veracruz.	7 - 8 August

JURISDICTION	DATE (1990)
Orizaba, Veracruz.	9 - 10 August
Acapulco, Guerrero.	16 - 17 August
Cuernavaca, Morelos.	23 - 24 August
Queretaro, Queretaro.	28 - 29 August
San Luis Potosi, S.L.P.	30 - 31 August
Aguascalientes, Agscs.	3 - 4 Sept.
Toluca, Estado de Mexico.	10 - 11 Sept.
Morelia, Michoacan.	12 - 13 Sept.
Puebla, Puebla.	18 - 19 Sept.
Tlaxcala, Tlaxcala.	20 - 21 Sept.
Pachuca, Hidalgo.	29 - 30 Oct.

APPENDIX 3

ACTIVITIES, INPUTS, AND OUTPUTS OF THE CONSENSUS MODEL, AS DISPLAYED IN THE MALTESE CROSS.

ACTIVITIES

A.1. Co-ordinate the planning programmes.

A.2. Co-ordinate the implementation of norms.

A.3. Use scientific and technical information.

A.4. Co-ordinate the implementation of programmes.

A.5. Co-ordinate the monitoring of the planned programmes.

A.6. Evaluate the programmes' results.

INFORMATION NEEDS

I.1. Vital statistics; population trends; health status indicators; socio-economic indicators; available human resources; medical equipment; scientific and technical information resources; research resources; local teaching institutions; local research institutions.

I.2. National and international policies and norms on education, research, and libraries. Instruction manuals available.

I.3. Primary and secondary sources of information. Statistical information on national and international activities regarding biomedical education and research.

I.4. National and institutional Health Programmes. Institutional programmes on education, research, and libraries.

I.5. Data on courses, research projects, and library services, as provided within the jurisdiction.

I.6. Standards, indicators, bibliographic information, planned programmes, implemented programmes.

OUTPUTS

O.1. Planning of the education, research, and library programmes within the jurisdiction.

O.2. Effective co-ordination of the implementation of institutional norms on education, research, and libraries.

O.3. Inventory of the resources that support the programmes, such as directories, catalogues, research registries, publications produced, conferences attended, technical reports.

O.4. Effective co-ordination of the implementation of training courses, research projects, library services, committee meetings.

O.5. Information system on courses, research projects, and library services.

O.6. Impact/effectiveness of programmes; technical reports; situational diagnoses. Decision making affecting the programmes; proposals for changes; opening of research fields; definition of new problems; cost-benefit analyses.

APPENDIX 4

VALUES ASSIGNED BY RCBER TO 16 INFORMATION SOURCES

A scale 5 - 10 was provided. "10" was assigned to the most useful source; "5" to the least useful. Information sources were valued according to their usefulness in conducting activities related to education, research, and libraries.

VALUE	JOURNAL ARTICLES					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	16	160	27	270	13	130
9	6	54	4	36	5	45
8	10	80	3	24	8	64
7	3	21	0	0	0	0
6	1	6	0	0	2	12
5	0	0	2	10	8	40
TOTAL	36	321	36	340	36	291

VALUE	BOOKS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	17	170	10	100	9	90
9	6	54	4	36	10	90
8	6	48	6	48	9	72
7	4	28	9	63	1	7
6	2	12	2	12	0	0
5	1	5	5	25	7	35
TOTAL	36	317	36	284	36	294

VALUE	INTERNAL REPORTS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	10	100	9	90	8	80
9	12	108	9	81	10	90
8	10	80	9	72	10	80
7	3	21	6	42	3	21
6	0	0	1	6	2	12
5	1	5	2	10	3	15
TOTAL	36	314	36	301	36	298

VALUE	EXTERNAL REPORTS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	5	50	6	60	3	30
9	4	36	6	54	6	54
8	13	104	9	72	7	56
7	8	56	6	42	6	42
6	3	18	3	18	5	30
5	3	15	6	30	9	45
TOTAL	36	279	36	276	36	257

VALUE	OFFICIAL DOCUMENTS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	13	130	15	150	16	160
9	4	36	5	45	5	45
8	11	88	7	56	6	48
7	3	21	4	28	3	21
6	2	12	2	12	2	12
5	3	15	3	15	4	20
TOTAL	36	302	36	306	36	306

VALUE	IMSS COLLEAGUES					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	7	70	6	60	6	60
9	9	81	11	99	6	54
8	13	104	10	80	12	96
7	2	14	2	14	3	21
6	3	18	3	18	5	30
5	2	10	4	20	4	20
TOTAL	36	297	36	291	36	281

VALUE	COLLEAGUES OUTSIDE IMSS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	0	0	1	10	1	10
9	3	27	3	27	2	18
8	13	104	12	96	12	96
7	4	28	4	28	2	14
6	6	36	2	12	5	30
5	10	50	14	70	14	70
TOTAL	36	245	36	243	36	238

VALUE	LIBRARIANS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	8	80	9	90	22	220
9	6	54	12	108	9	81
8	7	56	6	48	3	24
7	7	49	3	21	2	14
6	5	30	2	12	0	0
5	3	15	4	20	0	0
TOTAL	36	284	36	299	36	339

VALUE	INDEX MEDICUS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	13	130	23	230	14	140
9	7	63	5	45	4	36
8	5	40	3	24	10	80
7	5	35	2	14	0	0
6	0	0	0	0	0	0
5	6	30	3	15	8	40
TOTAL	36	298	36	328	36	296

VALUE	OWN NOTEBOOKS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	10	100	9	90	8	80
9	6	54	7	63	7	63
8	7	56	7	56	7	56
7	7	49	5	35	3	21
6	3	18	4	24	3	18
5	3	15	4	20	8	40
TOTAL	36	292	36	288	36	278

VALUE	NEWS PAPERS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	2	20	0	0	1	10
9	2	18	4	36	3	27
8	6	48	4	32	3	24
7	3	21	3	21	3	21
6	12	72	9	54	8	48
5	11	55	16	80	18	90
TOTAL	36	234	36	223	36	220

VALUE	EDUCATION		RESEARCH		LIBRARIES	
	WORKING MANUALS					
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	19	190	16	160	20	200
9	8	72	7	63	7	63
8	4	32	5	40	3	24
7	2	14	1	7	1	7
6	1	6	4	24	3	18
5	2	10	3	15	2	10
TOTAL	36	324	36	309	36	322

VALUE	COURSES					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	17	170	11	110	9	90
9	8	72	5	45	6	54
8	10	80	9	72	9	72
7	1	7	4	28	2	14
6	0	0	5	30	5	30
5	0	0	2	10	5	25
TOTAL	36	329	36	295	36	285

VALUE	THESES					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	6	60	11	110	4	40
9	7	63	9	81	8	72
8	10	80	7	56	12	96
7	7	49	4	28	3	21
6	3	18	2	12	1	6
5	3	15	3	15	8	40
TOTAL	36	285	36	302	36	275

VALUE	RESEARCH PROJECTS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	13	130	25	250	10	100
9	6	54	5	45	7	63
8	8	64	5	40	9	72
7	6	42	0	0	4	28
6	0	0	0	0	2	12
5	3	15	1	5	4	20
TOTAL	36	305	36	340	36	295

VALUE	WORKING MANUALS					
	EDUCATION		RESEARCH		LIBRARIES	
	No.	TOTAL	No.	TOTAL	No.	TOTAL
10	19	190	16	160	20	200
9	8	72	7	63	7	63
8	4	32	5	40	3	24
7	2	14	1	7	1	7
6	1	6	4	24	3	18
5	2	10	3	15	2	10
TOTAL	36	324	36	309	36	322

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