Stereotypes of information systems design, a literature review : a research report

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STEREOTYPES OF INFORMATION SYSTEMS DESIGN

A LITERATURE REVIEW

A Research Report

by

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ABSTRACT

Computerized, formalized information systems (CFIS) in organizations are the products of particular approaches to their design - in part at least. In turn, different approaches to design embody particular designer 'worldviews' about the elements of systems design, the concept of the design process, and design criteria.

This thesis argues that three stereotypical approaches to design incorporating particular worldviews can be identified in the literatures which address the design of CFIS in organizations. A survey of the CFIS design literature suggests this claim, and identifies differing levels of 'support' for each stereotype over time. These findings have implications for the practice and teaching of CFIS design and provide a basis for further research to examine the relative success of differing approaches to CFIS design.

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CHAPTER 1
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1.1 INTRODUCTION

This report explores the existence of typical 'approaches' to the computerization of information systems (CFIS) in organizations referred to as 'design stereotypes'. The existence of three such stereotypes is tested via two literature surveys; one survey treats a general[1] literature on design; and the other treats a more specific literature on approaches to aspects of CFIS design. Together, both surveys probe the existence of design stereotypes.

The research contained in this report is based on the following premises:

(a) common 'approaches' to CFIS design exist and can be identified;
(b) each common approach to CFIS design, draws from or is representative of a worldview (or frame of reference) which embodies:

  i) the elements seen as relevant and applicable to the design task;
  ii) a concept of what constitutes the design process, and
  iii) criteria as to what constitutes good design practice (that is, their "norms" for good design).

It will be argued that particular configurations of the elements of design and concepts and criteria of the design process can be constituted as stereotypes of design in this field. In any particular design situation, then, the design approach used is likely to utilize one of three stereotypes of design. The research described in this report is directed at identifying and defining design stereotypes. Hence, it provides an essential first step for

further empirical research aimed at identifying the relationship between stereotypes embodied in design approaches, the outcomes of design (the form of the designed system) and the ultimate success or failure of a computerized information system. Note, however that the present research has limited objectives.

The ideas for the research conducted in this report stem from the work of Bostrom and Heinen (1977), Mason and Mitroff (1973) and Checkland (1981). Each of these authors examine, in different ways, the concept that there are alternative frames of reference embodied in the approach taken by designers of computerized information systems. Bostrom and Heinen (1977) discuss this concept in the context of MIS design, Mason and Mitroff (1973) in the context of research into MIS and Checkland (1981) in the way in which a designer will interpret the elements of the problem situation faced.

1.2 ORGANIZATIONAL INFORMATION SYSTEMS ARE OFTEN FORMALIZED AND COMPUTERIZED

Information is important to organizations and is used in a variety of ways by a variety of organizational participants. For example, Mintzberg (1972) provides case studies of the importance of information to organizational management. He observes that "top" managers spend "about half" of their total time in receiving, generating and restructuring, using, and disseminating information and that they act as a "nerve centre of organizational information" (1972: 93). (The ways in which information is used in organizations and some reasons why information may be important are discussed in Section A of Appendix 1.)

Given the importance of information for individual functioning and for organizational functioning organizations are likely to invest resources to increase their capacity to gather and use information. The establishment of formal information systems is evidence of such investment. (The

purposes of formalization, informal systems and the process through which formalization occurs, and the impact of formalization on information systems are described in detail in Sections B, C and D of Appendix 1.)

Formal information systems also may be 'computerized' - that is, one or more computers may be used in the activities of the information system - information generation, processing, storage and output dissemination. The process of computerization involves the selection of computer hardware and the design and implementation of computer software to utilize that hardware.[2]

The use of computer technology (hardware and software) adds further complexity to the task of developing formalized information systems (FIS): technological factors must be considered and a new group - computer specialists, are often added to the previous group of participants in the system - those who generate, interpret, store and disseminate the output of the information system. The computerization process can result in either a conscious or unconscious redesign of the operations of a FIS, or it may leave it unchanged.

1.3 DESIGN QUESTIONS

In the process of computerizing FIS a number of questions must be addressed, either directly or indirectly.

Examples of such questions include:

- What degree of formalization should be designed?
- What purpose is the computerization intended to achieve?
- Of the large amount of information / data available, generated from both internal or external sources, what should be collected?
- How should the coding or categorization of information be performed?

- Of the large number of entities (individuals and groups) both internal and external to the organization, which ones should be involved in the design, operation and use of the CFIS?

Arguably, the fundamental design questions (DQ) are:

1. WHAT is to be designed?
2 HOW is it to be designed?
3. WHY is it being designed?
4. FOR WHOM is the design being performed?
5. BY WHOM should the design be performed?

1. WHAT IS TO BE DESIGNED?

The answer to this question is a "computerized formalized information system to operate within an organization". In this context a knowledge of what is to be designed requires an understanding of what activities / processes / structures / people constitute an organization, what constitutes an information system and what constitutes formalization.

To help obtain this understanding the constructs, organization and information system are briefly examined in Sections E and F of Appendix 1. (The concept of formalization has already been discussed.)

2. HOW IS IT TO BE DESIGNED?

This question relates to beliefs about how the act of design takes place. It asks: What tools and techniques are used to perform (and implement) the design? Alternative concepts of the CFIS design process are introduced in Section 1.4 and discussed in detail in Section G of Appendix 1.

3. WHY IS IT BEING DESIGNED?

This question relates to the objectives of the system being designed or of the design process itself. It can be argued that CFIS are designed to achieve one or

more purposes; for example, to improve the information processing capacity of the organization to enable it to be more effective in meeting its goals through successful co-ordination of its activities (Galbraith, 1977: 49). A number of other possible reasons for formalizing information systems are listed in Section B of Appendix 1.

4. FOR WHOM IS THE SYSTEM BEING DESIGNED?
The answer to this question relates to the possible varying views of who should constitute the 'designer's' client or referent group, (that is, the individual(s) or group(s) the designer believes the CFIS is to be designed for). The belief held about the constituents of this group may vary with the design approach adopted.

5. BY WHOM SHOULD THE DESIGN BE PERFORMED?
This question relates to the possible individual(s) or groups(s) who may design the CFIS. Its answer could also vary with the particular design approach adopted.

These questions will be considered further in Chapter 2.

Attempts to answer these questions have produced a variety of systems to serve different application needs, as well as a diversity of design outcomes in the form of CFIS, to serve similar or identical application needs. That is, when faced with a given problem, different designers, or groups of designers, have generated different outcomes in their attempts to answer the design questions posed above.

Some common examples of existing CFIS are management and financial accounting and related systems - such as general ledger, accounts payable, accounts receivable, inventory, purchasing, asset monitoring, sales analysis, marketing support, personnel, payroll - and manufacturing production control and distribution systems - such as material

requirements planning, production scheduling, product costing.

1.4 DESIGNER WORLDVIEWS

It is proposed in this report that the frames of reference embodied in the approaches taken by CFIS 'designers', will determine the way in which the fundamental design questions will be answered in particular situations.

The concept that CFIS designers utilize a frame of reference or worldview when approaching a design situation has been discussed previously.

Bostrom and Heinen (1977) argue that problems and failures in MIS are caused by organizational and behavioural problems, and that these, in turn, result from inadequate system designs. They state:

> "These bad designs are attributed to the way MIS designers view organizations, their members and the function of an MIS within them, that is, SYSTEMS DESIGNERS' FRAMES OF REFERENCE[3]." (1977: 17)

They discuss factors which they believe reflect the composition of system designers' frames of reference. These include:

1. Systems designers' explicit theories about people, organizations and the change process.
2. Systems designers' concept of responsibility.
3. Designer frameworks regarding variables effected by the design process.
4. Goal orientation of the designer.
5. Design referent group - who is the user?
6. Views on decision making models and organizational change.

Mason and Mitroff (1973) discuss the importance of the frame of reference used when developing or performing research into MIS. These authors identify the key variables comprising an MIS and argue that research and development of MIS had assumed only one or two states per variable. They argue that the study or development of MIS has been too limited in its consideration of these key variables and the consequence has been that the concept of MIS has suffered. These authors argue (without actually using the term 'frame of reference') that the research into and development of computerized information systems (in this case MIS) has been performed through an inadequate frame of reference. They identify and discuss what they believe are the five key MIS variables and some possible alternative states for each. The variables are:

1. The psychological types of system designers and users.
2. The class of problems that may be encountered, that is, structured, semi structured or unstructured.
3. The method of evidence generation (for example, data modelling).
4. The organizational context or organizational class of problem.
5. The mode of information presentation.

Checkland (1981), discusses the concept of designer worldviews in the context of information systems design. The term "worldview" is a way of describing the designer's set of values, beliefs and assumptions and is seen to determine the frame of reference which the designer will apply to any given CFIS design situation.

Designers' worldviews are shaped by their previous experiences, education and training, their predilections and the design situation encountered. (Although it could be argued that the definition of the term "worldview" is broader than that generally ascribed to a "frame of

reference", the two terms will be used synonymously in this report when describing the determinants of the CFIS designers approach to design tasks.)

Checkland (1981) also discusses the possibility that the worldview of each CFIS designer may be different. He supports this contention as follows (1981: 191):

- (computerized) information systems serve human activity systems (HAS);
- when designing an information system the designer must first be able to describe the HAS (possibly through a conceptual model);
- however, HAS (because of their complexity, ambiguity and dynamic nature) "... can never be described (or 'modelled') in a single account which will be either generally acceptable or sufficient ... there may well be as many descriptions of it as there are people who are not completely indifferent to it." (1981: 191);
- each description will only be meaningful according to a particular view of the world (worldview) "...because human beings can always attach different meanings to the same social acts." (1981: 214).

It follows that each designer, because they have their own view of the world could interpret a given CFIS design situation (because it takes place in the context of a HAS) in a different way and therefore approach the design task in a different manner.

Based on the discussion above the components of a designer's worldview may be categorized into (a) the assumptions and beliefs held by the designer as to what elements are relevant to design, (b) the concept of the design process they hold, and (c) their beliefs about what are the criteria of good design. Together these components determine the approach taken to design tasks.

Some examples of possible elements of design are:

i) who is responsible for the computerization process (the designer, the client or the referent group) (Bostrom and Heinen, 1977);
ii) the intended goals of the system (Bostrom and Heinen, 1977);
iii) the decision making model that is to be used for the design and that will be employed by the users of the CFIS (Mason and Mitroff, 1972);
iv) the nature of the environment in which the system will operate (Bostrom and Heinen, 1977);
v) the psychological types of the intended system users (Mason and Mitroff, 1972); and
vi) the most suitable mode in which information should be presented (Mason and Mitroff, 1972).

There are a number of alternative concepts of the design process that could be adopted. Arguably, these may be of three types:
(a) design as an intellectual process,
(b) design as an iterative process, and
(c) design as an operational / interactive process.

These three views can be distinguished both by the extent to which design is seen to be a planned process and by the direction in which the design activity occurs.

Designed changes may be viewed as taking place as the result of a totally planned process at one extreme (intellectual) or a form of natural selection at the other extreme (operational / interactive); in this latter case design is seen to occur as a result of interaction between participants in the organizational / social system experiencing change. In other words CFIS design may engender organizational / social change, or such change may constitute CFIS design (or at least engender such design).

In addition the direction in which the design activity takes place may be viewed differently. For example, design

may be seen to be a 'one-way' logical (intellectual) process (either intuitive, as described by Leavitt (1976), or analytical) or design may be seen as a two-way (iterative) process between the designer and those involved in the designed system (Fox et al, 1976). Again, design may be seen as taking place as a result of multidirectional interaction between all organizational participants.

(For detailed discussion of these three concepts of the design process see Section 1G of Appendix 1.)

Some examples of possible criteria of good design are:

i) a design which embodies the worldviews of all 'participants' in the design, or 'designers' and 'users' (Checkland, 1981);

ii) a design which assumes system users can be given a great deal of personal control over their activities (Bostrom and Heinen, 1977);

iii) a design which optimises task accomplishment through the technical system (Bostrom and Heinen, 1977);

iv) a design which improves the quality of working life (QWL) of organizational participants (Bostrom and Heinen, 1977).

1.5 DESIGNER WORLDVIEWS MAY BE STEREOTYPED

It has been observed that designer worldviews are embodied in approaches taken to concrete design tasks. Particular configurations of worldviews (elements, concepts of process, criteria) may recur typically across the approaches to a range of design tasks. These recurring configurations will be labelled stereotypes here. The existence of such stereotypes may be found

(a) directly in discussions of the question of worldviews of design, or

(b) as trace elements (traces) of approaches identified in, or advocated for design.

The body of literature containing the work of Bostrom and Heinen (1977), Checkland (1981) and Mason and Mitroff (1973) discusses worldviews and frames of reference which are applied in the design process. In so doing it directly identifies particular configurations of elements of design and concepts and criteria of the design process; that is, particular design stereotypes. This "general" literature provides the basis for the elaboration of the three design stereotypes within this report.

In contrast, the CFIS design literature rarely identifies the notion of worldviews or the concept that a number of different, and possibly conflicting worldviews could exist. Instead it tends to make assumptions about how CFIS design situations would or should be approached and concentrates discussion on one or more elements of the design process.

Underlying such discussion are assumptions that one of a small number of common approaches (for example, the Systems Development Lifecycle Methodology) would be adopted.

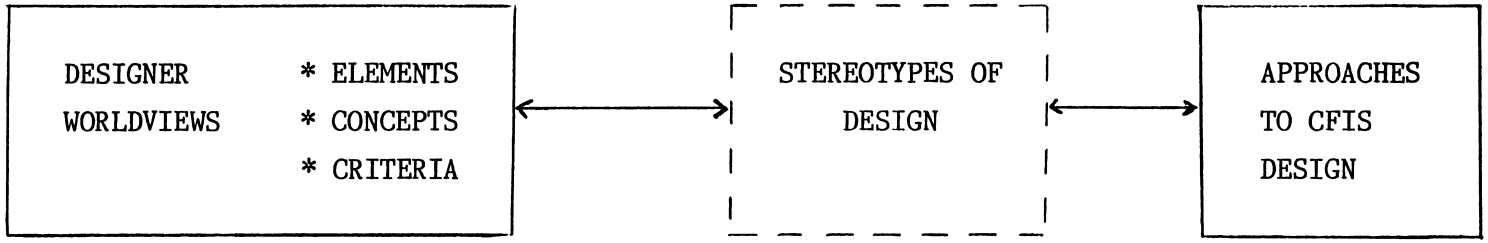
These common approaches to design can be viewed as traces of design worldviews, embodying different clusters of elements, concepts of process and criteria. Designers who use similar design approaches can be viewed as having similar worldviews. The holding of similar worldviews, in turn, can be viewed as evidence of stereotypes in design.

It is possible that the worldviews of each CFIS designer may be different. However, this is unlikely - as there are a number of reasons why singularity in approach, or stereotyping of worldviews would be likely. The literature on CFIS design reinforces some approaches only, as does CFIS design education. Professional standards also tend to reinforce 'preferred' approaches or at least codify them.

Stereotyping, then, 'intervenes' between designer worldviews and design approaches. This is illustrated in Figure 1.1. It

FIGURE 1.1

STEREOTYPES OF DESIGN



is produced both by repetition in practice and the social endorsement of certain intellectual traditions, and it may change both through practice and social renewal. The exploration of such processes, however, are outside the scope of the present study.

1.6 TESTING FOR THE EXISTENCE OF DESIGN STEREOTYPES

The "general" design literature describing particular worldviews will be linked to the specific CFIS design literature, which discusses elements of the CFIS design process, through the elaboration of three design stereotypes and the research conducted to provide support for their existence. The problem of this research, then, is to link the two types of literature in a manner which enables support for the three DS to be established.

In Chapter 2 the three design stereotypes, which arguably represent the major approaches discussed or assumed in the 'general' literature on design are elaborated. In Chapter 3 the mechanism for linking these stereotypes (configurations of worldviews) to the CFIS design literature - the description of a set of design elements against which each CFIS design reference (book or article) can be compared - is described. The research method employed to provide support for the existence of these stereotypes is detailed in Chapter 4, where the design elements are used to form the set of questions against which the CFIS design literature was compared. The results of the research are presented and discussed in Chapter 5, which examines the level of support found for each stereotype, the degree to which it has varied over time and whether there is an indication of editorial support[4] for any of the stereotypes. The examination of these three areas provides an elaboration of the nature and substance of support for each stereotype which assists in the interpretation of the results of the CFIS design literature survey. Finally, in Chapter 6, conclusions are drawn from the results of the research and

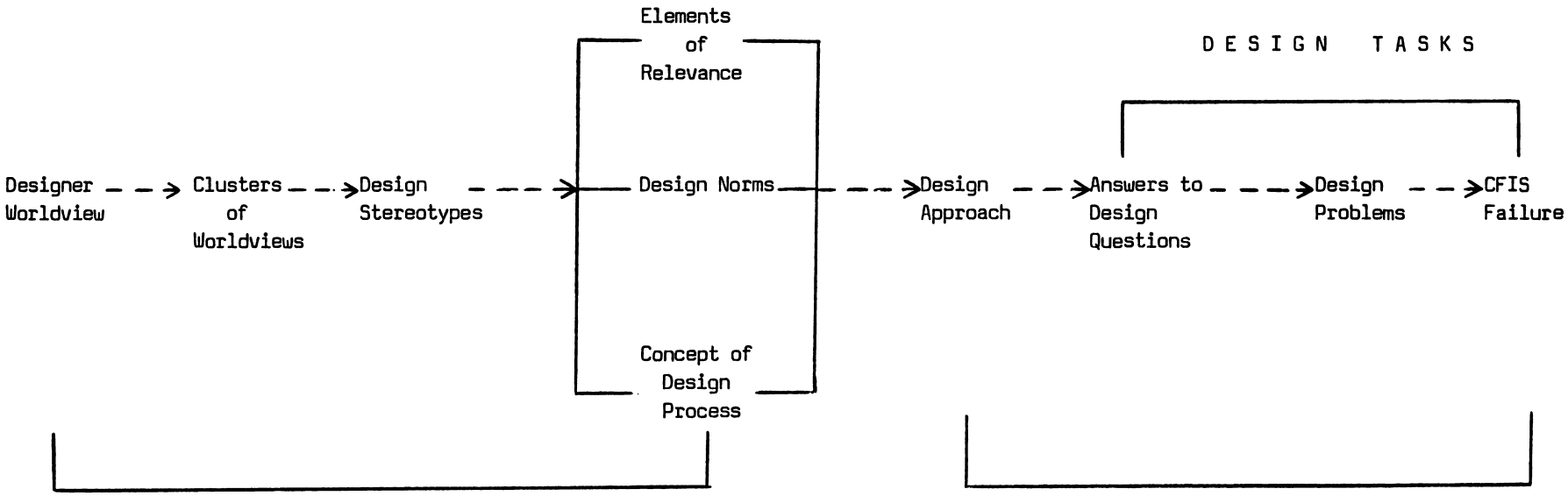
future research, designed to examine the relationship between the design stereotype observed and the design outcome produced, is discussed.

1.7 SUMMARY

An illustration of the arguments presented in this Chapter is provided in Figure 1.2. Stage 1 of this diagram shows that designer worldviews are seen to cluster to form common or stereotyped approaches to CFIS design. The components of these stereotypes are the design elements considered relevant, the norms for good design and the designer's concept of the design process. The section labelled 'Subsequent Research' illustrates the relationship theorized in this Chapter between the Design Stereotype adopted, the design outcome and the success or failure of the designed CFIS.

FIGURE 1.2

THE INFLUENCE OF DESIGN STEREOTYPES ON DESIGN OUTCOMES



Stage 1

- Theorized Design Stereotypes
- Empirical support for the existence of these Design Stereotypes

Subsequent Research

Theorized Relationship Between Design Approach, Design Outcome and Design Failure.

NOTES TO CHAPTER 1

1. The phrase "general literature on design" in this report refers to the body of literature which discusses design as a topic. This focus may constitute discussion of the concept or process of design itself or as it is applied to a particular field of the physical or social sciences. For example, the design or organizations, or the design of computerized formalized information systems. Work considered to be in this category and surveyed in this report included that of Churchman (1971), Argyris (1972; 1980), Galbraith (1973), Mason and Mitroff (1973), Argyris and Schon (1977), Bostrom and Heinen (1977), Hedberg and Mumford (1977), Pfeffer (1978), Cummings (1978), Boland (1981), Checkland (1981) and Schon (1981).

   The phrase "specific literature on approaches to aspects of CFIS design", on the other hand, refers to that body of literature which focuses on computerized formalized information systems rather than the concept of design. The literature in this category is described in Chapter 4 and those references surveyed in this report are listed in detail in Appendix 2.

   These bodies of literature may overlap where a reference discussing the concept or process of design also deals with the application of that concept or process to computerized formalized information systems.

2. "Design" in this context means all the stages of computerization except implementation. It includes - the study of information requirements, the examination of feasibility, software program and file design, program specification, programming and the testing of the completed system.

   "Implementation" describes the action of providing a functioning computer system to its identified users, educating them on how to operate the system and placing the system into use.

3. Emphasis added by author.

4. The term "editorial support" is used in this report to refer to journals which appear to include articles which favour or propose the views of one particular design stereotype to the exclusion of the other two. The term implies bias on the part of the editors of the journal.

CHAPTER 2
CFIS DESIGN STEREOTYPES

2.1 INTRODUCTION

The Chapter describes and distinguishes the three design stereotypes identified in discussions of worldviews in the "general" literature on design. Although this literature was not surveyed in the same manner as that described in Chapter 4 for the CFIS design literature a wide range of references from the areas of system theory and organization and social systems theory were surveyed. (Examples of these are provided in Footnote 1 of Chapter 1.) In detailing the substantive features of each stereotype, the Chapter provides the basis for the review of the CFIS design literature conducted in this report.

Briefly, it will be shown that there is support for the existence of three stereotypes, here labelled as follows:

1. The Computerized Information Systems Technical (IST) Approach
2. The Organizational / Behavioural Factors (OBF) Approach
3. The Interface (INT) Approach

These stereotypes are based on two commonly accepted and conflicting design philosophies (Stereotypes 1 and 2) and the theory, research and practice which attempts to reconcile, or balance, these approaches (Stereotype 3). The first two types are identified by Lucas et al (1980) in their preface to a set of papers from the IFIP[1] Working Conference titled "The Information Systems Environment" and the third type is typified by these authors in the way they identify the need to draw the two opposing approaches together. They state:

> "The conference ... indicated the gap which exists between the opposing design philosophies apparent to-day. At the one end of the spectrum are the technologists who place the hardware and software requirements first (Stereotype 1). At the other end of the spectrum are those who feel that

> human and organizational factors are the most important (Stereotype 2). Whilst this distinction has been apparent for many years, the conference illustrated again how difficult it is for designers who follow one extreme to come to terms with the necessity of taking other design criteria into account" (1980: p.xix) (the concern of the group categorized as Stereotype 3).

2.2 THE COMPUTERIZED INFORMATION SYSTEMS TECHNICAL (IST) APPROACH - STEREOTYPE 1

2.2.1 INTRODUCTION : IST APPROACH AND SUPPORTERS

The orientation of this approach is illustrated by Point 1 in Figure 2.1 which shows the design effort focusing entirely on the computerization aspects of the information system to the exclusion of organizational[2] considerations.

'Theoretical' support for the existence of a common approach to CFIS design of this type is abundant in the CFIS literature - especially that concerned with improving the design and successful operation of CFIS. Some examples, include Boland (1979), Checkland (1981), Bostrom and Heinen (1977), Hedberg and Mumford (1975) and De Maio (1980); all of these authors, however, criticise this type of approach.

Boland (1979) addresses this technically oriented approach in his description of rational analytic or "model based" approaches. He states that it

> "... starts with a statement of system goals and defines the tasks required to achieve those goals. The tasks identified are further reduced to decisions required for accomplishing the tasks, and the decisions are modelled to define information requirements." (1979: 261)

He criticises it by stating that it tends

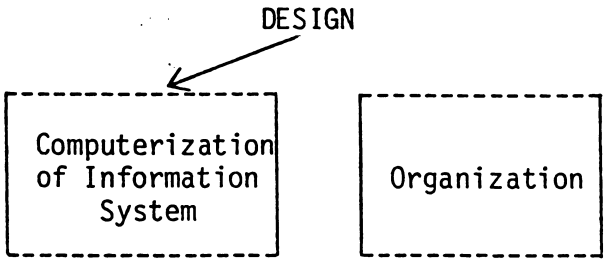
> "... to result on conceptions of the organization as being in a static equilibrium interacting with an environment which is effectively knowable, objectively verifiable and inconsequentially affected by the actions of managers." (1979: 261)

He also implies that this type of approach assumes a static, verifiable environment.

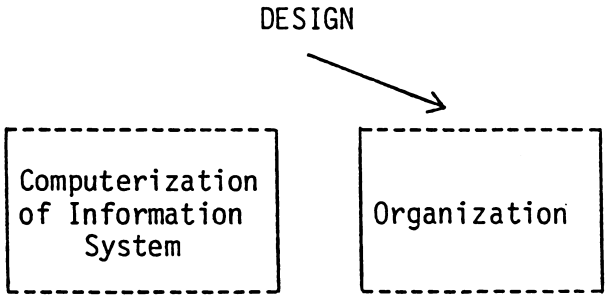
FIGURE 2.1

THE ORIENTATION OF EACH STEREOTYPE

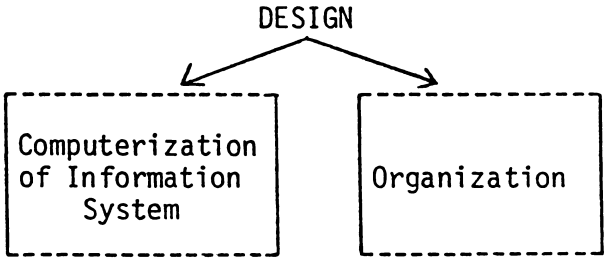
1. TECHNICAL APPROACH



2. ORGANIZATIONAL/BEHAVIOURAL THEORY



3. INTERFACE APPROACH



The major features of this stereotype are akin to those De Maio (1980) describes as the "traditional" or automated information systems analysis and design methods. He states:

"These methods

(a) Pay little attention to organizational facts, because they consider them as marginal and of no influence on the results of the analysis and of the major characteristics of the design.

(b) Define an ideal operating model of a general business by describing the so-called "processes" - considered as a system of activities to be carried out in order to reach the business objectives - leaving the organization completely out of the analysis.

(c) Do not refer explicitly to any theory or organizational approach.

(d) When, at analysis or design time, the organization is considered, dimensions other than the formal organization are disregarded.

(e) Finally, they assume that any organization may be "adapted" in the most appropriate way. In other words, once the information has been planned - regardless of organization - they begin assessing the consistency between the system as defined and the existing organization, i.e., structure and formal procedures. IF A DIFFERENCE EXISTS, ACTION IS TAKEN TO CHANGE THE ORGANIZATION." (1980: 105:6)[3]

The IST category may represent the common worldviews of data processing professionals and theorists (that is, those people involved in the design, development and operation of both computer hardware and software - such as, data processing managers, systems analysts and designers, programmers, operators, computer hardware engineers, computer scientists and those involved in the research into, and teaching of, these subject areas).

2.2.2 AN ILLUSTRATION AND PRIOR CONCEPTS OF THE IST APPROACH

An illustration of an approach to design consistent with the IST stereotype is shown in Figure 2.2. In this approach:

i) Designers are primarily those people with technical expertise (computer systems analysts and systems designers);

ii) They seek well defined requirements before commencing the "design";

iii) They see design as a problem solving, "technical" (software design) activity;

iv) They believe the design process is constrained by factors such as the availability and processing power of computer hardware, whether a Data Base Management System is used[4], and the productivity of available analysis and design techniques (for example, the tools and techniques of structured analysis; De Marco, 1979) and computer languages (for example, the availability of the most recent and most productive high-level computer languages)[5].

v) The system is primarily developed by the designers, with involvement from initiators and users when requirements are initially set, POSSIBLY at a review of the general design, and finally, when the system is implemented.

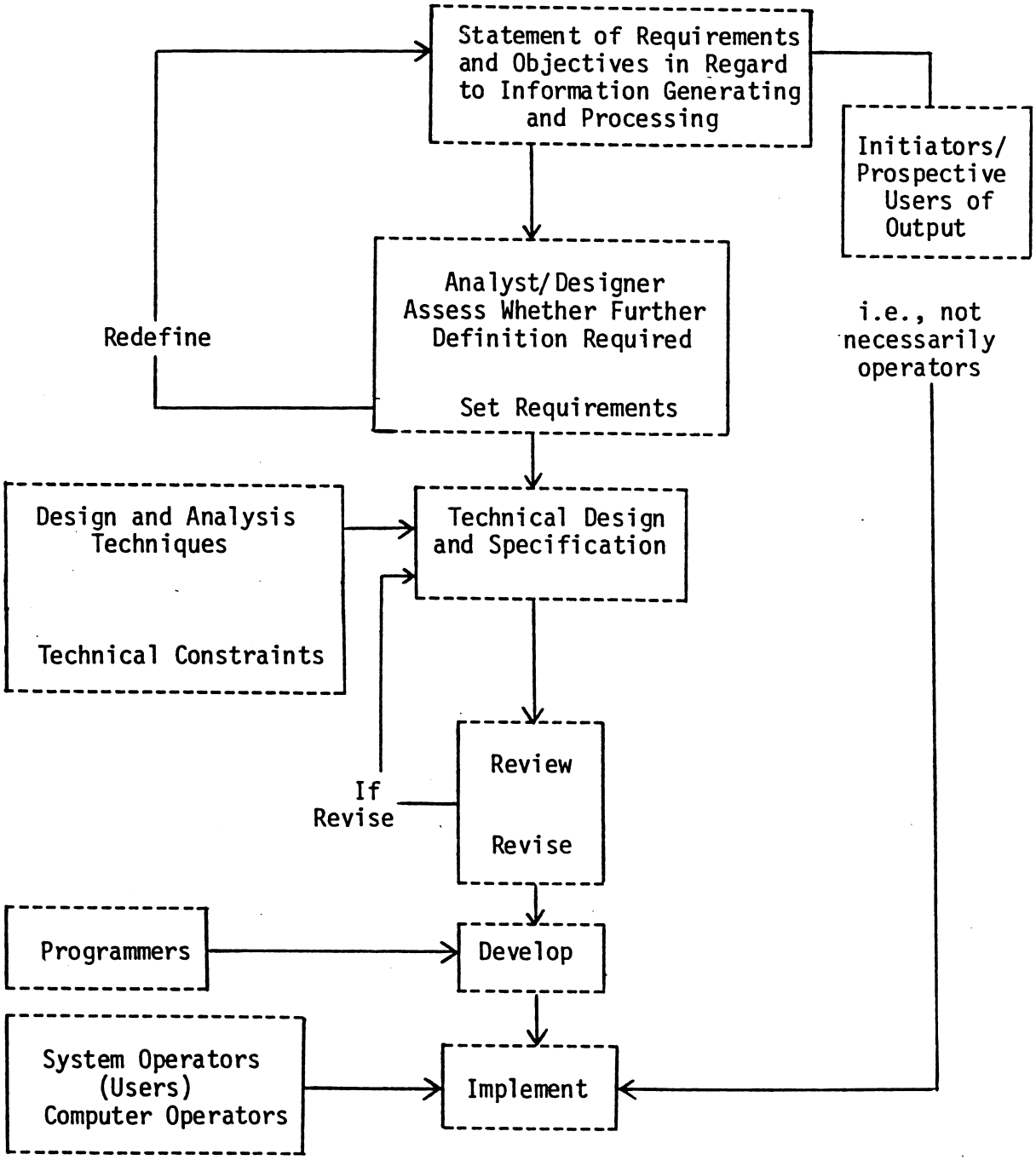
2.2.3 THE "NORM" FOR GOOD DESIGN

The IST Stereotype is characterized by technically oriented system design objectives. The norm for good design is met by those designs which achieve the technical objectives in the process of meeting the data collection, processing, transmission, storage and reporting requirements of the system initiators and users.

The technical objectives relate to hardware and software design and utilization. In general, these objectives are (a) to make the most efficient utilization of available hardware - by performing system processing functions with the minimum use of CPU (Central Processing Unit) time, seek time, disk and core space; (b) to ensure accurate processing, retrieval and transmission of data; (c) to

FIGURE 2.2

AN ILLUSTRATION OF THE IST DESIGN STEREOTYPE



ensure the system is easy to modify and maintain through modularization and through structured programming practices; and (d) to ensure maximum ease of design and standardization of the design process.

For example, De Marco identifies the major characteristics of good design as including those which:

(a) produce systems which are easy to modify;
(b) produce systems which are easy to test and "prove out";
(c) produce design documentation as a natural by-product of the design process;
(d) produce a structure which makes it easy to isolate the effects of any given change (modularization);
(e) used a methodology which caused convergence so that two different designers working on the same problem tended to come up with the same or similar solutions;
(f) used a methodology which caused a degree of partitioning to allow more flexible work allocation; and
(g) used a method which displayed the top-down characteristic so that more senior personnel could work on the architecture of the design, while junior designers worked on the details (1979: 297-8).

Chapin believes that good designs, compared with poor designs, achieve economy in the use of computer resources, run faster with less handling of data and are more easily understood. (1983: 23).

2.3 THE ORGANIZATIONAL/BEHAVIOURAL FACTORS (OBF) APPROACH - STEREOTYPE 2

2.3.1 INTRODUCTION : NATURE AND SUPPORTERS

The orientation of this approach is illustrated in Point 2 in Figure 2.1 which shows the organization as the focus of attention to the exclusion of the CFIS.

The CFIS design process is not the major focus of attention of this Stereotype. In general, the literature relating to organizational theory (OT) addresses the topic of CFIS design indirectly through beliefs about the way in which information processing requirements differ with different organizational structures, through beliefs about the way in which individual organizational participants seek out and utilize information or through the impact of CFIS on these two areas. These sets of beliefs are reflected in the two major categories of theory and research, behaviourism (individualism), and structuralism, contained in the OT literature (Cummings, 1978); Van de Ven and Astley (1981); Pfeffer (1982))[6]. Behavioural theorists and researchers are concerned with the behaviour of individuals and groups within organizations while structuralists are concerned with organizational structure and design issues.

These two schools of thought can be distinguished by an examination of the level of analysis through which each studies activity. Cummings (1978) states that in organizational behaviour (OB) literature the:

> "units of analysis are individual and micro (e.g., dyadic) interactions among individuals. Organizational characteristics (e.g., structure, process, climate) are seen either as "givens" which assume a constant state or as independent variables whose variations are assumed to vary with or cause variations in the relevant dependent variables. These relevant dependent variables are measures of individual or micro unit affective and/or behavioural reactions." (1978: 91).

The unit of analysis is the individual and the focus of study is the two way interactions between individuals, with organizational factors (for example, structure or size) either ignored or assumed to vary with the individual behavioural factors under examination.

It is often assumed that all behaviour in organizations arises from interactions between individuals and that organizations themselves do not "behave". This view is

supported by Weick (1969) and is outlines by Pfeffer (1982).

> "Organizations, and organizational processes, could not be understood except by considering the organizing process[7], and that was a process accomplished through the interactions among people, continually reaccomplished and renewed." (1982: 18).

Behaviouralists believe that studies which view organizations as undifferentiated collectivities can neglect the process occurring within the organizations that produce the results observed. (Argyris, 1972; Collins, 1981). Thus it is assumed that any effective study of organizational behaviour must take place through the analysis of dependent variables at the micro level of individual behaviour (and not at the macro level of the organizational entity).

Structuralists focus on the organization, not the individual, as the unit of analysis. Cummings describes the basis of this position:

> "Organizational structure, process, goals, technology, and, more recently, climate are the relevant dependent variables, assumed to vary systematically with variations in environmental characteristics but not with characteristics embedded within systematically clustered individuals." (1978: 91).

In this view human behaviour at the individual or micro level is not studied. It is assumed that collectivities such as organizations can be understood through the study of macrostructural concepts such as role, formalization, centralization, and organizational structure without necessarily considering the microprocesses that occur within them (Pfeffer, 1982)[8]. For example, Galbraith (1973) considers issues at the organization level including the way in which the capacity of an organization to process information varies with its structure.

This approach implies a view that the organizational entity is more than just the aggregation of the sum of the

individuals and activities that constitute it. This is supported by Mayhew (1980) in his explanation of structuralism.

> "In this view, the individual is never the unit of analysis in either research or theory construction. Rather in this structuralist conception of social life sociologists are studying a communication network mapped on some human population. That network, the interaction which proceeds through it, and the social structures which emerge in it are the subject matter ... In studying organizations, structuralists are concerned with at least two kinds of phenomena : (a) aggregated properties of populations, and (2) emergent (purely structural) properties of organisation itself." (1980: 338).

Some examples of the results of the study of organizations by structuralists include findings such as "size causes differentiation" (Blau, 1970; Meyer, 1972); "environmental uncertainty causes decentralization" (Burns and Stalker, 1961; Lawrence and Lorsch, 1967), and "the degree of routineness of the organization's technology causes the degree of formalization and decentralization". (Hage and Aiken, 1969).

The existence of two such opposing views of organizations and the way they should be analyzed raises the issue of whether a single OBF stereotype view can be identified. It is proposed that it can. The two schools of thought are inter-related and differ in the same way to the other two stereotypes in their focus on the organization rather than the technical aspects of CFIS design, and so their diverse views do not interfere with the differentiation of this DS from the IST and INT. In the terms of the five design questions the two schools of thought within the OBF approach tend to focus on the WHAT, the WHY and the FOR WHOM of the CFIS design process, rather than the HOW and BY WHOM.

This stereotype is proposed to represent the worldviews of organizational theorists and organizational consultants with regard to CFIS design. It is seen to include those

people involved in the study and design of organizational structures (processes), information needs, information processing capacity, tasks and job roles as well as those involved in studying the behaviour of individuals and groups within organizations. That is, it represents those people who believe that the human and organizational variables are the most important considerations in the CFIS design process.

Some examples of this type of approach include the work of Hedberg and Mumford (1975, 1977), Mumford and Sackman (1975), Mumford and Henshall (1978), Mumford and Weir (1979) and Mumford (1981).

2.3.2 AN ILLUSTRATION

The OBF stereotype is illustrated in Figure 2.3, which highlights several important aspects of this approach:

i) The "technical" aspects of CFIS design (that is, hardware/software design and operation) are not directly considered.

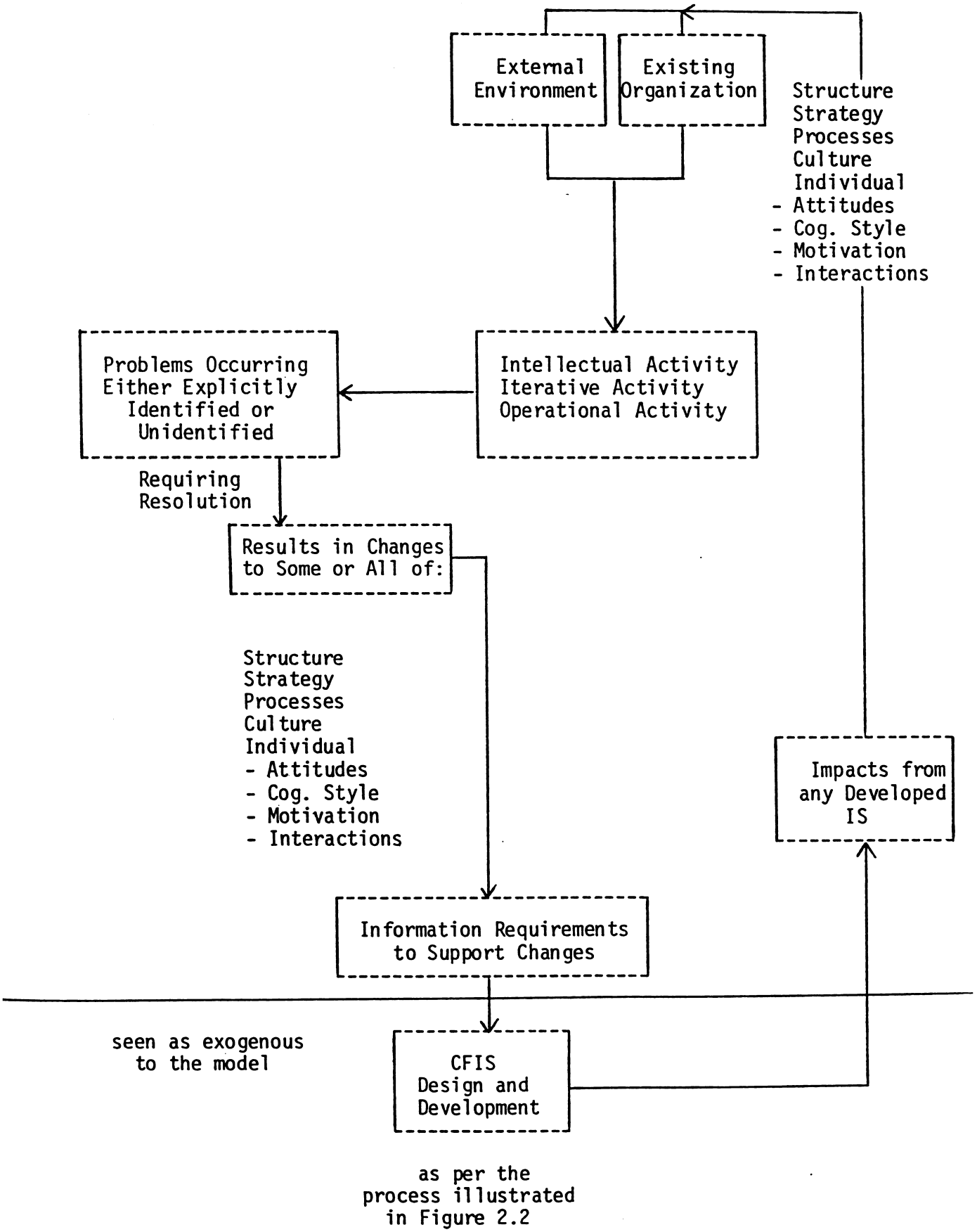
ii) Consistent with point (i), the participants in the CFIS design process are assumed to be organizational designers, organizational theorists, organizational social-psychologists and organizational participants. It is generally believed that the role of the computer professionals is to "implement" the designed solution. The term "implement" in this context covers the activities of hardware selection and software design, development and implementation.

iii) Discussion of information or information processing systems is restricted to general consideration of either -

   (a) the impact of various organizational structures - for example, Bureaucratic, Functional (process), Area Divisions, Product/Service Divisions - Galbraith, 1973; Galbraith, 1977; Tushman and Nadler, 1978; Markus and Robey, 1983; Mintzberg,

FIGURE 2.3

AN ILLUSTRATION OF THE OBF DESIGN STEREOTYPE



1983) and strategies - for example, size, vertical integration, territorial expansion, product service diversification into related or unrelated product areas - (Ginzberg, 1980) on the information processing needs of organizations - the structuralist perspective;

OR (b) the information needs, processing abilities of, and utilization by individual organizational participants with differing cognitive styles (Mitroff and Mason, 1983; Markus and Robey, 1983; Wedley and Field, 1984) at varying levels in organizations - performing various work roles - (Anthony, 1965; Mintzberg, 1973) facing different types of interaction (Weick, 1969; Argyris, 1977) and each, with their own motivations and objectives (Pettigrew, 1975; Pfeffer, 1980; Feldman and March, 1981, Markus and Pfeffer, 1983) - the behaviouralist perspective;

OR (c) the impact on organizational structural or behavioural factors arising from the implementation of computerized formalized information systems.

iv) Design, it is assumed, can occur through an intellectual process, an iterative process or as a purely operational process between organizational participants.

2.3.3 THE "NORM" FOR GOOD DESIGN

The OBF stereotype is characterized by its emphasis on organizational considerations. The norms for good design also contain this emphasis but vary between the two major schools of thought within this approach. Some examples are:

i) The view of contingency theorists (a group which is seen to form part of the structuralist school of thought) is that good designs are those where the developed CFIS enable the organization to achieve the best "fit" of its structure (and the inherent information

processing capacity of that structure) to its environment. Galbraith (1977), for example, argues that organizations need to adjust their information processing capacity to cope with new, emerging situations in their environment. He identifies several strategies whereby the structure of the organization can be changed to allow this "fit" and one whereby the organization can invest in formal information systems (assuming the environmental changes necessitate a need to increase the information processing capacity of the organization). Good designs in this situation would be viewed as those which best allow the required amount of information processing to take place to enable the organization to maintain (or achieve) a "fit" between its structure and its environment.

ii) Argyris (1980), (writing from a behaviouralist perspective), provides a different view of what constitutes good design. He proposes that most management information systems are designed to use information that is objective, precise, generalizable, trendable and comparable. That "... these very features generate conditions of distancing and injustice which, in turn, may lead individuals to distort the information in order to protect themselves." (1980: 15)

In his view well designed systems are those which do not generate such conditions and as a consequence, the need for individuals to distort information flows. Well designed CFIS are seen to encourage rather than inhibit learning through the open flow of undistorted information.

2.4 THE INTERFACE (INT) APPROACH - STEREOTYPE 3

2.4.1 INTRODUCTION : NATURE AND SUPPORTERS

In the last decade (since the mid 1970's) there has been a growing acknowledgement, in computing, organization and management literature, of the importance of considering organizational and behavioural, as well as technical, factors in CFIS design. For example, Landry and Le Moigne state:

> "The massive and spreading invasion of computers into the communication networks of social organizations has stressed the importance of gaining a better understanding of those human organizations with which the computer is coupled. Indeed, until recently, the focus of interest had been on the technological side of the man-machine systems ... However, in the last few years we have come to recognize the limitations of this technology-based orientation as a guide for the conception and development of information systems compatible with the requirements of social organization" (1977: 801).

Information systems and social organizations[9] are considered to be highly interdependent by many writers who hold the view that any redesign of one will affect the other. Bostrom and Heinen, for example, state:

> "... most technical systems design includes some social systems[10] design" (1977: 19), and warn that

> "Failure of (CFIS) designers and users to recognise this fact may lead to many dysfunctional consequences in the social system". (1977: 19).

This view is also supported by Landry and Le Moigne. They state:

> "The social organization and its IS are so embedded together that it is impossible to modify one without affecting the other." (1977: 804).

In this view a changed social organization or "social system" (i.e., the organizational/behavioural factors) will require new or modified information to support its functioning. On the other hand, a change in the Information System is viewed as affecting the way an organization

operates (through factors such as its impact on work roles and information transmission and dissemination channels).

The belief that the organizational, behavioural and technical factors are interdependent, and therefore need to be considered together in the CFIS design process, is the basis of the Interface Stereotype. The orientation of this approach, which contains elements of the two previous approaches, is illustrated by Point 3 in Figure 2.1 which shows both the organization and the CFIS as the focus of attention.

This category is proposed to represent the worldviews of those people who seek to consider both the organizational/ behavioural factors and the technical factors in the design of information systems for management. It is seen to include designers of computerized management information and decision support systems with these aims, and proponents of design methodologies, such as the Socio-Technical Approach (Bostrom and Heinen, 1977), which attempt to interface these areas. It may also include management scientists, accountants, business analysts and organizational theorists, analysts and designers - including organizational social-psychologists.

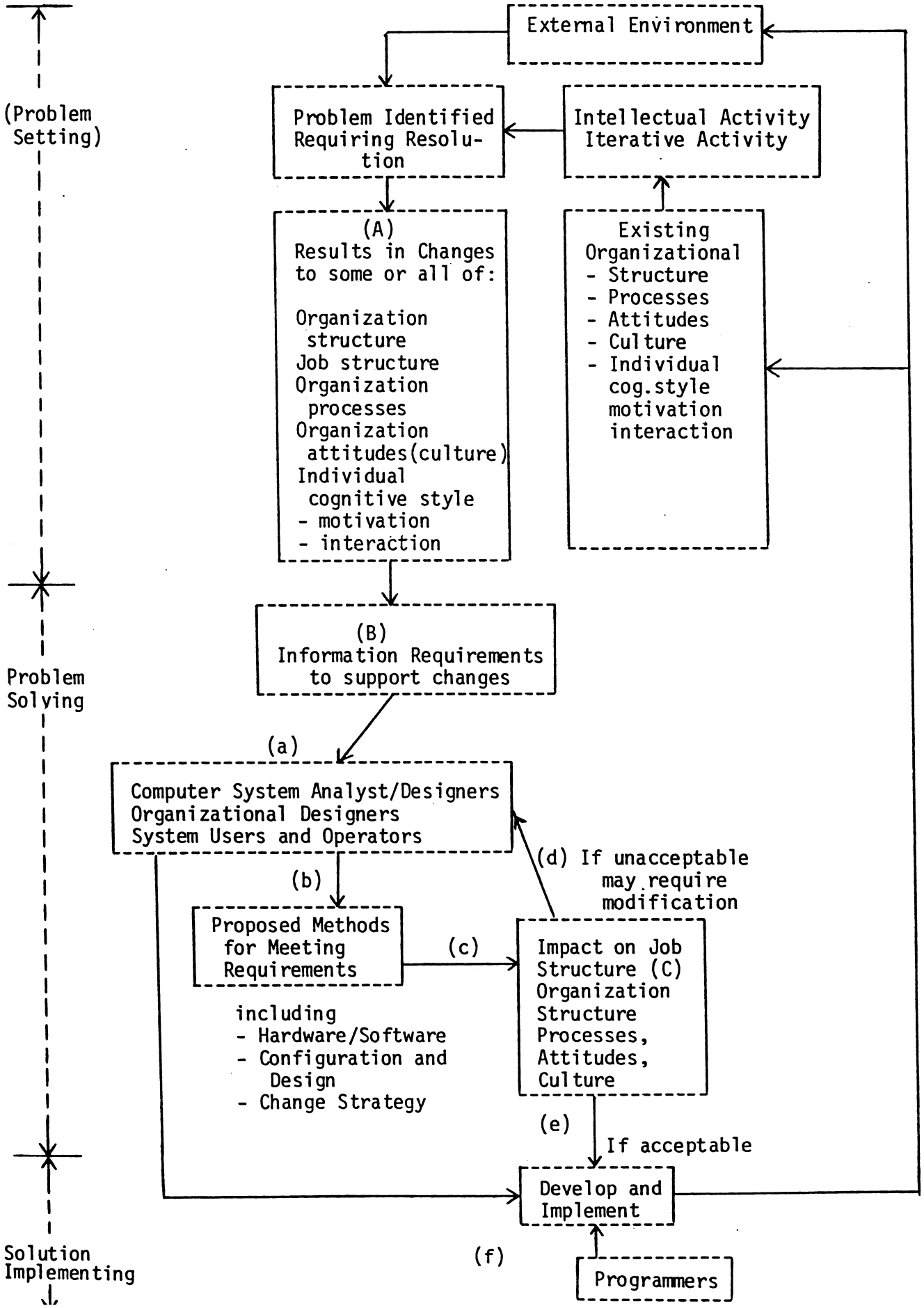
Although it could be argued that there is a degree of overlap between this approach and its supporting literature and that viewed to be supporting the IST and OBF stereotypes, the interface approach can generally be distinguished by its focus on the RELATIONSHIPS between the technical and organizational/behavioural factors - a focus not evident in the other stereotypes.

2.4.2 AN ILLUSTRATION

The Interface Stereotype is illustrated in Figure 2.4, which highlights several important aspects of this approach.

FIGURE 2.4

THE INTERFACE STEREOTYPE - AN ILLUSTRATION



These are:

i) Organizational, behavioural and technical factors are all considered.

ii) Consistent with Point (i) discussion of information or information processing systems includes discussion or organizational structures and strategies, behavioural factors (such as the information needs, processing abilities of, and utilization by individual organizational participants), and technical design factors (such as system and software design methods, development productivity tools and techniques, and available processing power).

iii) The participants in the design process should be all those who will be affected by its outcome - systems analysts/designers, system users and operators (including the providers of data/information input and the users of information output), and organization analysts/designers. Such participation would generally be seen to occur at all stages of the design / development / implementation activity.

iv) Changes in the social organization are generally[11] seen to result in requirements for changes in the organization's CFIS (Box A). However, consequent changes in the CFIS can result in further changes to organization/behavioural factors such as job structures, organizational processes, integrating mechanisms, culture and individual attitudes (Box C). In other words, the two areas are seen to be interdependent.

v) Design is seen to occur through a combination of intellectual and iterative activity which includes the stages of problem setting, problem solving and solution implementation.

vi) Initially, a clear definition of information requirements is sought to allow problem solving techniques to be utilized (Box B). However, it is acknowledged that requirements can, and most likely will, change, up until implementation, as the

organizational implications of the design become apparent. (This iterative cycle is indicated by arrows (a) to (f).

vii) Organizational and behavioural factors are considered a more important constraint, than technical factors, on design alternatives. (The diagram shows how the design cannot proceed onto development until the organizational implications are considered acceptable by those participants involved. (This point is reached at Box C).

It is clear that this approach incorporates many of the aspects covered in the IST and OBF stereotypes. However, it also provides a different, overall, perspective of the design process, one which accounts for the interdependencies between the variables involved, in a way not possible in the 'narrower' views portrayed in the previous two stereotypes.

2.4.3 GOOD DESIGN

Clearly, in this view, good designs are those which account for both organizational/behavioural and technical factors, and their interdependencies. Bostrom and Heinen, for example, believe that good design is achieved by the utilization of those techniques "... that tend to facilitate the improvement of both the social and technical systems" (1977: 29); that is, those which result in improvements in both the quality of work life of the work system's[12] member's and in task accomplishment (through increased productivity or increased quality). (1977: 18).

This emphasis on improvement of the technical and social aspects of the organization is also supported by Tricker, who states that through good design

> "... the information system designer (can contribute) to the evolution of his[13] organization to higher levels of coherence, connectedness and fruitfulness for all concerned". (1977: 220).

Landry and Le Moigne adopt a different perspective by identifying the attributes they believe a CFIS designer or design team need to have to produce a "good design". They state

> "In order to avoid random effects on the organization it is ... necessary for the professional IS designer to have, in addition to computer science expertise, extensive knowledge in those disciplines which touch upon organizations, such as organization theory, behaviour sciences, psychology, etc. ...: (1977: 804).

The interface stereotype does not necessarily lend itself to a particular method of setting problems or one particular technique for conducting the problem solving and solution implementing stages[14]. Importantly, however, it does emphasize that all three of these stages must take place and must incorporate both technical and organizational / behavioural factors.

2.5 SUMMARY : DIFFERENT DESIGN APPROACHES

The different description of each DS indicates that the approach to CFIS design activity, in general, and the set of substantive features of design, in particular, would differ for each of the three DS.

These differences are illustrated in Table 2A which compares a set of proposed answers to the fundamental design questions inferred from the descriptions of each as above. This Table highlights:

(a) the technical/computer orientation and narrow frame of reference employed by designers adopting the IST approach;

(b) the almost exclusive consideration of OB factors by designers adopting the OBF approach; and

(c) the broader frame of reference and consideration of interdependencies between the organization's structures, strategies and processes, its participants, and the CFIS which serve them, by designers adopting the interface approach.

The links between the three design stereotypes and the more specific CFIS design literature are discussed in Chapter 3. The establishment of such links provides the basis for the testing of this literature to identify support for the existence of these sterotypes.

TABLE 2A

SUMMARIZED COMPARISON OF THE DESIGN STEREOTYPES
BY FUNDAMENTAL DESIGN QUESTION

DESIGN QUESTIONS	DESIGN STEREOTYPES		
	IST	OBF	INT
WHAT	A CFIS based on a model of information input, storage and output requirements	A CFIS to enhance IP capability of the organization and to support its structures, strategies, processes and operations	A CFIS for the organization - one which takes account of the interdependencies, between the organization, its participants and the CFIS which serve them
HOW	Problem solving, consciously planned intellectual activity	Problem creation, problem solving. Planned or Unplanned intellectual, iterative or interactive activity	Problem creation, problem solving. Consciously planned intellectual or iterative activity
WHY	To produce a technically optimal solution to the model and maximize the effectiveness of machine utilization	To facilitate organization structures, processes and the QWL of its participants	As for OBF plus to meet the information needs of organizational participants and the effective use of technical resources
FOR WHOM	Users of output, initiators and those people who authorized the system	For those components (aspects) of the organization which will be improved for those organizational participants affected	All parties affected by the proposed system
BY WHOM	Computer professionals, systems analysts, system designers, programmers	Organizational designers, theorists, social psychologists, consultants and other participants	Organizational and technical designers as well as all affected participants (or their representatives)

NOTES TO CHAPTER 2

1. The International Federation for Information Processing.

2. The term organizational, used in this context, is intended to cover both organizational and behavioural considerations.

3. Emphasis added by the author.

4. De Marco defines the term data base as "... a special case of a file, one in which the components are related to each other by something more than simple concatenation..." "A data base is any file that can be accessed by a key other than its ordering key." (1979: 150).

   A data base management system (DBMS) is described by Cougar and McFadden as "... a comprehensive set of programs to store, retrieve and update data. It provides for the definition and creation of files and data bases, the maintenance of indexes, and for file security." (1977: 230).

5. High-level languages are described as:

   "... languages (which) permit the programmer to write computer instructions in procedural form or in a language of the problem to be solved. Generally, each statement in the language is equivalent to (many) machine language (the lowest level of machine instruction - represented in binary form) ... instructions ... This greatly increases the productivity of the programmer ..." (Cougar and McFadden, 1977: 319).

6. It can be argued that there is a third domain of theory and research which attempts to integrate the work of behaviouralists and structuralists. This group could be termed the "integrationists" and comprises those authors who attempt to find "intellectual bridges" to link these fields of knowledge. For example, Cummings suggests that an organization's structure can be viewed as a construct linking behaviouralism and structuralism through its positioning as an independent variable in the former field and as a dependent variable in the latter. He believes that it can be "conceived of as intervening between causal forces in the environment of organizations and the behaviour and attitudes of persons within organizations." (1978: 93). Other examples include Weick (1969) and Argyris who (as described by Boland) "... begins his analysis with the individual process of developing a personality in interaction with others, and expands his analysis

outwards from interpersonal interaction to the increasingly large social systems that emerge under different interaction patterns" (1981: 110).

In addition, some writers discuss both fields of knowledge without distinguishing the underlying assumptions and logic in each in an attempt to cover the organizational theory field as a whole. Some examples of this approach include Child (1977); Galbraith (1977); Robey (1979); Mansour and Watson (1980); Luthans (1981) and Markus and Robey (1983).

7. Organizing is viewed as "the process by which individual behaviours become interstructured, organized, and interdependent". (Pfeffer, 1978: 18).

8. The description of structuralism follows closely that provided by Pfeffer (1982), pp.20-23.

9. The term "social organizations" is used in this chapter to encompass both organizational and behavioural factors.

10. Bostrom and Heinen propose that an organization is a system "... made up of two jointly independent, but correlative interacting systems - the social and the technical" where the social system "... is concerned with the attributes of people (e.g., attitudes, skills, values), the relationships among people, reward systems, and authority structures", and the technical system "... is concerned with the processes, tasks, and technology needed to transform inputs to outputs." (1977: 17).

11. The word "generally" is used here as although changes in the social system are viewed as affecting the organization's information systems, this affect may, in some cases, manifest itself in changes to the informal information systems (as defined in Appendix 1) rather than the computerized formal information systems.

12. Bostrom and Heinen use the term "work system" to describe organization subunits such as departments (1977: 17).

13. The term "his" has been left in the text as this is a direct quote. For the purpose of this report this reference to "his" is representative of systems designers of both genders.

14. For a discussion of some approaches to systems analysis which deal, to varying extents, with the problem setting, problem solving and solution implementing process see Wood-Harper and Fitzgerald (1982). These authors compare the following major approaches:

    i) General Systems Theory Approach;
    ii) Human Activity Systems Approach;
    iii) Participative (Socio-Technical) Approach;
    iv) Traditional (SDLC Methodology) Approach;
    v) Data Analysis Approach;
    vi) Structured Systems (Functional Approach).

CHAPTER 3
RESEARCH LINKS

The illustrations and descriptions of the three design stereotypes presented in Chapter 2 are derived from substantive or methodological discussions in the general literature on design. It is the purpose of this Chapter to provide a means of linking the "general" design literature, which identifies the notion of worldviews, to the specific CFIS design literature in order to provide the basis for the empirical testing for the existence of the three design stereotypes conducted in this report.

A set of design elements which will enable this objective to be achieved has been derived from the work of Bostrom and Heinen (1977), Mason and Mitroff (1973) and Checkland (1981) who identify and elaborate a number of possible design criteria and norms that comprise a CFIS designer's frame of reference.

These features and their implications for the design approach adopted are as follows:

1. SYSTEM DESIGNER'S CONCEPT OF RESPONSIBILITY

   This feature focuses on the designer's beliefs about the concept of responsibility as it applies to the introduction of the new system. "The question is, 'Who is responsible for the change effort?'" (1977: 22). Bostrom and Heinen argue that the assumption made here is critical as they believe that the change effort can only be successful if the client (system initiator or authorizer) assumes responsibility for its success (1977: 23).

2. FRAMEWORK RE THE IMPACT OF CHANGE

   This feature focuses on the designer's beliefs regarding the variables which should be considered in

the change effort. Variables which could be considered include task (data processing - data collection, manipulation and transmission - and decision making), technology (computer related), organizational and behavioural variables. The types of variables included reflect the designer's approach to CFIS design.

3. DECISION MAKING (CHOICE) MODEL

This feature concerns the designer's view of the decision-making process which will be applied to the systems development effort. One of several processes could be assumed including, for example, "A rational decision-making process which examines alternative designs in terms of the goals of the system..." or a political process where the decision-making, in the development process becomes "... distorted and overlaid by political or power issues which are not always recognized or made explicit." (1977: 28)[1]

4. ENVIRONMENT

The environment of the systems development process could be assumed static or, alternatively, recognition could be made of its continually changing aspects. Bostrom and Heinen discuss the implications of the assumption made in regard to the environment. They point out that "... actions made during the design process may also create organizational changes." (1977: 28). For example, users may undergo significant learning during the design process (Powers and Dickson, 1973). This implies that the design process is a fluid, iterative process and not a linear sequence of steps (1977: 28).

5. PSYCHOLOGICAL TYPES

Using the Jungian (Jung, 1923) personality typology the authors identify four possible categories of personality types[2]. The assumptions designers make about the most dominant personality type of the users

of the system will influence the way in which it is designed. Given that the information needs within each personality type differ, an incorrect assumption about the psychological type(s) of the users may result in the output of the system not being of the type and form for which the users are psychologically attuned and therefore it may not be fully utilized.

6. PROBLEM TYPES

In discussing this condition the authors divide problems into two main categories: structured and unstructured decision problems[3]. Structured problems are further subdivided into decisions under certainty, under risk and under uncertainty. Designers can make assumptions that the problem types being faced will be capable of clear definition or they can acknowledge that the problem, or aspects of it, may not be capable of a clear definition. The assumption made will most likely influence the design approach chosen.

7. METHODS OF EVIDENCE GENERATION

Mason and Mitroff discuss the work of Churchman (1971) and identify five types of evidence generators or guarantors[4]. Each type requires a different type of information system (that is, different types of data collection methods - for different types of data, and therefore, different types of data storage processing and presentation). The assumption made in this regard will influence the approach to design adopted.

8. IDENTIFICATION OF WORLDVIEW CONCEPT

It can be argued that if designers realize that their approach to a design situation is governed by their own worldviews then it is more likely that they will acknowledge the existence of other possible worldviews and examine ways of catering for them in the CFIS design. In so doing they will be adopting a broader frame of reference.

The design elements described in this Chapter are summarized in Table 3A which identifies each element and proposes the orientation of each stereotype toward each design element.

TABLE 3A

COMPARISON OF DESIGN STEREOTYPES - BY DESIGN ELEMENTS

FEATURES	IST	OBF	INT
CRITERIA AND NORMS			
BOSTROM AND HEINEN (1977)			
1. CONCEPT OF RESPONSIBILITY	System Designer	Organizational Designers, Theorists, Social-Psychologists, Consultants and Other Participants	Organizational and Technical Designers As Well As All Affected Participants
2. FRAMEWORK RE IMPACT	Ignore Non-Technical Change. Focus on Decision Making and Data Processing Tasks	Ignore Technical Factors. Focus on Structural and Behavioural Variables	Focus on the Relationship Between the CFIS and Technical, Organizational, Structural and Social/ Behavioural Factors
3. DECISION MAKING MODEL	Rational	Rational, Political	Rational, Political
4. ENVIRONMENT	Static	Static or Dynamic	Dynamic
MASON AND MITROFF (1973)			
5. PSYCHOLOGICAL TYPE	Thinking-Sensation[5]	Greater Recognition of a Range of Psychological Types	Recognition of a Range of Psychological Types
6. CLASS OF PROBLEMS	Well Defined (Structured)	Structured and Unstructured	Structured and Unstructured
7. METHOD OF EVIDENCE GENERATION	Lockean[6] or Leibnitzian	Both the IST methods and methods which are suited to ill-structured problems	As for OBF
CHECKLAND (1981)			
8. WORLDVIEW CONCEPT	Not Identified	Not Identified	Identified and Considered Either Implicitly or Explicitly

NOTES TO CHAPTER 3

1. Bostrom and Heinen cite the work of Gibson (1975), Pettigrew (1975) and Pettigrew and Mumford (1975) to support the existence of this view of the decision making process.

2. Mason and Mitroff describe these four types in the following manner:

   "The Jungian typology is characterized by four major modes or psychological functions. Two of the modes pertain to the dominant psychological functions that an individual uses to perceive (sense) the objects of the world, while the other two modes pertain to the dominant psychological functions that the individual uses to evaluate (judge) the objects of its perception. Since the functions of perception are presumed to be independent of the functions for evaluation, four perception-evaluation combinations result. The alternative modes of perception are Sensation and Intuition. The alternate modes for evaluation are Thinking and Feeling. In most individuals, a preference for one mode of perceiving and one mode of evaluation is characteristically developed. The alternate modes remain, as a result, underdeveloped or unconscious." (1973: 47).

3. Mason and Mitroff define a decision problem as:

   "to choose from among a set of acts A1, ..., An that Ai which optimises (in some sense) the decision-maker's (Z's) return Uij, where Uij is the utility or value of Z of the outcome Oij corresponding to the doublet (Ai, Sj) where (Sj) is the set of the 'states of nature'." (1973: 479). This definition is derived from Raffia (1968).

4. See pp.480-483 of Mason and Mitroff (1973) for descriptions of these five types of information generators and guarantors.

5. The Thinking-Sensation psychological type is one of the four types contained in the Jungian Typology (Jung, 1923). "Sensation" is one of the ways an individual can use to perceive the objects of the world. A preference for this mode of perception indicates that the individual relies primarily on data received by his/her senses (rather than the alternative, intuitive, mode of perception where the individual perceives objects as possibilities). "Thinking" is one of the modes for evaluation. A preference for this mode indicates that the individual relies primarily on cognitive processes to make true/false type judgements based on formal reasoning (the alternative being the "feeling" type where the

individual relies primarily on affective processes to make personalistic, good/bad, like/dislike, type judgements) (1973: 477).

6. Mason and Mitroff cite earlier research (Williams and Mitroff, 1973) to argue that "the design of most, if not nearly all, MIS to date has been undertaken from the standpoint of Leibnitzian and Lockean enquiry. Lockean systems are based on concensus of opinion and facilitate this by building empirical, inductive representations of problems. Leibnitzian systems generate information from the construction of models of problems by proving axioms.

CHAPTER 4
THE RESEARCH METHOD

4.1 THE RESEARCH PROBLEM

It is the purpose of this Chapter to outline the research methods to be used to test support in the CFIS design literature for the existence of the three design stereotypes (DS) described in Chapter 2 and derived from the survey of the general literature on design.

Given the relationships between DS, design approaches and design outcomes proposed in Chapter 1, it is argued that research results supporting the existence of the three DS and indicating the manner in which such support was changing would provide a basis for further research to investigate the influence of the particular DS adopted on the outcome produced.

4.2 RESEARCH DESIGN - ATTRIBUTE TESTING

The tests to be performed in this Report involve examining the attributes[1] of writers on CFIS design in order to determine whether these match the substantive features of the design approaches proposed in Chapter 3, Table 3A for each of the three DS. (Writers on CFIS design will be used for the purposes of the research to represent the views of CFIS designers.)

The designer's attitudes or beliefs regarding each of these substantive features can be viewed as the attributes of that designer at any given time (or during any particular CFIS design task). That is, the designer either does or does not have a particular set of attributes. As such, the presence of these attributes can be quantified.

If the design approach of every (or most of the) sampled designer(s) can be classified into one of the three stereotypes, then the existence of the DS in the form theorized can be supported.

There are two main ways in which the attributes of CFIS designers could be identified (and therefore evidence gathered to support the existence of the DS). Firstly, a questionnaire, covering a sufficient number of aspects of the CFIS design process to identify designer attributes, could be administered[2] to a sample of CFIS designers[3]. Alternatively, the literature specifically supporting CFIS design (written by practitioners, researchers and educators) could be reviewed, through a framework of substantive features of CFIS design[4], to identify designer attributes - the assumptions made, and values and beliefs held, either explicitly or implicitly.

The literature review method was employed to obtain the results presented in this report. It is argued that this method is a valid way of obtaining evidence to support the existence of DS. It was used because it eliminated the problems of identifying and selecting an unbiased[5] sample of CFIS designers, and gaining access to them to administer the questionnaire.

The CFIS design literature - books and journals - constitutes the database from which the research results were drawn. In terms of the categories outlined by Howard and Sharp (1983: 140) the literature could be classified as a "secondary data source" - comprised of other people's research and opinions. However, as the type of research conducted in this report involves examining the views expressed by each author to determine whether they match the features of a DS, rather than each other's view on whether the DS exist, the literature can be viewed as a primary data source[6].

4.3 LITERATURE SEARCH METHOD

To achieve the objective of reviewing the publications - journals and books - on CFIS design, a broad examination of the literature was required. This was achieved by selecting

a wide range of serials and examining their contents over the timespan from 1970 to 1984.

Initially, the use of abstracting services was attempted. These included ANBAR (Abstract of Management Publications), the Business Periodicals Index, the Social Sciences Index, Computer and Control Abstracts and the Computer and Information Systems Abstracts. The topics of computer system design, information systems design[7] and organizational change / design / development provided the basis for this search. However, as the topic of CFIS design is addressed under many different titles, these services could not be effectively used to systematically identify references for the period under review. Instead, a search through a wide range of journals was conducted using the serials listing at the University of N.S.W. as the starting point. Journals were selected on the basis of combinations of a series of keywords - computer, information, data, systems, management, organization, design, development, behaviour and business. These keywords were chosen with the objective of selecting a sample of the literature which was not dominated by one or more particular applications of CFIS, for example accounting. It is believed that this resulted in a sample which concentrated more on CFIS design than on a particular application CFIS design.[8] A number of the original selections were rejected on the basis that they related to areas where all the material was completely irrelevant to the topics addressed in this report.[9] Other literature - textbooks cited in relevant articles and book reviews in those serials selected by the above means - were also examined.

The selection method provided an extensive range of articles and books for review. Of those references available only those which discussed computerized information systems design or discussed areas which were based on clear beliefs about the nature of this design process were reviewed in detail. As a result of this review process a number of

journal articles and books, sufficient to demonstrate both the existence of the Design Stereotypes and worldviews underlying each approach, were judged as pertinent to the issue of the design of CFIS. A complete list of the serials chosen for examination and a list of the results for all articles and books reviewed is provided in Appendix 2.

The references selected (articles and books) contained a variety of information on a wide range of topics related to CFIS design. The content varied from the presentation of the results of empirical research to discussion of opinions based purely on experience and non-structured (i.e., where no research design was employed) observations. As a result the quality of evidence supporting the views and assertions made in these references varied.

This variation does not invalidate or restrict the generalizability of the inferences that could be drawn from the results of the literature review as it is the attributes (values, beliefs and assumptions) of the authors that is being recorded and not how these attributes have been derived.

4.4 REVIEW FRAMEWORK

The method used to analyze the references selected was to construct a set of evaluation questions which, when applied to each book or journal article chosen, produced "yes" or "no" answers. These answers provided a basis for classifying each reference into one of the three design stereotypes.

These evaluation questions needed to be framed in such a way that the answers generated would provide information on the worldview or frame of reference - design elements of relevance, design norms and concept of the design process - the attributes held by the author. The answers derived could then be compared with the answers hypothesized below for each DS with a match indicating support for that particular DS by that author.

This approach to reviewing the literature database was deemed preferable to alternative methods, such as content analysis or an analysis of themes. Content analysis (described by Berelson, 1954: 489) would have provided numeric information on categories of words used, i.e., the frequency with which selected words were included in the text. This kind of analysis would not have provided information on the substance of each reference - the author's underlying values, beliefs, attitudes and assumptions - that is, the attributes being tested. An analysis of themes, involving an examination of the titles and sub-titles of each reference reviewed, would have provided even less information (particularly due to the differing use of terminology by authors to describe similar beliefs and the variety of interpretations that can be placed on the design terminology).

4.5 EVALUATION QUESTION

Given the theoretical foundation, in the work of Bostrom and Heinen (1977), Mason and Mitroff (1973) and Checkland (1981) for the substantive features of each DS outlined in Table 3A it would seem most appropriate to frame the evaluation questions (EQ) in the form "what is the author's stance (orientation) on feature 1 .... feature 8". However, most of the references reviewed did not discuss each of these features directly or make explicit their assumptions regarding these features. Therefore if these eight features were used as the EQ a great deal of inference would be required on the part of the researcher to generate a set of designer attributes that could be compared with those constructed for each DS (in Table 3A).

It is proposed that a simpler, more general set of questions which directly imply the author's position on each of the substantive features would reduce the amount of inference required on the part of the researcher and so improve the external validity of the results obtained. The EQ to be

used, their theoretical relationship to the eight substantive features and what they imply about the author's underlying values, beliefs and assumptions (frame of reference) are detailed in Table 4A and discussed as follows.

A. IS A PROBLEM SOLVING / MODEL BASED APPROACH TO DESIGN, SUCH AS THE SDLC METHODOLOGY, ACCEPTED?

The model based approach, which takes the information requirements or "problem" as a given to be solved, is the fundamental concept underlying a number of design methodologies. Boland describes the model based approach as follows:

> "The approach starts with a statement of system goals and defines the tasks required to achieve those goals. The tasks identified are further reduced to decisions required for accomplishing the tasks and the decisions are modelled to define information requirements." (1979: 261-2)

This approach is typified by the Systems Development Lifecycle methodology (SDLC) which appears[10] to be the most commonly discussed or assumed in the literature. (For example, see Berrisford and Wetherbe, 1979; Brittan, 1980; Hawryszkiewycz, 1981; Wood-Harper and Fitzgerald, 1982; or any one of a large number of textbooks on systems analysis and design such as Brooks et al, 1982; Jeffery and Lawrence, 1984). This methodology, and the model based approach in general, embodies one major underlying theme: "that one activity follows logically from its predecessor so that each stage is complete before the next begins" (Brittan, 1980: 13). These activities are listed in Figure 4.1.

Although many proponents of this approach consider the necessity for looping back to previous stages when detailed investigations and analysis reveal problems or indicate changes may be necessary (Brittan, 1980: 13) the objective is, as far as possible, to complete each stage before moving onto the next stage.

TABLE 4A

RELATIONSHIP BETWEEN SUBSTANTIVE FEATURES AND LITERATURE EVALUATION QUESTIONS

EVALUATION QUESTION	SUBSTANTIVE FEATURE	RELATIONSHIP IF A "YES" ANSWER IS ONLY GIVEN TO THIS EQ
1. Is a Problem Solving/ Model Based Approach to Design, such as the SDLC, Accepted?	1	Implies designer responsibility for the design process (Bostrom and Heinen, 1977; Boland, 1979)
	2	Assumes that when considering the change process, only task and technology variables are of interest (Bostrom and Heinen, 1977) because is assuming an input-output approach (Boland, 1979)
	3	Assumes rational decision making model (Bostrom and Heinen, 1977; Boland, 1979)
	4	Assumes static environment (Bostrom and Heinen, 1977; Boland, 1979)
2. Are Organizational/ Behavioural Factors Considered Important or Made Explicit?	2	Assumes only organizational / behavioural variables are of interest when considering the change process
	3	Consideration of behavioural variables implies consideration of non-rational decision making models
	4	Consideration of O/B variables implies consideration of dynamic environment
	5	Consideration of behavioural variables implies consideration of differing psychological types
3. Is the Worldview Concept or its Equivalent Identified?	8	The EQ is identical to the substantive feature. It implies a broad frame of reference has been adopted (Checkland, 1981)
4. Are Problems Other Than Well Defined Considered?	6	This is identical to the substantive feature. It implies that a broader frame of reference, on the part of the designer, than if only well structured problems were considered
	7	Implies other than model based methods of evidence generation will be used. Mason and Mitroff, 1973)

FIGURE 4.1

THE TRADITIONAL SYSTEM DEVELOPMENT LYFECYCLE

STAGES

1	Requirements Specification
2	Feasibility Study
3	Logical Design
4	Physical Design
5	Programming
6	Implementation
7	Post-Implementation Review

(Constructed from Jeffery and Lawrence, 1984: 3-5)

A "YES" answer to only this question would indicate that the author reviewed followed an approach approximating the IST design stereotype.

B. ARE ORGANIZATIONAL / BEHAVIOURAL FACTORS CONSIDERED IMPORTANT OR MADE EXPLICIT?

The identification by an author of the need to consider organizational or behavioural factors provides an indication of that author's values and beliefs regarding the CFIS design process and its participants. Examples of organizational factors include organizational structure, process, goals, technology and climate (Cummings, 1978: 91). Behavioural factors include aspects of motivation, learning or socialization, group structure and process, leader behaviour, task design, interpersonal communication, interpersonal change and conflict (Cummings, 1978: 44), decision making processes, political processes and power.

A "YES" answer to only this question would indicate that the author being reviewed followed an approach described by the OBF design stereotype.

C. IS THE WORLDVIEW CONCEPT OR ITS EQUIVALENT IDENTIFIED?

The worldview concept was introduced and discussed in Section 1.4 to highlight the importance of the frame of reference through which a designer approaches a CFIS design. The identification, in a reference, of a need to consider the frame of reference (values, beliefs and assumptions) or worldview of designers or other participants in the design process implies recognition of the potential and relevance of differing views between the designer and the organizational participants as to how the design should be approached and what factors should be considered relevant. Such recognition would impact the way the design process was followed as the designer would approach the task with a broader frame of reference. It also implies that the

designer would take a broader view of the impact of change from the new system, a view which would include both task and technology variables as well as the organizations social system (Bostrom and Heinen, 1977).

A 'YES" answer to this question would indicate that the author being reviewed followed the approach to CFIS design described by the INT design stereotype.

D. ARE PROBLEMS OTHER THAN WELL DEFINED CONSIDERED?

Recognition, by an author, of a problem type other than well defined indicates acknowledgement that different problem types exist and implies that different types of evidence generators and guarantors would be required for non-structured (ill-defined) problems (Mason and Mitroff 1973: 480-483). These beliefs would influence the CFIS design approach followed.

A "YES" answer to this question implies that the author being reviewed does not follow the IST approach to CFIS design.

4.6 HYPOTHESIZED CONFIGURATIONS FOR EACH DESIGN STEREOTYPE

Configurations of answers to the Evaluation Questions (EQ) can be hypothesized for each Design Stereotype. That is, given the descriptions of each DS in Chapter 2, the information generated from a reference by "yes" answers to the EQ provides a basis for classifying the author's approach to, or beliefs about, CFIS design into one of the three DS. The configurations proposed are as follows:

i) DESIGN STEREOTYPE 1 - THE INFORMATION SYSTEMS TECHNICAL APPROACH

It is proposed that references which follow or assume the IST approach will contain a "yes" answer to Question A but not to Questions B, C or D. Consistent

with the description of the IST approach, such references will discuss CFIS design through the SDLC methodology or a model based approach, will ignore organizational / behavioural factors, and will not acknowledge or consider the possibility of alternative competing worldviews. They will also assume that the requirements of the system to be designed are well defined.

ii) DESIGN STEREOTYPE 2 - THE ORGANIZATIONAL / BEHAVIOURAL FACTORS APPROACH

References which follow or assume the OBF approach will contain a "yes" answer to Question B and in some instances Question D, but not to Questions A or C.

Such references will discuss CFIS design in relation to its impact on organizational or behavioural factors. Their discussion will be oriented towards the OB factors which must be taken into account in the design and how the designed system can support organizational activities. They may also identify the need to design the CFIS to support the resolution of unstructured, ill-defined problems in the environment of the organization.

These references will tend to ignore technical design factors and generally, will not discuss system or software design approaches. They will also ignore the worldviews of the system designers. Discussion of worldviews would imply consideration of both organizational / behavioural and technical views on CFIS design. This is the approach of the Interface Stereotype.

iii) DESIGN STEREOTYPE 3 - THE INTERFACE APPROACH

References which follow or assume the INT approach will contain "yes" answers to Questions A and B. That is, they will be considering both the technical and the OB factors in their discussion.

In addition, any reference containing a "yes" answer to Question C - discussion of the worldview concept - would also belong to this stereotype as it would be acknowledging the existence of differing and competing design orientations and therefore demonstrate the application of a broad frame of reference to the CFIS design activity. Finally, these references may also contain "yes" answers to Question D as authors with this broader frame of reference may also acknowledge and discuss the implications of problems with varying degrees of structure on the design of a CFIS.

The configurations of answers, classified by design stereotype, are listed in Table 4B. These configurations will be compared with the results of the application of the Evaluation Questions to the selected references to categorize the specific CFIS design literature into the DS derived from the general design literature. This will allow an assessment of the level of support provided for the existence of the three DS.

4.7 SUMMARY

This chapter has described the nature of the research to be conducted and the process followed to develop a framework to be used to test the CFIS design literature for sets of CFIS designer attributes and therefore the existence of the three DS. The results of the application of this set of EQ to the references on CFIS design, selected from the literature review will be presented and analyzed in Chapter 5.

TABLE 4B

HYPOTHESIZED CONFIGURATIONS FOR EACH DESIGN STEREOTYPE

	EVALUATION QUESTIONS	MATCHING CONFIGURATIONS 1	2	3	4
IST	A	Y			
	B	-			
	C	-			
	D	-			
OBF	A	-	-		
	B	Y	Y		
	C	-	-		
	D	-	Y		
INT	A	Y	Y		
	B	Y	Y	plus	
	C	-	-	Y	Y
	D	-	Y	Y	-

NOTE: Y = Yes

NOTES TO CHAPTER 4

1. For a discussion of attribute testing see Moser and Kalton (1972) pp.61-62.

2. The questionnaire could be administered by correspondence or by interview. In both instances a structured questionnaire would be most appropriate.

3. This assumes a method of identifying CFIS designers and then choosing a random sample. The way in which this could be achieved is not a concern of this report as this method is not used.

4. These features may be framed in the form of questions that the reviewer can answer, based on an assessment of the contents of the particular reference examined.

5. The sample could have become biased through, for example, selecting only those designers to whom access could be obtained. Also the method of identifying CFIS designers could have resulted in a biased sample as practicalities would have necessitated the use of information such as job titles or job classifications rather than the actual activity of the designer.

6. That is, the literature can be viewed as a primary source as it contains the authors' expressed views on features of CFIS design.

7. The topic of information systems design was used to include the design of management information systems and decision support systems.

8. The exception to this was the Hewlett Packard Journal which was selected because it was the name of a computer hardware manufacturer and supplier.

9. For example, serials completely devoted to hardware design, the design of computer operating software or on the design of programming subroutine algorithms.

10. The word "appears" has been used here as although the SDLC methodology is discussed or assumed in most textbooks and a great number of articles on the subject of computerized information systems design, the author is not aware of any research that proves the SDLC is the most common view discussed.

CHAPTER 5
RESULTS OF THE LITERATURE REVIEW

5.1 INTRODUCTION

The purpose of the Chapter is to present and analyze the results of the application of the four Evaluation Questions to the selected journal articles and books and, in so doing, to demonstrate the level of support for the three DS in the specific CFIS design literature. This will be done by examining:

(a) the degree of support for the existence of each design stereotype;
(b) the degree to which this has varied over the period reviewed; and
(c) the degree to which the journals examined provided editorial support for each particular DS.

The aggregated results are presented in Table 5A. They show that all the substantive features of CFIS design encapsulated in each of the four EQ's were addressed by the literature but to substantially varying degrees. Questions A and B produced "yes" answers in a large proportion of the references whereas the features covered by Questions C and D were rarely discussed.

5.2 CLASSIFICATION OF RESULTS

Of the 209 references (articles and books) reviewed 205 could be classified into the three DS based on the configurations hypothesized in Table 4B. The four references not classified into one of the DS are described and discussed in Section A of Appendix 3.

Table 5B shows support for each of the three DS in the form defined and illustrated in Chapter 2, given the research method employed. Thirty-three percent of the references were classified as adopting an approach consistent with the IST stereotype, 40% for the OBF and 26% for the INT.

TABLE 5A

TOTAL RESULTS FOR EACH EVALUATION QUESTION

EVALUATION QUESTIONS	TOTAL YES ANSWERS	
	TOTAL	% OF ALL REFERENCES
A	113	54.1
B	137	65.6
C	14	6.7
D	35	16.7

The Questions were applied to 209 references.

TABLE 5B

RESULTING CONFIGURATIONS CLASSIFIED BY DESIGN STEREOTYPE

						TOTAL CLASSIFIED	% TOTAL REFERENCES
1. IST							
A	Y						
B							
C							
D							
ARTICLES	38					38	
BOOKS	30					30	
TOTAL	68					68	33.2
2. OBF							
A							
B	Y	Y					
C							
D		Y					
ARTICLES	60	10				70	
BOOKS	13	-				13	
TOTAL	73	10				83	40.5
3. INT							
A	Y	Y	Y				
B	Y	Y	Y	Y	Y		
C	Y			Y	Y		
D	Y	Y			Y		
ARTICLES	1	9	23	4	5	42	
BOOKS	2	4	4	2	-	12	
TOTAL	3	13	27	6	5	54	26.3
							100.0

NOTE: The detailed results for each reference reviewed are provided in Appendix 2.

These results are consistent with and therefore provide support for the proposition that the three design stereotypes exist.

5.3 CHRONOLOGICAL ANALYSIS

The results on a yearly basis, as illustrated in Figure 5.1, reveal that the relative level of support for each DS varied substantially over the review period.

Figure 5.1 shows the following:

i) the level of support for the IST approach is declining;
ii) the level of support for the OBF approach appears to be slowly increasing; and
iii) given the method used to conduct the chronological analysis the level of support for the INT approach is increasing at a greater rate than it is for the OBF approach.

The existence of these trends is further highlighted by the analysis of results presented in Table 5C, which compares the level of support for each DS, as a % of the total references reviewed, for the first eight years of the review period (1970-77), and the remaining seven years (1978-84). It shows:

i) a dramatic decrease in support for the IST approach - from 45% of references reviewed to 27%;
ii) a large increase in support for the OBF approach - from 35% to 43%; and
iii) a slightly larger (than for the OBF) increase in support for the INT approach - from 20% to 30%.

5.4 JOURNAL ANALYSIS

In order to test for the existence of editorial support[3] each of the journals reviewed were classified according to the DS its articles most often supported.

FIGURE 5.1

RESULTS FOR EACH DS AS A PERCENTAGE OF TOTAL REFERENCES REVIEWED BY YEAR (1)

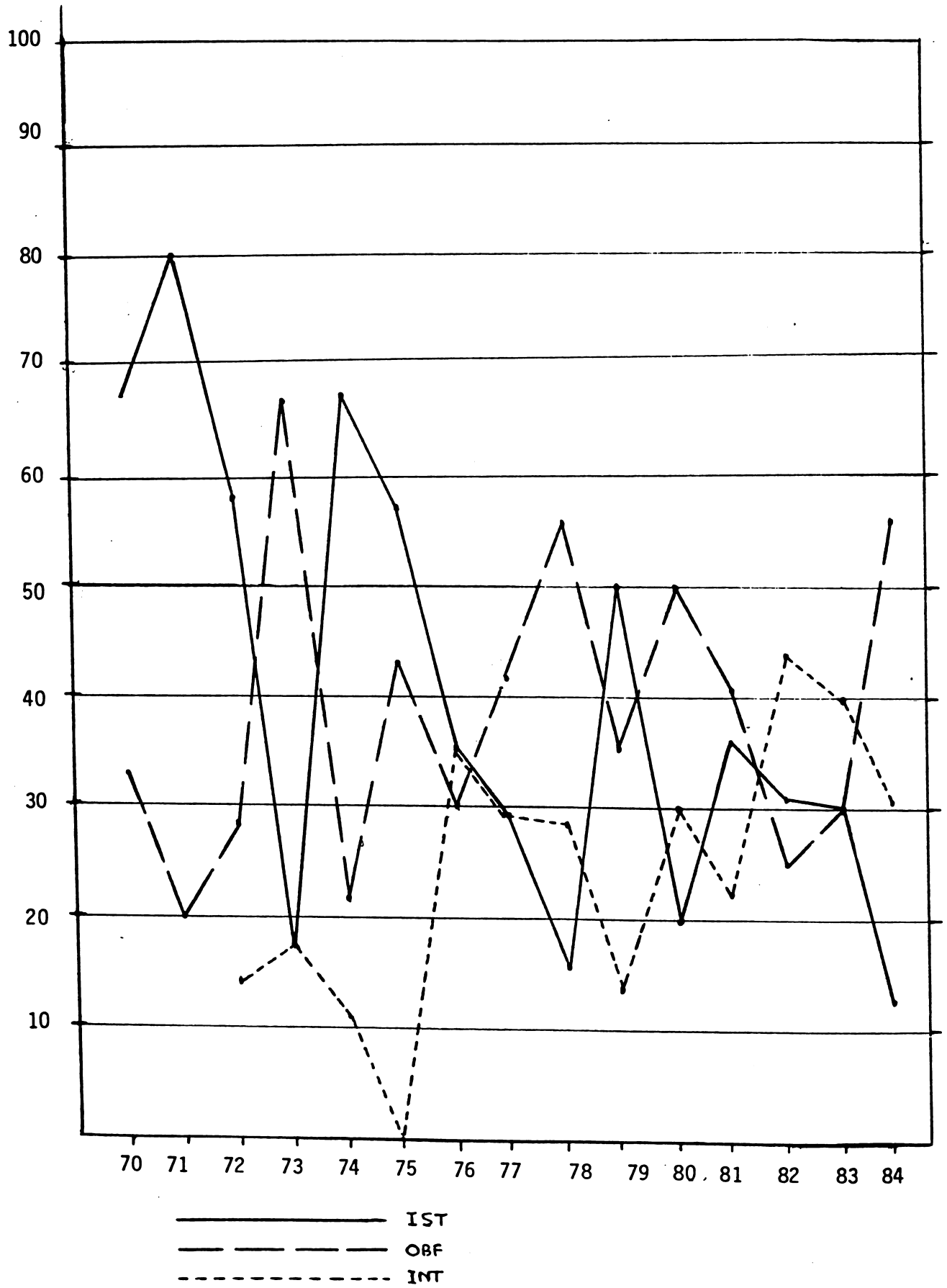


TABLE 5C

COMPARISON OF RESULTS - FIRST HALF (2) VS SECOND HALF OF PERIOD

(a) TOTAL REFERENCES

	1970-77 Number	% Total	1978-84 Number	% Total	Total Period	% Total
IST	33	45	35	27	68	33.2
OBF	26	35	57	43	83	40.5
INT	15	20	39	30	54	26.3
	74	100	131	100	205	100.0

(b) JOURNAL ARTICLES ONLY

IST	17	35	21	21	38	25.3
OBF	20	41	50	49	70	46.7
INT	12	24	30	30	42	28.0
	49	100	101	100	150	100.0

(c) BOOKS ONLY

IST	16	64	14	46	30	54.5
OBT	6	24	7	23	13	23.6
INT	3	12	9	31	12	21.9
	25	100	30	100	55	100.0

The results are presented in Table 5D which shows, by journal, the number of references supporting each particular DS. The journals were classified as supporting a DS if 75% or more of the references reviewed related to that DS[4]. Where the results for the journal did not meet this condition the two DS most strongly supported have been recorded. In some journals all three DS were well represented and so the journal has been recorded as supporting all DS.

The classifications for the 34 journals reviewed are summarized in Table 5E, which shows a predominance of journals supporting either the OBF stereotype or a combination of OBT and INT views (14 of the 26 journals which contained articles relating to CFIS design). This is consistent with the previous analysis which classified over 66% of the total references and 75% of journals as supporting the OBF or INT approaches (Tables 5B and 5C part (b)).

These results indicate that there may be stronger editorial support for OBF views or a combination of the OBF and INT views than for IST views alone. The IST approach is supported in less than 16% of the journals even though over 25% of the journal articles were classified into this stereotype. The results also show that almost half of the journals (12/26) contained a strong representation of the views of more than one design stereotype. In these journals there was no clear editorial support for the views represented by any one DS.

The classification for each journal was also examined chronologically to determine whether there has been any change in editorial support over the period reviewed. A comparison of journal classifications (based on the criteria discussed above) for the two periods 1970-77 and 1978-84 is presented in Table 5F.

TABLE 5D

JOURNAL CLASSIFICATION

NUMBER OF REFERENCES SUPPORTING EACH DESIGN STEREOTYPE

JOURNAL ABBREV.	IST ($\overline{DS1}$)	OBF ($\overline{DS2}$)	INT ($\overline{DS3}$)	CLASSIFIED AS
AMJ	-	4	-	OBF
AMR	-	3	1	OBF
AOS	-	7	-	OBF
ASQ	-	1	-	OBF
AIC	-	2	2	OBT/INT
ACB	-	-	1	INT
ACJ	3	-	-	IST
CMR	1	2	1	ALL STEREOTYPES
CA	-	-	-	-
CB	-	2	1	OBF/INT
CE	-	1	-	OBF
CJ	5	5	3	ALL STEREOTYPES
CP	2	3	-	IST/OBF
CS	-	-	-	-
DAT	15	9	9	ALL STEREOTYPES
DP	5	-	1	IST
DPE	-	-	-	-
HBR	-	1	1	OBF/INT
HPJ	-	-	-	-
HR	-	2	1	OBF/INT
ISJ	-	-	-	-
IM	-	1	-	OBF
IP	3	2	-	IST/OBF
IPM	1	1	1	ALL STEREOTYPES
JCSS	-	-	-	-
JCBI	-	-	-	-
JIP	1	-	-	IST
JIS	1	-	-	IST
JSM	-	7	1	OBF
MD	-	1	1	OBF/INT
MISQ	1	21	5	OBF
MS	-	4	2	OBF/INT
SMR	-	-	2	INT
SOC	-	-	-	-

TABLE 5E

JOURNAL CLASSIFICATION SUMMARY

STEREOTYPE	NUMBER OF JOURNALS
IST	4
OBF	8
INT	2
IST-OBF	2
OBF-INT	6
ALL	4
	26

* There were 8 journals reviewed which contained no articles on the topic of CFIS design.

TABLE 5F

JOURNAL CLASSIFICATION : FIRST HALF VS SECOND HALF OF PERIOD

JRNL ABBREV.	IST		OBF		INT		CLASSIFIED AS		OVERALL
	70-77	78-84	70-77	78-84	70-77	78-84	70-77	78-84	
AMJ				4			-	OBF	OBF
AMR				3		1	-	OBF	OBF
AOS			1	6			OBF	OBF	OBF*
ASQ				1			-	OBF	OBF
AIC				2		2	-	OBF/INT	OBF/INT
ACB						1	-	INT	INT
ACJ		3						IST	IST
CMR	1		1	1		1	IST/OBF	OBF/INT	ALL*
CA									
CB			2			1	OBF	INT	OBF/INT**
CE				1				OBF	OBF
CJ	1	4	1	4		3	IST/OBF	ALL	ALL**
CP	1	1	3				OBF	IST	IST/OBF**
CS									
DAT	9	6	4	5	4	5	ALL	ALL	ALL*
DP	2	3				1	IST	IST	IST*
DPE									
HBR			1		1		OBF/INT	-	OBF/INT*
HPJ									
HR			1	1	1		OBF/INT	OBF	OBF/INT**
ISJ									
IM			1				OBF	-	OBF
IP	3		2				IST/OBF	-	IST/OBF
IPM		1		1	1		INT	IST/OBF	ALL**
JCSS									
JCBI									
JIP		1					-	IST	IST
JIS		1					-	IST	IST
JSM			3	4	1		OBF	OBF	OBF*
MD			1			1	OBF	INT	OBF/INT**
MISQ		1	2	19		5	OBF	OBF	OBF*
MS			1	3		2	OBF	OBF/INT	OBF/INT**
SMR						2	-	INT	INT
SOC							-	-	-

(* represents references in both the first and second half of the period)

(** represents a shift in editorial support)

This shows that of the 13 journals which had references reviewed in both the first and second half of the period (marked with an *) eight had noticeable shifts in editorial policy (marked with **). Of these journals five contained a shift towards an INT orientation (CMR, CB, CJ, MD, MS), one towards IST (CP), one towards OBF (HR) and one equally towards IST and OBF (IPM).

These results can be interpreted to represent a small shift in editorial support towards the INT stereotype.[5]

5.5 DISCUSSION AND IMPLICATIONS OF RESULTS

The main findings of the CFIS design literature analysis - that there is support for the existence of the three DS; that the degree of support for each DS differs and is changing; and that there appears to be some editorial support for each DS and that this is also changing - have a number of implications for CFIS design.

5.5.1 SUPPORT FOR THE EXISTENCE OF THE THREE DESIGN STEREOTYPES

The support for the three DS indicates that common approaches to CFIS design do exist. Even though potentially, all CFIS designers could form different worldviews and employ different frames of reference when approaching a CFIS design task they do not appear to do so. Logically this implies that there are common, but alternative, ways in which the answering of the fundamental DQ's are approached by CFIS designers.

Possible explanations for this degree of commonality might be (a) coincidence, (b) that the DS are self reinforcing - that is, they have emerged from practice, have become incorporated into its supporting literature, influence its teaching and, in turn, its practice - or (c) that there are factors other than designer worldviews which lead groups of designers to adopt common approaches.

It is conceivable that either (a), (b) or (c), or any combination thereof, could provide an explanation for this commonality of approach. It is proposed that point (b) is a major determining factor which can be tested and, if supported, has greater implications for the practice and teaching of CFIS design[6] than could be derived from points (a) or (c). Existing DS influence or determine the CFIS designer's approach to the design task - the answering of the DQ's - and, as a consequence, (if inappropriate answers are generated) they can result in the creation of design problems and possibly the occurrence of design failure[7]. (A method for testing the influence of the DS on the answers generated to the fundamental DQ is outlined in Chapter 6.)

5.5.2 VARYING LEVELS OF DS SUPPORT

5.5.2.1 Overall Results

The results presented in Tables 5B, 5C and Figure 5.1 showed that there were different levels of support for each of the three DS and that these levels changed substantially over the period reviewed. They indicated the following for each stereotype:

* IST - Overall 1 in 3 references discussed or assumed the technical approach to CFIS design. However, this support declined rapidly from nearly 1 in 2 of the references reviewed in the first half of the period to only 1 in 4 in the second half.

* OBF - Overall 40% of references discussed the impact of the design of a CFIS on organizational or behavioural factors without considering the technical factors. During the review period the support rose from 35% in the first half to 43% in the second.

* INT - Support for the interface approach to CFIS design (which recognizes the interdependencies between

the organization and its information systems) grew substantially over the period from 20% in the first half to 30% in the second. Over the total period it was 26%.

5.5.2.2 Books Compared to Journal Articles

The relative level of support for each DS also varied substantially between the books and journal articles reviewed. Whereas the books reviewed strongly supported the technical approach, 54% (compared with 24% for the organizational / behavioural factors approach and 22% for the interface approach) the support in the journal articles was more evenly divided with the majority of support for the OBF approach 47% (compared with 25% for the technical approach and 28% for the interface approach). A separate examination of the trends in support for each DS, for the books and articles, showed that each produced results similar to the overall trends with the exception that for the books support for the OBF approach was constant over the two halves of the review period.

5.5.2.3 Broadening Views

These trends indicate that there has been a broadening of CFIS designer views from either a technical OR an organizational / behavioural approach towards a view of design which recognizes the importance of, and interdependencies between both sets of factors. There appears to be a growing belief that changes in information systems result in changes in the social system within the organization and that it is important to not only improve the technical system (for example, through increased productivity) but also the social system (for example, through an increase in the quality of work life of its participants).

5.5.2.4 Failure of the Technical Approach

It is proposed that the trend towards the broader interface approach is most likely an indication of a growing level of

dissatisfaction with the frequent design failures achieved through the use of the technical approach. The view that the use of CFIS design approaches which consider only technical factors, that is, which ignore OB factors, is responsible for the often reported CFIS failures is supported by a number of authors (Lucas, 1975; Mintzberg, 1975; Bostrom and Heinen, 1977; Moore, 1979; McKeen, 1983).

For example, Bostrom and Heinen state:

> "Many of the problems and failures of Management Information Systems .... have been attributed to organizational behavioural problems" (1977: 17).

Lucas also identifies the importance of considering non-technical variables. He states:

> "Because of our concern over technology we seem to have ignored the fact that almost all information systems exist within the context of an organization. If we adopt an organizational perspective a large number of variables must be added to existing models of the development and the operation of computer based information systems" (1975: 1).

Finally, a study of IS failure in 24 organizations conducted by Moore (1979) produced results attributing at least 90% of unsuccessful management support system developments to managerial considerations of a non-technical nature.

It can be argued that the move towards the interface approach reflects two main factors. Firstly, the influence of the growing body of authors discussing OB variables has introduced many CFIS designers to other worldviews leading to a broadening of their frame of reference. This has resulted from the studies into CFIS failure which have identified the neglect of OB factors on the part of designers as a major cause of such failures.

Secondly, although the OBF approach identifies additional factors for consideration it tends to ignore technical considerations. It stops short of providing a methodological

prescription for merging the hardware and software system design into the design of the social organization. That is, it is proposed that designers cannot easily translate the OBF prescriptions into the technical design that MUST take place.

5.5.3 EDITORIAL SUPPORT

Editorial support for particular DS appeared to exist but overall was not very strong. Only the OBF stereotype appeared to receive substantial editorial support. This DS was supported by AMJ, AMR, AOS, ASQ, CE, IM, JSM and the MISQ, most of which was oriented towards organizational designers, theorists, researchers and management. There was little editorial support for the other two DS. Three of the six journals classified as supporting the IST or INT approaches contained only one reference (IST - JIP, JSI; INT - ACB) indicating CFIS design was not an important topic in these serials. Consistent with the chronological analysis a comparison between the first and second half of the review period did identify a small shift in editorial support towards the interface approach.

These results reinforce the findings already detailed showing a shift away from the technical approach toward the interface approach, with strong support for the discussion of the importance of OB factors in a number of the organizational and management journals.

5.5.4 JOURNALS COMPARED TO BOOKS

An interesting aspect of the results presented is the difference in the relative support for each DS between the books and the journal articles reviewed (Table 5C, parts (b) and (c)).

A clear majority of the books reviewed, (54.5%), were classified as supporting the IST approach, whereas this approach received the least support in the journal articles (25.3%). On the other hand a majority of the journal

articles (46.7%, supported the OBF approach whereas only 23.6% of the books supported this approach. The support for the interface approach was also greater in the journals (28%) than in the books (21.9%).

This divergence could be interpreted in a number of ways. It may be a result of differences in the nature of journals and books, the audience the literature is directed at, or a difference in timing.

It could be argued that the nature of a journal compiled from contributions by a range of authors - allows it to present a broader range of views than a book (except perhaps for books containing a collection of readings). On the other hand[8] the author (or authors) of a book tend to concentrate on the indepth development and presentation of a particular topic, (for example, one feature of the CFIS design process). In addition, it can be argued that journals are generally directed more at educators and researchers with the objective of presenting and analyzing advances in theory and the results of recent research. Books, on the other hand, are aimed more at practitioners and educators, to present well established theory and methods of practice which are perceived to have been successful in practice.

These differences could create a difference in timing where new ways of approaching CFIS design (based on current theory and research), although presented in journals soon after they occur, do not appear in books until they have been established, to the satisfaction of the profession of CFIS designers, as "good" methods of practice.

This timing difference could be further compounded by the fact that journals appear regularly, for example monthly or quarterly, whereas several years can elapse between the commencement of research for a book and its publication. In addition, it can be argued that there is a gap between theory and research, and practice which needs to be bridged

for new design approaches to be adopted in practice. It is proposed that this bridge is created through education, as illustrated in Figure 5.2, and so it may take considerable time for the results of theory development and research to influence practitioners.

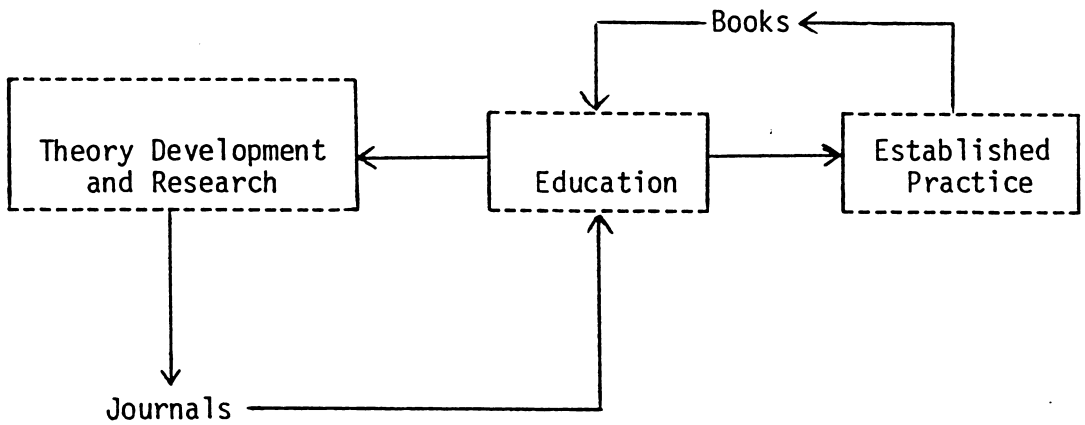
5.6 SUMMARY

This chapter has presented the results of the review of the CFIS design literature conducted according to the research method described in Chapter 4. Evidence was obtained to support the existence of the three DS derived from the general design literature and as detailed in Chapter 2. The results were analyzed and their implications discussed.

These results provide a basis for the discussion in Chapter 6 of possible further research into the influence of the DS adopted on the outcome of the CFIS design process.

FIGURE 5.2

PROPOSED BRIDGE BETWEEN THEORY DEVELOPMENT, RESEARCH RESULTS AND CHANGES IN PRACTICE



NOTES TO CHAPTER 5

1. The supporting data used to generate the graph presented in Figure 5.1 is presented in Table A1 in Section B of Appendix 3.

2. As the 15 year period cannot be divided into equal halves, it has been divided into 8 year and 7 year periods as an approximation of a half way point.

3. For a description of the term 'editorial support', see Footnote 3 in Chapter 1.

4. The figure 75% has been used as a means of representing a clear majority of references. (Using an alternative figure of 66.67% or 2/3 would have made little difference to the classifications made - three of the DS2-3 would have been classified as DS2).

5. The results of the analysis of editorial support are limited to the extent that no information about the articles rejected by the editors of each journal are available. It is possible, for instance, that the articles rejected may be of the same type as those accepted, that is, the editors do not have the opportunity to support one particular DS in preference to another because the articles submitted are all of the one DS.

6. Point (a), even if it could be supported, contains no predictive power in terms of the outcomes of CFIS design. Point (c) could be tested but may involve some variables which would be outside the scope of this research into CFIS design (for example, the social development of the designer). Point (b), however, can be tested and, if supported, has further implications for the teaching, practice and research into CFIS design.

7. This is based on the chain of influence outlined in Figure 1.2.

8. Excluding books which contain a selection of readings from a variety of authors.

CHAPTER 6
CONCLUSIONS AND FURTHER RESEARCH

6.1 SUMMARY AND GENERAL CONCLUSIONS

This report has presented research results which provide evidence to support the existence of three stereotyped approaches to the design of computerized formalized information systems in organizations. To provide a basis for achieving these results it was proposed that CFIS designers have differing worldviews, and that these cluster into different DS. Three stereotypes were identified and described, and were proposed to represent the major approaches to CFIS design. A method of research involving a survey of the CFIS design literature with the objective of providing evidence to support the existence of the three DS was outlined. The results achieved not only supported the existence of the three DS but identified differing levels and trends in support for each of the three DS. It has also been proposed that the particular DS adopted by a CFIS designer will influence the outcome of the design process.

These findings have important implications for the practice and teaching of CFIS design and provide a basis for further research into the CFIS design process.

6.2 IMPLICATIONS FOR PRACTICE AND TEACHING

The support obtained for the proposition that the three design stereotypes do exist, in the form described, has several implications for the practice and teaching of CFIS design. Firstly, it implies that for a given CFIS design task each DS would produce a different set of answers to the fundamental design questions and, most likely a different design outcome. Secondly, as the three DS represent alternative design approaches, it implies that for a given CFIS design the approach represented by one of the DS may be preferable to the approaches represented by

the other two DS. (That is, one DS may be more appropriate in the sense that its approach may be more likely to lead to a successful outcome for the CFIS design task than would the approaches of the other two DS). Consequently, a more successful CFIS design outcome may be achieved if designers ensure that all assumptions made and the frame of reference used with regard to the design are explicitly identified. A form of reflection-in-action, as described by Schon (1981), could be practised by CFIS designers to help them recognize all the assumptions made. This would ensure that the substantive features of the design approach - the design criteria considered relevant, the norms for good design and the concept of the design process adopted - are made explicit rather than being implied in the design approach taken. Such reflection may also provide a means by which CFIS designers can broaden the frame of reference they use to include additional design criteria or norms when approaching a design task.

To support the changes to practice suggested above the teaching of relevant topics to those practising, or who are to practice, CFIS design should be modified to provide designers with a means of achieving a broadening of views and the self reflection necessary to ensure the explicit identification of these views, beliefs and assumptions. This teaching could identify the possible influence the adoption of the design approach embodied in each stereotype will have on the answering of the fundamental design questions. It could also identify and analyze relevant design criteria, norms for good design and alternative concepts of the design process. The teaching of these topics would assist CFIS designers to more clearly identify the design approach they are adopting and the frame of reference they are utilizing (with regard to the substantive features embodied in that design approach). These topics may assist CFIS designers to recognize that the frame of reference (or worldviews) of other participants in the design process may conflict with their own but may need to

be reconciled if a successful design outcome is to be achieved.

6.3 LIMITATIONS

The research outlined in this report has the following limitations:

i) The use of a literature search and review rather than a field survey to determine the worldviews and design approaches of CFIS designers may be considered a weakness in the methodology of the research for two reasons. Firstly, as only a small proportion of practising CFIS designers write books or journal articles this media may not generally reflect the view of this group. Secondly, the method of obtaining the research results, to infer the answers to the evaluation questions from the writings of CFIS designers, may not have reflected designer views as accurately as would have been the case if direct questioning had been used (for example, through the direct use of a questionnaire). These two points may serve to limit the validity and reliability of the inferences drawn from the CFIS design literature with regard to the whole population of CFIS designers.

ii) A further limitation on the validity and reliability of the results produced arises from the manner in which the evaluation questions were constructed. Eight substantive features of design were derived from previous work in the general literature on design and these were then condensed into four questions by a mapping process. This process (illustrated in Table 4A) proposed that particular inferences about the designer's beliefs on some of the substantive features could be drawn from an affirmative result for each of the evaluation questions. The validity of these inferences varies for each evaluation question with the

inferences from Questions A and D (which was identical to one of the substantive features) being well supported in the CFIS design literature to Questions B and C which were not well supported. This is particularly so with Question B where the conceptualization of the design stereotypes was used as a basis for proposing the inferences that could be drawn about the beliefs of the designer rather than any direct theoretical support from the CFIS design literature.

Additional validation could have been achieved by engaging another researcher to test the evaluation questions against a sample of the literature and comparing the results with those of this researcher. The attainment of similar or identical results would have increased confidence in the validity of the questions and conversely, disparate results reduced such confidence. Due to the limited resources available to the researcher and the scope of the research report such additional testing was not performed.

iii) The sample chosen may have been biased as the selection of CFIS designers was based on those who had written books or journal articles. The factors which influence these designers to attempt publication of their work may make them different, in some respects, to other CFIS designers and as such not representative of CFIS designers as a group[1]. It is likely that any effects from this factor would bias the results in a way that would exaggerate the support for the OBF and INT stereotypes and understate the support for the IST stereotype[2]. It is also possible that the actual selection of books and articles could bias the sample as some journals and many books on the topic of CFIS design, or related areas, were not reviewed. Given the way the sample was selected it is proposed that any effects from this kind of bias would be small.

iv) The conclusions drawn about possible editorial support in journals for each design stereotype must be qualified to the extent that information on the articles rejected for publication was not available. That is, a predominance of articles supporting one particular design stereotype may be due to editorial support or it may occur because all articles submitted for publication may support a particular stereotype. In the latter case the editors could not influence the orientation of the journal.

v) For the purposes of compiling and analyzing the results of this research the assumption was made that the literature references were homogeneous. As linear aggregations and ordinal scales were used the analysis of results is strongly dependent on the validity of this assumption. For the reasons outlined in Section 3.3 this is believed to be a valid assumption[3].

vi) Another possible weakness in the methodology of the research may result from the use of only four Evaluation Questions to identify designer views. The number of questions or the framing of the questions may not always allow differences in the views of authors classified into the same DS to be identified. This will have resulted in authors with substantial differences in beliefs being classified into the same DS. The most likely effect on the results from this factor would be that sub-categories of CFIS designer worldviews would be hidden. More detailed research using a finer[4] measuring instrument would be required to determine the effects this limitation may have on the results produced.

6.4 FURTHER RESEARCH

Given the support found for the existence of the three DS, further research could be conducted to support the

proposition that the particular DS adopted influences or determines the answers that will be generated to the fundamental design questions and, consequently, determines the occurrence of design problems and CFIS design failure. Support for a causal link between the DS chosen and the design outcome would imply that a cause of CFIS design failure may be the use of an inappropriate stereotype. This would invite consideration of the following questions:

i) Is it possible that the adoption of one of the three DS would produce a more successful outcome than the other two for any given CFIS design task but that the "most appropriate"[5] DS will be different for different design tasks? or

ii) Is it possible that the adoption of one of the three DS would always produce a more successful outcome regardless of the design task than the other two and, if so, which of the three DS is superior?

The influence of the DS adopted on the answers generated to the design questions (DQ) could be tested by hypothesizing the answers to the DQ that would be generated by each of the three DS and performing research to determine whether such answers would be produced in practice. A possible set of hypothesized answers to the DQ for each of the three DS, that could be used in these tests, is detailed in Appendix 4. These answers are based on the discussion in Chapter 2 of the values, beliefs and assumptions (with regard to the substantive features of CFIS design) underlying each DS.

These hypotheses could be tested in a number of ways, including the following:

i) One or more case studies could be performed on CFIS design projects from their initiation to the point of operation.

ii) Laboratory experiments using CFIS designers as subjects or field surveys of CFIS designers could be conducted.

iii) Literature accounts of past CFIS designs could be studied.

In the type of research identified in points (i) and (ii) testing would take place at two points and would most likely involve the use of questionnaires. Firstly, a test would be administered to identify the DS adopted by each subject. Secondly, a test would be used to determine the set of answers to the five fundamental design questions that would be generated by each subject[6]. These answers would be compared with the hypothesized answers. The results of these comparisons would indicate the extent to which the hypothesized answers were obtained and therefore the extent to which the proposition, that the DS adopted would determine or influence the answers to the DQ, could be supported.

The further research suggested could produce results which allow a framework to be established to assist designers to identify, at an early stage in the design process, the existence of factors which would most likely lead to CFIS design failure. This would provide an opportunity for CFIS designers to adjust their approach in such a manner as to improve the chances of achieving a successful design outcome.

NOTES TO CHAPTER 6

1. The term "group" is used here in the same way as the term "population" would be used to describe a group from which a sample were being drawn for testing.

2. This argument is based on two premises:

   (a) that books are more representative of practising CFIS designers and these strongly support the IST (technical) stereotype; and

   (b) that designers who attempt publication are more likely to consider the wider aspects fo CFIS design and therefore would be more likely to consider OB factors as well as technical factors.

3. Based on this belief the most conceivable change to the results would occur if it was believed that where multiple authors contributed to the one book or one journal article that each author should be classified as adopting a particular stereotype rather than the reference itself. This change would have resulted in an increased sample size but further analysis would need to be performed to determine whether the support for each DS would have been substantially different.

4. For example, a seven or nine point questionnaire would provide an opportunity for greater discrimination between CFIS designer worldviews.

5. The term "more appropriate" is used in this context to mean "more likely to lead to a successful outcome for the CFIS design process".

6. A generalized CFIS design exercise could be used in conjunction with a questionnaire comprising the 5 DQ to perform this test.

APPENDICES

APPENDIX 1

DEFINITIONS

1A USE OF INFORMATION BY ORGANIZATIONAL PARTICIPANTS

1B PURPOSES OF FORMALIZATION

1C INFORMAL SYSTEMS AND THE FORMALIZATION PROCESS

1D THE IMPACT OF FORMALIZATION ON INFORMATION SYSTEMS

1E ORGANIZATIONS

1F INFORMATION AND INFORMATION SYSTEMS

1G CONCEPTS OF THE DESIGN PROCESS

1A USE OF INFORMATION BY ORGANIZATIONAL PARTICIPANTS

Information is collected and used for instrumental purposes (such as environmental surveillance or the monitoring of performance), strategic purposes (in political manoeuvres or power plays), and symbolic purposes (information gathering provides an occasion for interaction and may be used to rationalize events - Feldman and March, 1981). Arguably, all organizational participants, to varying degrees, have opportunities to create, gather, use and disseminate information. More particularly, however, managerial work and information processing are closely and necessarily related. Mintzberg, for example, describes managers themselves as information processing systems (1972: 92) and believes they play the central role, in regard to all other organizational participants, in the production and usage of information (1972: 93).

Information is central to both individual and organizational functioning and has been the focus of considerable research, at the individual and organizational levels of analysis, which is designed to understand and improve the uses of information by human beings (Feldman and March, 1981: 171) and organizations (Argyris and Schon, 1977).

Feldman and March, for example, state:

> "Information processing interpretations of cognition, economic theories of information, and cybernetic perspectives on adaptation all build on the idea that the processing of information is a vital aspect of human behaviour." (1981: 171)

Though there is agreement about the importance of information in organizational functioning amongst organizational and behavioural theorists and researchers there is less agreement about how and why it is important. The most common published view has been that the acquisition and use of information is an essential part of rational decision making processes. (See, for example, Clark, 1970; Lawrence and Lorsch, 1970; Galbraith, 1977; Khandwalla, 1977; Kast and Rozenweig, 1981). Information serves to

reduce uncertainty and consequently to improve the quality of decisions; in turn, it is believed that the efficiency and effectiveness of an organization in achieving its goals are enhanced.

Other more recent research questions this view (Pfeffer, 1980; Feldman and March, 1981). For example, it has been claimed that information is used in other ways, and arguably for other purposes. Information may be used to rationalize decision making, (ex ante or ex post), instead of functioning as an instrumental component of decision making; it may be used to symbolize rationality in circumstances when choices are not rational (Feldman and March, 1981), or to affect the distribution of power between individuals and between operational subunits within organizations. Information may be generated by practice, without conscious design or purpose. (Pettigrew, 1975; Pettigrew and Mumford, 1975; Salanick and Pfeffer, 1977; Pfeffer, 1981).

1B PURPOSES OF FORMALIZATION

Formal information systems may be initiated, promoted, enhanced or used to a number of ends, including:

1. the supplementation or replacement of particular or private information by public information systems;

2. the establishment or imposition of authoritative views through the control of information media and content;

3. the limiting of access to particular information through selective reporting and distribution of collected information;

4. the deliberate manipulation of information collection and analyses in order to bias publicly distributed information;

5. the substitution of quantified and written for qualitative and verbal information (which cannot be coded or easily categorized);

6. the substitution or supplementation of "soft" information with "hard" information.

1C INFORMAL SYSTEMS AND THE FORMALIZATION PROCESS

Informal information systems exist in every formal organization (Luthans, 1981: 339) and cannot be completely formalized. Such systems are personalized and so "whether the informal information system has negative or positive functions for the organization largely depends on the goals of the person doing the communicating." (Luthans, 1981: 338)

Davis (1953) has identified several ways in which informal information networks can be arranged. These include:

(a) GOSSIP - where the originator of the information NON-SELECTIVELY communicates with everyone;

(b) PROBABILITY - where the originator communicates RANDOMLY with others according to the laws of probability; and the

(c) CLUSTER CHAIN - where the originator communicates SELECTIVELY with those he or she can trust.

The cluster chain, the most prevalent form of informal communication (Luthans states that research shows the cluster chain to be the most prevalent form of informal communication - 1981: 339)

> "means that most people in management acted as passive receivers, and only a few (10 to 30 per cent in most cases) re-communicated the information originally to another person ... There was no established, consistent group of communicators, but some persons tended more than others to be active in communication." (Davis, 1953: 215).

Formalization involves creating categories and coding schemes (Galbraith, 1977: 25) which control the type of information and the manner in which it can be collected, stored, transmitted and reported. These categories and coding schemes constitute a language with which members of the organization can communicate. An example of such a language is the accounting system which every organization has, (Galbraith, 1977: 99), in one form or another.

1D THE IMPACT OF FORMALIZATION ON INFORMATION SYSTEMS

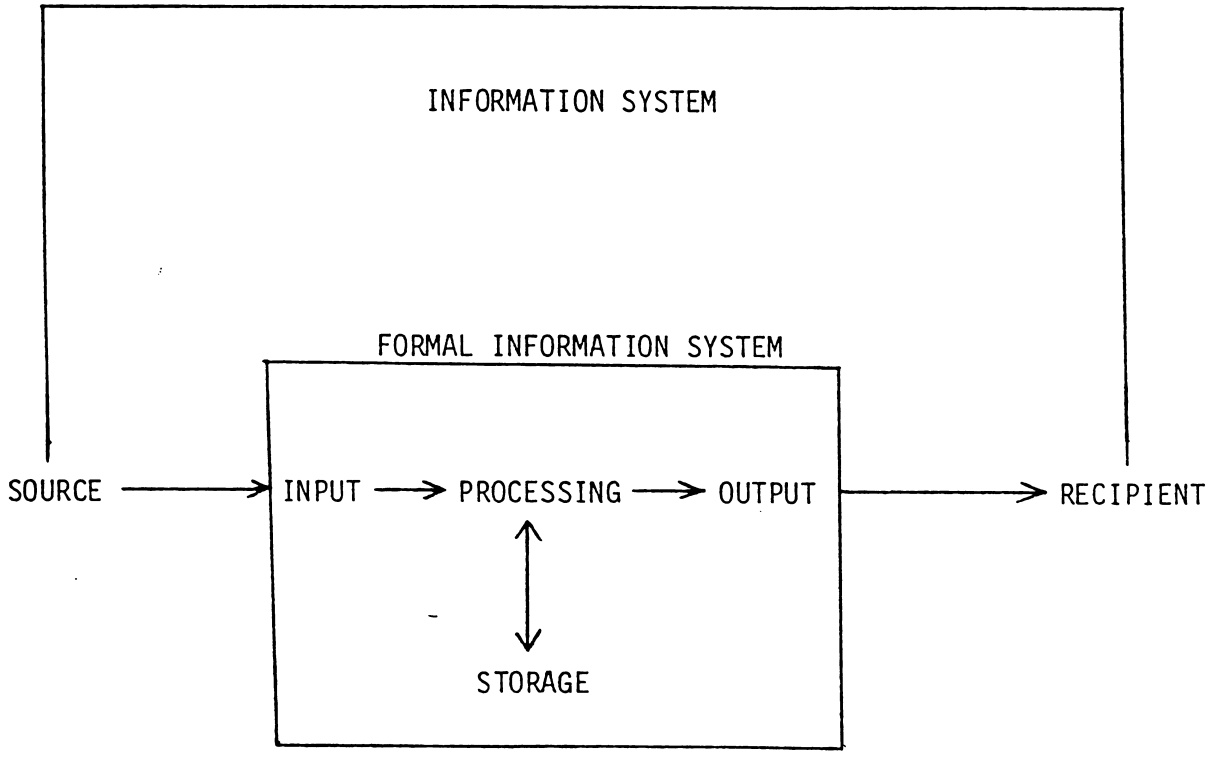
A formal information system is a form of intervention in an informal information system. This is illustrated in Figure A.1 which shows the formal information system intervening between the source of information and the recipient of that information. This intervention can be a complex process, which may involve modifying the content or presentation of the information, through some form of processing, before it is output to the recipient. It may also involve the storage of that information. This process normally involves people in each of the stages of the information system - information generation, processing (analysis or interpretation), storage and output dissemination.

Formalization depersonalizes information systems and can increase their accuracy (although Walton (1961) has found that informal systems can be quite accurate), re-channel information flows, and make such flows more consistent and predictable.

The formalization process permits transmission of more information with fewer symbols, thereby expanding an organization's communication channels (Galbraith, 1977: 99). It may also provide additional, more effective means of storing large quantities of information.

FIGURE A.1

AN INFORMATION SYSTEM



1E ORGANIZATIONS

Galbraith (1977: 2-4) identifies several essential attributes of organizations, as follows:

> "... organizations are (1) composed of people and groups of people, (2) in order to achieve some shared purpose, (3) through a division of labour, (4) integrated by information based decision processes, (5) continuously through time."

1F INFORMATION AND INFORMATION SYSTEMS

INFORMATION:

Tushman and Nadler (1978), in their discussion of information processing systems in organizations, define information as "data which are relevant, accurate, timely and concise" (1978: 614). They stress that "... information must affect a change in knowledge", and that "... data may or may not be information ..." and, as a consequence, "... data processing may or may not be information processing". (1978: 614). In other words, information is data that has sufficient relevance to affect a change in knowledge. (Such a change in knowledge could take place at either or all levels of the organization - individual, subunit, organization).

INFORMATION SYSTEMS:

Arnovick and Gee state that information systems

> "are environments composed of people, equipment and procedures organized to achieve specific information objectives." (1978: 369).

The functions of information systems are said to include:

> "... the generation of information from data, the facilitation of the use of data or information for action selection, and the transfer of data or information to other systems ..." (1978: 370). They also include the memorization and coupling functions. The information system:
>
> "must be able to connect inside the organization the memory system to the information processors (information processors include man as well as a computer or a man-computer system) and to the communication networks through which the information circulates." (Landry and Le Moigne, 1977: 801).

1G CONCEPTS OF THE DESIGN PROCESS

The three alternative concepts of the CFIS design process considered in this report are as follows:

(a) DESIGN AS AN INTELLECTUAL ACTIVITY

The organization, or human activity system can be viewed to be comprised of a number of CFIS, FIS and non-formalized information systems (NIS). This is illustrated in Figure A.2. Information and data (as distinguished in Section 1F) enter the organization into CFIS, FIS and NIS and are processed, stored and transmitted both within the organization and outside.

If viewed as an intellectual process, CFIS design would be seen to occur through the following stages:

1. FIS become overloaded and cannot cater for the level of information collection, processing, storage and dissemination needed by the organization.

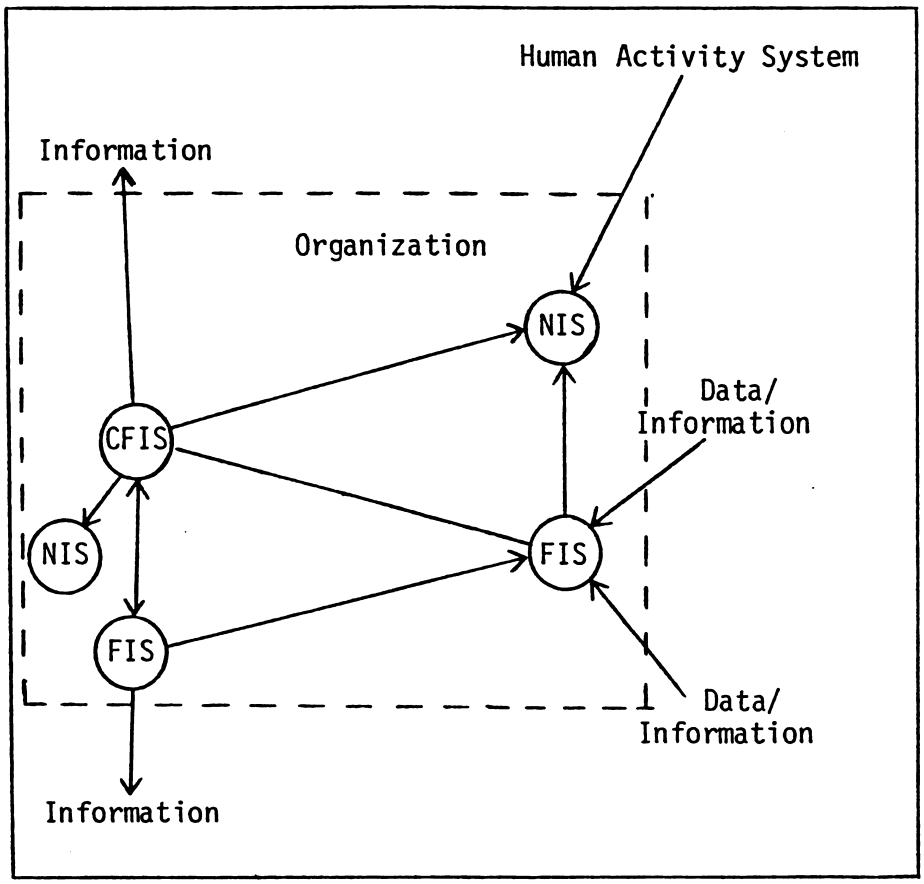
2. As a consequence, a CFIS is designed to increase the information processing capacity of the organization. The designer 'plans' to link or co-ordinate the new system with existing, or other planned CFIS and FIS.

3. The designer does not NECESSARILY plan to change the information flow, recipients, contributors, method of processing or degree of formalization but may CHOOSE to do so in an effort to produce a "good" design.

The intellectual process followed is illustrated in Figure A.3(a). The design effort is initiated by the designer's observations of difficulties, on the part of the organization either to maintain or increase its level of performance. The designer identifies the nature of the

FIGURE A.2

A VIEW OF FORMALIZED INFORMATION SYSTEMS AND ORGANIZATIONS



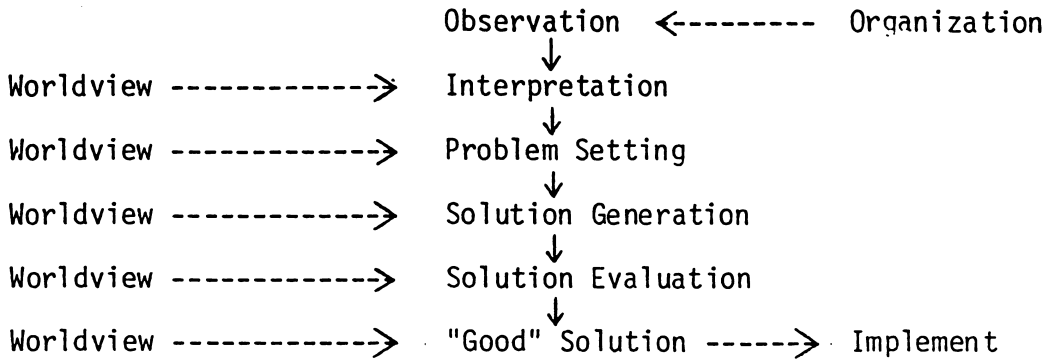
Data/Information flows — one way

two way

FIGURE A.3

ALTERNATIVE CONCEPTS OF THE DESIGN PROCESS

(a) INTELLECTUAL



(b) ITERATIVE

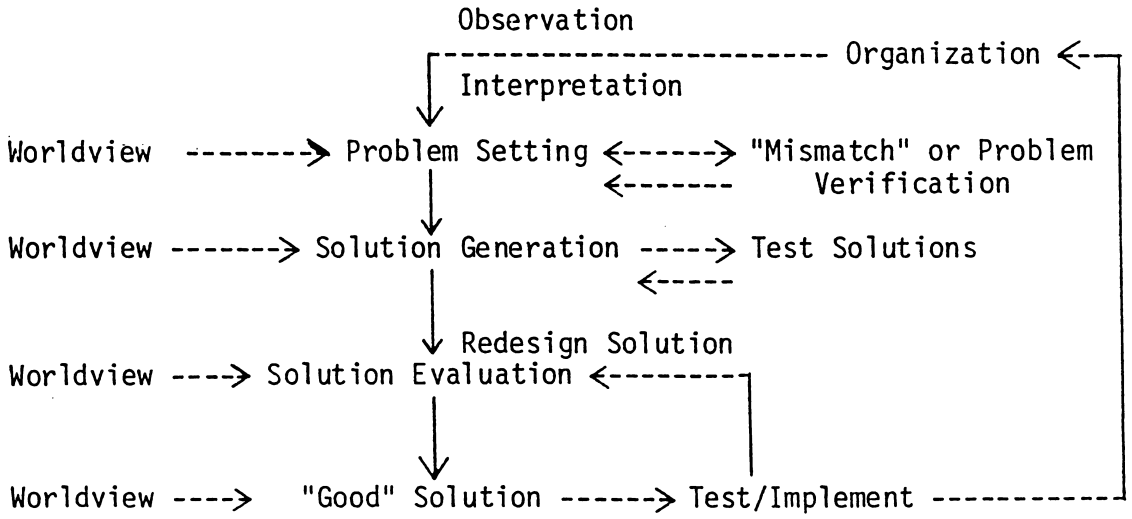
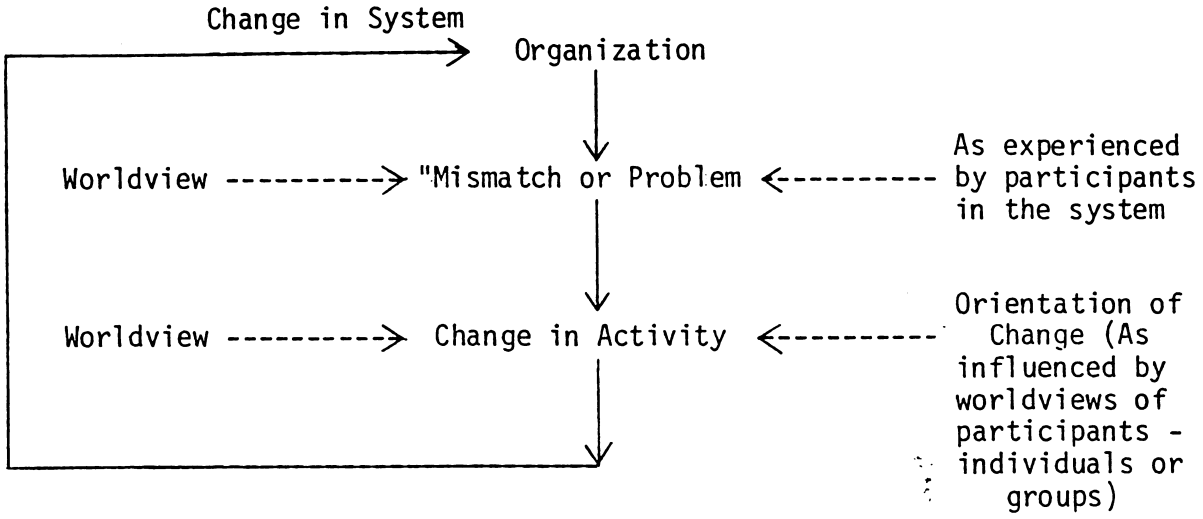


FIGURE A.3 (CONT.)

(c) OPERATIONAL/INTERACTIVE



problem and "sets" it. The problem - the design of a CFIS - is then solved via the generation of alternative solutions, the selection of the "best" solution (based on the designer's norm for good design) and the implementation of that solution in the form of software, hardware and "broader" systems design.

The designer's worldview is seen to influence what occurs through each stage of the process. Firstly, it determines how observations of activities or events in the human activity system are interpreted. Secondly, it influences the designer's sense-making activity, or what the designer sees as the Problem(s) of the situation. Finally, it influences the range of alternative solutions generated and provides the criteria, or frame of reference, for selecting a "good" solution. (That is, one which meets the designer's norms for good design). In this view design is a consciously planned activity, the designer has the capacity to reflect on the design activity and follows a set of planned design steps. The desired outcome of the design process may be to change the FIS and the human activity system in which it resides, or it may be to replicate a previous "good design" outcome for the FIS.

(b) DESIGN AS AN ITERATIVE PROCESS

The iterative process is similar to the intellectual process in terms of the view of the organization and the design stages followed. The differences are illustrated by Figure A.3(b) which shows iterations between the "intellectual" aspects of the problem-solving process and the organizational environment. These occur to test possible solutions and test the success of the implemented solution with a view to revision if it does not solve the problem(s) identified.

The worldview of the designer also influences each stage of this process but, to a lesser extent as the solution is tested in its organizational context. This process provides

an opportunity for the worldviews of those affected by the CFIS to affect its design and redesign.

The CFIS design is planned to relate to other existing CFIS or FIS but these relationships may be changed as a result of the testing of the CFIS design in its organizational or HAS context. This activity may change the FIS or maintain its original format for the computerization process.

(c) DESIGN AS AN OPERATIONAL / INTERACTIVE PROCESS

This view is illustrated in Figure A.3(c) which portrays the design process as an ongoing adjustment, in the form of problem solving, to the organization as a result of problems that are encountered. The way in which these problems are experienced / interpreted is determined by the worldviews of the participants of the HAS. The system is continuously being redesigned in an "unplanned" manner. There is no reflection on the design activity overall, and adjustment to the system occurs piecemeal, as necessary, and intuitively. Adjustments to the HAS or organization constitute (or generate, perhaps) change in FIS and are influenced by the worldviews of the participants in the HAS. There are no plans to alter either the HAS or the FIS or relate the CFIS to other CFIS or FIS.

In this view design is not intellectual activity but operational; the designers are all of the participants in the HAS affected by the FIS.

This view echoes Weick's (1969) notion of organizations as process oriented entities: "... the organization cannot be known until it has been enacted by the individuals comprising it, and those individuals will only come to understand the organization as they retrospectively reconstruct and make sense of what they have enacted." As a consequence, "understandings of purpose, goals and objectives are then the result of action, not the source of it (Boland 1979: 262). In this sense design is not

preplanned but an emergent process, the results and objectives of which can best be understood after they have occurred.

APPENDIX 2

DETAILED LITERATURE REVIEW RESULTS

2A SERIALS REVIEWED

2B RESULTS OF THE LITERATURE REVIEW - BY REFERENCE

2A SERIALS REVIEWED

SERIALS REVIEWED 1970-1984	YEARS WHERE OTHER THAN 1970-1984	ABBREVIATION
Academy of Management Journal		AMJ
Academy of Management Review	1976 Vol.1 to 1984	AMR
Accounting Organizations and Society	1976 Vol.1 to 1984	AOS
Administrative Science Quarterly		ASQ
Advance in Computers		AIC
Australian Computer Bulletin	1978 (Vol.2) - 1984	ACB
Australian Computer Journal		ACJ
California Management Review	1972 (Vol.14) - 84	CMR
Computer Applications	1973 (Vol.1) - 1982	CA
Computer Bulletin		CB
Computers and Eduction	1982 (Vol.6) - 1984	CE
Computer Journal		CJ
Computers and People	1970 (Vol.19) - 1983	CP
Computers and Society	1974 (Vol.5) - 1984	CS
Datamation		DAT
Data Processing		DP
DP Ed		DPE
Harvard Business Review		HBR
Hewlett Packard Journal		HPJ
Human Relations		HR
IBM Systems Journal		ISJ
Information and Management	1977 (Vol.1) - 81	IM
Information Processing		IP
Information Processing and Management		IPM
Journal of Computer and System Sciences		JCSS
Journal of Computer Based Instruction	1974 (Vol.1) 1982	JCBI
Journal of Information Processing	1978 (Vol.1) 1982	JIP
Journal of Information Science		JIS
Journal of Systems Management		JSM
Management Decision		MD
MIS Quarterly	1977 (Vol.1) - 84	MISQ
Management Science		MS
Sloan Management Review	1974 (Vol.15) - 84	SMR
Sociology		SOC

2B RESULTS OF THE LITERATURE REVIEW - BY REFERENCE

ARTICLES		EVALUATION QUESTIONS					
AUTHOR	YEAR	A	B	C	D	JRNL	DS
AHITUV AND NEUMANN	1984	Y	Y	-	-	MISQ	3
ALAVI AND HENDERSON	1981	Y	Y	-	-	MS	3
ALTER	1976	Y	Y	-	-	HBR	3
ALTER	1978	-	Y	-	-	MISQ	2
ARGYRIS	1977	-	Y	-	Y	AOS	2
ARNOVICK AND GEE	1978	Y	-	-	-	IPM	1
AVOTS	1973	Y	Y	-	-	DAT	3
BARIFF & GALBRAITH	1978	-	Y	-	-	AOS	2
BARKIN AND DICKSON	1977	-	Y	-	-	IM	2
BENBASAT AND TAYLOR	1978	Y	Y	-	-	MISQ	3
BERRISFORD AND WETHERBE	1979	-	Y	-	Y	MISQ	2
BOEHM	1974	Y	-	-	-	IP	1
BOLAND	1979	-	Y	Y	Y	AOS	3
BONCZEK ET AL	1984	Y	Y	-	Y	AIC	3
BONINI	1978	Y	Y	-	Y	CMR	3
BOSTROM AND HEINEN (Part 1)	1977	-	Y	Y	Y	MISQ	3
BOSTROM AND HEINEN (Part 2)	1977	-	Y	Y	Y	MISQ	3
BOYNTON AND ZMUD	1984	Y	Y	-	-	SMR	3
BRAVERMAN	1976	-	Y	-	-	DAT	2
BRITTAN	1980	Y	Y	-	Y	CJ	3
BRITTAN WHITE	1984	-	Y	-	-	MISQ	2
BRONSEMA AND KEEN	1983	Y	Y	-	-	SMR	3
CAMPBELL	1970	Y	-	-	-	DP	1
CERULLO	1980	-	Y	-	-	JSM	2
CHANDLER & MASSAWI	1974	Y	-	-	-	IP	1
CHAPIN	1983	Y	-	-	-	CP	1
CHENEY & DICKSON	1982	-	Y	-	-	AMJ	2
COLEMAN AND RILEY	1972	Y	Y	-	-	JSM	3
CONNELL AND BRICE	1984	Y	-	-	-	DAT	1
COSGROVE	1971	Y	-	-	-	DAT	1
DAFT AND McINTOSH	1978	-	Y	-	Y	CMR	2
DALY	1979	-	Y	-	-	DAT	2
DAMODARAN	1983	Y	-	-	-	DP	1
DANIEL	1976	-	Y	-	-	JSM	2
DAVENPORT	1981	Y	-	-	-	CJ	1
DE BRABANDER AND THIERS	1984	-	Y	-	-	MS	2
DICKSON	1981	Y	Y	-	Y	AIC	3
DOLL AND AHMED	1983	-	Y	-	-	MISQ	2
EDSTROM	1977	Y	Y	-	-	HR	3
EIN-DOR AND SEGEV	1978	-	Y	-	-	MISQ	2
EIN-DOR AND SEGEV	1982	-	Y	-	-	MISQ	2
FEENEY AND SLADEK	1977	Y	Y	-	-	DAT	3
FELDMAN & MARCH	1981	-	Y	-	-	ASQ	2
FID/TM	1974	Y	-	-	-	IP	1
FINNERAN AND HENRY	1977	Y	-	-	-	DAT	1
FRIED	1982	-	Y	-	-	DAT	3

ARTICLES		EVALUATION QUESTIONS					
AUTHOR	YEAR	A	B	C	D	JRNL	DS
GELLMAN	1973	-	Y	-	-	CP	2
GIBSON	1977	-	Y	-	-	JSM	2
GINZBERG	1978	-	Y	-	-	MISQ	2
GINZBERG	1980	-	Y	-	-	AOS	2
GINZBERG	1981a	-	Y	-	-	MISQ	2
GINZBERG	1981b	-	Y	-	-	MS	2
GLASSON AND HODGSON	1983	Y	Y	-	-	ACB	3
GUIMARAES	1981	-	Y	-	-	JSM	2
HAMMERSLEY	1980	Y	Y	-	-	CJ	3
HANSEN, McKELL & HEITGER	1977	Y	Y	-	Y	IPM	3
HAWRYSZKIEWYCZ	1981	Y	-	-	-	ACJ	1
HAWRYSZKIEWYCZ & WALKER	1983	Y	-	-	-	ACJ	1
HEAD	1971	Y	-	-	-	DAT	1
HENDERSON & NUTT	1978	Y	Y	Y	Y	AMR	3
HERSHAUER	1978	-	Y	-	-	JSM	2
HERZLINGER	1977	-	Y	-	-	HBR	2
HUBER	1981	-	Y	-	Y	MISQ	2
HUBER	1984	-	Y	-	Y	MISQ	2
IVES AND OLSON	1984	-	Y	-	Y	MS	2
JAMES	1980	-	Y	-	-	CJ	2
JONES	1976	Y	-	-	-	DAT	1
KEEN AND GERSON	1977	Y	Y	-	Y	DAT	3
KEIDER	1974	Y	-	-	-	DAT	1
KENDALL AND KENDALL	1981	-	Y	-	-	MISQ	2
KING	1978	Y	Y	-	Y	MD	3
KIMMERLY	1982	-	Y	-	-	DAT	2
KLING & SCACCHI	1980	-	Y	-	-	AIC	2
KLING & SCACCHI	1982	-	Y	Y	-	AIC	3
KOESTER & LUTHANS	1979	-	Y	-	-	AMJ	2
LAMB	1978	-	Y	-	-	DAT	2
LAND	1976	-	Y	-	-	CJ	2
LAND	1980	-	Y	-	-	CJ	2
LANDRY & LE MOIGNE	1977	-	Y	-	-	IP	2
LONGWORTH	1982	Y	Y	-	-	DP	3
LUCAS	1978	-	Y	-	-	MISQ	2
McCANN	1983	-	Y	Y	-	CE	3
McCARN	1970	-	Y	-	-	DAT	2
McINTOSH	1981	-	Y	-	-	AOS	2
McKEEN	1983	Y	Y	-	-	MISQ	3
MANN AND WATSON	1984	Y	Y	-	Y	MISQ	3
MANSOUR AND WATSON	1980	-	Y	-	-	AMJ	2
MARKUS AND PFEFFER	1983	-	Y	Y	-	AOS	3
MARKUS AND ROBEY	1983	-	Y	-	-	HR	2
MILLINGTON	1981	Y	-	-	-	CJ	1
MINTZBERG	1972	-	Y	-	Y	CMR	2
MITROFF & MASON	1983	-	Y	Y	Y	AOS	3
MOORE	1979	Y	-	-	-	MISQ	1
MORGAN & LIGHTMAN	1976	Y	Y	-	-	DAT	3
MOYNIHAN	1982	Y	Y	-	-	DAT	3

ARTICLES		EVALUATION QUESTIONS					
AUTHOR	YEAR	A	B	C	D	JRNL	DS
MUMFORD	1976	-	Y	Y	-	CB	3
MUMFORD	1980	-	Y	-	-	CJ	2
MUMFORD,MERCER,MILLS & WEIR	1971	-	Y	-	-	CB	2
MUMFORD,MERCER,MILLS & WEIR	1972	-	Y	-	-	MD	2
NAUMANN AND JENKINS	1982	-	Y	-	Y	MISQ	2
NYGAARD	1980	-	Y	-	-	CJ	2
OGDIN	1972	Y	-	-	-	DAT	1
ORKINS & WEISS	1975	Y	-	-	-	DAT	1
PAL	1984	Y	Y	-	-	CB	3
PARKIN	1982	Y	-	-	-	CJ	1
PATRICK	1976	Y	-	-	-	DAT	1
PATRICK	1980	Y	Y	-	-	DAT	3
PENGILLY	1976	Y	-	-	-	CJ	1
PETERS & TRIPP	1976a	-	Y	Y	Y	DAT	3
PETERS & TRIPP	1976b	Y	-	-	-	DAT	1
PETTIGREW	1975	-	Y	-	-	HR	2
POPE	1979	Y	-	-	-	ACJ	1
POWERS & DICKSON	1973	Y	-	-	-	CMR	1
PROWSE	1980	Y	Y	-	-	CJ	3
PROWSE & JOHNSON	1980	Y	-	-	-	CJ	1
READ & HARMON	1981	Y	-	-	-	DAT	1
ROBERTSON & ROBERTSON	1982	Y	-	-	-	DP	1
ROBEY	1979	-	Y	-	-	AMJ	2
ROBEY & FARROW	1982	Y	Y	-	Y	MS	3
ROBEY & MARKUS	1984	-	Y	-	-	MISQ	2
ROUSE & ROUSE	1984	-	Y	-	-	IPM	2
RUE	1976	-	Y	-	-	DAT	2
SAMID	1981	Y	-	-	-	DAT	1
SAUNDERS	1981	-	Y	-	-	AMR	2
SCHEWE	1973	-	Y	-	-	JSM	2
SCHMITT & KOZAR	1978	-	Y	-	-	MISQ	2
SCHNEIDERMAN	1982	Y	Y	-	-	DAT	3
SCHONBERGR	1980	-	Y	-	Y	MISQ	2
SEN	1983	Y	-	-	-	JIS	1
SENN	1978a	-	Y	-	-	MISQ	2
SENN	1978b	-	Y	-	-	MISQ	2
SHIGO ET AL	1980	Y	-	-	-	JIP	1
SOLOMON	1983	-	Y	-	-	DAT	2
STARKE & FERRATT	1976	-	Y	-	-	JSM	2
STEELY	1978	Y	Y	-	-	DAT	3
STREVELER	1978	Y	-	-	-	DAT	1
SWANSON	1974	-	Y	-	-	MS	2
TESTA	1974	-	Y	-	-	CP	2
THOMPSON	1970	Y	-	-	-	DP	1
TOMESKI & LAZARUS	1973	-	Y	-	-	CP	2
TOWNSEND	1980	Y	-	-	-	DAT	1
TRICKER	1977	-	Y	-	-	IP	2
TSICHRITZIS	1980	Y	-	-	-	DAT	1
TUSHMAN & NADLER	1978	-	Y	-	-	AMR	2

ARTICLES		EVALUATION QUESTIONS					
AUTHOR	YEAR	A	B	C	D	JRNL	DS
WALKER	1978	-	Y	-	-	DAT	2
WEDLEY & FIELD	1984	-	Y	-	Y	AMR	2
WEIL	1982	Y	-	-	-	DP	1
WEINMEISTER III	1971	Y	-	-	-	CP	1
ZMUD	1984	-	Y	-	-	MISQ	2
ZMUD & COX	1979	Y	Y	-	-	MISQ	3

TOTAL REFERENCES = 150

TOTAL FOR EACH DESIGN STEREOTYPE:

DS1 = 38 (IST)
DS2 = 70 (OBF)
DS3 = 42 (INT)

BOOKS

AUTHOR	YEAR	A	B	C	D	DS
BENNETT	1983	Y	Y	-	-	3
BINGHAM & DAVIES	1972	Y	-	-	-	1
BJORN ANDERSON	1980	-	Y	-	-	2
BJORN ANDERSON & HEDBERG IN NYSTROM & STARBUCK	1977	-	Y	-	-	2
BRIEFS ET AL	1983	-	Y	-	-	2
BROOKS ET AL	1982	Y	Y	-	Y	3
BURCH ET AL	1979	Y	-	-	-	1
CLIFTON	1971	Y	-	-	-	1
CONDON	1974	Y	-	-	-	1
COUGAR & KNAPP	1974	Y	-	-	-	1
COUGAR & McFADDEN	1977	Y	-	-	-	1
DAVIS	1974	Y	Y	-	Y	3
DE MARCO	1978	Y	-	-	-	1
DE MARCO	1979	Y	-	-	-	1
GALBRAITH	1977	-	Y	-	-	2
GANE & SARSON	1977	Y	-	-	-	1
GANE & SARSON	1979	Y	-	-	-	1
GILDERSLEEVE	1978	Y	-	-	-	1
GROSS & SMITH	1976	Y	Y	-	-	3
JEFFERY & LAWRENCE	1984	Y	-	-	-	1
JENSON AND TONIES	1979	Y	-	-	-	1
KAST & ROZENWEIG	1981	Y	Y	-	Y	3
KEEN & SCOTT MORTON	1978	Y	Y	Y	Y	3
KHANDWALLA	1977	-	Y	-	-	2
KILGANNON	1972	Y	-	-	-	1
LUCAS, LAND, LINCOLN & SUPPER	1980	Y	Y	Y	Y	3
LUCAS	1975	-	Y	-	-	2
LUNDBERG ET AL	1981	Y	Y	-	-	3
McCOSH RAHMAND & EARL	1981	-	Y	-	-	2
McCASH & SCOTT MORTON	1978	Y	Y	-	Y	3
MARKUS	1984	-	Y	-	-	2
MARTIN	1973	-	Y	-	-	2
MATTHEWS	1976	Y	-	-	-	1
MILLINGTON	1981	Y	-	-	-	1
MINTZBERG	1983	-	Y	-	-	2
MUMFORD & HENSHALL	1978	-	Y	-	-	2
MUMFORD	1981	-	Y	Y	-	3
MUMFORD & SACKMAN	1975	-	Y	-	-	2
MUMFORD & WEIR	1979	-	Y	-	-	2
MURDICK	1980	Y	Y	-	-	3
MURDICK & ROSS	1975a	Y	-	-	-	1
MURDICK & ROSS	1975b	Y	-	-	-	1
MYERS	1976	Y	-	-	-	1
OLLE, SOL & TULLY	1983	Y	-	-	-	1
OLLE, SOL & VERRIJN-STUART	1982	Y	-	-	-	1
ORR	1977	Y	-	-	-	1
RILEY	1981	Y	-	-	-	1

BOOKS

AUTHOR	YEAR	A	B	C	D	DS
SCHNEIDER & WASSERMAN	1982	Y	-	-	-	1
SEMPREVIVO	1976	-	Y	Y	-	3
STEWARD	1981	Y	-	-	-	1
TAUSWORTHE	1977	Y	-	-	-	1
TEBBS & COLLINS	1977	Y	-	-	-	1
YOURDON	1972	Y	-	-	-	1
YOUSSEF	1975	Y	-	-	-	1
ZELKOWITZ ET AL	1979	Y	-	-	-	1

TOTAL REFERENCES = 55

TOTAL FOR EACH DESIGN STEREOTYPE:

DS1 = 30 (IST)

DS2 = 13 (DS2)

DS3 = 12 (INT)

APPENDIX 3

LITERATURE REVIEW - SUPPORTING DETAILS

3A CONFIGURATIONS NOT CATEGORIZED

3B DETAILED RESULTS SUPPORTING FIGURE 5.1

- RESULTS FOR EACH DS AS A PERCENTAGE OF TOTAL REFERENCES REVIEWED BY YEAR

A. CONFIGURATIONS NOT CATEGORIZED

The four references not categorized as supporting either of the three DS were of the following configuration:

EQ	Configuration
A	Y
B	-
C	-
D	Y

These references most closely matched the configuration hypothesized for the IST stereotype. They were rejected because the combination they contained, of assumptions relating to the technical approach (the 'yes' answer to Question A) and to the existence of ill-defined problem types (the 'yes' answer to Question D), did not match the definition of IST as this DS specifically assumes well defined problems.

B. TABLE A1

DETAILED RESULTS SUPPORTING FIGURE 5.1 :

RESULTS FOR EACH DS AS A PERCENTAGE OF TOTAL REFERENCES REVIEWED BY YEAR

STEREOTYPES: IST OBF INT

YEAR	Articles	Books	Total	IST A	IST B	IST T	OBF A	OBF B	OBF T	YEAR TOTAL	% YEAR TOTAL * IST 1	OBF 2	INT 3
1970	2	-	2	1	-	1	-	-	-	3	67	33	-
1971	3	1	4	1	-	1	-	-	-	5	80	20	-
1972	1	3	4	2	-	2	1	-	1	7	58	28	14
1973	1	-	1	3	1	4	1	-	1	6	17	66	17
1974	4	2	6	2	-	2	-	1	1	9	67	22	11
1975	1	3	4	1	2	3	-	-	-	7	57	43	-
1976	4	2	6	5	-	5	4	2	6	17	35	30	35
1977	1	5	6	6	3	9	6	-	6	21	29	42	29
1978	2	2	4	13	1	14	5	2	7	25	16	56	28
1979	2	5	7	4	1	5	2	-	2	14	50	36	14
1980	4	-	4	9	1	10	4	2	6	20	20	50	30
1981	5	3	8	8	1	9	2	3	5	22	36	41	23
1982	3	2	5	4	-	4	6	1	7	16	31	25	44
1983	4	1	5	3	2	5	6	1	7	17	30	30	40
1984	1	1	2	8	1	9	5	-	5	16	13	56	31
	38	30	68	70	13	83	42	12	54	205			

* Rounded to nearest whole number

APPENDIX 4

HYPOTHESIZED ANSWERS TO THE FUNDAMENTAL DESIGN QUESTIONS FOR EACH DESIGN STEREOTYPE

1. STEREOTYPE 1 - INFORMATION SYSTEMS TECHNICAL APPROACH

It is proposed that the technical orientation of a CFIS designer following this DS would be reflected in the answers generated to the DQ. The following answers are hypothesized:

* WHAT IS TO BE DESIGNED?
  H1.1 - A CFIS based on a model of information input, processing, storage and output requirements.

* HOW IS IT TO BE DESIGNED?
  H1.2 - Through problem solving, consciously planned intellectual activity. A phased approach would be adopted utilizing the SDLC or a similar methodology.

* WHY IS IT BEING DESIGNED (WHAT ARE THE DESIGN OBJECTIVES)?
  H1.3 - To produce a technically optimal solution to the model (a modularized, structured approach to software design) and to maximize machine utilization.

* FOR WHOM IS THE DESIGN BEING PERFORMED?
  H1.4 - For the users of the output, initiators and approvers (usually management) of the system.

* BY WHOM SHOULD THE DESIGN BE PERFORMED?
  H1.5 - Computer professionals - systems analysts, system designers, programmers.

2. STEREOTYPE 2 - ORGANIZATIONAL/BEHAVIOURAL FACTORS APPROACH

The answers generated by a CFIS designer adopting this approach would reflect organizational considerations. These are hypothesized as:

* WHAT?

  H2.1 - A CFIS to provide information to support the organization's structure, strategies, processes and operations. For example, a system to enhance the information processing capacity of the organization, to cater for increasing levels of uncertainty or to encourage freely learning individuals through an open exchange of undistorted information.

* HOW?

  H2.2 - Through a combination of problem creating and problem solving activity, either consciously planned or unplanned, intellectual, iterative or interactive activity.

* WHY?

  H2.3 - To help the organization achieve its goals and to improve the QWL of its participants.

* FOR WHOM?

  H2.4 - For those components (aspects) of the organization which will be improved and for those organizational participants affected.

* BY WHOM?

  H2.5 - Organizational designers, theorists, social-psychologists (both internal and external to the organization) and organizational participants.

3. STEREOTYPE 3 - THE INTERFACE APPROACH

Finally, it is proposed that a CFIS designer adopting this approach would produce answers which reflect an understanding of the interdependencies between the organization and its information systems. The designer would also recognize CFIS design to be a dynamic, unstructured and non-rational process. The answers hypothesized for this approach are as follows:

* WHAT?

  H3.1 - A CFIS to provide information to support the organization's structure, strategies, processes and operations, and to support the information processing needs and decision making styles of the organization's participants. It should cater for the interdependencies between the organization, its participants and the CFIS which serve them.

* HOW?

  H3.2 - Through a combination of problem creation and problem solving activity consciously planned, intellectual or interactive activity, utilizing a methodology which identifies organizational, social-organizational and technical factors.

* WHY?

  H3.3 - To help the organization achieve its goals, to improve the quality of work life of its participants and, if possible, to obtain efficient utilization of the organization's computing resources.

* FOR WHOM?

  H3.4 - All parties affected by the proposed system.

* BY WHOM?

H3.5 - Organizational and technical designers as well as all affected parties (or their representatives).

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