

This item is held in Loughborough University's Institutional Repository (<https://dspace.lboro.ac.uk/>) and was harvested from the British Library's EThOS service (<http://www.ethos.bl.uk/>). It is made available under the following Creative Commons Licence conditions.



creative
commons
C O M M O N S D E E D

Attribution-NonCommercial-NoDerivs 2.5

You are free:

- to copy, distribute, display, and perform the work

Under the following conditions:

 **BY:** **Attribution.** You must attribute the work in the manner specified by the author or licensor.

 **Noncommercial.** You may not use this work for commercial purposes.

 **No Derivative Works.** You may not alter, transform, or build upon this work.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the [Legal Code \(the full license\)](#).

[Disclaimer](#) 

For the full text of this licence, please go to:
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

**THE LIKELIHOOD OF SUCCESS IN MANAGEMENT
INTELLIGENCE SYSTEMS: BUILDING A
CONSULTANT ADVISORY SYSTEM**

by

Morteza Seyed Forghani (Mr.)

A Doctoral's Thesis

Submitted in partial fulfillment of the requirements

for the award of

Doctor of Philosophy - Ph.D.

of the Loughborough University of Technology

June 1989

C

Morteza, Seyed Forghani 1989

DEDICATION

**To my Sister Muluk Forghani, my parents, and
my wonderful nieces Katherine and Victoria Rogers**

ACKNOWLEDGEMENT

During the course of this research I visited a number of organisations and interviewed many senior managers and consultants who, despite their pressing engagements and time constraints, agreed to participate in the case studies and received me in a courteous and friendly manner. Without their cooperation and involvement this research would have not been realised. Although I am obliged not to disclose their identity, I would like to express my sincere thanks to them all.

I would like to thank all the software suppliers who not only assisted me in obtaining access to their clients, but also provided me with a free copy of their software which proved of valuable help.

Special thanks to my Research Supervisor, Dr. Paul N. Finlay, for his very able assistance and considerable patience toward me throughout the course of the research.

Also thanks to my Director of Research, Prof. Geoff Gregory, who made it convenient for me to write up this thesis by allowing me to borrow the necessary equipment from the Department.

My thanks to all those members of Loughborough University of Technology and in particular members of the Department of Management Studies and the Banking Centre who assisted me in many different ways.

Many thanks to Mr. Johnathon Carton, who undertook the difficult task of transcribing some of the interview tapes.

Not least, I like to thank all members of my family, in particular my eldest sister, whose support, encouragement and patience made it possible for me to carry on with the research.

**THE LIKELIHOOD OF SUCCESS IN MANAGEMENT
INTELLIGENCE SYSTEMS: BUILDING A
CONSULTANT ADVISORY SYSTEM**

Table of Contents

Research Synopsis

Introduction	1
CHAPTER 1:	4
1.1 Research Scope and Objective	4
1.2 Research Methodology	5
1.2.1 Overall Methodology	5
1.2.2 Literature Survey I & II	7
1.2.3 Field Research	8
1.2.3.1 Introduction	8
1.2.3.2 Entre' Methods	8
1.2.3.2.1 Questionnaire Technique	8
1.2.3.2.2 Direct Approach	9
1.2.3.2.3 Back Door Approach	11
1.2.4 Methods Used in Doing Field Research	11
1.2.4.1 Introduction	11
1.2.4.2 Observation Technique	13
1.2.4.3 Involvement in MINTS Development	14
1.2.4.4 Interview Technique	14
1.2.5 Computerisation of the Success Model	15
1.2.6 Validation	16
CHAPTER 2:	17
2.1 Literature Survey I - Computer-Based Information Systems	17
2.1.1 Objective of the Literature Survey I	17
2.2.2 Definitions and Characteristics of CBIS	17
2.2.3 Types and Usage of DSS	24
2.2.4 Existing System Development Approaches	29
2.2.4.1 Traditional System Development Approach	29
2.2.4.2 Evolutionary System Approach	29
2.2.4.3 Change Process Model	31
2.2.4.4 Life Cycle System Development Approach	31
2.2.4.5 Prototyping Approach to System Development	32
CHAPTER 3:	33
3.1 The Concept of Management Intelligence Systems	33
3.1.1 Objective	33
3.1.2 The Place of EDP, MIS, and MINTS in Decision Making	33
3.1.3 The Relationship Between MINTS, DSS and MIS	41
3.1.4 Uncertainty and Decision Making	45
3.1.5 Institutional vs. ad hoc MINTS	48
3.1.6 A Suitable System Development Approach to MINTS	51
3.1.6.1 An Evaluation of System Development Approaches	51
3.1.6.2 Breadboarding Approach to MINTS	53
3.1.7 The People Involved in a MINTS Project	55

CHAPTER 4:	70
4.1 Literature Survey II - MIS/DSS Success	70
4.1.1 Objective	70
4.1.2 Previous Work	70
4.1.2.1 Definition of Success	70
4.1.2.2 Contributory Success Factors	72
4.1.2.3 Structuring a Model of Success	87
4.1.2.4 Techniques for Eliciting User's Responses	87
4.1.2.5 Techniques for Calculating System Success	88
4.1.2.6 Summary of Literature Survey Findings	94
4.1.3 The Approach to be Taken	95
4.1.3.1 Definition of Success	95
4.1.3.2 Contributory Success Factors for a MINTS	98
4.1.3.3 Structuring a Model of Success	98
4.1.3.4 Principles for a Measurement Technique	99
4.1.3.4.1 A Technique for Eliciting Responses	99
4.1.3.4.2 A Technique for Calculating Success	99
CHAPTER 5:	100
5.1 Field Research	100
5.1.1 Objective	100
5.1.2 A Proposed Model of Success	100
5.1.3 Choice of Case Studies	115
5.1.4 Breakdown of the Case Studies	115
5.1.4 Results of the Case Studies	123
CHAPTER 6:	143
6.1 A Consultant Advisor for Assessing MINTS Success	143
6.1.1 Introduction	143
6.1.2 Identifying a Measurement Instrument	143
6.1.2.1 Criteria Used for the Choice of an Instrument	143
6.1.2.2 Software Packages Considered	144
6.1.3 Dejavu	146
6.1.3.1 An Overall View of Dejavu	146
6.1.3.2 A Hierarchical Tree Structure	147
6.1.3.3 A Method of Eliciting User's Responses	147
6.1.3.4 A Method of Assigning Importance	148
6.1.3.5 Critical Success Factors	148
6.1.3.6 Internal Workings	149
6.1.3.6.1 Mathematical Calculations	149
6.1.3.6.2 Comparison with Conventional Weighted Average Technique	152
6.1.4 The Consultant Advisory System	154
6.1.4.1 Scope of a MINTS Project	154
6.1.4.2 The User of the Consultant Advisory System	155
6.1.4.3 Importance Score Assigned to Success Factors	155
6.1.4.4 Performance Score Assigned to Success Factors	156
6.1.4.5 Dealing with Irrelevant and Currently Unknown Factors	156
6.1.4.6 Style and Level of Questions	157
6.1.4.7 Number of Questions Asked	158
6.1.4.8 Questions about Critical Success Factors	158
6.1.4.9 Distinction Between MIS and MINTS	159
6.1.4.10 The Computerised Consultant Advisory System	159

CHAPTER 7:	161
7.1 Research Validation Methodology	161
7.1.1 Introduction	161
7.1.2 Methodology	163
7.1.3 Verification of Measurement Instrument	166
7.1.4 Construct Validation	169
7.1.5 Content Validation	170
7.1.6 Criterion Validation	174
7.1.7 Useability	179
Concluding Remarks:	
Summary and Conclusions	182
Further Research	185
References	187
Bibliography	203
Appendices:	
Appendix A : Results of Field Research	
Appendix B : The Mathematical Calculations in the Consultant Advisory System	
Appendix C : 'n out of k' factors	
Appendix D : Computer Program of the Consultant Advisory System on a floppy diskette	
Appendix E : Validation Results of MINTS Project 1	
Appendix F : Validation Results of MINTS Project 2	
Appendix G : Validation Results of MINTS Project 3	

Research Synopsis

Management Intelligence Systems are a class of Decision Support Systems aimed at providing intelligence about an ill-structured decision to a decision-maker. The research objective was to build a 'Consultant Advisory System', a computerised model of success, to assist internal consultants in assessing the likelihood of success for a Management Intelligence System (MINTS). The system would also be capable of allowing the consultant to identify reasons which might lead to a low likelihood of success, so that corrective action can be taken. The approach taken is different from many other studies which have concentrated on the success of a computer-based information system after implementation, rather than assessing success throughout the whole process of initiating, developing and implementing such systems.

The research has been based on a detailed survey of the literature on Management Information systems (MIS) and Decision Support Systems (DSS) and 39 field investigations involving detailed interviews with the key actors involved in a MINTS project.

Two phases of MINTS development were identified: (A) ensuring a right environment and (B) maintaining relationships. About 280 factors were distilled as significant for the successful development of a MINTS and these have been incorporated in a computerised advisor. Validation of MINTS in general and the advisor in particular is discussed in detail.

INTRODUCTION

Introduction

Although computers first became available commercially in the early 1950s, few organisations had investigated their possible applications to management seriously before 1955 [156].

It was not until the late 1960s when their introduction into the office became widespread [156]. Early Management Information Systems (MIS) were concerned with the distribution of voluminous reports based on 'hard' data available, rather than with the decisions to be made. The designers of such systems did not know that a major task of an effective MIS is to filter data, not to proliferate it. The problem was remedied by selective dissemination of reports and the discovery of the principle of management exception reporting.

A problem with MIS was, although the reports produced were of help to some operational and middle-management, they were of much less interest to top management. A major reason was that, while these systems processed internal 'hard' data, the top management stood at the interface between a company and its environment, who had a need for intelligence about its internal as well as its external environment. The design of modern information systems for intelligence purposes was in its infancy. A major problem was that most of the information required by top management was available only as man-readable, natural language text and converting into machine-readable form proved difficult. Moreover, the higher the management level, the more ill-structured were the problems facing the management.

Since the late 1970s, Decision Support Systems (DSS) has become the new buzzword in the application of computers to situations that are not fully structured. Such applications were made possible due to rapid advances in technology, specially the advent of powerful and cheap microcomputers and of high level programming languages and presentation techniques.

During the last decade, the term "Expert System" has become another popular buzzword. Despite the early exaggerated promises in the ability of these systems to simulate human thinking, as yet they are in their infancy and so far only capable of dealing with routine and structured problems.

Although great advances have been made in the understanding of DSS, the area of DSS remains complex and controversial. Moreover, DSS are not homogenous. A class of support systems termed "Management Intelligence System" (MINTS) is identified in this study. These systems provide intelligence to decision-makers in dealing with ill-structured decisions.

INTRODUCTION

Measuring the effectiveness of computer information systems has proved a difficult task. As information systems budgets grow and resource allocation challenges information system managers (e.g. consultants), reliable methods to assess information system effectiveness and to identify causes of poor performance assume great importance [114].

In the early days, the success of information systems were evaluated in simple cost-benefit terms. Moreover, as these systems were well-defined, 'hard' system methodology was used for their development. The success of these systems was considered from a product point of view.

With DSS (and specially MINTS) having few 'objective' benefits, an assessment is required of the success of these systems through controlling their development process. This thesis offers a computer model of success in MINTS for internal consultants.

The work carried out by the researcher is divided into seven chapters. In Chapter 1, the scope of the research and its objective, as well as the research methodology are discussed fully, except that the validation methodology warrants its own chapter - Chapter 7.

Chapter 2 is devoted to the initial literature survey carried out in the area of computer-based information systems for the purpose of focusing the research scope and its objectives. In this chapter, different types of computer-based information systems are defined and discussed. It is here that the class of support systems termed MINTS is identified. Development approaches to building computer-based information systems are also discussed.

MINTS are defined and fully discussed in Chapter 3. A comparison is also made between different types of support systems. A breadboarding approach is argued to be a suitable approach for building MINTS. In this chapter, the key actors in the development of MINTS are identified.

Having focused the research objective to measuring the likelihood of success throughout a MINTS project, a second literature survey was felt required in the area of MIS/DSS success. This literature survey is fully discussed in Chapter 4. A list of contributory success factors is produced, and an assessment of the existing measurement techniques for assessing the success of a computer-based information system is discussed. Finally, a new definition of success is offered based on a process approach, and a set of criteria is identified for selecting a suitable measurement technique for assessing the likelihood of success for a MINTS project.

INTRODUCTION

The next step was to assess the extent to which the list of contributory success factors extracted from the literature was applicable to MINTS. For this reason field research was carried out. Chapter 5 offers a discussion of this research. A modified and extended list of contributory success factors is offered as applicable to MINTS success. Detailed results of the field research is also produced in Appendix A.

In Chapter 6, the methodology behind the Consultant Advisory System is presented. A group of Expert System and MINTS generators are evaluated in order to find a suitable software package for computerising the model of success. The internal workings of the measurement technique used in the Consultant Advisory System for measuring success is also discussed here with a fuller discussion given in Appendix B.

In Chapter 7, an overall validation methodology is offered, into which is fitted the validation carried out by the researcher into the model of success and the Consultant Advisory System.

Finally, a summary of the research together with some conclusions are given. Further research is also proposed.

CHAPTER 1	4
1.1 Research Scope and Objective	4
1.2 Research Methodology	5
1.2.1 Overall Methodology	5
1.2.2 Literature Survey I & II	7
1.2.3 Field Research	8
1.2.3.1 Introduction	8
1.2.3.2 Entre' Methods	8
1.2.3.2.1 Questionnaire Technique	8
1.2.3.2.2 Direct Approach	9
1.2.3.2.3 Back Door Approach	11
1.2.4 Methods Used in Doing Field Research	11
1.2.4.1 Introduction	11
1.2.4.2 Observation Technique	13
1.2.4.3 Involvement in MINTS Development	14
1.2.4.4 Interviewing Technique	14
1.2.5 Computerisation of the Success Model	15
1.2.6 Validation	16

**PAGE
NUMBERING
AS ORIGINAL**

1 CHAPTER 1

1.1 Research Scope and Objective

As will be explained in the course of the following chapters, the research objective had to be modified on a few occasions. The initial area of research was to study how in practice managers validate decision models created by consultants.

The scope of the research was soon extended to cover the full area of Decision Support Systems (DSS). However, the new research area still revolved around the three major elements of the initial research area; managers, consultants, and decision models, but with a completely different emphasis. The new emphasis was on how managers and consultants go about introducing, developing and implementing DSS, in order to identify a set of conditions or factors for building DSS successfully.

Having carried out a literature survey in the area of DSS, the researcher found, as will be explained in the next Chapter, the concept of DSS to be rather ill-defined and as yet a controversial concept. The area of DSS, depending on how it is defined, can be very large. A DSS is sometimes referred to as any system that assists a decision-maker in his decision-making. The implication of such a definition is that any system such as an Electronic Data Processing (EDP) and Management Information Systems (MIS) can be regarded as a DSS. For the purpose of this research such a definition was found too general and not helpful.

However, based upon a detailed literature survey of DSS, the researcher identified a class of support systems which was termed Management Intelligence Systems (MINTS). The concept of MINTS is discussed fully in Chapter 3. For the moment, it is sufficient to define a MINTS as a computer-based support system that provides intelligence in dealing with ill-structured decision problems. However, the scope of the research was focused on MINTS, and the research objective was modified to building a model of success to assist consultants in measuring MINTS success. Very soon it was decided to computerise the model of success, which was to be called Consultant Advisory System. The Consultant Advisory System was to assist internal consultants in the following ways;

- (a) as a checklist for going about a MINTS project,
- (b) for identifying the problematic areas so that corrective action can be taken in time to improve the MINTS project's likelihood of success.
- (c) to assess the overall likelihood of success for the MINTS project.

1.2 Research Methodology

1.2.1 Overall Methodology

Figure 1.1 depicts the overall research methodology which was followed in conducting the research, which is followed by a detailed discussion of its major parts.

**TEXT BOUND
INTO
THE SPINE**

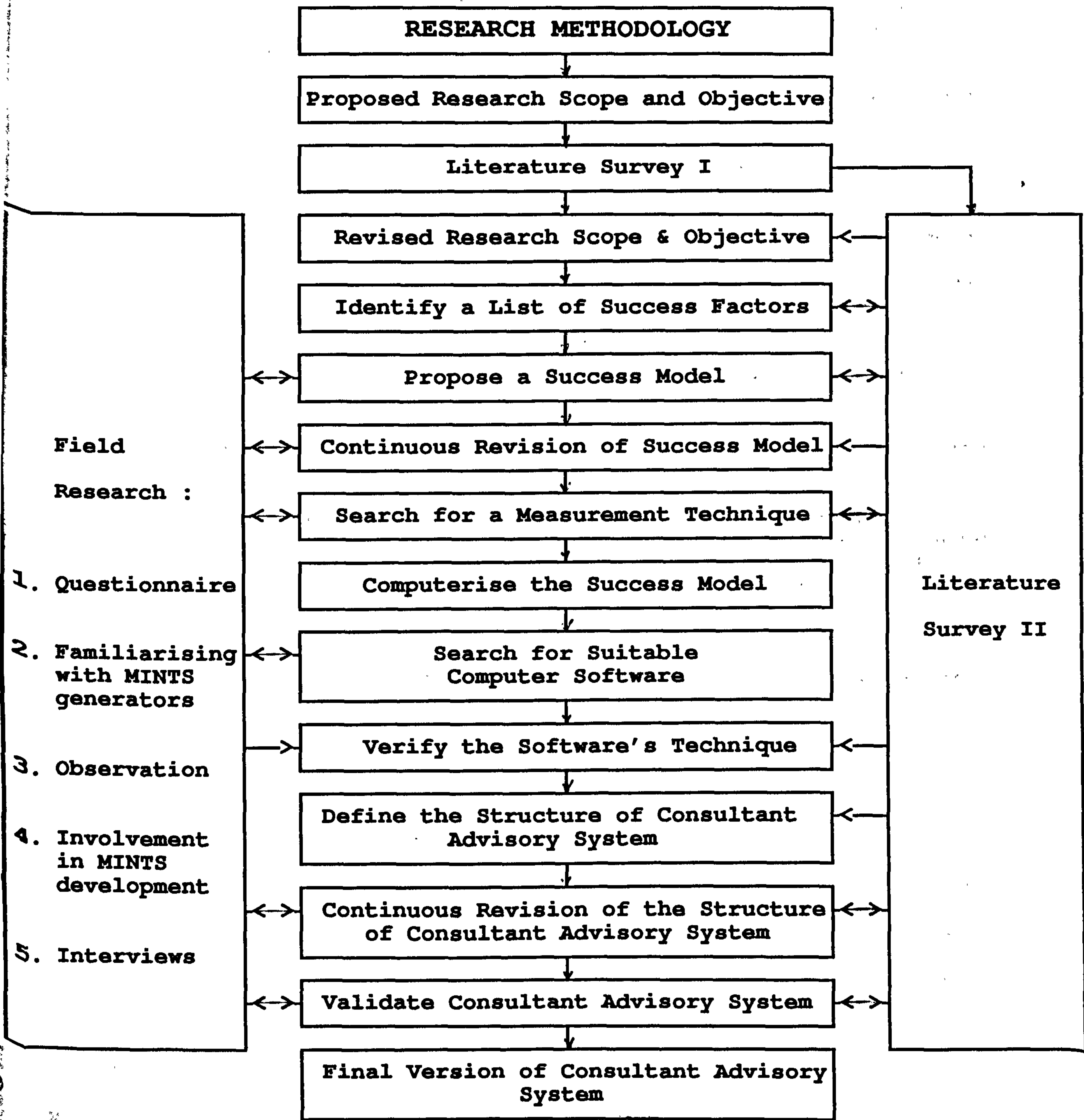


Figure 1.1

1.2.2 Literature Survey I & II

Two rounds of literature surveys were carried out. The literature survey I was in the area of Decision Support Systems (DSS). Based on this literature survey, a new class of support systems was identified and referred to as "Management Intelligence Systems" (MINTS). This resulted in carrying out a second literature survey to identify a list of contributory success factors applicable to MINTS. However, as MINTS was a new area, the researcher felt it important to consider the literature on the success of Management Information Systems (MIS) and DSS in identifying a set of success factors that could be applicable to MINTS.

The search for a set of contributory success factors proved that there existed a large number of such factors. The problem, however, was that many of these success factors were too general - in the form of "Motherhood" statements, like;

"The more user-friendly a system, the greater the likelihood of success".

Moreover, the researcher was faced with the following problems;

- (a) success factors were too general to measure.
- (b) there existed a number of measures of success based on a product approach. In other words they measured the success of a computer-based information system after its implementation. None of which was felt sufficient for defining success throughout a MINTS project.
- (c) a number of shortcomings were associated with the measurement techniques suggested for calculating success. A major shortcoming was that these techniques were based on an additive/linear approach, while a multiplicative/non-linear approach was regarded by more recent studies as more appropriate for measuring an individual's perception.

The first problem was dealt with by breaking down the contributory success factors into other factors and structuring them in order to make a greater sense of them.

The second problem, was dealt with by offering a new measure of success based on a process approach which included many of the measures of success suggested in the literature.

As regards to the third problem, the literature survey results in a number of concepts, principals that were regarded as important for a measurement technique. These were used in further search for a suitable measurement technique based on a multiplicative approach.

1.2.3 Field Research

1.2.3.1 Introduction

Field research was required to investigate the relevance and the importance of the identified contributory success factors to MINTS.

The initial step was to establish contacts with a number of organisations involved in the area of MINTS. A number of methods were considered in obtaining 'entre' to organisations. These were;

- (a) Questionnaire Technique
- (b) Direct Approach
- (c) Back door approach

Having obtained 'entre' to some organisations, a number of approaches were adopted in conducting the field research. These were;

- (a) Observation Technique
- (b) Familiarising with MINTS generators
- (c) Interviewing Technique
- (d) Building MINTS

1.2.3.2 'Entre' Methods

1.2.3.2.1 Questionnaire Technique

The researcher considered using a questionnaire technique as a method of collecting data as well as obtaining 'entre' to companies, but this proved unsuccessful.

A questionnaire was issued to a group of managers who were doing an MBA course at Loughborough University. There were two objectives behind the questionnaire; (i) to assess whether or not the respondents could provide a meaningful response to a set of qualitative questions, and (ii) to use the questionnaire as a way of obtaining the respondents' agreement to provide the researcher with a case study of the use of computer-based information systems within their organisation. The response to (ii) was very poor, and those who did respond, although prepared to make a reply to the questionnaire, were not willing to commit themselves to be interviewed. This was because; some respondents were not sure if they would stay in their present company, some were going on holiday, and some were not willing, nor had the authority to commit their organisation.

The researcher also noticed that unless the questionnaire was in the form of a YES or NO, or a multi-choice, most of the respondents were not willing to spend time answering the

descriptive questions: it was difficult to make sense of the replies from the few who did. It was also noticed that unless a questionnaire is a short one, the respondents will not bother to reply.

Moreover, there is a question mark on the validity of a questionnaire technique;

- (a) a posted questionnaire limits the researcher's control on who answers the questionnaire.
- (b) there is a great deal of risk in the respondents misunderstanding the definitional and conceptual issues.
- (c) the researcher has no control on whether or not the respondents follow the guidelines as suggested in the questionnaire.
- (d) a questionnaire is usually short and brief. This means that a rich picture is not obtained.
- (e) the researcher remains unaware of the context within which the questions are answered.

1.2.3.2.2 Direct Approach

Initially, it was decided, to identify a number of organisations which had been involved in building MINTS. A number of journals (such as the Journal of the Operational Research Society, European Journal of Operational Research, Omega, Journal of Applied Systems Analysis, Interfaces, Decision Sciences, Management Sciences, Data Base, Industrial Management Review) were searched for cases of British companies' involvement in MINTS projects. Based on this exercise, one relevant case study involving a MINTS was found. Subsequent direct correspondence proved successful in establishing contacts with the company.

Having failed to identify any more cases of organisations involved in MINTS in the aforementioned journals, the researcher wrote to a small number of major organisations in the hope that they may be involved in the area of MINTS. This resulted in one successful entre', but failed in the other cases. The cases which failed, could have been due to any combination of the following reasons;

- (a) The researcher had failed to offer some incentives in exchange for their time.
- (b) The researcher did not have any contacts within the companies.
- (c) The companies felt that the researcher was seeking sensitive data. They were not prepared to allow an outsiders to assess their system, nor to interview their system users.
- (d) They were genuinely busy, and the researcher's timing was not right.

CHAPTER 1

However, lessons were learnt. It was concluded that the major area to tackle in order to improve the chance of obtaining entre to these companies was to come up with some reasonable incentives. The researcher could offer the following;

- (a) Offer his services, and expertise (e.g. knowledge of some software packages) in the area of MINTS. This could be in the form of doing some programming, or designing guidelines for building a MINTS. In fact the first entre' was obtained because the researcher was able to offer programming skills, in exchange for being allowed to go around and interview the members of the company. The same technique made it possible for the researcher to establish contact with a number of other companies.
- (b) Offer an informal introduction on some of the software packages. The objective was to create interests and a potential for a MINTS project in which the researcher could become involved as a case study.
- (c) Offer information on the state of the art, and sharing some of the research findings. This was tried in few cases, but the researcher found that the real incentive behind the companies allowing him entre' was to collect intelligence on their competitors.
- (d) Offer some publicity, through writing articles, with a written approval of those concerned. This technique was used most successfully in the case of establishing contacts with software suppliers.
- (e) Invite interested members of a number of companies to a seminar on MINTS, to be held at Loughborough University Department of Management Studies. The objective would be to offer some hands-on experience on some software packages. Thus creating a link between the University and the companies. The researcher decided against this option, due to problems of organising a seminar. There was also, at the time, a lack of adequate number of micro-computers within the department. Also the researcher was not sure of the response rate, and whether or not he would attract the right people for the purpose of the research. The cost of running such a seminar, as well as the time and effort for preparing and organising such an event also were factors that had to be taken into consideration.

Another problem against writing to companies was that not many companies were using MINTS. Many companies are still in the process of establishing their MIS, and do not as yet wish to commit themselves to MINTS. Moreover, the researcher had no way of knowing which companies were using a MINTS.

Due to the above problems, the researcher needed a different strategy which could offer results. A "back door" strategy was considered.

1.2.3.2.3 Back Door Approach

A "back door" strategy was to be aimed at those organisations selling and distributing software packages. Theoretically, this seemed to be an effective strategy, for two main reasons; firstly because the researcher could offer them real incentives;

- (a) they would be most interested in publicity.
- (b) they would be most interested in having a liaison with academic institutions, namely Loughborough University of Technology.

Secondly, they would be in the position to introduce the researcher to their clients. In this way, it would be possible for the researcher to know who is using MINTS, and be introduced to the right people.

An additional advantage of this strategy was that, software packages could be obtained free of charge, to gain hands-on experience of their capabilities and limitations. In turn, this could be used as a valuable advantage when approaching organisations using or wishing to use a MINTS.

A further and very important potential from establishing contacts with software suppliers was that the researcher could attend some of the user meetings and promotional presentations as an effective means of getting to know the users, and creating contacts.

However, when the above strategy was put into practice, it proved extremely successful, as the majority of contacts were obtained through this strategy. In fact the above assumptions were all realized.

There was some degree of bias associated with this approach, and this will be dealt with in Chapter 7 on validation.

1.2.4 Methods Used in Doing Field Research

1.2.4.1 Introduction

In carrying out field research the researcher adopted three different approaches, observation, personal involvement in building MINTS, and interviewing.

For the purpose of carrying out interviews with consultants, system users and intermediaries more effectively, the researcher found it necessary to have some familiarisation

with some of the MINTS generators available in the market. This familiarisation was in the form of understanding the capabilities and limitations of MINTS generators, and their user interface. This was felt to be important, in giving the researcher some degree of technical expertise and enabling him to ask more specific questions regarding the capabilities and limitations of the MINTS generators used in the cases investigated.

As MINTS generators are expensive to purchase, the researcher had to rely on a number of software suppliers to provide him with a free copy of their software. There also existed few MINTS generators which were available within the University. In some cases, where it was not possible to obtain a free copy of the MINTS generator, the researcher attended user forums or a demonstration session.

The MINTS generators obtained were; Cope, dealing with qualitative decisions using cognitive mapping technique; Expert Choice, dealing with qualitative and multi-attribute type decision problems using scaling methods such as pairwise comparison, and judgemental analysis; Express, a multidimensional, relational database and financial planning package, offering such analytical techniques as forecasting, goal seeking, statistical analysis, financial and mathematical modelling; FCS, a financial planning package, offering forecasting, statistical analysis, financial and mathematical modelling; Finar, a financial planning package, offering forecasting, goal seeking and a range of statistical and financial functions; Javelin, an spreadsheet type package with a central information base offering a large number of financial and time series functions; MasterModeller, a financial planning package, offering a range of statistical and financial functions; Priority Decision System (PDS), dealing with qualitative and multi-attribute type decision problems using scaling methods such as pairwise comparison, and judgemental analysis; Predict, a worksheet-based modelling tool, dealing with uncertainty using such techniques as simulation, decision tree, queuing, statistical analysis, financial and mathematical modelling; Report Manager, a multi-dimensional spreadsheet, offering a set of statistical and financial functions; and Supertree, offering decision tree technique.

The researcher also attended a training course or a demonstration on some other MINTS generators. These were; Acumen, a multi-dimensional relational database and financial/marketing planning package, offering goal seeking, simulation, risk analysis, and a range of statistical and financial functions; Artemis, offering project scheduling technique; DM, a text database for manipulating qualitative information; and Transit, offering vehicle scheduling technique.

1.2.4.2 Observation Technique

Using an observation technique as a means of collecting data can be very time demanding. For this reason, the researcher limited the use of this technique to only one organisation. This was done in the form of a six months research within the computer division of a large multinational company which was responsible for providing the users with MIS and MINTS.

This company was chosen not only because it was ahead of its competitors in using information technology, but also because of its proximity to Loughborough.

For a period of six months, the researcher spent three days per week as a consultant within the Computer Division, where he was provided with the equipment and facilities needed to carry out the research. The researcher was given free access to the users, both senior and middle management. Moreover, the researcher was always invited to both user group meetings and management meetings. The user meetings were used as a forum for exchange of ideas in terms of problems faced, solutions found, and applications of MIS and MINTS.

The management meetings usually included senior users and technical intermediaries who discussed the problems of using new technology and plans for further developments.

During the course of the research, the researcher observed the interaction between the people involved in MIS and MINTS, which gained a great deal of insight into the company's politics and human interaction within the context of information technology. Moreover, the researcher witnessed on a daily basis the users' interaction with computer-based information systems, in terms of the limitations and capabilities of the systems and those of the users.

The computer division also provided training courses for the users, as well as technical support. This provided the researcher with an excellent opportunity to observe and indeed participate in these activities. The researcher was also asked on a few occasions to give seminars to the users and the management in the area of MINTS.

Moreover, the researcher created and implemented a set of guidelines for building MINTS within the company, especially in the area of user interface. These guidelines were used by all the technical intermediaries who were in charge of building decision models for the system users.

1.2.4.3 Involvement in MINTS Development

During the six months period of research within the company mentioned previously, the researcher became involved in building two MINTS for two senior managers. The researcher acted as both consultant and technical intermediary. The two MINTS projects offered the researcher a great deal of insight into interaction between the key people involved in a MINTS project, and the problems associated with providing a system user with a MINTS.

The MINTS projects gave the researcher a great deal of insight into managerial decision making. The researcher also had to spend a great deal of time in terms of finding out what information and in what format was available within the company. This required in-depth familiarization with the existing MIS and other sources of information within the company. The researcher found his previous dealings and contacts with management of great value which helped him to interact with the two senior managers and other personnel successfully.

1.2.4.4 Interviewing Technique

Having obtained access to a number of organisations, the key actors involved in a MINTS project were interviewed in detail. The interviews were based on a combination of the following techniques;

- (a) Structured Interview - pre-defined checklist of questions on success factors, and
- (b) Open-ended interview - to explore the existence of additional success factors, as well as obtaining a richer understanding of the success factors already identified.

This approach allowed the researcher to obtain an in-depth understanding of the contributory success factors for MINTS projects, and the way in which such systems are developed and implemented. It also enabled the researcher to have some degree of control on the direction and the depth of the interviews.

The researcher opted for using a dictaphone as a method of recording the interviews. In a small number of the case studies, specially private companies, he was not given permission to record the interviews.

During the case studies undertaken, a great deal of effort was put into interviewing the key people involved in the MINTS under consideration. This was done not only to obtain a balanced view of the situation, but also as a means of

cross checking the information collected from different sources. In some cases, the key people involved in a MINTS were interviewed as a group.

The pre-defined checklist/model of success was based on the success factors identified through the second literature survey. The success model was expanded and modified after every case study.

In the majority of the case studies more than one MINTS project was explored. As part of the methodology, the researcher tried, whenever possible, to investigate both failed and successful MINTS projects, and often asked the interviewees to compare the success and failed projects.

The choice for interviewing technique was based on the following reasons;

- (a) The researcher can obtain detailed information, thus giving him a better insight into the issue under discussion.
- (b) An opportunity to ask further relevant questions, based on the information received.
- (c) The interviewees may volunteer very important and sensitive information.
- (d) An interview technique offers flexibility, with the chance to change the questions' emphasis as an interview session proceeds.
- (e) The researcher being in a better position to analyse and validate the information gathered.
- (f) Because of a more detailed understanding of the subject area gained through detailed discussion with a number of interviewees, the researcher will be in a stronger position, to some extent as an expert, to generalise the results.
- (g) An opportunity to form an overall opinion of the interviewee and his organisation, by observation.
- (h) Through an interview technique, the researcher can avoid misunderstanding of questions and concepts by the interviewee.

1.2.5 Computerisation of the Success Model

In order to computerise the model of success developed by the researcher, a search was carried out for software satisfying the set of criteria that are fully discussed in Chapter 6. This resulted in identifying a suitable software package.

Having identified a suitable software package, the next stage was to verify the internal calculations of the chosen software. This was done through mathematically proving the consistency and accuracy of the calculations.

1.2.6 Validation

Based on literature survey, the researcher identified an overall methodology for validating the model of success as well as the Consultant Advisory System. The proposed validation methodology is fully discussed in Chapter 7.

.....	17
CHAPTER 2	17
2.1 Literature Survey I - Computer-Based Information Systems ..	17
2.1.1 Objective of the Literature Survey I	17
2.1.2 Definitions and Characteristics of CBIS	17
2.1.3 Types and Usage of DSS	24
2.1.4 Existing System Development Approaches	29
2.1.4.1 Traditional System Development Approach	29
2.1.4.2 Evolutionary System Approach	29
2.1.4.3 Change Process Model	31
2.1.4.4 Life Cycle System Development Approach	31
2.1.4.5 Prototyping Approach to System Development	32

2 CHAPTER 2

2.1 Literature Survey I - Computer-Based Information Systems

2.1.1 Objective of the Literature Survey I

As already stated, the research scope was extended from validation of decision models to cover the full area of Decision Support Systems. The research objective was to identify a set of contributory success factors in building a Decision Support Systems (DSS).

This chapter is a review of the literature in search for answers to the following issues.

- (a) define the term Decision Support Systems (DSS),
- (b) identify types of DSS,
- (c) identify DSS characteristics and how these characteristics differ from those of other computer-based information systems, namely EDP and MIS, and
- (d) identify system development approaches to DSS and other computer-based information systems.

2.1.2 Definitions and Characteristics of CBIS

The term Decision Support Systems (DSS) was first introduced by Keen and other faculty at the Sloan School of Management at MIT in the 1970's (see Wagner [172] and Freyenfeld [58]). The DSS concept remained relatively obscure until late in the decade, and was, according to Bennett [19], loosely applied to almost any interactive system for managers. Since then, there has been a rapid growth of knowledge based on both theoretical/academic work and practical research/development, and much of this has been used in computer-based information systems.

However, there still remains some degree of disagreement and contradiction on how a DSS should be defined. Some, as described by Sprague [159], believe that DSS starts where Management Information Systems (MIS) leaves off. This group of thought can be referred to as the Evolutionary View. Hall [71] refers to another school of thought, called Mission View, who hold an opposite view to the first group.

Evolutionary View

According to Hall [71], there are four major stages of information systems evolution. Operations Research and Management Science is suggested by Keen [86] as another stage to this evolution.

First stage - Electronic Data Processing (EDP):

In such systems, data processing tasks are independent and self contained. EDP systems support only routine transaction processing.

Second stage - Integrated Data Processing (IDP):

At this stage, EDP systems are linked together. Output from one application is input for another. In addition, the range of tasks is expanded to include non-transaction tasks such as capital budgeting.

Third stage - Management Information Systems (MIS):

The MIS provides all organisational units with the information they need to function, as well as performing basic transaction processing, control and operations functions within the organisation.

Keen [90] argues that the main impact of MIS has been on structured tasks where standard operating procedures, decision rules and information flows can be reliably predefined. It is the objective of such systems to improve efficiency by reducing costs, turnaround time, and replacing clerical personnel. According to Keen, the relevance of such systems for management decision-making has mainly been indirect (e.g. providing reports and access to data).

Fourth stage - OR/MS:

Keen adds Operation Research (OR)/Management Science (MS), as another stage of information systems evolution. The impact of these systems has mostly been on structured problems rather than tasks, where the objective, data and constraints can be prespecified. OR/MS generate better solutions for given types of problems. The relevance of these systems for managers have been the provision of detailed recommendations and new methodologies for handling complex problems.

Fifth stage - Decision Support Systems (DSS):

According to the evolutionary viewpoint, this stage came about with the advent of DSS due to technological advancements, both in hardware (e.g. the advent of powerful Personal Computers), and user-friendly software (e.g. spreadsheets and financial modelling packages). DSS provided an opportunity for the computer-illiterate users to be less dependent upon EDP/MIS/OR professionals, as it offered them the use of complex techniques via a user-friendly interface. Information processing and analysis was no more the sole domain of computer experts.

Based on the evolutionary viewpoint, DSS are different from EDP and MIS. For example, Keen argues that while MIS focuses on providing information, DSS supports decisions. The objective of DSS is, therefore, to provide managers with a supportive tool, under their control, which extends their range and capabilities to improve their effectiveness, was opposed to efficiency, in dealing with semi-structured decision problems. A DSS does not impose its own solution by automating the decision process but assists the manager to make a better informed judgement.

Keen [88] uses the term DSS in situations where a 'final' system can be developed only through an adaptive process of learning and evolution. He defines DSS as the product of a development process in which the DSS user, the DSS builder, and the DSS itself are all capable of influencing one another and resulting in evolution of the system and the pattern of its use.

Mission View

This view regards DSS as an important subset of what MIS has been and will continue to be. Also, under this view, support systems are classified as either Operational Support Systems (OSS) or DSS.

An OSS supports daily operations and is primarily concerned with tactical, planning and operational control decisions. Its main impact is in the automation of structured decisions. In this view, MIS represents the entire set of systems used to manage and process information, thus they conclude OSS and DSS are subsets of this entire system.

Other Schools of Thought on DSS

There are still other groups who have adopted yet different ways of defining DSS. Sprague refers to two distinct groups of thought describing DSS by definition, and characteristics. Others have defined DSS by comparing its characteristics with those of EDP and MIS, by its components, by its application, and by its user.

Describing DSS by definition:

The first group defines DSS as an interactive computer based information system, which helps decision-makers utilize data and models to solve unstructured problems. Since this definition proved restrictive, in that few actual systems could then be regarded as DSS, others, like Alter [7,9] broadened the above definition, arguing any system that makes some contribution to decision-making is a DSS - excluding transactional processing.

Describing DSS by Characteristics:

The second group, like Keen [87], have examined a large number of systems in order to produce a set of characteristics for DSS. These characteristics include;

- (a) They tend to be aimed at the less well structured, underspecified problems that upper level managers typically face.
- (b) they attempt to combine the use of models or analytic techniques with traditional data access and retrieval functions.
- (c) they specifically focus on features which make them easy to use by non-computer people in an interactive mode.
- (d) they emphasize flexibility and adaptability to accommodate changes in the environment and the decision-making approach of the user.

Wagner [156,157] holds the view that a DSS should have the following characteristics;

- (a) speed and ease of development and modification to meet changing circumstances,
- (b) speed of response to maintain the manager's own thought process,
- (c) a structure which is understood by the manager, reflecting his own way of thinking.

Describing DSS by Comparison:

A third group, like Norgaard [124] and Belohlav & Raho [17] define DSS by comparing such systems with other computer-based information systems, as shown in Table 2.1.

Describing DSS by components:

Bonczek et al. [22,23] define a DSS as a computer-based information system with three interacting components; (a) a language system which provides communication between the user and other components of the DSS, (b) a knowledge system which consists of data or procedures, and (c) a problem processing system linking the other two components and consisting of one or more of the general problem manipulation capabilities required by decision-making.

Describing DSS by its application:

Even among those with more moderate views, there exist some disagreement on the types of decisions that DSS should support. Keen & Scott Morton [91], in contrast to Sprague [159], Hall [72] and Brown [28], restrict the types of decisions supported by DSS to semi-structured decisions and argue that the support required for unstructured decisions should come from human intuition where the role of any

Table 2.1: Characteristics of Information Processing Systems [17]

	EDP	MIS	MINTS
Focus	Data	Information	Decisions
Objectives	Predetermined	Predetermined	Predetermined/ ad hoc/contingent
Structure	Desinged from technical perspective	Designed from the organisational perspective	Desinged from the individual perspective
	Hardware emphasis	Both hardware & software emphasis	Primarily software emphasis
	Rigid procedures	Semi-structured procedure	Unstructured procedures
Output	Rigid format Declarative/ summary reports	General format Standardized/ interrogative reports	User-specified format Iterative-interactive/ unstructured reports

computer-based information system would be very limited. However, in agreement with Alter [7], Wagner [172] and with Wynne [179], they argue that MIS improves 'efficiency' through automating administrative tasks while DSS improves 'effectiveness' in decision-making, and argue that the following conditions warrant a DSS;

- (a) the existence of a large database (which makes access to it troublesome and the conceptualisation of it difficult)
- (b) the necessity of manipulation or computation for a solution,
- (c) the existence of some time pressure, and
- (d) the necessity of judgement either in what constitutes the problem or to create alternatives, or in choosing a solution.

Keen and Scott Morton [91] define an unstructured problem as one with ambiguous objectives and outcomes. They refer to 'efficiency' in decision-making as the means for accomplishing a given defined task to achieve outcomes as well as possible, against a predefined set of performance criteria such as time, cost, or effort. They refer to 'effectiveness' in decision making as the means of widening and improving a decision-maker's perception of his decision situation, so that he becomes more confident of the nature of the decision problem, its relevancy and appropriateness. They further argue that decision makers need to be concerned with efficiency in the case of structured problems, where goals and the criteria for measuring their achievement can be predefined, and with effectiveness in unstructured problems.

Moore & Chang [118] argue that the concept of semi-structured to unstructured problems is not meaningful, because this concept depends on an individual's or group's perception of the structuredness of the problem at hand. They define DSS as a system that can be extended, capable of dealing with ad hoc data analysis and decision modelling, where the time horizon is future, and the usage is irregular and at unplanned intervals.

What is ignored by Moore & Chang is that if a problem is completely structured, in the sense that no judgement is required from the part of the decision-maker, then there would be no need for decision support. On the other hand, however, it would be impossible to build a DSS to deal with a completely unstructurable problem. A DSS therefore deals with the sort of problems that are in between the two extremes of complete structuredness and unstructuredness.

Ginzberg & Stohr [69] disagree that a DSS is appropriate only to future oriented planning problems, and not to current control problems. They argue that there is no difference in the decision process, whether the problem is

to analyse last month's sub-standard performance of a complex manufacturing facility in order to design a corrective course of action, or to plan next year's operations. Both, they argue, require completion of the entire intelligence-design-choice-implementation cycle, and neither is likely to be totally structurable or unstructurable. They are both, therefore, good candidates for a DSS.

Sprague's view is to some extent shared by Watson and Hill [175] and Wynne [179]. The former argue that, unlike MIS which has subsumed EDP in many organisations, DSS coexist with MIS and support the 'tough' information requests that MIS have not been able to serve. Wynne also argues that DSS are complementing EDP/MIS transaction-oriented systems and they;

- (a) generally use internal as well as external data,
- (b) rely upon the flexible use of data bases jointly with a library of standardised models and the ability to assemble quickly ad hoc models and prototype systems to support manager/user judgement, and
- (c) extend the productive applicability of the computer into the less structured, more judgemental and proactive areas of management problem solving/decision-making - a move from the computer focus to the information focus.

Describing DSS by its user

Based on the study of a number of DSS, and on available computer software, Freyenefeld extends the term 'manager' to 'decision-maker' as the user of DSS. He defines a DSS as an interactive data processing and display system which is used to assist in a concurrent decision-making process and which also conforms to the following characteristics;

- (a) it is sufficiently user-friendly to be used by the decision-maker(s) in person,
- (b) it displays its information in a format and terminology that is familiar to its user(s), and
- (c) it is selective in its provision of information and avoids exposing its user(s) to an information overload.

Freyenfeld [57] stresses that decision/machine interaction must be direct and in person. This means that very few present systems would fit within his definition of DSS. Indeed, as argued by Ginzberg & Stohr [69], there are many decision-makers who do use computer assistance but use it indirectly through intermediaries, and this is specially true at the top management level.

Unlike Sprague and Keen & Scott Morton [91], Wagner [172] limits the appropriateness of DSS to executive management - seeing them as an extension of a manager's mind.

Little [98] defines DSS as model-based set of procedures for processing data and judgements to assist a manager in his decision-making.

Sprague uses a pyramid as a visual model to characterise the dimensions of an information system. As shown in Figure 2.1, the vertical dimension represents the various levels of management (e.g. operations, middle and top) and the horizontal dimension represents organisation functions such as production, marketing and personnel, etc., and the depth dimension represents the DSS dimension. Thus DSS can be visualised as cutting across all management levels and functional areas.

Under this view, therefore, DSS is not merely an evolutionary advancement of EDP and MIS, and it will not replace either. Also DSS is not directed exclusively at top management, rather it interacts with other information systems to support decisions at all levels within an organisation. While EDP and MIS provide support for management in structured decisions through reports and direct query facilities, DSS provides support in semi-structured and unstructured decisions.

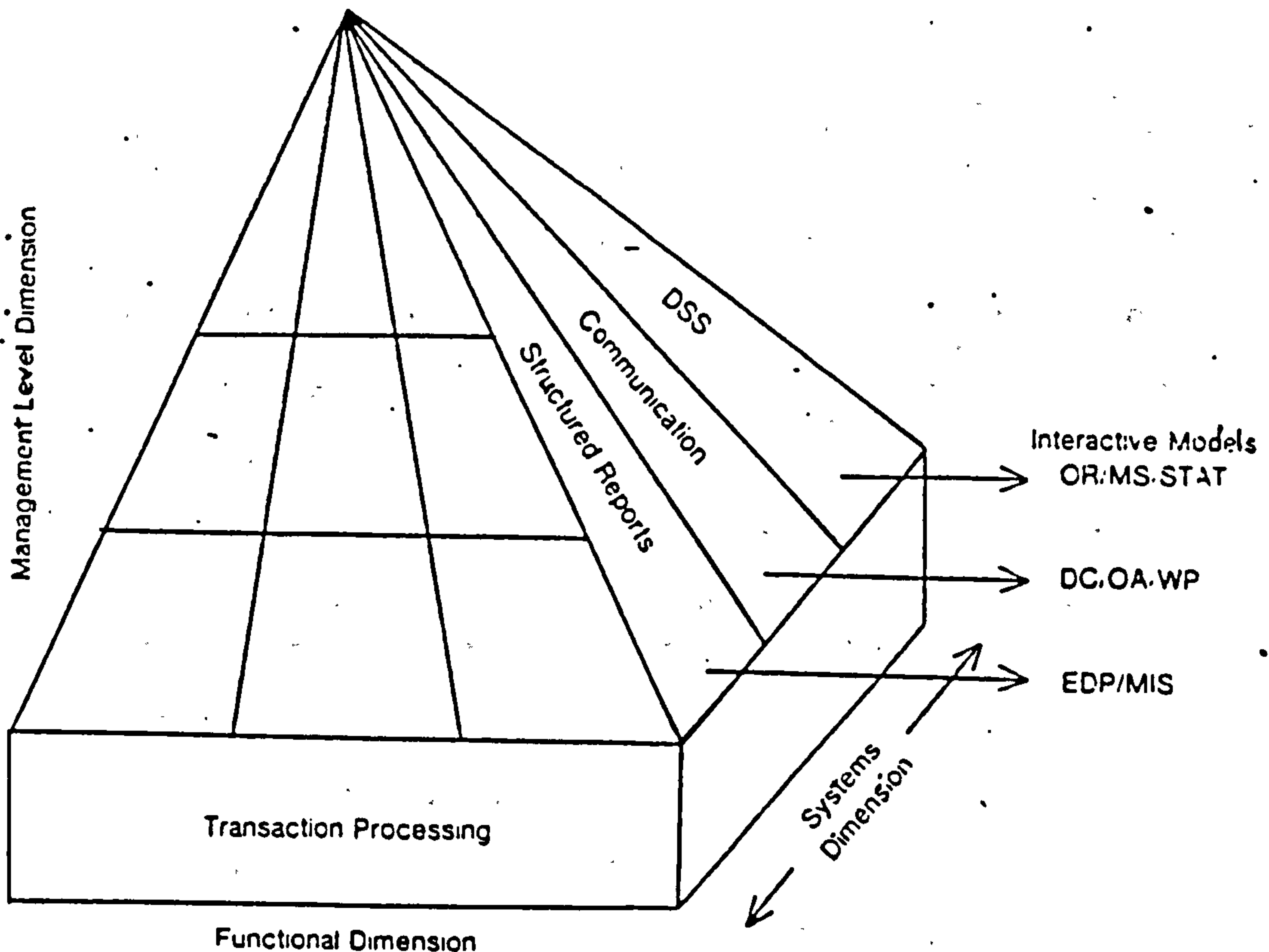


Figure 2.1 ; A Complete View (Sprague [159])

2.1.3 Types and Usage of DSS

Keen [88], Sprague [159] and Moore & Chang [118] make a distinction between DSS and other computer-based information systems in that the DSS user's needs evolve as they become enabled to structure their problem further due to a better understanding of their problem and the system. Ginzberg & Stohr [68], on the other hand, accept that some DSS will evolve more rapidly than other systems, but reject the argument that an evolving usage pattern is particular to just DSS. According to Ginzberg & Stohr, in the case of some DSS, the initial structuring may be all that can be accomplished for quite some time; therefore a stable usage pattern rather than an evolving one may be the case for a prolonged period of time.

A number of other DSS usage patterns have been suggested. Moore & Chang argue that the usage pattern of DSS is unplanned. They, therefore, exclude systems which are used at regular, planned intervals to support decisions about current operations. Scott & Morton [91] say that the usage of a DSS is interactive, and Lucas [102] argues that DSS usage is voluntary. Schultz & Slevin [151] argue for user involvement in the development and design of their DSS.

Although user participation is not particular to DSS, user involvement in DSS development is more important than in other, less innovative computer-based systems. This is because DSS are less well defined, thus imply greater change, and require more training than many other systems. Without user involvement it would be impossible to resolve design uncertainties and to prepare the users for the new system. Ginzberg & Stohr, however, do not regard user involvement as a criterion for identifying or defining DSS.

Ginzberg & Stohr also argue that an interactive usage pattern is not a good characterisation of most DSS. They argue that there are DSS, especially those used by top managers, who are used through an intermediary. They instead regard user control as a better DSS characteristic.

DSS differ from most conventional computer-based systems in their orientation towards change. Conventional systems, for the most part, attempt to avoid change, to maintain status quo in the organisation. DSS, on the other hand, are change inducing; they attempt to alter the way people or organisations define and solve problems.

According to Alter [7,8], DSS is not a homogenous category and they may differ in what they do and how they do it. Alter bases his categorisation of DSS on the degree of action implication of system output (i.e. the degree to which the system's output directly determine the decision. He therefore classifies DSS into two broad categories or dimensions; data-oriented and model-oriented. He further

breaks down each category into sub-categories and in total he fits seven types of DSS in between the above two dimensions. Ginzberg & Stohr argue that there are some DSS that do not fall easily within Alter's DSS taxonomy - for example, Holsapple and Whinston [80] are both data oriented and model-oriented, while others, such as GADS (Carlson et al. [31]), are graphics-oriented. Apart from performing different types of operations, Alter also makes a distinction between the seven types of DSS according to their characteristics. This is shown in Table 2.2.

Characteristics of Particular System Types

Type	Type of Task	Hands-on User	Decision Maker	Key Role	Key Usage Problem		
Data Oriented	Data Retrieval	Nonmanagerial	Nonmanagerial	Hands-on user	User motivation and training		
	Data Analysis	Operational	Operational	Hands-on user	Can people figure out what to do with the system?		
Model Oriented	Simulation	File Drawer System	Operational	Nonmanagerial	Nonmanagerial	Hands-on user	How effective is the intermediary?
		Analysis Information System	Operational	Nonmanagerial	Nonmanagerial	Hands-on user	How effective is the intermediary?
	Accounting Model	Planning	Staff analyst or manager	Planner or line personnel	Manager or planner	Intermediary, feeder	Integration into planning process
	Representational Model	Planning	Staff analyst	Manager	Intermediary	Understanding	
	Optimization Model	Planning	Staff or nonmanagerial	Manager or nonmanagerial	Intermediary	Understanding	
Suggestion Model	Operational	Nonmanagerial	Nonmanagerial	Hands-on user	User motivation and understanding		

Table 2.2: A TAXONOMY OF DECISION SUPPORT SYSTEMS (After Alter [7

Characteristics of Particular System Types

Type	System Initiator	Key design and Implementation Problem	Key change Issue	Key technical Problem
Data Retrieval	File Drawer System	Defining the data; procedural changes	Changing information sources and procedures	System crashes; retrieval from large data base
	Data Analysis System	Defining how to use system; assessing impact on decisions	Unfreezing job image and way of approaching problems	Flexible retrieval from broad data base
	Analysis Information System	Focusing usage development; entrepreneurial control of project	Using system as a vehicle for change	Flexible retrieval from broad data base
Simulation	Accounting model	Getting people to participate seriously in planning process	Unfreezing procedures people are familiar with	Checking consistency of intention; meaning of numbers
	Representational model	Richness vs. understandability	Unfreezing ways of approaching problems	Modelling technology
Suggestion	Optimization model	Richness vs. understandability	Unfreezing ways of approaching problems	Modelling and solution technology
	Suggestion model	designing rules sensibly	Unfreezing standard procedures; avoiding a fear reaction	Task modelling

Table 2.2: A TAXONOMY OF DECISION SUPPORT SYSTEMS (After Alter [7

Donovan & Madnick [43], distinguish between DSS based on the nature of the decision situations for which they are to provide decision support. They categorise DSS to be either institutional or ad hoc. An institutional DSS deals with recurring decisions (e.g. Portfolio Management System developed by Gerrity [190]). These DSS take several years to be developed. An ad hoc DSS deals with specific problems which are not recurring and are not anticipated. For this type of problems, an ad hoc DSS needs to be general purpose and flexible. An example of an ad hoc DSS is the Generalized Management Information System [193].

Sprague [159] also offers a DSS taxonomy based on the different approaches to model development; Specific DSS, and DSS Generators.

As the name implies, Specific DSS are designed to support only specific applications. These applications usually represent major development projects and often are written in procedural languages such as FORTRAN or COBAL. This approach has not received widespread acceptance. The principal impediments are high development costs, lack of flexibility, and lack of interest on the part of users to get adequately involved in the design and maintenance of these systems.

DSS Generators are software packages that provide users with the capability to develop Specific DSS quickly and easily. Some of the popular packages are Empire, Executive Information Services, FCS-EPS, Express, and spreadsheets such as 1-2-3. As well as model development capabilities, these packages typically offer other features useful to the DSS function such as; a library of prewritten functions (e.g. depreciation schedules, NPV, and cost allocation, and so on), an electronic spreadsheet capability, graphics capabilities, and data management capabilities. The advantage of this approach over the Specific DSS is that it is an electronic workbench. From this stagepoint, Specific DSS can be developed quickly or changed to accommodate shifts in user needs without incurring heavy consumption of resources.

Bonczek et al. [22,23] categorise DSS as either using a procedural or non-procedural language. When using a procedural language, the user must not only specify what he requires but he is required to give step-by-step instructions as to how certain data needed by him is to be retrieved or how a computation is to be performed. In contrast, in the case of a non-procedural language, the user does not need to specify how his instructions are to be carried out, but only what he requires to be done. On the continuum of procedurality may also lie a command language enabling the user to name a predefined procedure to execute

a model or to produce a report. A combination of these three levels of procedurality for data and model oriented interfaces provides nine different possible classes of DSS.

Freyenfeld [57] taxonomy of DSS is based on both technical characteristics and specific applications of computer-based systems. He categorises DSS into the following six types;

- (a) Chief Executive Information Systems (CEIS)
- (b) Commercial Operational Analysis and Planning Systems (COAPS)
- (c) Industrial Operational Analysis and Planning Systems (IOAPS)
- (d) Preference Determination Systems (PDS)
- (e) Cognitive Mapping Systems (CMS)
- (f) Expert Advisory Systems (EAS).

Some of these systems can serve several different purposes, of which DSS is only one, and while all DSS fall into one (or sometimes more) of the foregoing categories, not all systems within each of these categories are necessarily DSS. Details of the above types of DSS are given in Table 2.3.

There are those, however, who disagree with making any distinction between MIS and DSS. Naylor [120], for example, argues that there is nothing new about DSS that does not exist in Management Science and MIS and disputes the need for the new term DSS.

2.1.4 Existing System Development Approaches

2.1.4.1 Traditional System Development Approach

The traditional/classical system approach has been applied to developing and implementing traditional systems such as EDP and MIS. This approach is characterized by a problem solving orientation (Boland [21], Mitroff et al. [117]) wherein an EDP or MIS is regarded as providing a valuable 'product'. The phases involved in a problem solving orientation, as suggested by Mitroff et al., are conceptualization, model definition, solution generation, and implementation. A traditional system approach involves (i) the user playing the role of an information resource with limited opportunities for input and learning (Urban and Karash [167]) and basically no opportunity to carry out an active role in modelling and solution generation, (ii) relying primarily on the system analyst's expertise to assure appropriate problem conceptualization, model definition, solution generation and implementation [167].

Table 2.3

DSS Types	Specific Application Area	Technical Characteristics
CEIS:		
<ul style="list-style-type: none"> - reflect CE's ideas - individual/collective decisions - strategic decisions - stimulus to be more analytic & less ad hoc - monitoring performance - identifying key issues - information on performance vs. competition 		<ul style="list-style-type: none"> - stand alone - substantial relational database - constructed from scratch/heavily customised existing system - user friendly (menu driven, light pen, touch screen) - presentation (coloured graphics) - frequent updates, data validation - security - models (no need for OR and forecasting tools, what-if analysis on preprocessed information, only some analytical tools ,e.g. DCF, simple trend extrapolation) - flexible, robust, adoptable - evolving development - no computer experience needed. Training limited to less than 1 hour.
COAPS:		
<ul style="list-style-type: none"> - Financial, commercial and marketing decisions - for widespread use, offering each individual the capability for building his own virtual system, without being affected by others. - access to much of quantitative information - multidimensional analysis and reporting 		<ul style="list-style-type: none"> - large, usually mainframe - sometimes homegrown, but generally using DSS generators. - large relational database. Access to other databases. - may contain a data dictionary - large no. of terminals. - models: Wide range of OR, forecasting, simulation, optimization tools - colour graphics - no computer experience needed. Few days training.
IOAPS:		
<ul style="list-style-type: none"> - for Planning, troubleshooting, and training - learning system for management, problem solving akin to TV games. - all levels of management 		<ul style="list-style-type: none"> - mainframe - smaller database than that of COAPS - linked via network to other computers - lacks multi-dimensional analysis & reporting, but more powerful interactive OR tools (e.g. simulation & optimization) - user friendly as CEIS - colour graphics - models: wide range of optimization & simulation capabilities - for higher levels of management, light pens.
PDS:		
<ul style="list-style-type: none"> - multi-criteria decisions - individual/group decisions 		<ul style="list-style-type: none"> - supplied as software product - microcomputers - no database - context independent - user providing the information
CMS:		
<ul style="list-style-type: none"> - major problems concerning people, situations or logical arguments - breaking down a problem into a series of statements and mapping their inter-relationships, identifying key issues. 		<ul style="list-style-type: none"> - mainframe, mini, or micro - no database - context independent - systematic manner to identify positive/negative links between statements.
EAS:		
<ul style="list-style-type: none"> - contains an expert's knowledge about an specific area of human activity - uses interactive dialogue and offers advice, together with reasoning. 		<ul style="list-style-type: none"> - mainframe, mini, micro - data and logic kept separately - often deals with uncertainties and inexactitudes, while conventional programs produce precise results.

2.1.4.2 Evolutionary System Approach

In contrast to the traditional system approach, an evolutionary approach, is argued by Urban and Karash [167] attempts to maximize user input by beginning with simplistic models and interactively updating these models based on feedback from actual usage by the user. It attempts to create a mutual exchange of information about (i) the user and analyst's potential skills and knowledge base that might be appropriate for solving the problem, (ii) potential solutions, and (iii) personal critiques of these solutions. The approach utilizes an interactive user/analyst learning process as means to generate a more appropriate definition of system requirements. This approach is suggested most suitable for developing DSS (Sprague [159], Alavi & Henderson [3], Keen & Scott Morton [91], Hopkinson [79], Alavi [2], Robey & Markus [135], Henderson & Ingraham [75], Mason & Carey [112]).

In a study by Alavi and Henderson [3], an evolutionary approach was found to be more effective than a traditional system development approach. This is also consistent with the position taken by Boland [21], Ginzberg [65], Keen and Scott-Morton [91], Urban and Karash [167].

2.1.4.3 Change Process Model

Ginzberg (65) and Keen & Scott-Morton [91] argue that the Lewin [97] and Schein [147] change process model offers a basis for developing and implementing computer based information systems. The model involves three stages; unfreezing, change, and refreezing. Unfreezing involves establishing the necessary conditions for change. Many of the situational factors, such as top management support or client-felt need, are evaluated and manipulated, if necessary, during the unfreezing process. The change stage involves those tasks normally associated with the traditional system approach (e.g., model definition). Finally this change model explicitly confronts the problems of institutionalizing (refreezing) a system or a model.

2.1.4.4 Life Cycle System Development Approach

A 'life cycle' system development approach has also been applied to developing and implementing an EDP or MIS. This approach is also suggested for developing DSS (Alter [7]). This approach can be described in general terms as a way to break a systems project into phases, activities, and tasks in order to accomplish the overall work in the project. In this way systems projects can be planned and controlled in a business-like manner. Although, according to Murdick [119], this approach is widely used, there exist no standard

method of defining its different phases. In his study, Murdick listed seventeen different systems development life cycles published by different information systems authors. One method of breaking down a systems project is to follow steps such as analysis, design, construction & testing, implementation, operation & maintenance, and evaluation & control. These steps are carried out rather rigidly and in a chronological order. Although a small degree of iteration may be necessary in between these steps, nevertheless, each step needs to be completed rather fully, before the system builder can move on to the next step.

The life cycle approach discussed above has also been applied to Decision Support Systems (Meador, Guyote & Keen [114], Alter [5,7]).

2.1.4.5 Prototyping Approach to System Development

According to Alavi [2] there is no unique definition for such term as prototyping. Hopkinson [79] argues that the term 'prototype' can be applied to any system that is developed rapidly and which is exposed to the user for interactive development and modification based on the user hands-on experience of working with the system.

The term prototyping is borrowed from the engineering discipline. Sprague & Carlson [160] define the term 'prototype' as an early version of a system that exhibits the main features of the later operational system. In the engineering discipline, the same term has been referred to as a small scale version of a fully developed system or product. This implies that, one is clear, if not in detail, of how the end product is to look like. For example, when building an aeroplane, the designer is clear of his objective that he is building an aeroplane and not a car. Secondly, he knows how the end product, though not in fine details, is going to look like. Thirdly, he knows the major parts or elements that make up an aeroplane. Fourthly, a prototype is built with the aim of minimizing costs in testing the feasibility and practicality of clear defined engineering ideas, before going to full production. And finally, the end product is usually something very close and similar to the prototype - a full refined version of the prototype.

Early in the systems development life cycle, a 'prototyping' approach has also been used as a method of developing an initial model of the desired system such as EDP or MIS. Edelman [47] describes this approach in terms of four steps; users provide a general specification, system designers develop a prototype, users try it out, and system designers modify the system to meet the users' detailed specifications.

1	. . . . .	33
2	. . . . .	33
3	CHAPTER 3	33
	3.1 The Concept of Management Intelligence Systems	33
	3.1.1 Objective	33
	3.1.2 The Place of EDP, MIS, and MINTS in Decision Making	33
	3.1.3 The Relationship Between MINTS, DSS and MIS	41
	3.1.4 Uncertainty and decision making	45
	3.1.5 Institutional vs. ad hoc MINTS	48
	3.1.6 A Suitable System Development Approach to MINTS	51
	3.1.6.1 An Evaluation of System Development Approaches	51
	3.1.6.2 Breadboarding Approach to MINTS	53
	3.1.7 The People Involved in a MINTS Project	55

3 CHAPTER 3

3.1 The Concept of Management Intelligence Systems

3.1.1 Objective

As discussed in the previous chapter, there exist no clear and universally accepted definition of DSS. Moreover, the term DSS in itself is too broad to refer exclusively to any specific type of computer-based information system. A survey of the literature on DSS, however, led the researcher to a class of support systems which is termed Management Intelligence System (MINTS).

It is the objective of this chapter to define MINTS, and suggest a clear distinction between MINTS and other support systems, especially MIS.

Also, in this chapter, an evaluation of the system development approaches discussed in the previous chapter is carried out to find a suitable approach for developing and implementing MINTS.

3.1.2 The Place of EDP, MIS, and MINTS in Decision Making

Managers are constantly engaged in the intertwined process of planning and control. They are constantly monitoring both their organisation and its environment: in the light of this monitoring they may move on directly to take action. The action to be taken may be autonomous - relying on recipes as Johnson & Scholes [84] put it. In these cases there is little in the way of planning and decision-making, and the monitoring-action nexus is akin to mechanical process control.

However, from time to time the monitoring process will throw up a new situation for which the recipe is not available and then there is a need to assess formally the options available and to decide between them. When this occurs the planning and control cycle is as shown in Figure 3.1.

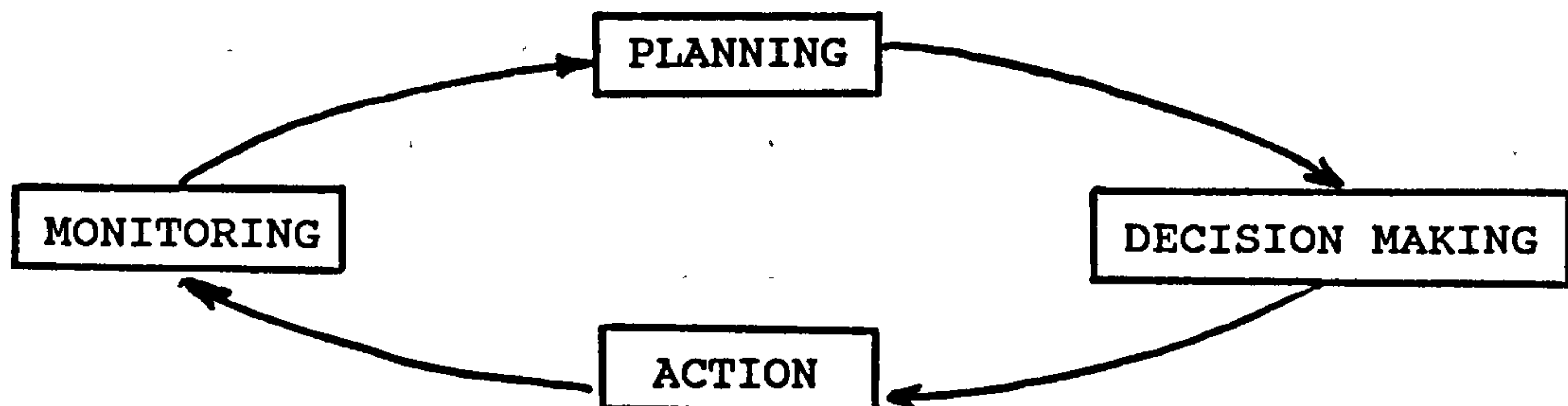


Figure 3.1: A Basic model of planning and control

Ackoff [1] described managers as being in a "mess", as being confronted by a set of interacting and overlapping problems. With this view, it can be seen that it would be unwise for a manager to concentrate solely on a single problem: he needs to take account of the interaction of any particular problem with the other problem areas. To do this he needs a broad model containing all the important interactions. This broad view or model will be termed a scenario.

As a lead in to the model being developed, the monitoring and planning process shown in Figure 3.1 can be alternatively depicted in Figure 3.2. Here the manager's broad view of his organisation and its links with its environment (his scenario) is open to prompting by an alerting mechanism. In the light of this prompting, the problem area within the scenario is defined and this portion of the scenario is then focused on in the search for the problem's solution, resolution or dissolution [1].

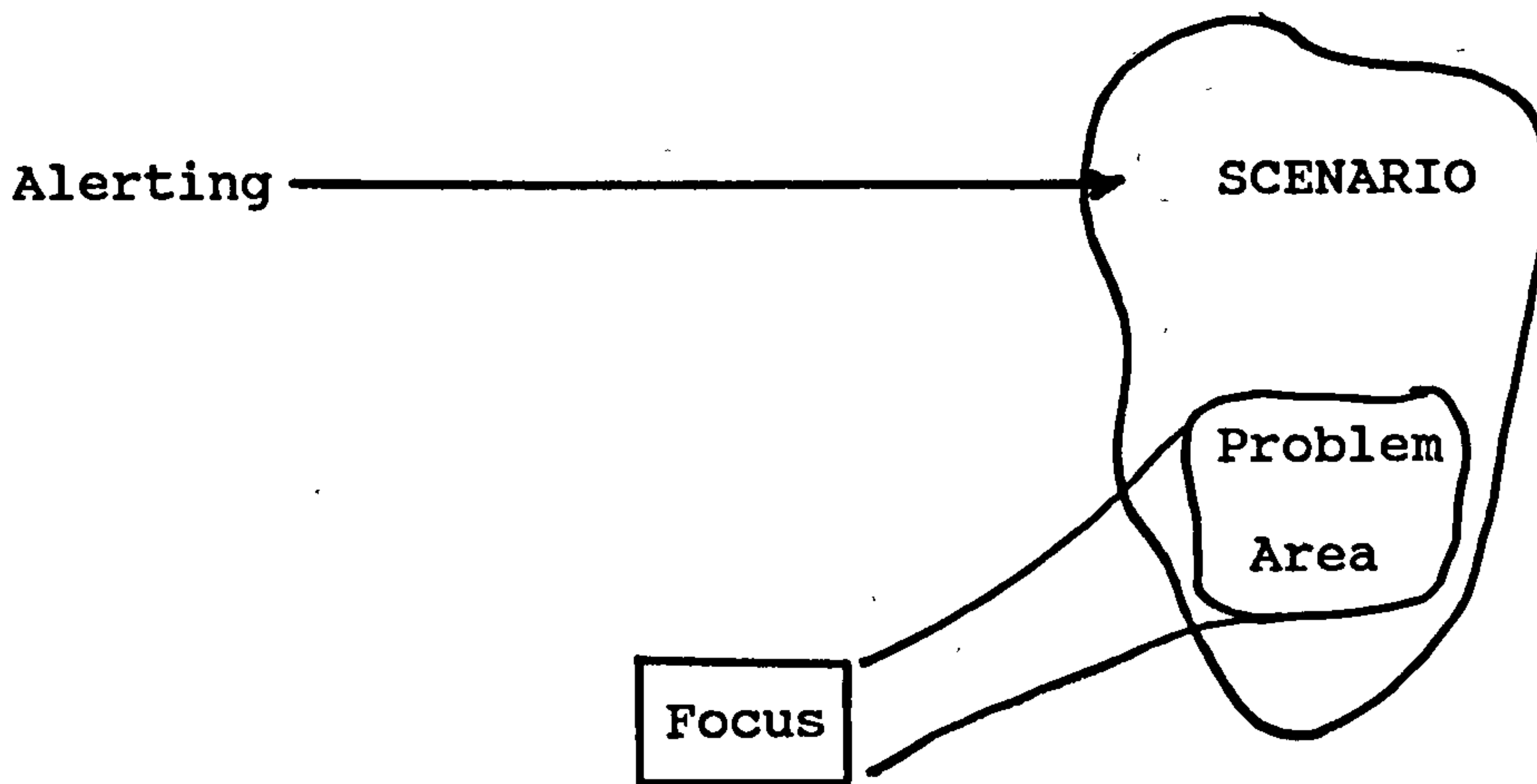


Figure 3.2: Monitoring and planning

The outcome of the focusing activity is a better understanding of the problem area. This better understanding is a more appropriate structuring of part of the manager's scenario and is likely to make for a better decision.

Where a manager uses resources outside his own capabilities to help in providing focus, the situation is akin to operational military intelligence. Here, intelligence officers gather information and present the commander with an overview of the war situation (ensuring that their scenario 'fits' that of the commander) together with a list of options that they see as open to him. After questioning

and digesting what the intelligence officers have to tell him, the commander is then in a better position to make a more informed decision.

Murray [120] defines intelligence to be the outcome of the meshing of reconciliation of a set of information carrying inferences. With this definition it can be seen that the focus activity shown in Figure 3.2 is producing intelligence.

Managers and their organisations are daily confronted by an infinity of stimuli from within and from outside the organisation. Only some will be relevant and in order not to be overwhelmed, selection must take place. Data can be defined as stimuli that are accepted by a manager or organisation, where 'accepted' means that they have passed the tests applied. Perhaps the simplest example of acceptability is that in a commercial order-processing system whereby only numerical data are acceptable for the quantities of goods ordered.

Information can be defined as data that are seen as directly relevant to a person or an organisation; management information as data seen as directly relevant to a manager in his job. For a managing director of a company engaged in selling fast-moving consumer goods, the piece of data concerning a single sale is unlikely to constitute information for him, whereas the monthly aggregated sales almost certainly would.

The combination of these definitions with the ideas embodied in Figure 3.2, allows Figure 3.3 to be drawn. Although 'computer' terms are used here, this model is of general applicability and not confined to computer systems.

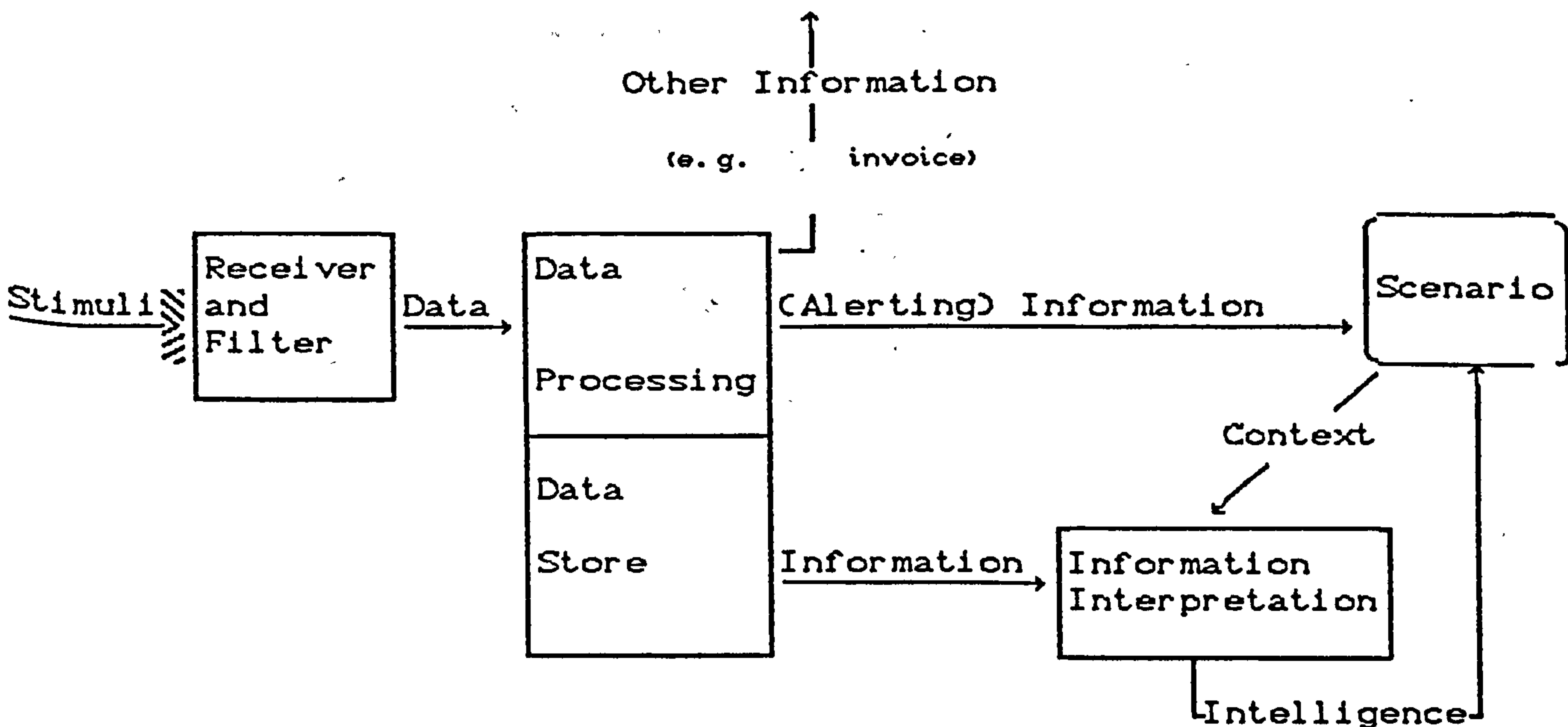


Figure 3.3: A Model of the relationship between Data, Information, and Intelligence within the context of a decision scenario

In Figure 3.3, data is processed to produce information. Some of this information (termed 'other information') is used outside the organisation. The management (alerting) information would be produced from data through the processes of aggregation, exception, etc. What had been loosely termed 'focus' in Figure 3.2 has been relabelled 'information interpretation' in Figure 3.3, with the interaction of the scenario with the activity of information interpretation explicitly labelled.

The distinction between data processing and information interpretation is not an absolute one, but nevertheless it is fairly clear-cut. Data processing takes place according to well-defined rules, rules about which there is no controversy and which depend little on the immediate context. For example, a system for reporting monthly variances will contain rules that follow accounting definitions, and will operate in the same way almost irrespective of how well the organisation is performing.

In contrast, information interpretation is an activity which is context dependent - even perhaps to the extent of bending the evidence to give the manager what he wants! And unlike data processing, the output is not unidimensional (such as aggregated or exceptional items) but multidimensional in the sense that the output does reconcile the superficially unreconcilable, and combines incommensurates (such as sales and morale). Additionally, one can say that information interpretation creates a whole that is greater than the sum of the parts, whereas data processing does not. Information interpretation produces intelligence which enhances a manager's understanding of his scenario not just in response to a particular situation but in general terms. Thus it should enable the manager to make a more appropriate response to alerting information.

Figure 3.3 is incomplete in that there is no link between the scenario and the data processing facility. There must be such a link since the rules of data processing must come from the scenario of the manager. In turn, the receiving and filtering (the acceptance test) required to produce the necessary data will be defined from the data processing requirement. Also, the feedback of action from scenario to real worlds needs to be shown.

The complete model derived from Figure 3.3 with these enhancements is shown in Figure 3.4.

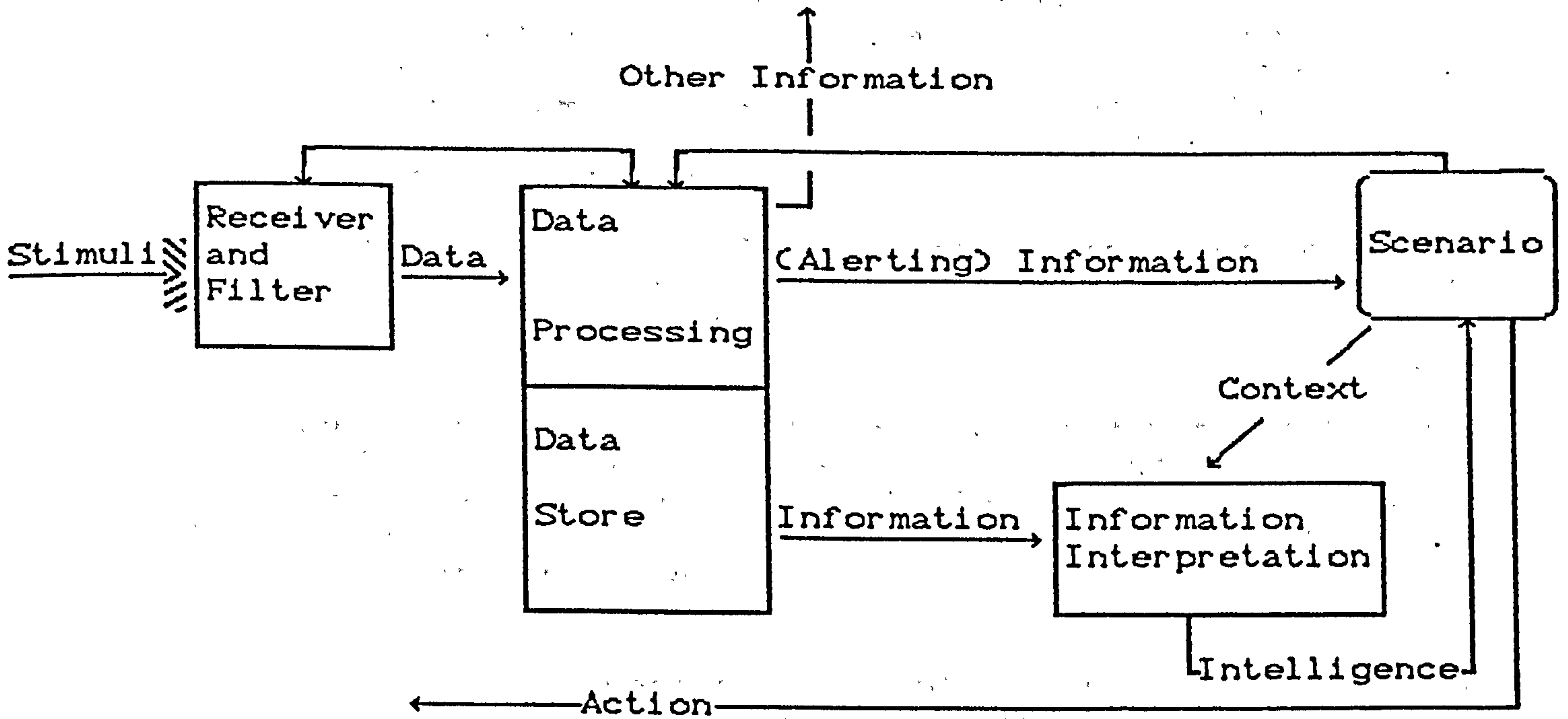


Figure 3.4 : A Model of the relationship between Data, Information, and Intelligence within the context of a decision scenario

As shown in Figure 3.4, Data Processing is carried out using EDP, and management (alerting) information is provided through MIS. As far as Information interpretation, result of which is intelligence, is concerned, the researcher suggests that a new class of support system is required. This new class of system is called Management Intelligence Systems (MINTS).

The researcher has chosen the term MINTS for that type of system that provides support in dealing with a decision issue, which is inherently somewhat unstructured, in specific terms, and which necessitates valuable judgemental input from the part of the decision-maker in dealing with it.

The term MIS is proposed here to be reserved for that part of the total computerised system that is concerned with providing alerting (management) information.

A MINTS involves interpretation of information selected from a base of data/information, resulting in production of more intelligence for a decision-maker dealing with a decision issue more effectively. As such, a MINTS would be a system, computerised or not, that acts as a focus - for thought or debate - and promotes learning and compromise by reducing uncertainty in the nature of a decision issue as well as means of tackling the decision issue.

The term DSS should be used in a general sense to refer to, as suggested by Sprague [159], all systems that help in dealing with any part or stage of a decision problem - including EDP, MIS and MINTS.

The above definition of MINTS is based upon the concept of focus. This implies that the area of concern is neither completely unstructured, nor completely structurible. In other words, the prime application of a MINTS is to bring some degree of structuredness to decision problems that are partly unstructured.

Sometimes it is not possible to produce a precise definition of a problem, and this is especially true of soft system - where objectives are difficult or impossible to define and where cause and effect are only hazily understood. One well known methodology for tackling very unstructured problems is that of Checkland [34]. A schematic of the stages in this approach is reproduced in Figure 3.5. The methodology has been devised to encourage the raising of issues and the structuring of debate. In fact, through the multiple root definitions that one is encouraged to formulate, a set of idealised situations or scenarios is generated. The link between the Checkland methodology and MINTS occurs in steps 4 and 4a where, starting from a given scenario, a detailed focus may be required. However, in contrast to MINTS, unfettered use of the Checkland methodology may go well beyond what is envisioned in the creation of MINTS, in the sense of changing mind sets to the extent of revolution.

Having defined MINTS and made a clear distinction between MIS and MINTS, it is very helpful to present an overall view of the characteristics of MINTS. These characteristics are presented in Table 3.1, based on the work done by Belohlave & Raho [17] in particular, also that of Sprague [159], Norgaard [124], Thierauf [165], and the researcher's own point of view.

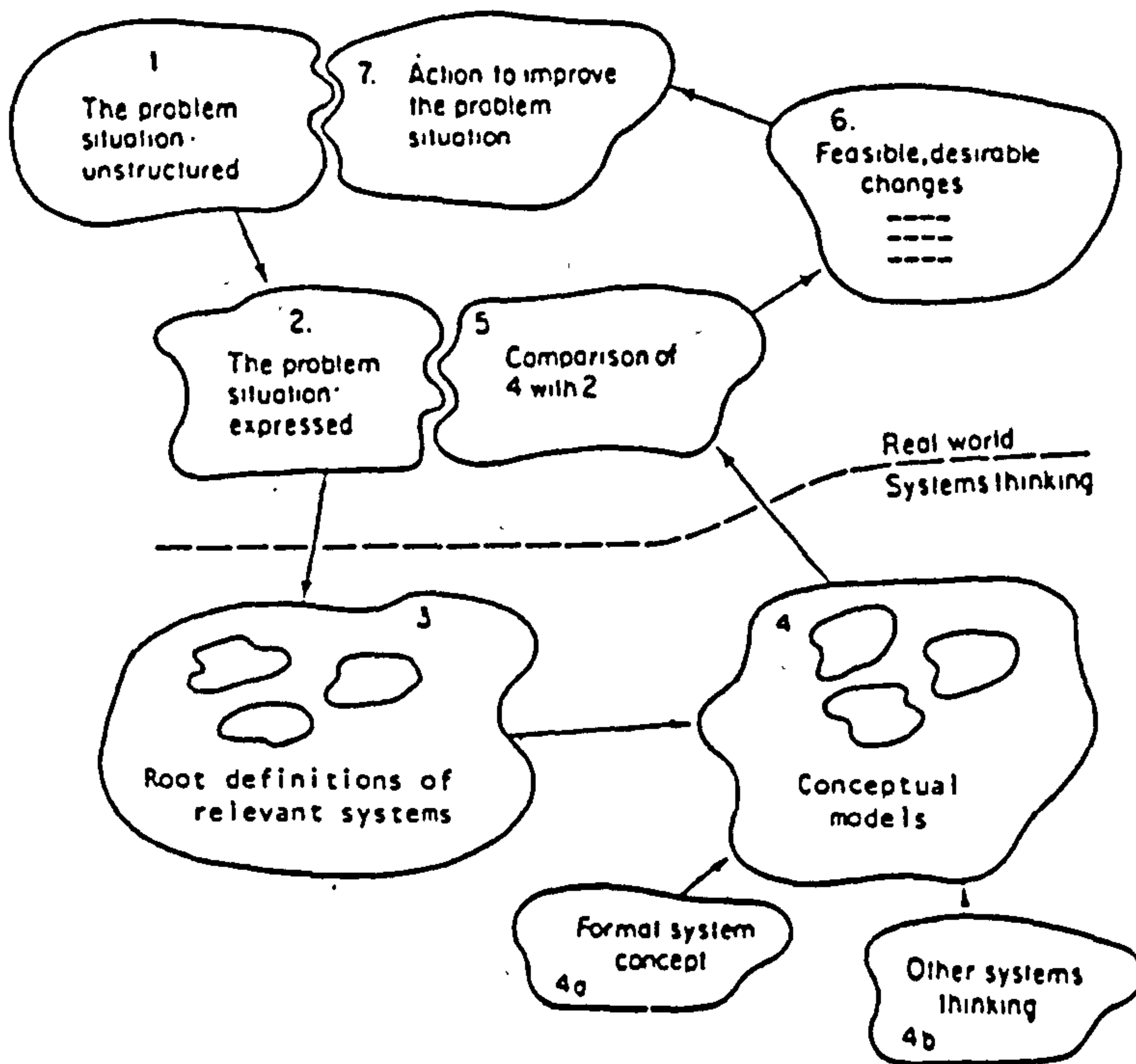


Figure 3.5 : The methodology in summary
(After Checkland [39])

Table 3.1 : The Emphases Associated With Types of Support Systems

	Electronic Data Processing (EDP)	Management Information Systems (MIS)	Management Intelligence Systems (MINTS)
(1) Type of System:	Custodial operational systems	Internal control/budgeting system	Planning systems
(2) Focus:	On data, storage and efficient processing	On efficient and structured information flow	On effective decisions, use of models, user-friendliness, flexibility, adaptability, and quick response
(3) Objective:	Prespecified	prespecified	Ad hoc/contingent
(4) Organisational Level:	Operational levels	All management levels	All management levels
(5) Type of situation:	Within fixed procedures	Within fixed policies	Within a given scenario
(6) Created by:	IT specialists	IT specialists/business analysts	Users/business analysts
(7) Design Perspective:	Tehnical	Organisational	Individual/small group
(8) Design Methodology Used:	'Classical' systems approach	'Classical' systems approach & prototyping of inputs/outputs	'Breadboarding'
(9) Hardware/Software Orientation:	Hardware	Hardware & software	Software
(10) Models:	i) Fixed logic ii) Deterministic data iii) Arithmetic & mathematical iv) Deterministic data	Fixed logic Mainly deterministic relations Mainly arithmetic & mathematical Mainly deterministic	Evolutionary logic Judgemental relations
(11) Output:	i) Rigid format ii) Declatative/summary reports iii) An answer iv) 'Other' information	General format Standardised/interrogative reports An answer Management Information Past, present & future	Probabilistic data User specified format Iterative/interactive unstructured reports Insight, learning, dialogue, intelligence Intelligence Present & future
(12) Time Scale:	Past & present	Past, present & future	Present & future
(13) Context:	Context independent	Context independent	Context dependent
(14) Exactitude:	Precision & accuracy	Precision & accuracy	Accuracy
(15) Validation:	'Classical' systems methodology Mandatory	'Classical' systems methodology Essentially mandatory	Appropriatness
(16) Usage:			Discretionary

3.1.3 The Relationship Between MINTS, DSS and MIS

Sprague uses Simon's model of decision making in order to illustrate the relationship between MIS/EDP, OR/MS and DSS;

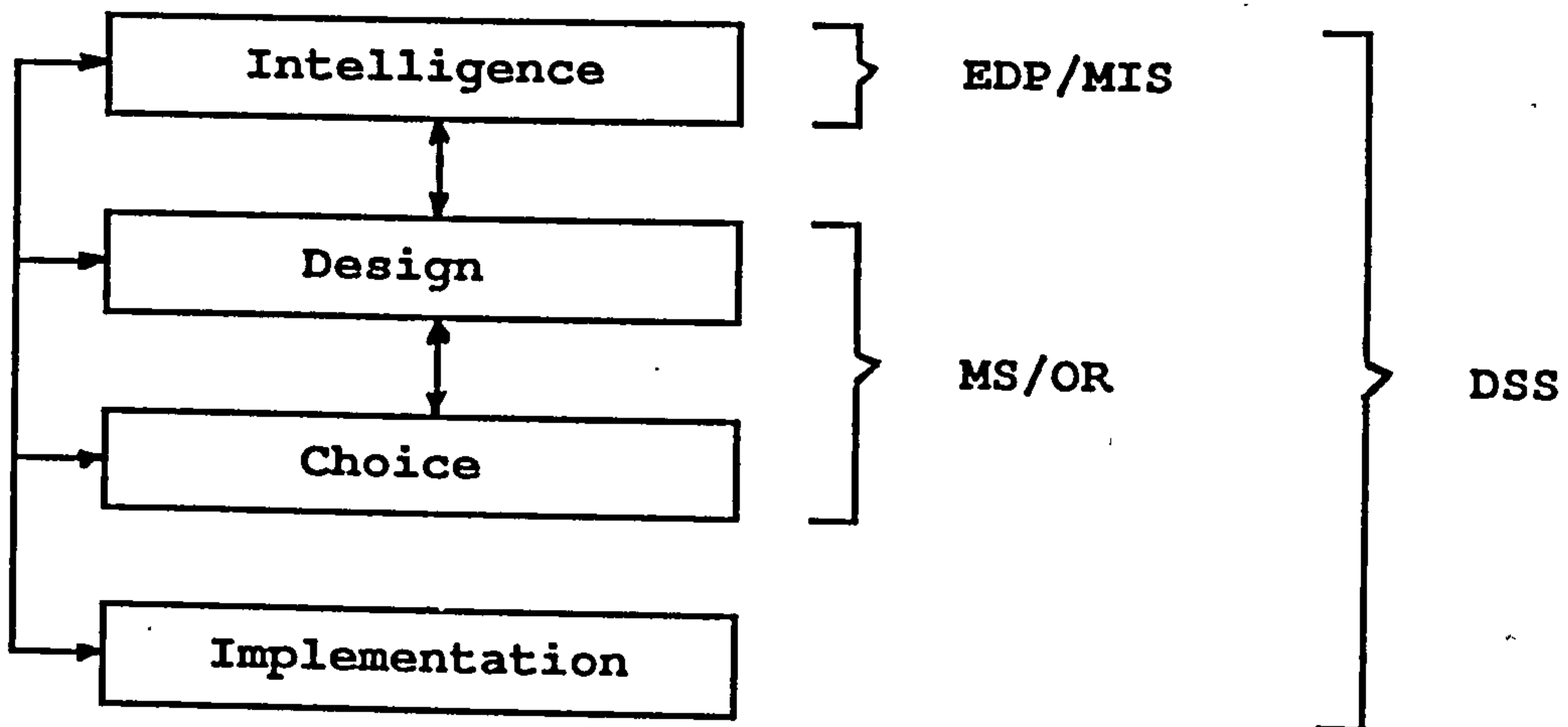


Figure 3.6: Phases of Decision Making [159]

Based on this model, MIS/EDP provide "intelligence" to decision-makers. "Intelligence" is defined by Simon [156] as searching the environment for conditions calling for decisions. Raw data is obtained, processed and examined for clues that may identify problems. The researcher, however, regards this as "alerting information" and not as "intelligence". "Alerting information" is an appropriate term for some of the output from such systems as an MIS. Simply because an MIS can basically inform decision-makers that either things are going according to plan (for example, sales are \uparrow X as planned), or that something has gone wrong (for example, sales are much lower than planned). Such "alerting information" is overwhelmingly "hard" information, as to how an organisation has performed at operational level in the past, and how it is performing currently. "Alerting information" does not, however, tell decision-makers what has caused the problem; for example why sales are down. When such a question is raised by a decision-maker, he may then be supplied with much more information than he requires, which may or may not tell him what has caused the problem. The information provided is not specific, but general and the decision-maker is expected to search through the information provided and somehow figure out what may have caused the problem. More importantly, an MIS does not assist decision-makers in how to deal with the problem.

"Intelligence", as defined by Murray [115], is the best interpretation obtained from the meshing and reconciliation of a set of information carrying inferences. This information can be "soft" and/or "hard", coming from an internal and/or external sources, and with different time horizon (present and future). In addition, the researcher argues, "Intelligence" is specific rather than general; in the sense that it is related to a specific problem within a decision-maker's scenario. This means that "intelligence" is context dependent; in that it is obtained as a result of investigating and analysing a specific problem and interpreting the consequences of the different ways of tackling that problem within a decision-maker's scenario. Just as "data" can be "information" once placed within a context, "information" can become "intelligence" once meshed together and reconciliated to be relevant to a specific problem within a decision-maker's scenario. In this way, a decision-maker's scenario is taken to be a combination of different bits of intelligence about his working environment which are gathered through time.

Using a military issue as an example of "intelligence", a General is more interested in knowing what the enemy is up to, in terms of which direction it is coming from, where it is aiming to hit, and how it can be repelled than being informed that the enemy is approaching. The fact that the general is notified that the enemy is approaching, is "alerting information", forcing the General to consider the

problem facing him seriously. He then wants "intelligence" about the enemy's activities and plans, and ways of counter-attacking the enemy. Moreover, the General requires "intelligence" with regard to specific activities of the enemy. For example, he may have a plan to attack the enemy on a certain day and at a specific place, and wishes to know about the movements of the enemy on that day and at that specific place, as these are critical input to his plan. The more "intelligence" about the enemy which affect the General's plan, the better the General will be able to consider certain alternatives and provisional plans in detail, rather than having a large number of options open to him with little detailed analysis. The General does not require to be provided with "alerting information" about all the enemy's activities at all fronts, as most of that information does not affect his scenario, but that of other Generals. An MIS provides "alerting information" to all Generals without a specific scenario in mind, while MINTS, by dealing with a problem and ways of tackling it, are scenario dependent, thus provide "intelligence" to the decision-maker.

With the above definition of "intelligence", then using Simon's model, "intelligence" is the result of the design and choice stages of decision-making. The researcher, therefore, offers a modified version of Simon's model, as shown in Figure 3.7, which shows the relationship between MIS/EDP, and MINTS. MS and OR are not mentioned in this model, as a MINTS may use MS and OR techniques in tackling a decision problem. Also the implementation phase is not shown separately, as it is regarded as part of the choice phase as discussed by Simon.

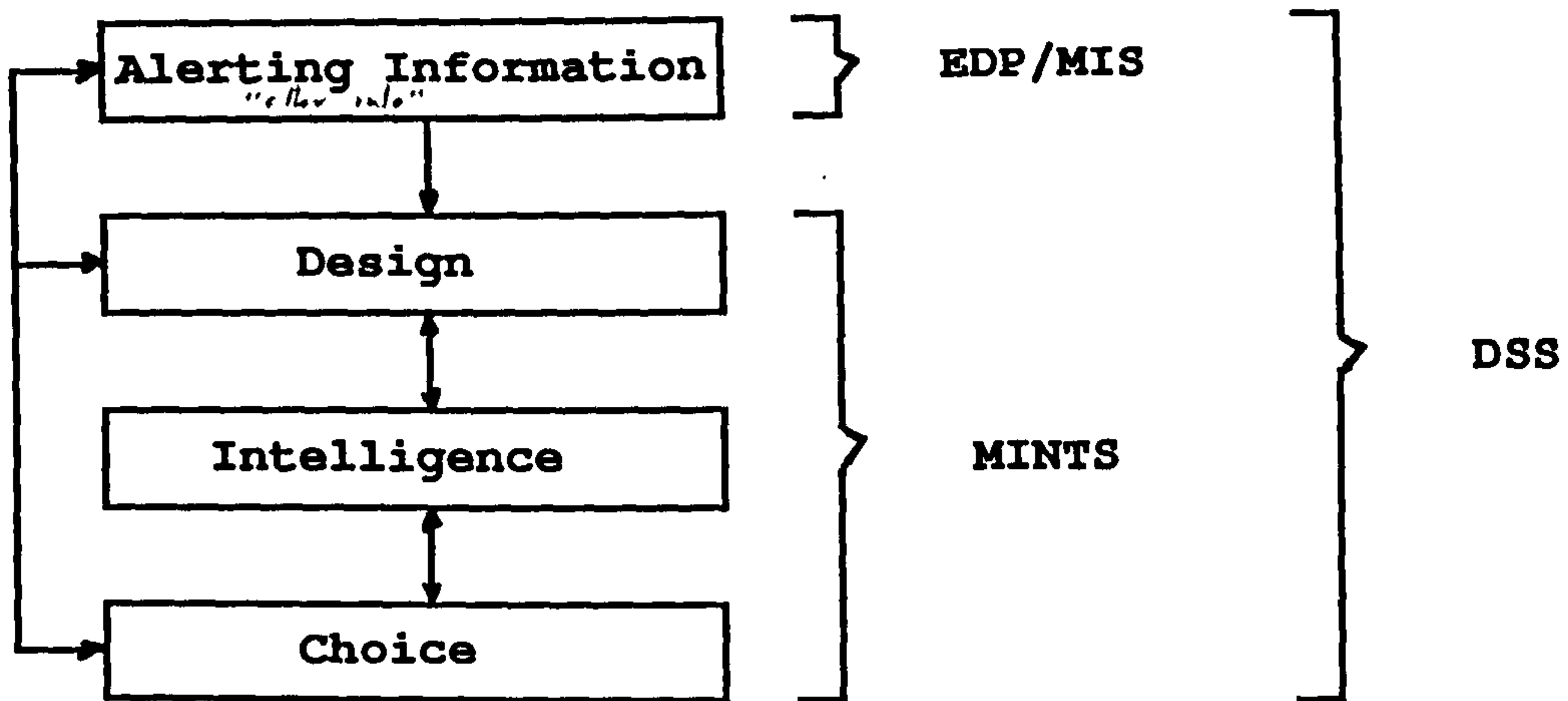


Figure 3.7: Phases of Decision Making

3.1.4 Uncertainty and decision making

Several writers emphasise the use of DSS in unstructured situations, but do not go further and consider the types of situations and the consequences of them (but see Brookes [27]). An approach better suited to a study of how DSS systems are devised, constructed and implemented, is one based on process, and this in turn requires that uncertainty is taken into consideration.

The type and level of uncertainty affect a manager's ability to cope with a problem. Uncertainty is manifest in a number of ways. In a rough order of the increasing difficulty managers find in handling uncertainty, sources of uncertainty lie in:

- i) TERMS - uncertainty in the definition of terms.
- ii) DATA - uncertainty in data values to be entered into the model and those required from it. This uncertainty can be viewed as being of three types:
 - a) where the value is inherently deterministic but is not known precisely,
 - b) where the value is stochastic and is defined by a probability distribution,
 - c) the probability of occurrence is not known.
- iii) LOGIC - uncertainty in the rules applied:
 - a) uncertainty in the form of individual cause and effect relations where the relationship can be considered a deterministic one,
 - b) uncertainty in the consequences of interacting deterministic relationships where data is deterministic,
 - c) uncertainty in the consequences of interacting deterministic relationships where data is stochastic,
 - d) uncertainty in the form of cause and effect relations where the logic is fuzzy.

Earl [45] has taken Thompson and Tuden's view [166] of the organisational decision-making under uncertainty and developed a view of system design under different states of uncertainty. Uncertainty is in the ends sought by decision-makers and by the means of achieving them. Uncertainty about means should be taken to mean uncertainty about the relationships between cause and effect (about the rules of the logic of models), and uncertainty in the values taken by variables (uncertainty in the data model). Uncertainty about ends, on the other hand, should be taken to mean not so much in defining possible objectives but in making them according to preference. The possible combinations of uncertainties are summarised in Figure 3.8.

		Preferences about Possible Outcomes	
		Agreement	Disagreement
Beliefs about Causation	Agreement	Computation	Compromise
	Disagreement	Judgment	Inspiration

Figure 3.8: Tompson and Tuden's Matrix of Decision Issues

1) Low uncertainty about Ends/Low uncertainty about means:
When there is low uncertainty on the two dimensions - consensus on means and ends exists prior to the use of a support system - then the decision problem can be dealt with by computation and management reports. In other words, a support system functioning as an answer and management report generating are appropriate to this type of decision problem. Most accounting systems, such as data processing and management information system are of this type.

2) Low uncertainty about ends/High uncertainty about means:
When an organisation has a clear idea about its objectives, e.g. increase sales volume and hence its profitability, but the decision-maker(s) is(are) not clear as to how to achieve this objective, e.g. whether through reducing prices or increasing the advertising activities or improving product quality or even selling a different product, then the decision problem requires judgement on the part of the decision-maker(s). In this case an appropriate support system is a MINTS if it provides the means for learning, and insights by helping the decision-maker(s) to better

understand the variety of different courses of action or alternatives and their consequences and the key factors influencing them, or even provide the decision-maker(s) with further alternatives that otherwise could have not been considered. In this way, then the decision-maker(s) can learn through trial and mistakes without being under pressure of incurring financial losses, which is one of the penalties of the real world. Examples of this type of MINTS are those planning systems that allow 'what-if' questions to be answered thus allowing the decision-maker(s) to understand the output of each alternative and its implications, or systems which provide simulation facilities.

3) High uncertainty about ends/Low uncertainty about means: In this case, there is agreement and certainty about the means, but disagreement about the objectives of decision makers. An example would be when the Marketing Manager is concerned with increasing the sales volume through investing in a new outlet, but the Financial Manager is concerned with not stretching the company beyond its financial resources. Here an appropriate support system is a MINTS which creates a situation in which the decision-makers could have means of dialogue and reach a state of compromise - give and take situation. An example of a DSS in this category would be a newly arrived Priority Decision System (PDS) which helps decision-makers and policy makers to state the criteria behind their preferences and give weights to them. The system checks any inconsistencies in the preferences and the weightings given. This not only helps an individual to become more conscious of his priorities and the weightings he attaches to each priority, but gives a group of decision-makers the opportunity of learning about the way and the degree to which each member of group feels about his priorities. The PDS is also said to provide each individual decision-maker with equal chance of expressing his views without being under pressure by other group members. Such a MINTS could bring about some degree of compromise through dialogue and better understanding among the decision/policy makers.

4) High uncertainty about ends/Low uncertainty about means: Lastly, when an organisation finds itself in a desperate and critical situation in which there is high uncertainty and disagreement about its objectives, where it is going, and how it should get there, then an appropriate support system would be one which could help to generate ideas and stimulate creativity and inspiration. The contribution of computerised support systems in this area seem rather limited to say the least. The brainstorming technique is a method of helping with this type of decision problem.

3.1.5 Institutional vs. ad hoc MINTS

Donovan and Madnick [43] make a distinction between "institutional" DSS and "ad hoc" DSS. An institutional DSS is regarded as one which supports recurrent decisions and which evolves over several years as system users learn and extend their needs and capabilities. An example of such a DSS is the Portfolio Management System (PMS) as suggested by Keen & Scott Morton [91]. In contrast, ad hoc DSS support a wide variety of decision problems that are not usually anticipated or recurring. Examples of this type of decision problem is the building of a new factory, or entering a new market. Keen & Scott Morton compare the characteristics of these systems in Table 3.2;

TABLE 3.2: Adapted from Donovan and Madnick [43]

Characteristics of DSS	Institutional DSS	Ad hoc DSS
Frequency of a decision type	High	Low
Types of decisions	Few	Many
No. of people making same decisions	Many	Few
Range of decisions supported	Narrow	Wide
Range of users supported	Narrow	Wide
Range of issues addressed	Narrow	Wide
Specific data needed in advance	Usually	Rarely
Specific analysis needed in advance	Usually	Rarely
Problems recurred	Usually	Low
Importance of operational efficiency	High	Low
Duration of specific type of problem being addressed	Long	Short
Need for rapid development	Low	High

A similar but extended version of Table 3.2 is produced, as shown in Table 3.3. In this Table, some of the characteristics of institutional and adhoc MINTS are compared with those of an MIS.

CHAPTER 3

TABLE 3.3: Characteristics of Institutional and Ad hoc MINTS and MIS

System characteristics	Institutional MINTS	MIS	Ad hoc MINTS
Frequency of a decision type	High	High	Low
Types of decisions	Few	Few	Many
No. of people making same decisions	Many	Many	Few
Range of decisions supported	Narrow	Narrow	Wide
Range of users supported	Narrow	Narrow	Wide
Range of issues addressed	Narrow	Narrow	Wide
Specific data needed in advance	Usually	Usually	Rarely
Specific analysis needed in advance	Usually	Usually	Rarely
Problems recurred	Usually	Usually	Low
Importance of operational efficiency	High	High	Low
Duration of specific type of problem being addressed	Long	Long	Short
Need for rapid development	Low	Low	High
Costs	High	High	low
Hardware/Software orientation	Hardware	Hardware	Software
Hard/soft data orientation	Hard	Hard	Soft
Type of problem	Structured/ semistructured	Structured	Semistructured unstructured
No of users	Many	Many	One/few
Development time period	Long	Long	Short

As shown in Table 3.3, there is a great deal of similarity between an institutional MINTS and an MIS. This implies that the most part of an institutional MINTS is basically an MIS - a MINTS reliant upon an MIS. This is because an institutional MINTS requires a large quantity of 'hard' data and relatively little 'soft' data. Other evidence in support of this point is the emphasis laid on operational efficiency of an institutional MINTS, as well as that of an MIS. As discussed in chapter 2, a characteristic by which many have made a distinction between an MIS and a DSS (MINTS in the above Table), is improved 'efficiency' for the former as against improved 'effectiveness' for the latter. Improved efficiency is most obtained in the areas related to storing, processing and analysing hard data, which can be computerised to be carried out much faster, cheaper and on a larger scale. Moreover, like an MIS, an institutional MINTS is likely to take several years to be developed and implemented. This is supported by Keen & Scott Morton who have shown by their examples of institutional DSS, that the development time scale for such systems is very long -

several years. The researcher suggests that most of the development time for such systems is taken up by their MIS part which is needed by different system users.

An organisation which embarks upon building an institutional MINTS must first, therefore, store, process and analyse its 'hard' data efficiently. In other words, the organisation needs to have its MIS established, before it can successfully embark upon building a MINTS which needs to heavily rely upon its MIS.

Taking away the MIS part of an institutional MINTS, the MINTS part of the system may not be very complex or large. Moreover, an institutional MINTS, may be the result of a combination of ad-hoc MINTS which are built over a long period of time, sharing the same MIS.

In terms of assessing the likelihood of success for an institutional MINTS, the researcher does not deal with the success of the MIS part of such systems. Firstly, because this study is concerned with MINTS rather than with MIS, and secondly the literature is filled with studies on MIS success. This means that the sort of criteria used in assessing the success of an MIS will not appear in the Consultant Advisory System. For example, the Consultant Advisory System does not measure the success of an institutional MINTS in terms of increased efficiency or profitability or productivity.

3.1.6 A Suitable System Development Approach to MINTS

3.1.6.1 An Evaluation of System Development Approaches

The researcher holds the view that a 'breadboarding', which is another term for an evolutionary and adaptive approach, is a more appropriate approach for developing and implementing MINTS, than a traditional system approach, a life cycle approach or a prototyping approach. This is discussed below.

In order to show why a traditional system development approach is more suitable to such systems as an EDP or MIS and not a MINTS, it is appropriate to discuss some of the characteristics of an EDP or MIS. These systems are designed to store, process, analyse and report 'data' or 'information' on a large scale that are needed on a routine basis for different ends and that can be predefined rather clearly and in detail. Also the input and the output of such systems are predefined rather rigidly. The system builder has, therefore, clear instructions as to what is required from the system he is about to build. The development time scale for an EDP/MIS is usually very long. This is because of the sheer size and the complexity of such systems, caused by such things as different sources of data, different sets of data formats and levels of aggregation, high level of accuracy and precision required in terms of system input and output - hence detailed and time consuming programming, testing and debugging - and the number of people involved who have different requirements from the system. Another characteristic of EDP and MIS is that their users cannot use them live until the whole system, or an independent part of the overall system is developed and implemented. EDP and MIS are not designed to deal with ad hoc decision problems, they are designed rather for problems that are on-going and where improved efficiency can be obtained to justify the costs. These systems are built from an organisational perspective, rather than an individual perspective, hence the individual users' requirements are compromised for the sake of providing an organisational/departmental service.

The type of problems for which MINTS are designed, on the other hand, is very different from those of EDP and MIS. By definition, MINTS deal with semistructured to unstructured problems, where the user requirements can not be prespecified clearly and in detail. It is a function of MINTS to help the user to define his problem. This view is also supported by Bennett [19]. He argues that decision-makers have trouble describing a decision-making process and rely on conceptualization, such as pictures or charts when making or explaining a decision. Because of this, he argues that a decision support should not require a decision maker to be able to describe the decision-making process before the system is built, but should help the decision maker conceptualize his problem. Indeed, the person

for whom a MINTS is developed is unlikely to have a detailed understanding of the total problem area facing him. This means that only a portion of the total problem can be defined at a time.

A way in which a problem area for a MINTS can be successfully defined is through a better understanding of the different parts of that problem area in an incremental fashion. By learning from the portion of the problem for which a MINTS is designed, for interactive use, the user will then be enabled to define further requirements for tackling another portion of the total problem. As a better understanding of the parts of the total problem is obtained, this may result in the user adjusting and modifying his overall scenario, and consequently affecting the scope and the nature of the total problem - hence an adaptive development approach. As a result of an incremental and adaptive development approach, a MINTS is built that can deal with a portion of the problem that is of significant value to the system user. As already stated, the total problem can not be prespecified in its entirety as it does not remain stable due to its dynamic environment. This means that the different steps of a life cycle approach must be reiterated often, and unlike a life cycle approach, the move from one step to another will not be carried out in any specific chronological order. These steps are so short lived that they are in effect combined in a seamless process.

The development approach for a MINTS is based on close collaboration between the system user and the builder (i.e. the consultant) who agree on a small but significant portion of the total problem as the starting point which forms the "initial" body of the MINTS. Both the consultant and the system user have distinctive capabilities and viewpoints which must be merged to make the task of developing and implementing a MINTS more successful. A MINTS is not something that the consultant will provide to the system user, but something they will develop together, by combining their knowledge and expertise and learning from each other.

Often the system user is interactively involved in the process of model building. By using the initial body of the MINTS, a better understanding of some other parts of the total problem area is obtained and further requirements are specified for the next additions to the initial MINTS. This takes a short period of time, usually weeks, and is repeated through further understanding of the problem area and user confidence with the system. Additions to the initial MINTS are carried out several times over a period of a few months, until a relatively large and stable system is evolved which provides the user with a wide range of decision support. This is the stage when the consultant with the consent of the user may decide to greatly reduce his involvement to just providing one-off type technical support. As the system user's needs evolve, the consultant

may have to be asked to get actively involved in supporting the user to add further additions to the system. Although the frequency and the extent of change will decline, it does not usually stop; with the exception of a MINTS which is designed for "one-off" type problem.

It is clear that a prototyping approach is not suitable for developing MINTS, because users do not know sufficiently well what they want; a prototyping approach requires a fairly detailed system specification before proceeding. The iterative process in the case of MINTS is a crucial part of the learning process for the system user. Unlike an EDP/MIS development, a MINTS development approach results in the installation of an adaptive process in which the user and the part of the MINTS which is in the process of being built, interact to confront the problem area for which the MINTS is being designed, as well as responding to the changes in the user's scenario.

3.1.6.2 Breadboarding Approach to MINTS

The researcher suggests that the term 'breadboarding' to be used to refer to an evolutionary or adaptive approach for developing a MINTS. The term breadboarding is borrowed from electronic engineering. A 'breadboard' is a board with a matrix of holes on it, which are to accommodate transistors and associated components. Once the transistors are placed on the board, they form a complex interlinked network. The critical issue is that, the input to any individual transistor is influenced by the output required from it by its next immediate transistor. Because of this it is not possible to add additional transistors in isolation from the rest of the network. Due to the interdependency of transistors in the network, a valid approach is a step by step and gradual build up of the network. Such an approach allows the effect of any new additional transistors on the rest of the network to be checked, and readjustments to be carried out where necessary. Any readjustments, may in turn necessitate further readjustments, until the network behaves as required.

The reason for adopting a breadboarding approach for developing MINTS is that the nature of such an approach matches well with the nature of MINTS. As users do not know in sufficient detail what they need, a breadboarding approach allows a step by step build up of a MINTS. Indeed, the objective behind such an approach is to allow the user to play around with a few simple concepts which are translated into a tangible and physical form. The strategy behind this initial session is to educate and allow the user time to absorb and appreciate the potential opportunities offered by the MINTS in dealing with some of his decision problems. A realisation of the existence of new ways of dealing with a problem by the user, will then prompt him to

define his requirements in further detail. Indeed, it is only when users start using a MINTS, that their needs begin to evolve. Moreover, users' needs tend to evolve quite rapidly and not always in predictable directions. In short, the breadboarding approach will satisfy a small portion of a user's needs at a time, and this in turn will give the user further scope, gradual confidence, and time to evaluate his needs in more detail, as well as expanding them in his own pace, without prior commitment to other than the next stage.

The breadboarding approach described above is close to the way Simon [156] describes how an adaptive system is designed. Such a system, he argues, is one that adapts to changes of several kinds over three time horizons. In the short run, the system allows the user to search for answers within a relatively narrow scope. In the intermediate time horizon, as the user learns from the system, the system capabilities and activities are modified. In the long run, the system evolves to support different user needs and provides different sets of capabilities in dealing with a decision problem.

For a breadboarding approach to be a success, the following requirements need to be satisfied;

- (a) system development should be carried out in a speedy manner,
- (b) any new concepts or requirements must be given a tangible presence,
- (c) the time scale in between the deliverables must be short,
- (d) the user(s) must be continually involved throughout the development and implementation stage,
- (f) gradual user learning through 'hands-on' experience,
- (g) responsiveness to user needs with minimum delay,
- (h) step by step build up of the MINTS (within an overall strategy), but without prior commitment to other than the next step,
- (i) continuous reappraisal and remodification of the portion of MINTS built, in the light of changing needs, and
- (j) staff continuity. It is not enough to leave users with a set of manuals explaining, quite often not clearly - at least from the users' point of view, how to perform certain tasks. The users must have convenient access to experts or professionals who guide the users through the evolutionary stages of the system, and making sure that the system meets the users' needs and that the next generation system is in good hands.

3.1.7 The People Involved in a MINTS Project

A distinction has been made between the terms "user" and "end-user". The term user, or the "problem solver" as referred to by Checkland [34], is someone who uses the system interactively and is "anxious to bring about improvement in a problem situation". Sprague [159] defines the term "user" as the person faced with the problem or decision - the one that must take action and be responsible for the consequences. This decision-maker is, according to Welsch [177], the "end-user", or as suggested by Checkland, is the "problem owner" who gains most from the system. Yaverbaum [180] defines the "end-user" as a person who interacts with a computer as part of his job but is not a programmer or analyst.

The term "end-user" can be confusing, as it is often difficult, in the area of EDP and MIS, to know who the end-user is. Indeed, these systems are basically designed to bring about organisational improvements through improved operational efficiency in the running of an organisation. Taking the definition of a "problem owner" as suggested by Checkland, different people, such as top management, or even the shareholders of an organisation, may be regarded as the problem owners, as they may gain most from such systems.

It must be emphasized that MINTS are designed to assist decision-makers who may have a decision problem to tackle, or want to gain a better understanding of a problem situation. In this sense the decision-maker for whom the MINTS is designed is the person who most benefits from the assistance provided by the MINTS. The researcher refers to such person or persons as a "system user". A system user may use a MINTS interactively or through an intermediary. An intermediary may be involved in developing a MINTS in terms of building decision models using a MINTS generator (equivalent to a DSS Generator as defined by Sprague), or he may simply provide the system user with advice in terms of interpreting certain results of an analytical technique. The researcher does not regard an intermediary as a system user, but simply as "intermediary". This is because an intermediary does not use a MINTS to deal with his problem, instead he provides support for the system user.

Sprague defines the intermediaries for a DSS as the person who helps the system user, perhaps merely as a clerical assistant to push the buttons of the terminal, or perhaps as a more substantial "staff assistant" to interact and make suggestions.

Keen & Scott Morton [91] use the terms "chauffeur" and "intermediaries" interchangeably. They have divided intermediaries into two groups; "technical intermediaries" and "staff intermediaries". A technical intermediary helps involvement with design process, formalizing of ideas and

needs, and evolving personalized system. This role is performed by an EDP or MIS department or an internal consultancy services department, which is usually outside the system user's department. A staff intermediary acts as the interface between the system user and the system, translating questions, operating the system, and providing analyses. He is usually from the system user's department.

Welsch [177] uses the term "integrating agent" to refer to the intermediaries as the human interface between the system user and the designed system. According to this definition, an integrating agent can be either from the system user's department or from an EDP or MIS department.

It is clear from the above definitions of an intermediary that the term is used in a very general manner which refers to any person, both from within and outside the system user's department, who helps the system user. The researcher holds the view that a distinction needs to be made in terms of the internal and external intermediaries. This is needed, as it is an objective of this study to develop a Consultant Advisory System which takes into account the roles played by different people involved in a MINTS. An underlying assumption on which the Consultant Advisory System is built, is that the success of a MINTS depends on how well the consultant establishes and maintains relationships with and between the different actors in a MINTS. With this aim in mind, the researcher, proposes to categorise the human interface between the system user and his MINTS into two main groups; those from the system user's department and those from an in-house consultancy services department providing MINTS support (it is appropriate to reiterate at this stage that this study is primarily concerned with internal consultants). As the former group are likely to have a more direct, closer, and longer rapport with the system user than the second group, they are referred to as the "intermediaries". The latter group is referred to simply as "consultant" which refers to an individual consultant or a consultancy team. A consultancy team comprises both technical and business oriented people such as; management scientist, an operations researcher, a business analyst, and Programmers. A consultant is basically responsible for providing system users with a MINTS designed to deal with an specific application area. A MINTS is rather similar to an Specific DSS as defined by Sprague. A consultant is in charge of configurating the software and hardware, and also involved in the building of the "initial" MINTS.

Intermediaries can be divided into two groups; technical and clerical intermediaries. A technical intermediary may be someone who works closely with a decision-maker (the system user of the MINTS). He may have, prior to the MINTS, provided the decision-maker with decision support in the conventional manner. In this case, he has a good

understanding of the decision needs of the decision-maker. The MINTS will basically computerise part of the activities of the intermediary, with which he is well familiar, and enable him to provide a more effective decision support to the decision-maker. A technical intermediary may or may not be computer literate; he is required to operate and maintain a MINTS, as the system user may not wish to or have the time to become involved in the operation and maintenance of the MINTS. He may also be required to become involved in building decision models for the system user, using a MINTS generator.

A clerical intermediary refers to a member of the system user's department, who does the key punching for inputting a set of information into the system. He is not required to have any business or technical skills about the MINTS. A clerical intermediary may be the system user's secretary.

Bennett [19] uses the term "integrating agent" to refer to the human interface between a DSS and the system user. Bennett does not make a distinction between an intermediary and a consultant who assists a system user in developing his MINTS. However, the roles defined by Bennett for an integrating agent, describe clearly the roles that can be played by a consultant;

- An exegetist who explains the system and interpret the concepts and objectives underlying its design. He can help the system user with at least the 'initial MINTS', which is based on simple functions and approaches.
- A confidant who provides support, helps overcome misconceptions, and encourages the system user to view the system as a tool under personal control rather than a threat.
- A crusader who can demonstrate the power and value of the MINTS. A new system often involves substantial costs in terms of time, effort, and learning. Once the novelty of the system wears off, the system user is aware of these immediate costs, while the benefits are less clear and more distant. The consultancy team can point out to these benefits and maintain the momentum of the project.
- A teacher who can be far more effective than manuals or seminars, particularly with non-technical professionals, in tailoring the training to the individual. He can also help structure problems to exploit the system's capabilities.

Welsch [176] uses the term information transfer specialist in place of intermediaries. The researcher regards an information transfer specialist to be the same as a consultant. The roles of an information transfer specialist as specified by Welsch are very similar to those suggested

by Bennett for an integrating agent. As the researcher uses the term consultant in place of an information transfer specialist or an integrating agent, then the following roles apply to a consultant;

An information transfer specialist, according to Welsch, carries out the following roles in his technical capacity;

- Introductory training and review: initial orientation of the user regarding operation, applications, and capabilities of the DSS, and periodic review and update.
- Technical consultant: Advise regarding system operation as well as hardware, software, and database design and problem resolution.
- Technical interpreter: translate between the decision maker's language and that of the computer; help in structuring the decision-maker's information needs and requests.
- Decision consultant: advise and assist the user in the decision-making process.
- Ad hoc programmer: rapid generation of programs in response to ad hoc requests by the user.

An information transfer specialist's functions as a facilitator are;

- Missionary: help the user to overcome apprehensions about the DSS and personalize the system.
- Maturation-Inducting: help the decision-maker explore system capabilities and facilitate evolutionary growth in decision-making and in the man-machine relationship.

Checkland [34] uses the terms "system owner" and "problem owner". He defines a system owner as the person or persons who could modify or demolish the system. The system owner has either the authority or been given the responsibility to maintain the system. This means that the role of system owner can be played by different people, such as the system user, or the sponsor financing the system.

Similarly, the term "problem owner" can be confusing as the problem owner may be someone other than the system user. Checkland defines the term "problem owner" as the person or persons taken by an investigator to be those likely to gain most from achieved improvement in a problem situation. This term has been adopted by Checkland because a problem owner can be different from the person or persons who use a system. However, in the case of a MINTS, the objective is to make the system user for whom the system is designed more

effective in his decision-making. He is therefore the person most gaining from the system, especially when the use of such systems is discretionary.

The researcher, therefore, uses the term "system user", to imply system ownership as well as problem ownership; hence there is no need to use the terms "system owner" and "problem owner". However, the responsibility of maintaining a MINTS can be delegated to an intermediary who with the consent of the system user can modify the system.

Checkland also uses the term "problem solver" defined as a person or persons anxious to bring about improvement in a problem situation. Within the context of MINTS, this role is usually played by the system user or the consultant, which means that there is no need for a new term such as problem solver.

Another important key actor is the "sponsor", who is a person or persons who pay for the system costs. The role of an sponsor is played by a member of the management, sometimes associated with the finance department. Often a MINTS may require a relatively small budget, in which case a system user's department is able to pay for it out of its budget, and the system user may not need to go further than asking for authorisation from his immediate superior, or in some cases the system user himself may have the authorisation. As political support and financial support may come from different members of the management, the researcher uses the term "sponsor" to refer to the source who authorises the budget for the project.

There also exist a "MINTS champion", who may be anxious to bring about improvement in a problem situation, by encouraging the system user and/or the sponsor of a need for a MINTS. A "MINTS champion" is a more appropriate term than "problem solver", as the latter may be mistaken as someone who has contributed towards developing the MINTS. A MINTS champion may also assist the system user in obtaining approval for the project, by selling the idea of a proposed MINTS to senior management.

The term "supporting political actors" is used to refer to those members of management who are needed for obtaining political support for a MINTS, as they are in a position to influence decisions within an organisation. They should not be mistaken with a MINTS champion, who is someone who pushes the idea of MINTS among the potential system users and management.

There is another group who may be involved in a MINTS project. When a MINTS requires information from an EDP or MIS, then EDP/MIS staff can also play a role in the MINTS development. Collaboration from the EDP/MIS staff can prove very important in the success of the MINTS, as they hold

information that is needed by the MINTS. This group is referred to as the "custodians of information". A custodian of information can also be any individual who is in the possession of some information that is required by the MINTS. The custodians of information may hold both "hard" and "soft" information.

In terms of the characters involved in a DSS, Sprague [159] offers a framework as shown in Figure 3.9.

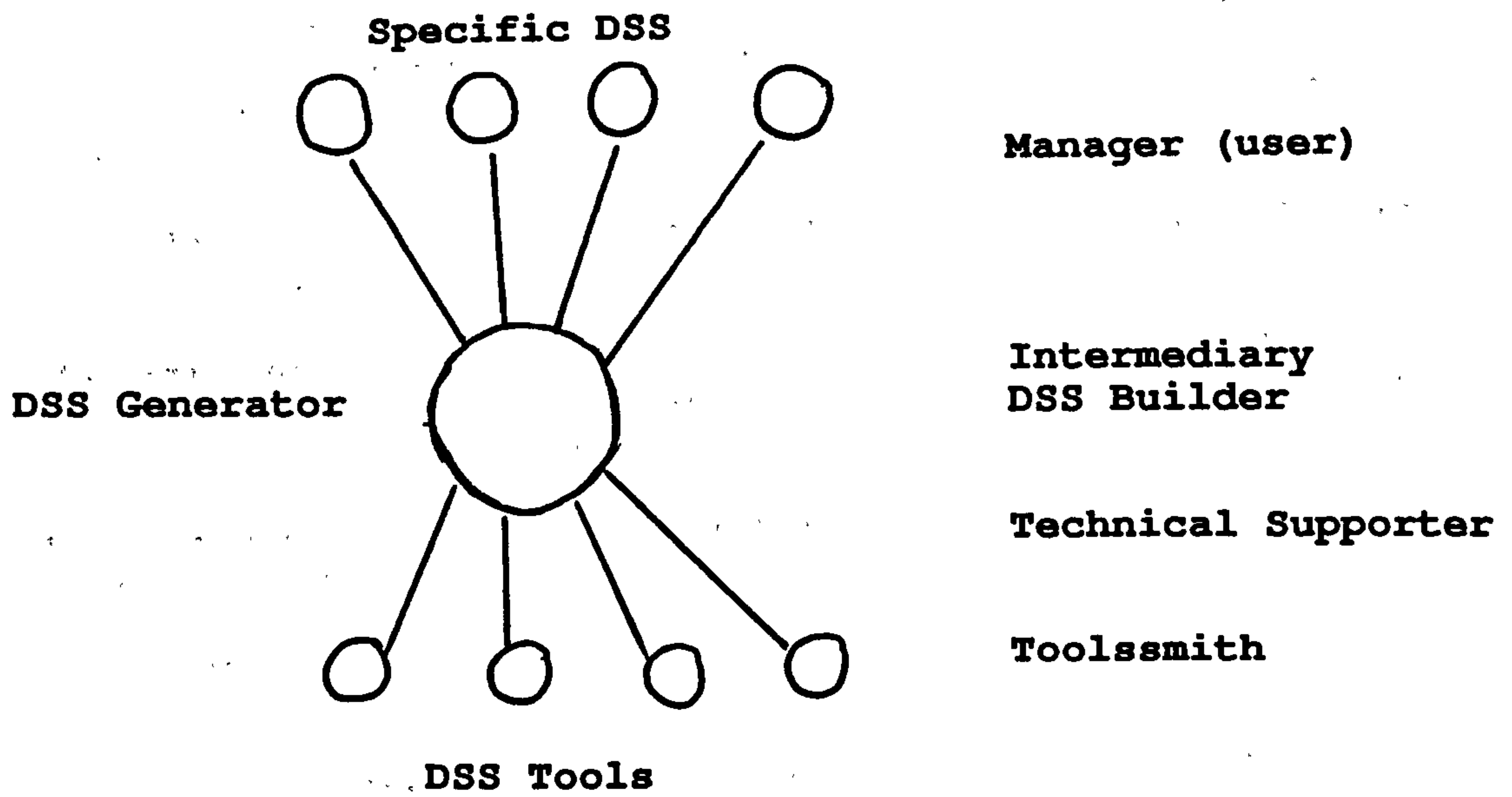


Figure 3.9: Three levels of DSS with five associated roles for managers and technicians [159]

Before defining the roles of the characters mentioned in Figure 3.9, it is appropriate to state what Sprague means by the different levels of DSS. According to Sprague, a Specific DSS gives the manager the capabilities and flexibility to search, explore and experiment with the problem area, within certain boundaries. Over time as changes occur in a task, the environment and the user's behaviour, the Specific DSS must learn to accommodate these changes through the reconfiguration of the elements in the DSS generator, with the aid of the DSS builder. Over a longer period of time, the basic tools evolve to provide the technology for changing the capabilities of the Generators out of which the Specific DSS is constructed, through the efforts of the toolsmith.

Sprague defines the characters involved at the different levels of a DSS as follow;

- The manager or user: is the person faced with the problem or decision - the one that must take action and be responsible for the consequences.
- The intermediary: is the person who helps the user, perhaps merely as a clerical assistant to push the buttons of the terminal, or perhaps as a more substantial "staff assistant" to interact and make suggestions.
- The DSS builder or facilitator: assembles the necessary capabilities from the DSS Generator to "configure" the specific DSS with which the user/intermediary interacts directly. This person must have some familiarity with the problem area and also be comfortable with the information system technology components and capabilities.
- The technical supporter: develops additional information system capabilities or components when they are needed as part of the Generator. New databases, new analysis models, and additional data display formats will be developed by the person filling this role. It requires a strong familiarity with technology, and a minor acquaintance with the problem or application area.
- The toolsmith: develops new technology, new languages, new hardware and software, improving the efficiency of linkages between subsystems software and hardware, etc.

Based on the previous discussion of the roles of a consultant, it can be seen from the role definitions offered by Sprague, that the role of a DSS builder and technical support are played by the consultant. The researcher uses the term MINTS Tools Builder in place of Toolsmith, which refers to a person who invents new technology, including

those computer experts employed by software/hardware vendors who design new technology in building new systems. The term MINTS Generator Builder is suggested to refer to Technical supporter and those experts behind developing and designing software packages. These are shown in the following Figure which is a modified version of Figure 3.10.

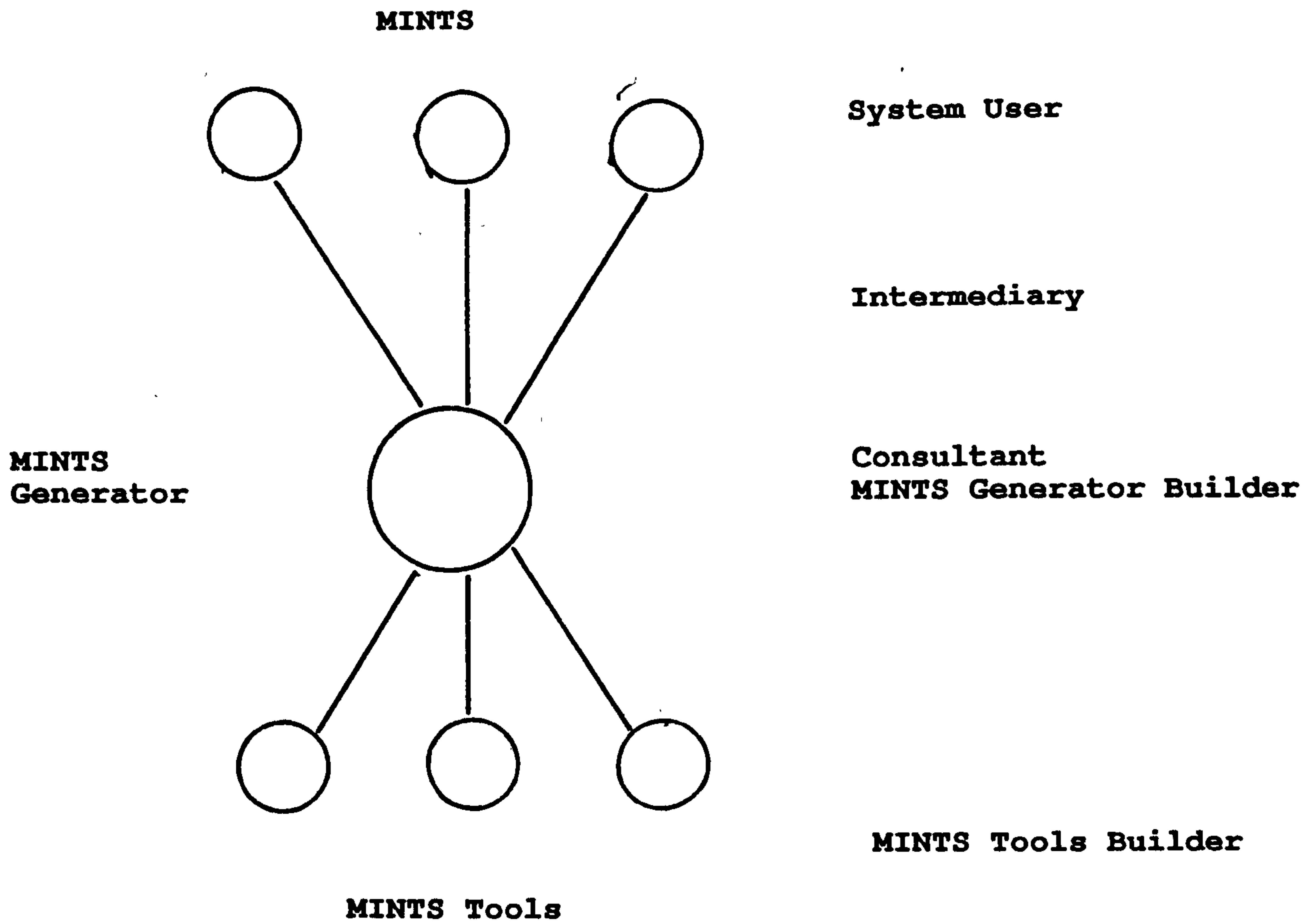


Figure 3.10: Levels of MINTS with associated actors for their development

A MINTS Generator is a system which offers a user friendly environment and a set of analytical techniques for dealing with semi-structured to ill-structured problems. A MINTS Generator may be capable of dealing with different application areas. Once a MINTS Generator is applied to an application area, the outcome is a MINTS.

A MINTS tool refers to hardware and software elements which provide the technical capability for developing a MINTS or a MINTS Generator. Examples of this would be special purpose programming languages, colour graphics hardware and supporting software.

The following framework, as shown in Figure 3.11, shows the relationship between all the different actors involved in different levels of a MINTS;

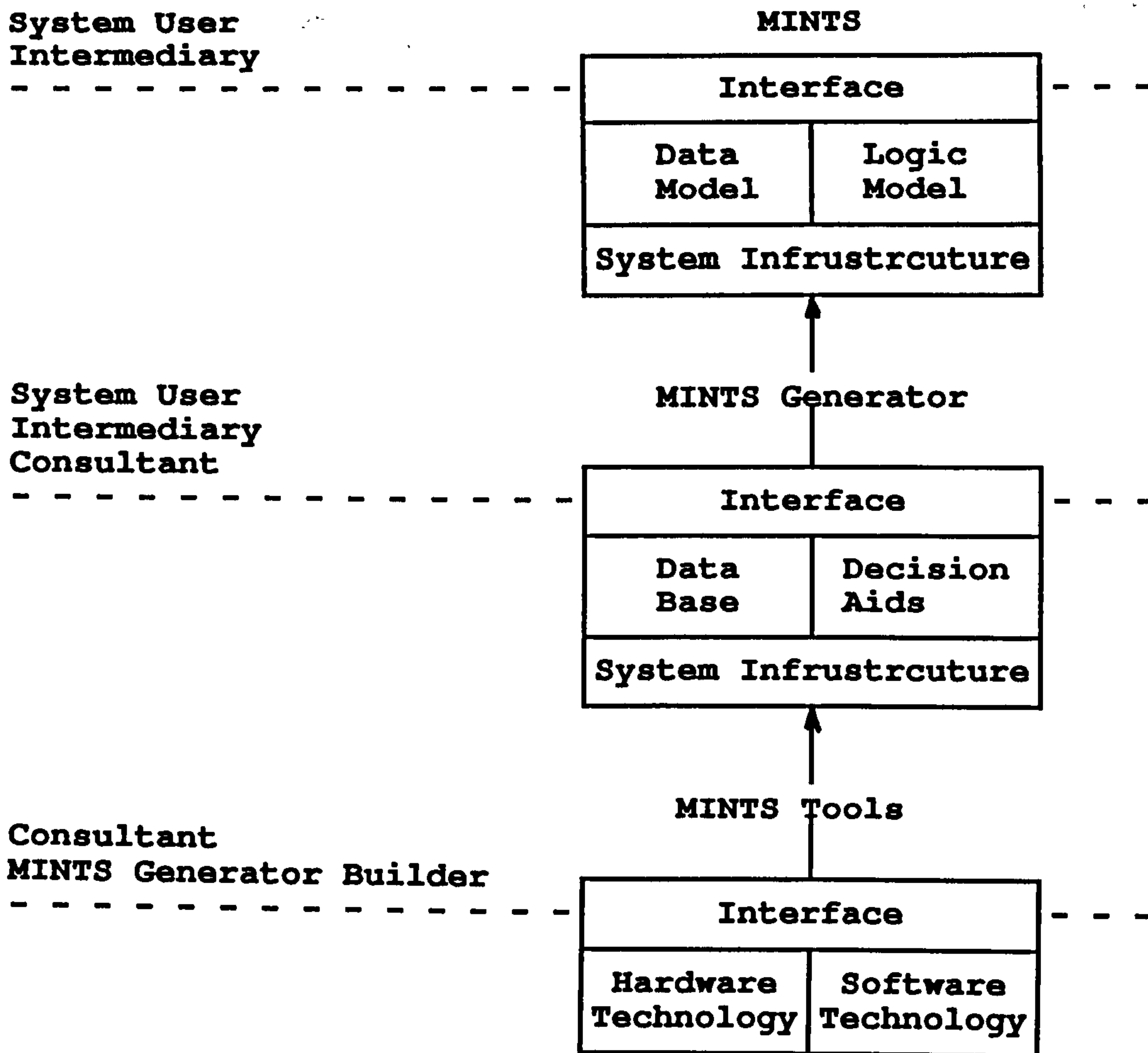


Figure 3.11: Levels of MINTS and the actors involved in their development

In a MINTS project, however, not all the above actors are involved by an internal consultant. The actors that are excluded are MINTS Tools Generator and MINTS Generator Builder. Indeed, as argued by Sprague, those who deal with new technology are rarely involved in a DSS project. They are, he suggests, increasingly employed by hardware and software vendors, and not by the system user's organisation.

Figure 3.12 shows the relationship between those involved in a MINTS project.

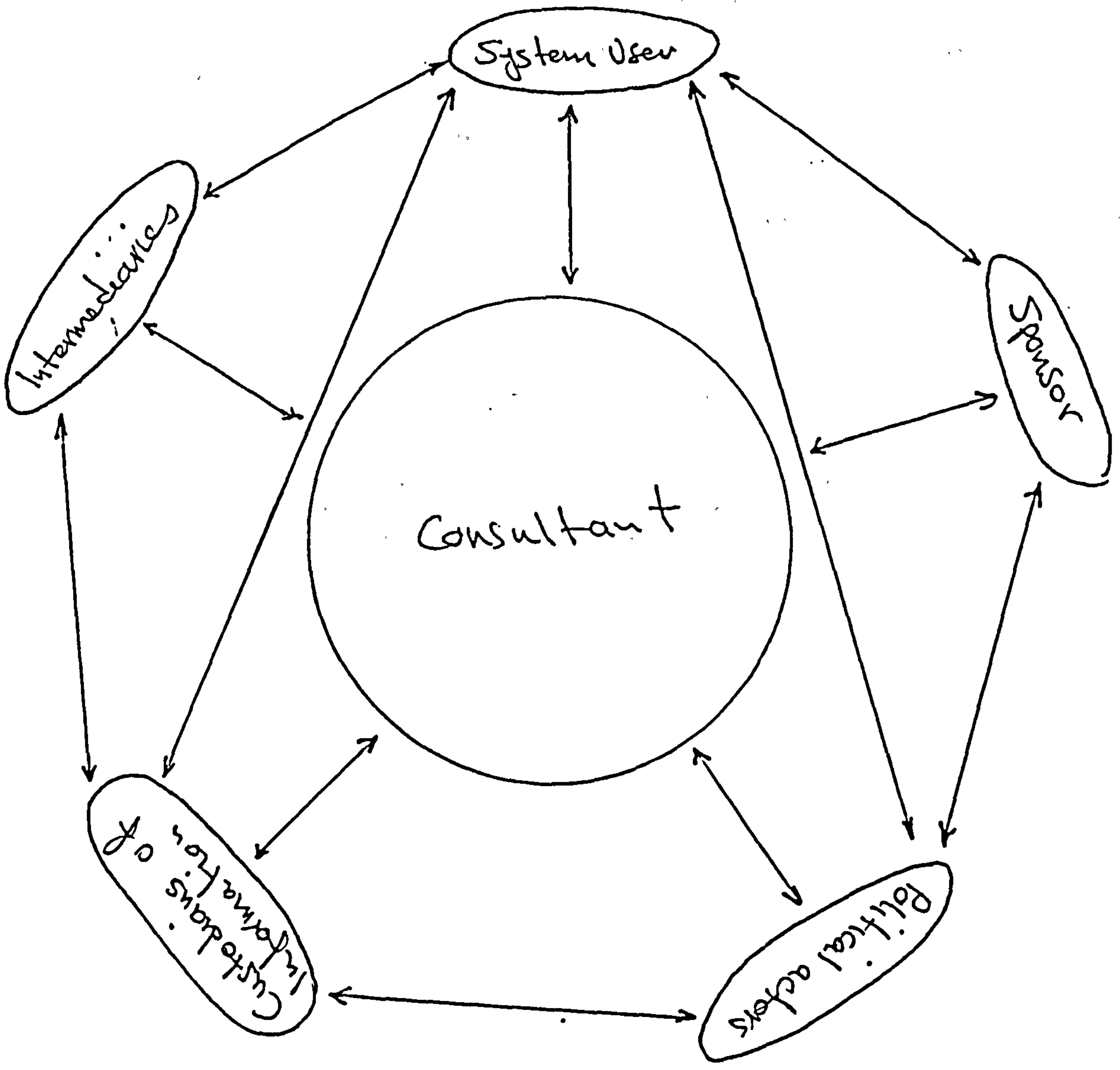


Figure 3.12: Relationship between the actors involved in a MINTS project

It is appropriate to summarise the roles of the actors as depicted in Figure 3.12. These are as follow;

System user: person for whom a MINTS is developed.

Consultant: person responsible for delivering a MINTS.

Intermediary: (a) a technical intermediary uses the MINTS interactively and interprets the results of decision models for the system user. (b) a clerical intermediary performs simple routine tasks such as data entry.

Sponsor: person or persons in position to authorise the go ahead for the MINTS project.

MINTS Champion : a person who pushes the idea of the MINTS among potential system users and management.

System User' Immediate Superior : person to whom the system user is directly accountable.

Supporting Political Actors : members of management who are needed for obtaining political support for the MINTS.

Information Custodians: person or persons collecting and holding information required by the MINTS and providing access path to such information.

4 CHAPTER 4

4.1 Literature Survey II - MIS/DSS Success

4.1.1 Objective

With the MINTS class of support systems identified, the literature was surveyed to find answers to the following questions;

- (a) what is meant by MINTS success?
- (b) what are the contributory success factors for MINTS?
- (c) how a large number of success factors should be structured?
- (d) How a success score should be elicited for contributory success factors?
- (e) What technique should be used for computing overall likelihood of success, as well as computing the success likelihood of any group of success factors?

In order to answer these questions, the researcher reviewed the literature on the success/failure of MIS and DSS. The aim was to then apply appropriate findings from this second literature survey to MINTS.

4.1.2 Previous Work

4.1.2.1 Definition of Success

Measuring success of Management Information Systems (MIS) has been the focus of many studies [4,14,15,24, 42, 49, 50,62,64,65,73,82,83,85,94,103,109,115,128,130,132,134,136, 139,148,150,151,154,161,164,181,183]. There also exists a number of studies which have considered the measurement of success of Decision Support Systems (DSS) [6,9,13,58,63,86, 114,144,145,176,177].

A lack of a standard definition for the different types of computer-based information systems has meant that the studies that have purported to have, for example, examined the success of a DSS, may have examined the success of an MIS. A clear example of this is the work of Alter [9], whose definition of DSS includes MIS. Others, like Alloway and Quillard [4], and Miller & Doyle [115] have examined computer-based information systems in general, regardless of their different types.

The majority of studies on MIS/DSS success [4,9,14,15,24, 42,49,50,58,62,64,73,82,83,85,94,103,109,115,128,130,132,136, 139,144,145,148,150,151,154,161,164,177,181, 183] have laid the emphasis on measuring the success of a computer-based information system after its implementation. Thus, they have overwhelmingly adopted a product approach in

measuring success. In other words, they have defined system success, from the view point of user satisfaction with the final system. Some studies [14,132,144,151] have adopted user satisfaction of the system as a measure of success. Some [32,60,130] have used increased profitability of the organisation as a measure of success, and some [32,108] have used an improvement in the quality of decisions or level of performance for an individual as a measure of success. System usage has also been used as a measure of success [6,15,94,99,130,164].

Some studies, like those of Alloway & Quillard [4], and Miller & Doyle [115], have tried to measure an organisation's overall computer-based information system success. These studies have not given a name to the adopted measure of success, but defined computer-based information success in terms of satisfying a list of success factors. Using a mathematical equation, they combined the weightings assigned to these factors by the respondents to derive an overall score for system success.

Other studies [41,63,115,132,176,177] have favoured a multi-dimensional factor approach as a way of defining system success. Doll [41] and Ginzberg [63], for example, have categorised success factors into different dimensions, and used a 'two-level' approach in defining system success. The first level consisting of the dimensions, and the second consisting of the success factors pertaining to each dimension. Doll, defines system success in terms of five dimensions; software, database, adoptability, project implementation sequence, and maintenance cost. By combining the overall score of the dimensions, he derived an overall score for system success. On each dimension, success is calculated as appropriately meeting a set of conditions. For example, the dimension software, is defined in terms of a set of success factors as being able to manage the development, selection, cost, and maintenance of the programs that help users do their work. Welsh [13] used three measures of success, 'acceptance of DSS', 'effective utilization', and 'overall satisfaction'. He further divided these into six separate categories.

In a critical review of 31 studies proposing a measure of success, Ives & Olson [83] showed that four different measures of success have been used. These are 'system quality', 'system usage', 'user attitudes' and 'information satisfaction'. For example, the higher the rate of system usage of a computer-based information system is assumed by these studies that the more successful is the system. While some of these studies had found a positive correlation between system success and these measures of success, others had found little or no correlation. Although these studies have adopted surrogate measures of success for measuring system success they, like others, have defined system success in terms of a set of contributory success

factors. For example, in their literature search for a definition of user satisfaction, Bailey & Pearson [14] concluded that there was general agreement that satisfaction in a given situation is the sum of one's feelings or attitudes toward a variety of factors affecting that situation.

Only some studies [6,14,49,65,73,92,115,128,132] have extended the definition of an information system's success to include factors other than those relating directly to the product. Alter [6] included such factors as maintaining close relationship with the user throughout the development of a DSS and providing the user with a service rather than a product. Ginzberg used a change model and emphasizes the importance of a process approach to MIS development. He suggested that some of the factors making a distinction between success and failure of an MIS are the extent of project definition and organisational commitment to change and support for an MIS.

4.1.2.2 Contributory Success Factors

A large number of contributory success factors have been identified in the studies examining MIS and DSS success. These factors differ greatly from one study to another. This is mainly due to a definitional problem as to what computer-based information systems were investigated. However, there exists agreement among many authors on a few success factors which are crucial to the success of a computer-based information system. These are; felt need, user involvement, management support, and use of intermediary.

Crucial Success Factors

It has been the prevailing wisdom that a successful system development and implementation depends on two major conditions, felt need for the system and active user involvement throughout system development and implementation (Alter [6]). In fact many studies have found strong support for user involvement as a crucial success factor in system development (Robey & Farrow [134], Gibson [62], Lucas [103], Zmud & Cox [185], Powers & Dickson [130], Senn [154], Swanson [164], Kaiser & Srinivasan [85], Baroudi, Olson & Ives [15], and Maish [109], King & Rodriguez [94], Lonnstedt [99], Alter [6]).

Lucas [103] argues that user participation will lead to increased user commitment, and decreased resistance to change. User participation is believed, by Robey & Farrow [134], to improve user understanding of the system, as well as resulting in a more accurate and complete assessment of user information requirements. Moreover, user

participation will result in users having more realistic expectations of the capabilities of a system (Gibson [62], Ginzberg [64]).

A study, carried out by Baroudi, Olson, & Ives [15], showed support for the traditional view that user involvement is positively associated with user information satisfaction as well as system usage. They also found that user information satisfaction will lead to increased system usage, rather than the other way round. For their study, they used 47 activities comprising user involvement which were derived from a review of the literature and their questionnaire. These activities were then classified by the stages in the system development life cycle during which they were performed. Twenty seven of these activities were appropriate for one or more stages.

In fact, a number of studies have found a significant correlation between systems satisfaction, as a measure of success, and user involvement (Swanson [164], Kaiser & Srinivasan [85], Powers & Dickson [130], Baroudi, Olson & Ives [15], and Maish [109]). System usage has also been used in a number of studies as a measure of success. These studies found a positive relationship between system usage and user involvement (Swanson [35], King & Rodriguez [94], Lonnstedt [99], Alter [6], and Baroudi, Olson & Ives [15]).

Alter [6] supports the argument for user involvement and felt need as crucial elements of a successful system implementation. His study of 56 decision support systems showed that those systems that suffered significant implementation problems were characterised by a lack of user involvement and user initiation. While he found relatively few problems in systems in which the users had an active role in the initiation or implementation stages.

The need for user involvement and user initiation has also been supported by Lonnstedt [99].

Alter further argues that it is too simplistic to say that users must be involved in system development. The question to be asked, he argues is not that users must be involved, but what measures should be taken to ensure user involvement and a real need for the system. To answer this question, he suggests using the following strategies;

- spend more time to find out what the users really want.
- pay serious attention to user capabilities and management style.
- maintain close contact with the user throughout development.
- provide users with service rather than a product.

- design a simple system which does not overload the user.
- use an evolutionary approach that exploits the user's learning curve.

Ives & Olson [83] believes that the level of user involvement may differ according to the type of information system and/or the stage in the development process. For example, they argue that user involvement/participation may even be inappropriate for a system which, for example, requires considerable technical expertise or systems where the product is invisible or unimportant to users. However, in the case of a MINTS, user involvement is crucial, because system designers cannot produce an effective system without the necessary knowledge which is possessed by users. Also because it is crucial to have users' acceptance of the system, due to the discretionary nature of DSS use.

Traditionally management support has also been regarded as a crucial factor for a successful system. Sanders & Courtney [145] gave further support to this view, and confirmed the impact of top management support on the implementation stage of a DSS. They further found evidence relating to the role of training in DSS development, and showed the length of use as a critical factor contributing to DSS satisfaction.

The use of intermediaries has also been suggested by many as crucial to the successful building and implementing a DSS [5,35,87,177]. Welsch [177], for example, argues for the inclusion of an appropriate role for an intermediary, an information transfer analyst, within the design of a DSS, if the DSS implementation is to be a success. An information transfer specialist is vital in increasing the level of use and acceptance of a DSS.

Keen [87] and Alter [5] have also argued that DSS in specialised languages should be made available to managers through intermediaries, rather than enticing them to interact directly with systems. For there is too much opportunity for misuse when DSS is left in the hands of users who really do not understand the capabilities or limitations of such systems. Andriole [13] has also stated that his research and direct applied experience showed that the presence and active participation of an intermediary is a prerequisite to successful usage of a DSS

However, an effective intermediary is hard to find. Indeed, an intermediary must be capable of playing different roles, such as a programmer, an implementor, and a part of corporate planning team (Keen[87]). According to Furest [59], effective intermediaries are found in

firms with specialised staff to support the technical requirements of learning, using and interpreting these models.

According to Welsch [177], an information transfer specialist is one who introduces users to DSS, provides them with information services and acts as an interface between the computerised systems and the decision-makers using them.

Welsch sees the role of the information transfer specialist as twofold. In his technical role, he assists the user in learning and operating the DSS, as well as in using it effectively in decision-making.

Other Success Factors

There are other studies which have, in addition to the above success factors, suggested many other success factors.

Raymond [73] adopted a multidimensional item approach in defining user satisfaction as a measure of system success. In defining user satisfaction, the following success factors were considered by Raymond;

- Output Quality: reliability, relevancy, accuracy and precision.
- Man-machine interface: user's understanding, participation, currency of output, and convenience of access.
- Support factor: processing of requests for system changes, time required for system development.
- EDP Staff & services: relationship with EDP staff, attitude of EDP staff, communication with EDP staff.

Swanson [164] measured MIS system success, based on a set of 16 factors;

- | | |
|--|--|
| - timeliness of reports | - reliability of MIS system |
| - relevance of data | - convenience in using terminals |
| - uniqueness of information | - documentation |
| - accuracy of data | - response time |
| - instructiveness of data | - adequacy of report formatting capabilities |
| - conciseness of data | - clarity and meaningfulness of data |
| - support from systems and programming group | - readability of data |
| - convenience of time table for MIS operating schedule | - efficiency of query language |

Welsch [176] used a 40 item multidimensional perceptual measure of DSS implementation success. His scale consisted of three high level dimensions and 6 lower level dimensions;

Acceptance of DSS	-----	- support for DSS
		- reliance on DSS
Effective Utilization	-----	- extent of usage
		- improved decision-making
Overall Satisfaction	-----	- effectiveness of DSS
		- usefulness of DSS

Bailey & Pearson [14] identified 38 distinct factors influencing user-satisfaction. These are;

- flexibility
- timeliness
- completeness
- relevancy
- currency
- response time
- perceived utility
- feeling of participation
- job effects
- format of output
- security of data
- volume of output
- vendor support
- priorities determination
- attitude of the EDP staff
- understanding of systems
- communications with the EDP staff
- schedule of products and services
- organisational competition with the DP unit
- accuracy
- reliability
- confidence in systems
- precision
- error recovery
- convenience of access
- documentation
- degree of training
- feeling of control
- mode of interface
- expectations
- language
- technical competence of the EDP staff
- processing of change requests
- top management involvement
- relationship with the EDP staff
- charge-back method of payment for services
- time required for new development.

Bailey & Pearson suggest that not all 38 factors can have an impact on every user's satisfaction, as the causes may differ from one user to another. However, they believe that any of the factors could have a significant role in some user's satisfaction measure.

Miller & Doyle [115] in measuring information systems effectiveness in the financial services sector identified 38 success factors categorised into 7 dimensions as listed below;

- Characteristics of conventional systems: completeness of output information, accuracy of output information, more monitoring systems, relevance of report contents, currency of output information, volume of output information, report availability and timeliness, more exception systems.
- Strategic management issues: top management involvement, strategic IS planning, business-related systems priorities, using database technology, overall cost-effectiveness of IS, use of steering committee.
- User involvement: users' feeling of participation, users's control over IS services, IS-user management communications, users' understanding of systems, user confidence in systems.
- Responsiveness to new system needs: prompt processing of change requests, short lead time, new systems development, responsiveness to changing user needs, IS support for users, preparation of new system proposals, flexibility of data and reports
- End-user computing: more analysis systems, more enquiry systems, effective training of programmers or users, ease of user access to terminals.
- Information system staff quality: user-oriented systems analysts, competence of systems analysts, technical competence of IS staff, larger IS effort to create new users, positive attitude of IS to users.
- Reliability of service: low % hardware and systems downtime, efficient running of current systems, data security and privacy.

Alloway & Quillard [4], have offered a list of 26 success factors for measuring the success of an information system function;

- communication with managerial users
- involvement of senior user managers in IS policy formulation and evaluation
- efficiency of hardware utilization
- hardware and system downtime
- responsiveness to user needs
- training programs for users in general
- IS strategic planning and allocation of resources to key business areas
- IS capabilities
- Data security and privacy
- increasing the proportion of IS effort expended in creating new systems
- Quality of IS system analysts
- the attitude of IS personnel toward users
- technical sophistication of new systems
- technical competence of the IS staff
- improving new systems development (time, cost, quality, distribution)
- the new system request backlog

- developing more monitor^{ing} systems
- user-oriented systems analysts who know user operations
- developing more exception systems
- developing more inquiry systems
- IS support for users in preparing proposals for new systems
- developing more analysis systems
- appropriate IS budget size or growth rate
- availability and timeliness of report delivery to user
- running current systems (costs, ease of use documentation, maintenance)
- IS profitability (from charge-outs for services)
- report contents (relevance, currentness, flexibility, accuracy)

Ginzberg [65] using the Kolb/Frohman [192] model of change (scouting, entry, diagnosis, planning, action, evaluation, and termination) argues that multiple issues are involved during the different stages of building an MIS, which are unlikely to be of equal importance at each stage. He further argues that there are key recurrent issues at different stages, requiring resolution for a successful implementation process. Initially, he suggests that the following factors allow a differentiation to be made between success and failure;

- (a) extent of project definition and planning,
- (b) organisational commitment to the project,
- (c) breadth of analysis,
- (d) user responsibility for system,
- (e) commitment to change, and
- (f) user ownership of system

But based on further analysis, he concludes that factors (a), (b) and (e) are central to successful MIS implementation. Although factors (b) and (e) are related to commitment, Ginzberg's view is that they imply different types of commitment. While factor (b) type commitment refers to taking all necessary actions for making sure that the system is a good one and that it provides a solution to the organisation's problem, factor (e) is concerned with the willingness of those involved to make the necessary changes in behaviour, procedure, etc., as required by the new system. Factor (a) implies detailed consideration of organisation needs, project impacts, training requirements, and careful definition of project team members' roles.

Ginzberg also found that while no individual factor was sufficient to completely distinguish successful cases from failures, a combination of all factors could do so. For example, a project will not be successful due to either project commitment or organisational commitment alone.

But both these factors together can contribute to success. Also although factor (c) can contribute to project success, it cannot make up for a lack of commitment.

Sanders [144] selected 20 contributory success factors from the studies carried out by Welsch's [176], Schultz & Slevin [151] and Ginzberg [63] for measuring the individual user's perception of DSS success. Based on the results of his questionnaire, Sanders identified 13 reasons or factors which the respondents believed to be associated with the success of their DSS. Sanders grouped the 13 factors under two overall measures of success as shown below;

A) Overall Satisfaction;

- I have come to rely on DSS in performing my job.
- DSS is extremely useful.
- all in all I think that DSS is an important system for this organisation.
- personally benefited from the existence of DSS in this organisation.
- I have become dependent on DSS
- as a result of DSS, I am seen as more valuable in this organisation.

B) Decision Making Satisfaction

- DSS has improved the quality of decisions I make in this organisation.
- utilisation of DSS has enabled me to make better decisions.
- as a result of DSS, the speed at which I analyse decisions has increased.
- use of data generated by DSS has enabled me to present my arguments more convincingly.
- as a result of DSS, more relevant information has been available to me for decision-making.
- DSS has led me to greater use of analytical aids in my decision-making.
- as a result of DSS, I am better able to set my priorities in decision-making.

Little [98] argues that for a DSS to be a success it must be;

- simple
- robust
- easy to control
- adaptive
- complete on important issues
- easy to communicate with

Meador, Guyote & Keen [114] argue that effective management of DSS development requires;

- an explicit plan for the full development life cycle,
- careful assignment of responsibility for DSS developments
- appropriate user involvement and direction, and
- on-going user needs assessment and problem diagnosis.

They found that the success of a DSS in bringing about the desired organisational impact is associated with the management of DSS development and use over time. For a DSS to be useful they suggest that it must be responsive to the continuous changes in decision environments and managers' perceptions of their decision environments. Hence an adaptive design and development strategy must be the main feature of DSS development. They therefore suggest small-scale prototyping, continued incremental development and responsiveness to users' changing needs and ongoing management of DSS development and use as some of the steps improving DSS success.

The conclusion from the respondents opinion of the impact on their DSS was that perceived success of DSS depends not only on the fit of the DSS within the organisational decision making context, but also on its overall cost-effectiveness and worth. The following factors were identified as important to the success of a DSS;

- | | |
|------------------------------|----------------------------------|
| - top management emphasis | - increase in user effectiveness |
| - return on investment | - adaptability of organisation |
| - technical do-able | to change |
| technically do-able | - urgency of user needs |
| - DSS development costs | - uncertainty of DSS design |
| - impact on DP resources | objectives |
| - degree of user involvement | - "soft" benefits |
| | - company politics |

Doll [41] believes that management, rather than hardware, software, or technical expertise, is becoming viewed as the missing ingredient in the recipe for successful MIS development efforts. In order to measure the overall success of MIS development, Doll considered six objectives, which he believes need to be satisfied before an overall MIS development success can be achieved. The success of each objective is also based on the satisfaction of a number of factors.

In the firms with successful MIS development efforts, top management made more effective use of six mechanisms for managerial guidance; executive steering committees, written overall development plans, mutually agreed upon development priorities for system implementation, long-term funding commitments by top management, system planning objectives, and project development policies.

There are also others who have supported the idea of an steering committee as a way of involving top management and users (Lucas [102], Nolan [122], Randor & Bean [131], Miller & Doyle [115], Carlin [30], Doll & Ahmed [42], McKeen & Guimaraes [113], Ein-Dor & Segev [50]).

Fuerst [59], believes that effective use of decision models depend on user understanding, ease of use and model responsiveness. Each of these criteria is affected by a number of factors;

- user understanding can be improved by self-documentation, user assisted design, and technical sophistication that evolves modularity.
- ease of use can be improved by a model which is interactive, conversational, English like and non-procedural language.
- a non-procedural language is very important if the gap between man and machine is to be reduced. Such a gap exist because man is not structured in his thought process and the way he analyses and extracts information from different sources.
- model responsiveness can be improved by persuading the user to use the available "what-if" analytical capability, sophisticated graphics, and summary information which is relevant to the user's needs.

For a DSS to be effective, it must be of an adequate level of technical sophistication in relation to the users' needs. Thus, simply because a DSS possesses some technical features (such as forecasting, decision tree, regression analysis, risk analysis, simulation, and linear programming), does not make it effective. This view is supported by Srinivasan [161] who argues that such features must be both desired and used if technical sophistication is to lead to systems effectiveness. To this the researcher also adds that technical sophistication must match the users' ability to understand the limitations of such tools and, more importantly how to interpret the results. Users find decision models less useful when the solution is based on complex analytical techniques which users find difficult to interpret (Bruggere [29]).

Wahi, Popp, & Stier [173], believe that the following criteria have been the reasons for MIS success at Weyerhaeuser;

- commitment and involvement of the business,
- frequent reviews with the business,
- knowledge of the business on the planning team,
- technical reviews with IS personnel,
- business acceptance of the team leader,

- visibility of products on display wall.

They further argue that another invaluable element in the success of their project was the Information Systems Manager and his detailed knowledge of the business at Weyerhaeuser (as he had been employed in the business before moving to the Information System Department), and his rapport with its managers and staff.

Ginzberg [64] carried out a study of user expectations as predictors of project success or failure. The results of his study suggests that users who have a more realistic expectations of their system prior to implementation, are more satisfied with the system and use it more often than those users whose pre-implementation expectations are unrealistic. He argues that the definition stage of a project is most crucial. It is during this stage that early warnings about the success or failure of a project can be noticed. His study, therefore, suggests a number of indicators as the early warnings of MIS implementation outcomes. The definition or exploration stage is also crucial as it is during this stage that users obtain a better understanding and deeper insight into their decision problems and decision environment. Instead, much of the effort is focused on the i) modelling, ii) interpretation of post-modelling and iii) implementation stages of problem-solving (Vazsonyi [168]).

Bean et al. [16] who examined the impact of a number of organisational issues, such as industry type, organisational size and level of decentralization, on the successful implementation of system, found weak correlations between these factors and implementation success.

There are other contributory success factors that have been identified by other researchers. As it is beyond the scope of this study to state the results of these studies individually, Table 4.1 is produced which gives a summary of the factors stated above and those identified by other researchers. Against each success factor, a reference number for its source is also given. For the purpose of this study, the success factors in Table 4.1 are restructured into a more meaningful representation.

Table 4.1: A Summary of the Literature on Contributory Factors to the Success of Computer-based Information Systems

	Source
MIS appreciation;	
- timeliness of reports	,14,164,152,187,
- relevance of data	,164
- uniqueness of information	,164
- accuracy of data	,164,152,187
- instructiveness of data	,164
- conciseness of data	,164
- clarity and meaningfulness of data	,164
- readability of data	,164
- efficiency of query language	,164
- convenience in using terminals	,164
- documentation	,164
- response time	,164
- adequacy of report formatting capabilities	,164
- support from systems and programming group	,164
- convenience of time-table for MIS operating schedule	,164
Profitability	,49
Application to major problems of organisation	,49
Quality of decisions or level of performance	,49
Usage of system;	,123,181,111,81,49,176,164,94,99,6,15,48,185,187,137,138,283,189,149,31
- urgency of user needs	,114,137,138
- attitude towards the potential of MIS	,48,184,187,137,138,
- extent of top management support for MIS	,145,178,94,185,137,174
- quality of MIS staff	,4,137
- adaptable to support multiple decisions rather than a single one	,31
Overall satisfaction;	,176,144
- System satisfaction	,164,85,138,15,189,94,185,186,137
- effectiveness of DSS	,176
- usefulness of DSS	,176,144
- importance of DSS to the organisation	,144,64
- benefits of DSS to the user	,144
- DSS resulting in the user's being seen valuable to the organisation	,144
User satisfaction;	,49,123,181,111,81,132,94,185,143,149,
- Decision-making satisfaction;	,144
- Increase in user effectiveness;	,114,31
- improved quality of decisions	,49,176,144,96,174
- improved speed of decision-making	,144
- presenting arguments more convincingly	,144
- greater use of analytical aids in decision making	,144
- availability of more relevant information	,144,99,174
- better able to set priorities in decision making	,144
- help to conceptualize a problem	,31
- Output quality	,132
- reliability	,132,14,164,115
- relevancy	,132,14,164,115
- accuracy and precision	,132,14,164,115
- completeness of output information	,115,14
- more monitor systems	,115
- currency of output information	,14,132,115,4
- volume of output information	,14,115
- report availability and timeliness	,115,4
- more exception reports	,115,4

- User-machine interface;	,132,193,46,105,158
- User involvement;	,114,83,134,62,103,185,85,6,64,164,115,130,154,15,109,94,99,198,
- communication with managerial users	,4
- involvement of senior user managers in IS policy	,4
- persuading the user to use the available 'what-if' analytical capability, sophisticated graphics, summary information relevant to the user's needs.	,99
- users' feeling of participation	144,14,132,115
- users's control over IS services	,115
- IS-user management communications	,115
- user's understanding of system's capabilities and limitations;	,14,59,87,5,132,115,174
- passive understanding;	,19
- how to get started	,19
- what functions available	,19
- syntax of different commands	,19
- active understanding: of how to use system in the task at hand	,19
- knowing the meaning and uses of different functions	,19
- documentation	,41,14,59,164,4,96,36
- user-assisted design	,59
- technical sophistication that evolves (modularity)	,114,59,4
- design a simple system which does not overload the user	,6,19,36,174
- pay serious attention to user capabilities and management style	,6
- maintain close contact with the user throughout development	,6
- use an evolutionary approach that exploits the user's learning curve.	,114,6,79,75,74,112,135,9,162
- DSS must be of adequate level of technical sophistication in relation to the user's needs.	,59,161
- DSS must be easy to learn and use	,114,59,4,105,201,174
- interactive model	,59,158
- conversational model	,59,158
- English like model	,59
- none-procedural language	,59
- efficiency of query language	,14,164
- availability of memory aids (e.g. names of data)	,31
- training time	,116
- time to recover from errors	,116
- warm-up time after time away from the equipment	,116
- physical and mental strain	,116
- use of graphics	,116
- easy to use input facilities	,116
- type and rate of errors	,116
- context explicit, clear instructions what to do	,19
- user confidence in systems	,14,115,158
- validity of information	152,187
- currentness of information or reports	,4,152,187
- user confidence in using the tools	,158,
- spend more time to find out what the users really want	,6
- provide users with service rather than a product	,6
- inappropriate in the development stage of a very technical systems (MIS)	,83
- crucial in the development stage of a DSS.	,83
- crucial for obtaining user acceptance, due to voluntary nature of DSS.	,83
- convenience of access	,59,164,115,201,96
- more analysis systems	,115,4
- response time	,199,174
- on-line usage	,94,185,143
- Delays in flow of information	,199,200,143,148

- more enquiry systems	,115
- effective training program for users	,114,14,115,4,186
- Support factor:	,132
- support from systems and programming group	,164
- Responsiveness to new system needs;	,115,59
- prompt processing of change requests	,115
- short development time	,14,132,115
- responsiveness to changing user needs	,114,14,115,4
- IS support for users preparation of new system proposals	,115,4
- MIS staff & services quality:	,132,115
- relationship with EDP/MIS staff	,132,14,189
- positive attitude of IS to users	,132,14,115,4
- communication with EDP staff	,132
- user-oriented systems analysts	,115
- competence of systems analysts	,115,4
- technical competence of IS staff	,14,115,4
- larger IS effort to create new users	,115
Felt need for the system	,6,99
User initiation	,6,99
Acceptance of DSS;	,176
- support for DSS	,176
- reliance on DSS	,176,144
Extent of project definition and planning	,114,65
Charge-back method of payment for services	,14
User responsibility for system	,65
Commitment to change	,65
Organisational commitment to the project	,65
Adaptability of organisation to change	,114
Format of output	,14
Mode of interface	,14
Perceived utility	,14
Realistic expectation of the system by the user	,14,64
Organisational position of EDP	,14
Job effects	,14
Organisational competition with EDP	,14
Priorities determination	,14
User control	,14,31,36,158
- easy to change parameters	,31
- easy to get user-defined output	,31
- allow for different skill levels	,31
Vendor support	,14
Strategic management issues;	,115
- top management involvement and support	,41,114,14,145,178,115
- Executive steering committee	,41,42,182,122,131,115,38,113,58
- Written approval plans for system development	,41
- Agreed policies for system development	,41
- Long term funding commitments from management, based on a written plan and mutually agreed development priorities	,41
- mutually agreed system planning objectives for selecting right projects	,64
- mutual agreement on the criteria for evaluating the system	,64
- strategic IS planning	,115
- business-related systems priorities	,115
- using database technology	,115
- overall cost-effectiveness of IS	,115

Reliability of service;	,115
- Low % hardware and systems downtime	,115,4,96
- efficient running of current systems	,115
- data security and privacy	,115,4
- validity of information	152,187
formulation and evaluation	,4
IS strategic planning and allocation of resources to key business areas	,4
IS capabilities	,4
increasing the proportion of IS effort expended in creating new systems	,4
user oriented systems analysts who know user operations	,4
developing more inquiry systems	,4
appropriate IS budget size or growth rate	,4
Use of intermediaries	,177,13
If the user does not understand DSS, then he must use it through intermediaries	,87,5
intermediaries must have the expertise to provide support for the technical requirements of the users and how to interpret the decision models	,59
intermediaries should help the user to explore the DSS capabilities	,177
intermediaries should facilitate evolutionary growth in decision-making and man-machine interaction.	,177
An explicit plan for the full development life cycle	,114
careful assignment of responsibility for DSS development	,114
On-going user needs assessment and problem diagnosis.	,114
DSS On-going management of DSS development	,114
On-going management of DSS use	,114
DSS must be adaptable	,114
DSS must provide analytic and mathematical functions for performing 'what-if' and sensitivity analysis	,114
DSS development must not be based on an ad-hoc tactical plan (life cycle)	,114
Project development policies for encouraging user management understanding, involvement, and control of logical design decisions.	,41
Information Systems Manager's detailed knowledge of the client's business the reasons for the system must be known	,173
the importance of the problem being addressed	,64
the way the system will be used	,64
Agreed terms of reference for the scope, timetable and objectives of the design team and its relationship to the rest of organisation.	,38
A code of conduct to indicate what behaviour to be accepted and promoted within the design team.	,38
A resource pool on which the design team can call legitimately as the need arises.	,38
Level of aggregation of information	152,187
flexibility to support information requirements of different decisions	,31
familiar representations	,31
allow for different skill levels	,31
present what the user understands and relevant to the job	,56,158
offer library programs, databases	,31
characteristics of problem	,99
- quantifiability of variables	,99
- problem limitation	,99
political acceptability	,96
communication accomplishments	,96
Match of model and problem	,174
risk factors:	,9
- non-existent or unwilling user	,9
- disappearing users, implementors, or maintainers	,9

- loss or lack of support
 - lack of experience with similar systems
- DP department skills;
- project management skills (planning and control)
 - education, motivation and training of users
 - expertise in building DSS
 - intimate knowledge of DP department's operations
 - leadership ability
 - sensitivity to political issues.

,9
,9
,114
,114
,114
,114
,114
,114
,114
,114

4.1.2.3 Structuring a Model of Success

Many studies like those of Bailey & Pearson [14], Alloway & Quillard [4], and Swanson [164] have not applied any structure to their model of success. They have simply used a list of success factors without any dimensions or sub-factors. Some studies [41,65,127,176,183], however, have adopted a multi-dimensional approach as a way of structuring their list of success factors. Ginzberg [65] and Doll [41], for example, have categorised success factors into different dimensions, and used a 'two-level' approach in structuring their list of success factors. The first level consists of the dimensions, and the second consists of the success factors pertaining to each dimension. Doll, defines system success in terms of five dimensions; software, database, adoptability, project implementation sequence and maintenance cost, but offers no name for it. By combining the overall score of the dimensions, he derived an overall score for system success. For a definition of success as regards to the dimensions, he defined it as a set of conditions that should exist for a dimension to have been carried out successfully. For example, the dimension software, is defined in terms of success in being able to manage the development, selection, cost, and maintenance of the programs that help users do their work.

The researcher found Zahedi's [181] work of interest. She used a Hierarchical Tree Structure in structuring critical success factors combinations. She also argued for a "series configuration" and a "k out of n configuration" when considering a number of success factors in measuring a system success. A "series configuration" takes place when each one of the success factors under consideration in measuring a system success, i.e. critical success factors, must work for the system to be a success. A failure in any one such success factor will result in an overall failure. A "k out of n configuration" takes place when a system is a success as long as k out of n success factors relevant to the success of that system work. A failure in a combination of such success factors, rather than any individual success factor, results in the system failure.

4.1.2.4 Techniques for Eliciting Users' Responses

Many studies have adopted a questionnaire approach in identifying contributory success factors for a system. A review of many studies showed that a Likert [193] type scale was popular as a way of eliciting an individual's perception (Robey and Farrow [136], Schewe [148], Swanson [164], Zmud [183], Bailey and Pearson [14], Doll [41], Alloway and Quillard [4], Kaiser and Srinivasan [161], Ives, Olson and Baroudi [15,82], Ginzberg [65], Cata-Baril and Huber [33],

Fuerst [58], Ives and Olson [83], Sanders and Courtney [145]). Basically, respondents are required to score a factor from a scale ranging from an extreme positive pole to an extreme negative pole.

Doll [41], for instance, used a Likert scale with 5 intervals, ranging from 'almost never', to 'almost always'. A Likert scale with 7 intervals, ranging from very poor to excellent, was used by Miller & Doyle [115].

Swanson [164] used a 0.0 to 1.0 scale with arbitrary intervals of 0.1, 0.3, 0.5, 0.7, and 0.9, and a "don't know" with 0 scale for measuring MIS appreciation as a measure of success. These intervals were further divided into equal intervals.

Bailey & Pearson's [14] measurement of users' perceptions involved the use of a semantic differential scale with four adjective pairs (consistent to inconsistent, strong to weak, significant to insignificant, and good to bad), each having seven intervals denoted by adverbial qualifiers; extremely, quite, slightly, neither/equally, lightly, quite and extremely.

Many of the success factors identified by these studies are defined in general terms, thus introducing bias into the calculations due to a difference of opinion between the researcher and the respondents as to their meaning. Another result of this generalisation is a lack of adherence to the concept of orthogonality. This concept refers to the independence of a set of factors (Hoffman [77], Miller & Doyle [115]). In other words, it is required that there exist as little independence or overlapping between a set of success factors as possible, so that multiple scoring of success factors is minimized.

4.1.2.5 Techniques for Calculating System Success

The most common technique adopted by a number of studies [14,41,115,164] for obtaining the likelihood of success of an MIS or DSS is to calculate the mean score for all the success factors. Some of these studies [41,115,164] have adopted a simple arithmetic mean, assuming an equal importance for each success factor.

Doll's [41] measurement technique for overall MIS success was based on summing the scores for the 6 objectives for MIS development. These objectives were assigned equal weights;

$$\text{MIS Development Success} = \text{Project Success} + \text{Software} + \text{Database Adaptability} + \text{Project Implementation Sequence} + \text{Maintenance Cost} + \text{Adapaptability}$$

In other words, MIS development success was measured as the sum of the scores for the 37 items which the respondents were asked to score.

Miller & Doyle [115] examined the overall information systems effectiveness of the firms studied and calculated the composite success measure as the arithmetic mean of performance ratings for all the success factors as perceived by all the respondents in a company.

Swanson [164] measured MIS appreciation based on a set of 16 questionnaire items. An MIS appreciation score of a manager was taken as the simple average of the scores for the 16 items. All the items were assumed to be equivalent indicators, thus weighted equally in scoring.

A major shortcoming of using a simple arithmetic mean is that it does not allow for an importance rating of success factors. In other words, it assigns an equal importance to all success factors. In reality, however, success factors do not have equal importance. Indeed some factors may be critical to success, so that a lack of any one critical success factor will result in an overall failure (Zahedi [181], Rockart [140]). There are also success factors which though may not be critical to cause system failure on their own, but still they are important enough to have different degrees of impact on the success of a project. For example the impact of two or three important factors may be equal to the impact of 5 or 6 less important factors.

An improvement on the arithmetic mean, has been suggested by Bailey and Pearson [14], and Alloway and Quillard [4]. They have adopted a weighted average technique in preference to an arithmetic mean. In other words, in their questionnaires, they not only asked the participants to indicate how they scored the performance of each success factor within their own organisation, but also how important they believed each factor to be. When calculating the overall success score, the performance score of each factor was multiplied by its importance (the weighting of that factor). Then the average of the results for all the factors produced an overall score for success.

Bailey & Pearson used the sum of a user's positive and negative responses weighted by the importance assigned to a set of success factors (the reaction to factor j by individual i multiplied by the importance of factor j to individual i). However, they believed that their measure of user satisfaction, as it stood, was deceiving. The overall result was directly related to the number of factors scored. Thus an individual who had only scored 20 factors would be shown to have a lower satisfaction than another user who had scored 30 factors, while in reality the first user may have been more satisfied than the

second. Bailey & Pearson overcome this problem by using only those factors with at least one non-zero response in the four adjective pairs. This meant that factors having a zero response were omitted from having an effect on the overall result.

Alloway & Quillard also developed a similar instrument to that of Bailey & Pearson's, based on 26 success factors. In measuring overall information system success, they assessed the relative importance of each of the 26 success factors as well as the information system's actual performance on these same factors. They then computed the system success by combining importance and performance as in the following formula;

$$\sum_{c=1}^{26} \frac{\text{Importance}_c \cdot \text{Performance}_c}{\text{Importance}_i} = \text{Success}_m$$

where $c = 1-26$ are the success factors, and success_m is the success score as perceived by manager m .

In order to then obtain an score for the system success for an organisation, they calculated the weighted arithmetic mean of the success scores for all relevant managers.

There are, however, three major shortcomings with both simple arithmetic mean and weighted arithmetic mean;

- (a) Both simple arithmetic mean and weighted arithmetic mean are based on a summation/additive approach. In other words, they both are members of the larger class of linear models [100,155]. This means that the contribution of each success factor to the system success is considered in isolation from that of the other success factors. This is not in accord with reality, where as there are more success factors satisfied, the contribution of the next success factor to the overall success is diminished. More recent research in the area of information integration in person perception, in particular the work done by Anderson [12], however, advocates a multiplicative approach in combining a number of factors in making a judgemental decision about an object. A multiplicative or a cumulative approach assumes that one piece of information modifies or modulates another. In other words, the more favourable information about an object is gathered

in forming a perception of that object, the less one's perception of the object is affected by the additional favourable information.

- (b) According to Shanteau and Nagy [155], another consequence of an additive approach is that as more success factors are considered, the more extreme or polarized the combined result would become (i.e. 'the more the better').
- (c) The concept of "n out of k" requires a zero value to be assigned to those factors that are not relevant to the success of a system in order to exclude the effect of the irrelevant factors from any calculations. As discussed above, Bailey & Pearson, and Alloway & Quillard have taken this into consideration, by assigning a zero performance value to the success factors. But this does not fully exclude the effect of irrelevant factors from the calculations. This can be shown by considering the weighted average technique used by Alloway & Quillard;

$$\sum_{c=1}^{20} \frac{\text{Importance}_c \cdot \text{Performance}_c}{\text{Importance}_c} = \text{Success}_m$$

As can be seen from the above formula, each success factor is given two scores; performance (which is the users' response) and importance (which is the weighting assigned to each success factor). By assigning a zero performance score to an irrelevant success factor, that factor is eliminated only from the denominator, while its importance is still included in the calculations. For the purpose of exposition, suppose that the general model of success comprises only five contributory success factors, and only the first three factors are relevant to an specific system. In order to exclude the irrelevant factors, they are assigned a zero performance score. The importance and performance scores are shown below;

Factors	Importance (%)	Performance (%)
A	65	35
B	75	48
C	84	65
D	54	0
E	61	0

Using the conventional weighted average technique shown earlier, the weighted average is calculated as follow;

$$\begin{aligned} \text{Weighted Average} &= \frac{65*35 + 75*48 + 84*65 + 54*0 + 61*0}{65 + 75 + 84 + 54 + 61} \\ &= \frac{111335}{339} = 33.4 \end{aligned}$$

As can be seen the importance scores of the two irrelevant factors are still included in the calculations. In order to completely exclude the effect of the irrelevant factors from the above calculations, their importance should also be excluded. In other words, the weighted average should be;

$$\begin{aligned} \text{Weighted Average} &= \frac{65*35 + 75*48 + 84*65}{65 + 75 + 84} \\ &= \frac{11335}{224} = 50.6 \end{aligned}$$

This bias in the calculations will increase as the number of irrelevant factors increases.

Critical and Non-critical Success Factors

As a method for quantifying the reliability of information systems, Zahedi [181] uses the concept of critical success factors. This concept can also be used as part of a technique for measuring system success, as there are success factors that can be critical to any information system's success. Critical success factors are regarded as the key areas where things must go right for an information system to succeed. These are different from other factors which though not critical but are nonetheless important. A failure in any one critical success factor leads to an overall failure, while only a combination of non-critical success factors can cause an overall failure. The studies in the area of DSS and MIS success have not made a distinction between critical and non-critical success factors in measuring system success.

Level of Definition

Many of the success factors identified by the studies reported here are defined in general terms, thus introducing bias into the calculations due to a difference of opinion between the researcher and the respondents as to their meaning. The degree of user-friendliness of a computer-based information system is an example of a general success factor that can cause a difference of opinion between the respondent and the researcher. The term user-friendliness can include such things as, menu-driven, simple and relevant on-line help, English-like programming language, full-screen editing facility, quick graph facility, manual and automatic macro command facility, system prompts for user errors, spelling function, system ability to deal with time automatically, automatic backup facility, and so on and so forth. Unless such general success factors are broken down and defined in specific terms, the respondents may have difficulty in understanding their meaning. Hence they may assign a wrong score to these success factors as a way of commenting on the performance of their computer-based information systems. In addition, different users of the same system may have different understanding of these loosely defined success factors, thus giving conflicting scores.

Orthogonality

Another result of the above generalisation is a lack of adherence to the concept of orthogonality. This concept requires as little overlapping between contributory success factors as possible, so that multiple scoring of success factors is minimized.

For example, Swanson uses such success factors as clarity and meaningfulness of data, and readability of data. There is little distinction between clarity and readability of data, and it is expecting too much from the respondents to know the difference.

Raymond [132] and Bailey & Pearson [14] use such success factors as relationship with EDP staff, and communications with EDP staff. Miller and Doyle [115] use success factors like prompt processing of change requests, and responsiveness to changing user needs. They also make a distinction between users' control over IS services, and IS support for users. If users have control over IS services, it then implies that IS services are obliged to provide support for the users. Another example of a lack of adherence, by Miller and Doyle, to the concept of orthogonality is the distinction they make between competence of systems analysts, and technical competence of IS staff, as success factors in measuring information system staff quality. But they refer to systems analysts as IS staff.

4.1.2.6 Summary of Literature Survey Findings

Based on the literature survey reported in this chapter, the following can be concluded;

- (a) Measuring success of MIS has been the focus of many studies [4,14,15,24,42,49, 50,62,64,65,73, 82, 83,85,94,103,109,115,128,130,132,134,136,139,148,150, 151,154,161,164,181,183]. There also exists a number of studies which have considered the measurement of success of (DSS) [6,9,13,58,63,86,114,144,145,176, 177].
- (b) A lack of a standard definition for the different types of computer-based information systems has meant that the studies that have purported to have, for example, examined the success of a DSS, may have examined the success of an MIS. A clear example of this is the work of Alter [9], whose definition of DSS includes MIS. Others, like Alloway and Quillard [4] have examined computer-based information systems in general, regardless of their different types.
- (c) A large number of studies [4,9,14,15,24,42,49,50, 50,58,62,64,73,82,83,85,94,103,109,115,128,130,132, 136,139,144,145,148,150,151,154,161,164,177,181,183] have laid the emphasis on measuring success after the implementation of computer-based information system. They have thus adopted overwhelmingly a product approach in measuring success.
- (d) Although other studies [6,14,49,65,73,92,115,128, 132] have taken a step further, and partly attempted to assess success at pre-implementation stages, they have considered only a small number of success factors pertaining to pre-implementation stages of computer-based information system.
- (e) The manner in which the models of success developed by the above studies are presented is basically in the form of a list of success factors without any structure to them. A few studies adopted a 'two-level' approach.
- (f) A Likert scale has been favoured by most of the studies [4,14,15,33,41,58,65,82,83,136,145,148,161, 164,183] for eliciting an individual's perception.
- (g) A simple arithmetic mean or a weighted average technique have been favoured by many studies for calculating the combined effect of the success factors.

- (h) Only a few studies, such as those of Alloway & Quillard, and Bailey & Pearson, have assigned an importance score and a performance score to the success factors.
- (i) The same set of contributory factors may not be applicable to every system - "n out of k" concept.
- (j) There is no specific reference in any study to who should make inputs to or use the model of success.
- (k) A hierarchical tree structure approach is a suitable and practical way of organising a large number of success factors.
- (l) The concept of critical success factors has not been used by the studies assessing the success of MIS or DSS.

4.1.3 The Approach to be Taken

4.1.3.1 Definition of Success

The measures of success identified in the literature survey are; 'system quality', 'system usage', 'information satisfaction', 'user satisfaction', 'profitability', 'quality of decisions', and 'application to major problems of the organisation'. These measures of success are based on a product approach, which measures the success of a system once it is implemented.

As it is the objective of this study to build a Consultant Advisory System that measures the success of a MINTS throughout its evolving development, a process approach rather than a solely product approach is more appropriate. As suggested by Ein-Dor & Segeve [51], perhaps a combination of the measures of success suggested in the literature is a better method of measuring the success of a computer-based information system.

In order to measure the likelihood of success for a MINTS project, one needs to consider all aspects of a MINTS, from its conception through its evolving development and implementation.

As a MINTS needs to fit the political context within which it is to operate, it is crucial that the actors involved in such a project remain satisfied throughout the development. The consultant, therefore, needs to ensure a right environment, including establishing a working relationship with the key actors, for the MINTS, as well as maintain a good working relationship with and between the actors in a MINTS project. A MINTS consultant is attempting to introduce

a degree of change which affects a number of people. The researcher holds the view that ensuring a right environment for a MINTS is equivalent to the unfreezing stage in the Lewin-Schein change model. Maintaining relationships, on the other hand, refers to the change and refreezing stages of the Lewin-Schein [97,147] model. It is however important to notice that it is difficult to separate the change and refreezing stages for a MINTS. This is because; (i) the development and implementation stages of a MINTS are carried out concurrently, and (ii) MINTS are evolutionary which means that new requirements are identified throughout the development and implementation process.

As the initial phase in a MINTS development, the consultant must make sure that a favourable climate exists for a proposed MINTS. Ginzberg [64] refers to this as the definition stage, and argues that this is a crucial stage of assessing the likelihood of success for a project. He further argues that it is during this stage that early warnings about the success or failure of a project can provide a basis for either committing further resources to the project or aborting it completely. The right climate for a MINTS means that certain situations exist which signal there is a good chance of the MINTS being a success. For example, there must exist a real need for the proposed MINTS on the part of the potential system user. The consultant must, therefore, make sure that the system user is convinced of the need for the MINTS. Also, the key people such as the system user's immediate superior and the sponsor for the proposed MINTS must not be against the MINTS. This means that there must exist a favourable management culture that not only does not resist the employment of such systems but actually encourages them. A consequent of such a management culture is that support and finance for the MINTS can be obtained much more easily. There must also exist a right organisational and system infrastructure for the MINTS, as well as the key actors having the right commitment and capabilities for making the MINTS work. Shortly, these will be explained in more detail.

Assuming that there exist a right climate for a proposed MINTS, the next stage is to make sure that the actors involved in the proposed MINTS are kept satisfied in playing their roles. The consultant must, for example, make sure that the MINTS satisfies the system user's requirements, that the MINTS performs according to his expectations, that he is given adequate training, and is provided with prompt support.

The idea of establishing and maintaining relationships is also supported by Vickers [169,170], who defines any system as bundles of inter-acting relations, internal and external. According to Vickers, it is the primary task of the person who introduces change, e.g. a consultant, to keep all these relations, internal and external, within their permissible

ranges - and hence to detect and correct instabilities before they become overwhelming. He further argues that the secondary task of a change agent is to change some or all of these relationships, if and when he can, in a way which is regarded by all who cannot be ignored as being on the whole more acceptable to them than the previous state.

The researcher proposes to use two main stages for developing and implementing a MINTS which need to be carried out by a consultant;

- (A) ensuring a right environment for the MINTS, and
- (B) maintaining relationships.

The more favourable the environment and the better maintained the relationship between the people involved in a MINTS project, the more successful would be the project. As there exist a number of contributory success factors associated with each of the two stages, the success of a MINTS project can be defined in terms of how well these contributory success factors are satisfied. As a measure of success, the researcher proposes to use 'MINTS project success' as a dependent measure which is defined in terms of the success of the stages A and B. The success of stages A and B have in turn been defined in terms of a number of dimensions. For example, a major dimension used in stage B, is user satisfaction.

A right environment is defined in terms of having the right organisational and system infrastructure required for the MINTS, as well as the key actors having the right capability and commitment for making the MINTS work.

In order to have a favourable organisational infrastructure for the MINTS it is required that: the organisation is financially capable of affording the MINTS; that it is capable of accepting the changes imposed upon its existing formal systems and its management, that there is a place for the MINTS within the overall IT strategy of the organisation, and that the organisation is stable enough to accept the MINTS. In terms of organisational stability it is required that: the position of the system user and the intermediary is permanent, in that they carry on playing their roles; that either the organisation's procedures and operations remain adequately stable for the MINTS to be of a practical use or that the MINTS is capable of accommodating the organisational changes; and that there exists a political/psychological environment favourable to the MINTS. The political context within which a MINTS is to operate is of special importance and requires the consultant to not only know about the key actors involved in the MINTS project but also that he ensures the existence of a good working relationship between the key actors. The existence of a favourable system structure is also very important for the MINTS, as there must exist a strong base of data and

suitable MINTS software and hardware to make the MINTS a reality. It is also very important that the consultant ensures that the key actors have sufficient capability and commitment for accepting the MINTS.

Maintaining relationships between the key actors requires the consultant to ensure that the system user and/or the intermediary are kept satisfied with the MINTS by delivering to them what they need to perform their job effectively for which the MINTS was designed, and that the other key actors also remain committed to the MINTS and that they continue to play their part in making the MINTS a success.

4.1.3.2 Contributory Success Factors for a MINTS

As it is the research objective to build a model of success for MINTS, a list of appropriate contributory success factors were needed to be identified. As an initial step, it was decided to carry out a literature survey on MIS and DSS success and identify a list of success factors. The list was then to be used as a basis for conducting a field research to establish which factors were applicable to a MINTS.

Based on the literature survey reported in this chapter, a large number of success factors were reported to have been associated with the success of a computer-based information system. For the purpose of this research, these factors have been structured in Table 4.1, to be used for further analysis as will be discussed in the course of chapter 5 on field research.

4.1.3.3 Structuring a Model of Success

A hierarchical tree structure is a suitable and practical way of organising a large number of success factors for a MINTS, for the following reasons;

- (a) an effective and easy way of presenting a large number of main-factors and sub-factors.
- (b) an effective way of breaking down a large number of factors into sub-sections, thus making the problem of measuring success less difficult.
- (c) an effective way of measuring success rate for individual main-factors, or sub-factors, as well as a group of factors.
- (d) an effective way of locating problematic areas, or factors with low likelihood of success.

The researcher also holds the view that the two configurations; 'series' and 'n out of k', need to be taken into consideration.

4.1.3.4 Principles for a Measurement Technique

4.1.3.4.1 A Technique for Eliciting Responses

A Likert scale for eliciting responses and measuring the importance and the performance of individual success factors will be used. Apart from the fact that this is a proven technique for eliciting an individual's perception of an object, it is a simple and easily understood technique. As it is the research objective to build a Consultant Advisory System for the use by an internal consultant, it is important that the consultant can easily express his perception of the success factors in relation to a MINTS project. Moreover, using a Likert scale allows the use of numeric and semantic values. The semantic values can be used as a way of eliciting how a consultant views the performance of success factors with regard to a MINTS project, and numeric values for calculating the overall impact of a large number of success factors.

4.1.3.4.2 A Technique for Calculating Success

Recent research suggests a multiplicative approach is appropriate in modelling an individual's views and perception.

A number of other points were raised in this chapter that need to be taken into consideration when calculating the success of a MINTS. These are;

- (a) each success factor should be assigned a performance score,
- (b) each success factor should be assigned an importance score,
- (c) in order to eliminated the effect of an irrelevant success factor, both the performance and importance scores for that success factor must be zero.
- (d) a multiplicative approach, rather than an additive approach should be adopted in calculating an individual's perception of the success of a system. In other words, the more success factors are satisfied, the less would be the impact of the next success factor on the system success.

1	. . . . .	100
2	. . . . .	100
3	. . . . .	100
4	. . . . .	100
5	CHAPTER 5	100
	5.1 Field Research	100
	5.1.1 Objective	100
	5.1.2 A Proposed Model of Success	100
	5.1.3 Choice of Case Studies	115
	5.1.4 Breakdown of the case studies	115
	5.1.5 Results of the Case Studies	123

5 CHAPTER 5

5.1 Field Research

5.1.1 Objective

In this chapter, the researcher discusses the field research carried out and presents a model of success for the use in building the Consultant Advisory System. The purpose behind the field research was to offer field evidence in support of the contributory success factors that the researcher had identified based on literature survey II, and to extend the model of success.

5.1.2 A Proposed Model of Success

In the previous chapter a large number of contributory success factors associated with computer-based information systems were identified and brought together in Table 4.1. Success factors that are considered applicable to MINTS have been extracted from Table 4.1 to form Table 5.1.

Table 5.1: A Summary of the Literature on Contributory Factors to the Success of Computer-based Information Systems

	Source
Profitability	,49
Application to major problems of organisation	,49
Quality of decisions or level of performance	,49
Usage of system;	,123,181,111,81,49,176,164,94,99,6,15,48,105,107,137,138,282,138,109,142
- urgency of user needs	,114,137,138
- attitude towards the potential of MIS	,48,184,107,137,138
- extent of top management support for MIS	,145,178,184,185,137,174
- quality of MIS staff	,4,137
- adaptable to support multiple decisions rather than a single one	,31
Overall satisfaction;	,176,144
- System satisfaction	,164,85,138,15,189,94,185,107,137
- effectiveness of DSS	,176
- usefulness of DSS	,176,144
- importance of DSS to the organisation	,144,64
- benefits of DSS to the user	,144
- DSS resulting in the user's being seen valuable to the organisation	,144
User satisfaction;	,49,123,181,111,81,132,94,185,143,149
- Decision-making satisfaction;	,144
- Increase in user effectiveness;	,114,31
- improved quality of decisions	,49,176,144,96,174
- improved speed of decision-making	,144
- presenting arguments more convincingly	,144
- greater use of analytical aids in decision making	,144
- availability of more relevant information	,144,99,174
- better able to set priorities in decision making	,144
- help to conceptualize a problem	,31
- Output quality	,132
- reliability	,132,14,164,115
- relevancy	,132,14,164,115
- accuracy and precision	,132,14,164,115
- completeness of output information	,115,14
- more monitor systems	,115
- currency of output information	,14,132,115,4
- volume of output information	,14,115
- report availability and timeliness	,115,4
- more exception reports	,115,4
- User-machine interface;	,132,193,46,185,158
- User involvement;	,114,83,134,62,183,185,85,6,64,164,115,138,154,15,189,94,99,197,
- communication with managerial users	,4
- involvement of senior user managers in IS policy	,4
- persuading the user to use the available 'what-if' analytical capability, sophisticated graphics, summary information relevant to the user's needs.	,99
- users' feeling of participation	,144,14,132,115
- users's control over IS services	,115
- IS-user management communications	,115
- user's understanding of system's capabilities and limitations;	,14,59,87,5,132,115,174
- passive understanding;	,19
- how to get started	,19
- what functions available	,19
- syntax of different commands	,19
- active understanding: of how to use system in the task at hand	,19
- knowing the meaning and uses of different functions	,19
- documentation	,41,14,59,164,4,96,36

- user-assisted design	,59
- technical sophistication that evolves (modularity)	,114,59,4
- design a simple system which does not overload the user	,6,19,36,174
- pay serious attention to user capabilities and management style	,6
- maintain close contact with the user throughout development	,6
- use an evolutionary approach that exploits the user's learning curve.	,114,6,79,75,74,112,135,9,162
- DSS must be of adequate level of technical sophistication in relation to the user's needs.	,59,161
- DSS must be easy to learn and use	,114,59,4,185,281,174
- interactive model	,59,158
- conversational model	,59,158
- English like model	,59
- none-procedural language	,59
- efficiency of query language	,14,164
- availability of memory aids (e.g. names of data)	,31
- training time	,116
- time to recover from errors	,116
- warm-up time after time away from the equipment	,116
- physical and mental strain	,116
- use of graphics	,116
- easy to use input facilities	,116
- type and rate of errors	,116
- context explicit, clear instructions what to do	,19
- user confidence in systems	,14,115,158
- validity of information	,152,187
- currentness of information or reports	,4,152,187
- user confidence in using the tools	,158,
- spend more time to find out what the users really want	,6
- provide users with service rather than a product	,6
- inappropriate in the development stage of a very technical systems (MIS)	,83
- crucial in the development stage of a DSS.	,83
- crucial for obtaining user acceptance, due to voluntary nature of DSS.	,83
- convenience of access	,59,164,115,281,96
- more analysis systems	,115,4
- response time	,199,174
- on-line usage	94,185,143
- Delays in flow of information	,199,288,143,148
- more enquiry systems	,115
- effective training program for users	,114,14,115,4,186
- Support factor;	,132
- support from systems and programming group	,164
- Responsiveness to new system needs;	,115,59
- prompt processing of change requests	,115
- short development time	,14,132,115
- responsiveness to changing user needs	,114,14,115,4
- IS support for users preparation of new system proposals	,115,4
- MIS staff & services quality;	,132,115
- relationship with EDP/MIS staff	,132,14,189
- positive attitude of IS to users	,132,14,115,4
- communication with EDP staff	,132
- user-oriented systems analysts	,115
- competence of systems analysts	,115,4
- technical competence of IS staff	,14,115,4
- larger IS effort to create new users	,115
Felt need for the system	,6,99
User initiation	,6,99
Acceptance of DSS;	,176

- support for DSS	,176
- reliance on DSS	,176,144
Extent of project definition and planning	,114,65
Charge-back method of payment for services	,14
User responsibility for system	,65
Commitment to change	,65
Organisational commitment to the project	,65
Adaptability of organisation to change	,114
Format of output	,14
Mode of interface	,14
Perceived utility	,14
Realistic expectation of the system by the user	,14,64
Organisational position of EDP	,14
Job effects	,14
Organisational competition with EDP	,14
Priorities determination	,14
User control	,14,31,36,158
- easy to change parameters	,31
- easy to get user-defined output	,31
- allow for different skill levels	,31
Vendor support	,14
Strategic management issues;	,115
- top management involvement and support	,41,114,14,145,178,115
- Executive steering committee	,41,42,102,122,131,115,38,113,58
- Written approval plans for system development	,41
- Agreed policies for system development	,41
- Long term funding commitments from management, based on a written plan and mutually agreed development priorities	,41
- mutually agreed system planning objectives for selecting right projects	,64
- mutual agreement on the criteria for evaluating the system	,64
- strategic IS planning	,115
- business-related systems priorities	,115
- using database technology	,115
- overall cost-effectiveness of IS	,115
Reliability of service;	,115
- Low % hardware and systems downtime	,115,4,96
- efficient running of current systems	,115
- data security and privacy	,115,4
- validity of information	,152,187
formulation and evaluation	,4
IS strategic planning and allocation of resources to key business areas	,4
IS capabilities	,4
increasing the proportion of IS effort expended in creating new systems	,4
user oriented systems analysts who know user operations	,4
developing more inquiry systems	,4
appropriate IS budget size or growth rate	,4
Use of intermediaries	,177,13
If the user does not understand DSS, then he must use it through intermediaries	,87,5
intermediaries must have the expertise to provide support for the technical requirements of the users and how to interpret the decision models	,59
intermediaries should help the user to explore the DSS capabilities	,177
intermediaries should facilitate evolutionary growth in decision-making and man-machine interaction.	,177
An explicit plan for the full development life cycle	,114
careful assignment of responsibility for DSS development	,114
On-going user needs assessment and problem diagnosis.	,114

DSS On-going management of DSS development	,114
On-going management of DSS use	,114
DSS must be adaptable	,114
DSS must provide analytic and mathematical functions for performing 'what-if' and sensitivity analysis	,114
DSS development must not be based on an ad-hoc tactical plan (life cycle)	,114
Project development policies for encouraging user management understanding, involvement, and control of logical design decisions.	,41
Information Systems Manager's detailed knowledge of the client's business	,173
the reasons for the system must be known	,64
the importance of the problem being addressed	,64
the way the system will be used	,64
Agreed terms of reference for the scope, timetable and objectives of the design team and its relationship to the rest of organisation.	,38
A code for conduct to indicate what behaviour to be accepted and promoted within the design team.	,38
A resource pool on which the design team can call legitimately as the need arises.	,38
Level of aggregation of information	,152,187
flexibility to support information requirements of different decisions	,31
familiar representations	,31
allow for different skill levels	,31
present what the user understands and relevant to the job	,56,153
offer library programs, databases	,31
characteristics of problem	,99
- quantifiability of variables	,99
- problem limitation	,99
political acceptability	,96
communication accomplishments	,96
Match of model and problem	,174
risk factors;	,9
- non-existent or unwilling user	,9
- disappearing users, implementors, or maintainers	,9
- loss or lack of support	,9
- lack of experience with similar systems	,9
DP department skills;	,114
- project management skills (planning and control)	,114
- education, motivation and training of users	,114
- expertise in building DSS	,114
- intimate knowledge of DP department's operations	,114
- leadership ability	,114
- sensitivity to political issues.	,114

The success factors in Table 5.1, augmented by the factors arising from the researcher's knowledge of MINTS development, were used to form an initial model of success. This model is shown in Table 5.2, and was the initial template against which the case studies were approached and tested.

Table 5.2:

Contributory Success Factors	Literature Support
A) Ensuring A Right Environment	
1) Organisational Infrastructure	
1.1) Acceptability of MINTS	
1.1.1) Affordability of the MINTS costs	
1.1.2) Adaptability of organisation to change	
1.1.2.1) Extent of changes required of formal systems	114, 65,
1.1.2.1.1) Procedures	
1.1.2.1.2) Operations	
1.1.2.2) Management adaptability to change	65,
1.1.2.2.1) Management culture	
1.1.2.2.1.1) Education	
1.1.2.2.1.2) Exposure to IT	
1.1.3) Place of MINTS within IT strategy	65,
1.2) Organisational Stability	
1.2.1) Staff turnover	9,
1.2.1.1) User permanence	9,
1.2.1.2) Sponsor permanence	9,
1.2.1.3) Intermediary permanence	9,
1.2.2) Stability of procedures and operations	
1.2.2.1) Frequency of changes	
1.2.2.2) Extent of changes	
1.2.3) Political/psychological environment	
1.2.3.1) Intelligence on the key actors by the consultant	158, 114,
1.2.3.1.1) System user	
1.2.3.1.2) MINTS champion	
1.2.3.1.3) Intermediary	
1.2.3.1.4) Sponsor	
1.2.3.1.5) System user's immediate superior	
1.2.3.1.6) Custodians of information	
1.2.3.1.7) Supporting political actors	
1.2.3.2) Relationship between the key actors	
1.2.3.2.1) Consultant's relationship	
1.2.3.2.1.1) With the system user	14, 59, 67, 5, 132, 115, 96, 174

1.2.3.2.1.2) With the system user's immediate superior
1.2.3.2.1.3) With the intermediary
1.2.3.2.1.4) With the MINTS champion
1.2.3.2.1.5) With the sponsor
1.2.3.2.1.6) With the supporting political actors
1.2.3.2.1.7) With the custodians of information
1.2.3.2.2) System User
1.2.3.2.2.1) With intermediary
1.2.3.2.2.2) With system user's immediate superior
1.2.3.2.2.3) With sponsor
1.2.3.2.2.4) With supporting political actors
1.2.3.2.2.5) With custodians of information
1.2.3.2.2.6) With MINTS champion
1.2.3.2.3) Sponsor
1.2.3.2.3.1) With system user's immediate superior
1.2.3.2.3.2) With political actors
1.2.3.2.3.3) With custodians of information
1.2.3.2.3.4) With intermediary
1.2.3.2.3.5) With MINTS champion
1.2.3.2.4) System User's Immediate Superior
1.2.3.2.4.1) With supporting political actors
1.2.3.2.4.2) With custodians of information
1.2.3.2.4.3) With intermediaires
1.2.3.2.4.4) With MINTS champion
1.2.3.2.5) MINTS Champion
1.2.3.2.5.1) With supporting political actors
1.2.3.2.5.2) With custodians of information
1.2.3.2.6) Intermediary
1.2.3.2.6.1) With custodians of information
1.2.3.2.6.2) With supporting political actors
1.2.3.2.7) Supporting political actors
1.2.3.2.7.1) With custodians of information

2) System Infrastructure	
2.1) Maturity of the existing systems (MIS/EDP)	
2.1.1) Software for the MINTS	
2.1.1.1) Availability	
2.1.1.2) Suitability for the application area	
2.1.1.3) Compatibility with the existing software	
2.1.2) Hardware for the MINTS	
2.1.2.1) Availability	
2.1.2.2) Suitability for the MINTS software	
2.1.2.3) Compatibility with the existing hardware	
2.1.2.4) Accessibility to the existing hardware	
2.1.3) Data/information for the MINTS	
2.1.3.1) Availability	86, 99, 9,
2.1.3.2) Accessibility	152, 187,
2.1.3.3) Validity	152, 187,
2.1.3.4) Level of aggregation/disaggregation	
2.1.4) Performance of the existing systems (MIS/EDP)	
2.1.5) Extent of technical expertise available	
3) Capability and commitment of actors	
3.1) System User	
3.1.1) System user's capability	
3.1.1.1) Knowledge of the application area	
3.1.1.1.1) Knowledge of the problem	
3.1.1.1.2) Knowledge of a solution	
3.1.1.2) Knowledge of the MINTS	
3.1.1.2.1) Expertise of the analytical technique	
3.1.1.2.2) Ability to interpret the results	
3.1.1.2.3) Expertise in the MINTS programming language	
3.1.2) System user's commitment	
3.1.2.1) Perception and urgency of need	114, 137, 138, 6, 99
3.1.2.2) System user initiation/involvement in system spec.	115, 4, 6, 99, 9
3.1.2.3) Acceptance of the change and efforts required	14, 65
3.1.2.4) Acceptance of the MINTS potential and support	176, 115, 48, 104, 107, 137, 138,
3.1.2.5) Existence of intermediary support	59, 9
3.1.2.6) Acceptance of responsibility for MINTS	65,
3.1.2.7) Charge-back method of payment	14,

3.2) Sponsor	
3.2.1) Commitment to MINTS	145, 178, 104, 105, 137, 174,
3.2.1.1) Availability of funds	
3.2.1.2) MINTS project priority	
3.2.1.3) Political pressures	
3.2.1.4) Involvement in the MINTS project	41, 114, 14, 145, 178, 115
3.2.1.5) Written approval plans for MINTS development	41,
3.2.1.6) Benefits from the MINTS	
3.2.1.6.1) Personal benefits from the MINTS	
3.2.1.6.2) Organisational benefits from the MINTS	
3.2.1.7) Attitude to the MINTS	
3.3) Custodians of Information	
3.3.1) Commitment	
3.3.1.1) Ability to cope with additional workload	
3.3.1.2) Willingness to cooperate	
3.3.1.3) Political pressure	
3.4) Consultant	
3.4.1) Commitment	
3.4.1.1) MINTS Priority	
3.4.1.1.1) Financial and political benefits	
3.4.1.1.2) Availability of a resource pool	4, 38,
3.4.2) Consultant's capability/credibility	14, 115, 4, 114, 340, 137, 132,
3.4.2.1) Familiarity with application area	
3.4.2.1.1) Ability to identify a short-term problem	
3.4.2.1.2) Ability to identify the long-term implications	
3.4.2.2) Technical know-how in building MINTS	114, 14, 132, 115, 4, 137, 340,
3.4.2.3) Experience with similar MINTS	9,
3.4.2.4) Ability to deliver on time	
3.4.1.5) Provision of technical support	132, 115,
3.4.1.6) Provision of training	
3.4.1.7) Interpersonal skills	
3.5) MINTS Champion	
3.5.1) Commitment	
3.5.1.1) Benefits from the MINTS	
3.5.1.1.1) Personal benefits from the MINTS	
3.5.1.1.2) Organisational benefits from the MINTS	

- 3.5.1.2) Political pressure
- 3.5.2) Influence
- 3.6) Intermediary
- 3.6.1) Technical intermediary
- 3.6.1.1) Capability
- 3.6.1.1.1) Knowledge of the application area
- 3.6.1.1.1.1) Knowledge of the problem
- 3.6.1.1.1.2) Knowledge of a solution
- 3.6.1.1.2) Knowledge of the MINTS
- 3.6.1.1.2.1) Expertise of the analytical technique
- 3.6.1.1.2.2) Ability to interpret the results
- 3.6.1.1.2.3) Expertise in the MINTS programming language
- 3.6.1.2) Commitment
- 3.6.1.2.1) Workload
- 3.6.1.2.2) Personal benefits from the MINTS
- 3.6.1.2.3) Acceptance of responsibility for the MINTS
- 3.6.1.2.4) Political pressure
- 3.6.2) Clerical
- 3.6.2.1) Commitment
- 3.6.2.1.1) Level of expertise
- 3.6.2.1.2) workload
- 3.7) System User's Immediate Superior
- 3.7.1) Influence
- 3.7.2) Commitment
- 3.7.2.1) MINTS benefits
- 3.7.2.1.1) Personal benefits from MINTS
- 3.7.2.1.2) Organisational benefits from MINTS
- 3.7.2.2) System user's need for the MINTS
- 3.7.2.3) Political pressures
- 3.7.2.4) Involvement in the MINTS project
- 3.8) Supporting Political Actors
- 3.8.1) Commitment
- 3.8.1.1) Benefits from the MINTS
- 3.8.1.1.1) Personal benefits from the MINTS
- 3.8.1.1.2) Organisational benefits from the MINTS
- 3.8.1.2) Political pressures

41, 114, 14, 145, 178, 115, 104, 105,
137, 340, 174

41, 114, 14, 145, 178, 115,

3.8.2) Influence

B) Maintaining Relationships

1) System User

1.1) User satisfaction

- 1.1.1) MINTS support
- 1.1.1.1) Match of model and problem
- 1.1.1.1.1) Problem limitations
- 1.1.1.1.1.1) Portion of variables known
- 1.1.1.1.1.2) Quantifiability of variables
- 1.1.1.1.1.3) Understanding of relationships
- 1.1.1.1.2) System limitations
- 1.1.1.1.2.1) Dealing with the "Must haves"
- 1.1.1.1.2.2) Dealing with the "Nice to haves"
- 1.1.1.1.2.3) Internal adaptability
- 1.1.1.1.2.3.1) Supporting different time horizons
- 1.1.1.1.2.3.2) Allowing different modes of input
- 1.1.1.1.2.3.3) Modification/addition of functions
- 1.1.1.1.2.4) External adaptability
- 1.1.1.1.2.4.1) Capability to support various decisions
- 1.1.1.1.2.4.2) Adaptability to different users' needs
- 1.1.2) MINTS benefits
- 1.1.2.1) Improved quality of decisions
- 1.1.2.2) Improved speed of decisions
- 1.1.2.3) More convincing arguments
- 1.1.2.4) More use of analytical aids
- 1.1.2.5) More relevant information
- 1.1.2.6) Evaluation of more scenarios
- 1.1.2.7) Setting priorities better
- 1.1.2.8) Helps to conceptualize a problem
- 1.1.3) Convenience of access
- 1.1.4) System user confidence in the MINTS
- 1.1.4.1) Confidence in results
- 1.1.4.1.1) Currentness of information
- 1.1.4.1.2) Validity
- 1.1.4.2) System reliability

123, 101, 111, 81, 132, 188,
105, 143, 149,

161, 59, 174,

99,

99,

99,

31,

114, 49, 176, 144, 64, 99, 174, 31

114, 49, 176, 144, 96, 174, 31,

144,

144,

144,

144, 99, 174,

144,

31,

132, 164, 115, 202, 96,

14, 115, 158,

4, 152, 187,

152, 187,

115, 4, 96,

1.1.4.3) User confidence in using the tools	158,
1.1.5) Understanding of MINTS	
1.1.5.1) Model complexity vs. user's capability	14, 132, 59, 115, 87, 5, 174,
1.1.5.2) System user involvement	114, 64, 164, 115, 83, 134, 62, 103, 1
85, 85, 6,	
1.1.5.3) Effective training	130, 94, 99, 15, 154
1.1.5.4) Gradual MINTS development/learning	114, 14, 115, 4, 186,
2,	114, 59, 6, 9, 79, 75, 74, 112, 135, 16
1.1.5.5) Documentation	41, 14, 59, 164, 4, 96, 36,
1.1.5.6) Userfriendliness of user-machine interface	114, 132, 59, 4, 105, 202, 194,
	46, 174,
1.1.5.6.1) Presentation	31,
1.1.5.6.1.1) Use of familiar representations or verbs	144, 6, 99, 19, 36, 174, 158
1.1.5.6.1.2) Amount and relevance of information on screen	114, 59, 4, 178, 105, 202, 174,
1.1.5.6.2) Ease of use	116,
1.1.5.6.2.1) Training time	116,
1.1.5.6.2.2) Time taken to feel confident	116,
1.1.5.6.2.3) Time taken to recover from errors	14, 31, 36, 158,
1.1.5.6.3) User control	31,
1.1.5.6.3.1) Ease with which parameters can be changed	19,
1.1.5.6.3.2) Context explicit, clear instruction what to do	31,
1.1.5.6.3.3) User-defined input formats	59,
1.1.5.6.3.4) User-defined output formats	31,
1.1.5.6.3.5) Non-procedural language	59,
1.1.5.6.3.6) Different skill levels to suit the user	148, 200, 143, 201, 174,
1.1.5.6.4) English like programming language	31, 19,
1.1.5.6.5) Responsive	19,
1.1.5.6.6) On-line help/memory aids	19,
1.1.5.6.6.1) What functions available	59,
1.1.5.6.6.2) What functions do	
1.1.5.6.6.3) How to interpret results	
1.1.5.6.6.4) What is the next step	
1.1.5.6.6.5) How to recover from errors	
1.1.5.6.6.6) Syntax of commands	
1.1.5.6.6.7) Extent of help	
1.1.5.6.6.8) Library of programs and databases	

1.1.5.6.7) Interactive model	59, 158,
1.1.6) Level of user support	132, 6,
1.1.6.1) Short development period	14, 132, 115,
1.1.6.2) Short period of time between deliverables	114, 14, 59, 115, 4, 158,
1.1.6.3) Technical support	14, 64,
1.1.6.4) Responsiveness to new needs	177, 87, 5, 13, 65,
1.1.7) User expectations	132, 164, 115, 202, 96,
	14, 115,
2) Intermediary	4, 152, 187,
2.1) Intermediary satisfaction	115, 4, 96,
2.1.1) Convenience of access	14, 132, 59, 115, 87, 5, 174,
2.1.2) Intermediary confidence in the MINTS	114, 64, 164, 115, 83, 134, 62, 103,
2.1.2.1) Confidence in the results	185, 85, 6, 130, 94, 99, 154
2.1.2.1.1) Currentness of information	14, 14, 115, 4, 186,
2.1.2.1.2) Validity	41, 14, 59, 4, 96, 36,
2.1.2.2) System reliability	114, 6, 9, 79, 75, 74, 112, 135, 162
2.1.2.3) Intermediary confidence in using the tools	114, 132, 59, 4, 105, 202, 194, 46,
2.1.3) Intermediary understanding of the MINTS	174, 158
2.1.3.1) Model complexity vs. intermediary's capability	31,
2.1.3.2) Intermediary involvement in the MINTS development	144, 6, 99, 19, 36, 174, 158
	114, 59, 4, 178, 105, 202, 174,
2.1.3.3) Effective training	116,
2.1.3.4) Documentation	116,
2.1.3.5) Gradual MINTS development/learning	116,
2.1.3.6) Userfriendliness of user-machine interface	14, 31, 36,
2.1.3.6.1) Presentation	
2.1.3.6.1.2) Use of familiar representations or verbs	
2.1.3.6.1.1.1) Amount and relevance of information on screen	
2.1.3.6.1.1.2) Relevance of information to the job	
2.1.3.6.2) Ease of use	
2.1.3.6.2.1) Training time	
2.1.3.6.2.2) Time taken to feel confident	
2.1.3.6.2.3) Time taken to recover from errors	
2.1.3.6.3) Intermediary control	
2.1.3.6.3.1) Ease with which parameters can be changed	
2.1.3.6.3.2) Context explicit, clear instructions what to do	

2.1.3.6.3.3) User-defined input formats	31,
2.1.3.6.3.4) User-defined output formats	
2.1.3.6.3.5) Non-procedural language	
2.1.3.6.4) English like model	59,
2.1.3.6.5) Responsive	148, 200, 143, 201, 174, 158,
2.1.3.6.6) On-line help/memory aids	
2.1.3.6.6.1) What functions available	19,
2.1.3.6.6.2) What functions do	19,
2.1.3.6.6.3) How to interpret results	33,
2.1.3.6.6.4) What is the next step	
2.1.3.6.6.5) How to recover from errors	19,
2.1.3.6.6.6) Syntax of commands	19,
2.1.3.6.6.7) Extent of help	
2.1.3.6.6.8) Easy of use	
2.1.3.6.6.9) Library of programs and databases	
2.1.3.6.7) Interactive model	
2.1.4) Level of support provided for the intermediary	59,
2.1.4.1) Technical support	
2.1.4.2) Responsiveness to the needs of the intermediary	
3) Sponsor	
3.1) Continued commitment to the MINTS	
3.1.1) Further development and maintenance costs	
3.1.2) Availability of funds	
3.1.3) Political pressures	
4) System user's immediate superior	
4.1) Continued commitment to the MINTS	
5) Custodians of Information	
5.1) Continued willingness to cooperate	
5.2) Ability to cope with workload	
6) Supporting Political Actors	
6.1) Continued support for the MINTS	

- 7) Consultant
- 7.1) Commitment
- 7.1.1) Continued availability of the resource pool
- 7.1.1.2) Satisfaction with the MINTS progress
- 7.1.1.3) Impact on other projects

As explained in chapter 4, and shown in Table 5.2, MINTS success is defined in terms of (A) ensuring a right or favourable environment for the MINTS and (B) maintaining good relationship between the key actors involved in a MINTS.

A right environment is defined in terms of having the right organisational and system infrastructure required for the MINTS, as well as the key actors having the right capability and commitment for making the MINTS work.

In order to have a favourable organisational infrastructure for the MINTS it is required that: the organisation is financially capable of affording the MINTS; that it is capable of accepting the changes imposed upon its existing formal systems and its management, that there is a place for the MINTS within the overall IT strategy of the organisation, and that the organisation is stable enough to accept the MINTS. In terms of organisational stability it is required that: the position of the system user and the intermediary is permanent, in that they carry on playing their roles; that either the organisation's procedures and operations remain adequately stable for the MINTS to be of a practical use or that the MINTS is capable of accommodating the organisational changes; and that there exists a political/psychological environment favourable to the MINTS. The political context within which a MINTS is to operate is of special importance and requires the consultant to not only know about the key actors involved in the MINTS project but also that he ensures the existence of a good working relationship between the key actors. The existence of a favourable system structure is also very important for the MINTS, as there must exist a strong base of data and suitable MINTS software and hardware to make the MINTS a reality. It is also very important that the consultant ensures that the key actors have sufficient capability and commitment for accepting the MINTS.

Maintaining relationships between the key actors requires the consultant to ensure that the system user and/or the intermediary are/is kept satisfied with the MINTS by delivering to them what they need to perform their job effectively for which the MINTS was designed, and that the other key actors also remain committed to the MINTS and that they continue to play their part in making the MINTS a success.

Detailed discussion of these factors is avoided, as they will be explained in a summary format when presenting the results of the field research.

5.1.3 Choice of Case Studies

The choice of the case studies was rather limited. This was because;

- (a) the researcher had to rely upon the consultants interviewed or software suppliers to provide him with access to their clients,
- (b) the client's willingness to become involved in a case study, and
- (c) the eligibility of the computer system as a MINTS.

Often the researcher was given a list of clients to contact, and this gave some degree of control as to which clients to contact. The researcher also approached a number of consultants and software suppliers in order to widen the spectrum of MINTS applications and MINTS generators. This also helped the researcher to consider different analytical techniques offered by different MINTS generators.

During the course of the research, the researcher managed to interview a much larger number of consultants and system users than reported in Table 5.3. The majority of these cases fell within the definition of an MIS rather than MINTS, and hence these cases are not reported here.

A number of criteria was considered in making sure that the case studies were appropriate for the research. In each case, the system under investigation must have been built for a decision-maker as a system user. The system had to have at least a decision model which was built within the context of an specific decision issue or problem facing the system user, rather than a system designed to provide general management reports to a number of decision-makers as in the case of MIS. The decision model must have involved some degree of uncertainty and address the future, rather than being restricted to historical data. A consultant must have helped the system user or the intermediary in building the system, at least for its initial application area.

5.1.4 Breakdown of the case studies

The field research was based on 39 case studies. A breakdown of the case studies is given in Table 5.3. Within this table, the nature of the organisation investigated, the people interviewed, MINTS generator used in building the MINTS, the analytical technique used for dealing with the decision problem, the decision problem to which the MINTS was applied, and the position of the system user are shown. For the sake of avoiding disclosure of information about the organisations investigated and the people interviewed, no names are mentioned. The names of MINTS generators used in building the MINTS investigated are also not disclosed as this would have identified the organisation and/or the key

actors. For this reason, the MINTS generators are given alphabetical code names. The researcher has also assigned a reference number to the case studies to identify where the same organisation was involved in more than one case study.

Table 5.3 : A Breakdown of the Case Studies

Case No.	Ref. No.	Nature of organisation	Interviewees	MINTS software	Technique	Decision Problem	System User	Comments
1)	1	Consultancy	C	A	Inventory scheduling	Inventory Mgmt for an airline	Head of Eng. Dept.	C: Consultant
2)	2	Consultancy	C	B	Behavioural scoring	Loans/credits	Financial Director	
3)	3	Chemical Industry	C, SU	C	Simulation of integrated plants	Planning & control	Production Manager	SU: System User
4)	4	Power Station	SU, IN	D	Financial modeling & forecasting	Cost of power station	General Manager	IN: Intermediary
5)	5	Property Co.	SU	E	Risk analysis, probability distribution, simulation	Acquisition proposal	Financial Director	
6)	6	Consultancy	C	F	Financial modelling, forecasting, statistical analysis, goal seeking, simulation	General		
7)	7	Consultancy	C, SU, IS	G	Strategic vehicle scheduling	Vehicle scheduling	Distribution Manager	IS: Immediate Superior

8)	8	Social Security	C, SU	H	Huristics, multi-criteria/ qualitative decisions	Deployment of resources	Deputy Divisional Director
9)	9	Social Security	C, SU	H	Huristics, multi-criteria qualitative decisions	Re-ordering resources	Deputy Divisional Director
10)	10	Consultancy	C,	D	Financial modelling & forecasting,	Acquisition of a large no. of shops	Entrepreneur
11)	10	Consultancy	C	D	Financial modelling & forecasting	Tube station refurbishment, Cash flow profile	Project Manager
12)	11	Consultancy	C, SU	D	Financial modelling & forecasting	Investment in start-up co.	Financial Analyst
13)	12	Post Office	SU	E	Risk analysis/ probability distribution, simulation,	Capital investment appraisal	Asst. Director
14)	13	Pharmaceutical Co.	SU	I	Modelling, statistical & mathematical analysis	Performance evaluation	Sales Manager

15)	14	Pharmaceutical Co.	SU	J	Financial modelling, forecasting, statistical & mathematical analysis,	Strategic planning	Business Manager
16)	15	Brewing Co.	C, SU	K	Simulation	Delivery scheduling	Operations Manager
17)	16	Hanging garment carriers	C, SU	L	Scheduling	Delivery scheduling	Operations Manager
18)	17	Consultancy	C, SU	M	Text manipulation	Market intelligence	Marketing director
19)	18	Stock broker	SU	D	Financial modelling & forecasting	Balance of payment	Economist
20)	19	Consultancy	C	N	Financial/market modelling & forecasting	Strategic Market planning & forecasting	Marketing manager
21)	20	Consultancy	C, SU, IN	O	Scheduling	Scheduling mining operations	Operation Manager
22)	21	Confectionary	C	P	Financial/market modelling, forecasting, goal seeking, statistical analysis	Product launch, advertising	Marketing/Sales Manager

23)	22	Consultancy	C	Q	Financial modelling & forecasting	General
24)	23	Public development Corporation	SU	Q	Financial modelling & forecasting	Long-term financial projection Financial Director
25)	24	Health Authority	SU	Q		
26)	25	Consultancy	C	M	Text manipulation	General
27)	26	Pharmaceutical	SU	R	Scheduling	Material planning requirement
28)	27	Manufacturing	SU	E	Risk analysis, probability distribution, simulation,	Production modelling Managing Director
29)	28	Consultancy	C	S	Linear programming	
30)	29	Consultancy	C	T	Financial modelling, forecasting & statistical analysis	General
31)	30	Mining industry	C	U	Project scheduling	Modelling underground ventilation network Ventilation Engineer Manager
32)	31	Mining industry	C	V	Simulation	face design Mine manager

33)	32	Chain store	SU	D	Investment appraisal	Appraisal of new stores	Financial controller
34)	33	Food Industry	SU	F	Financial modelling, forecasting, goal seeking	Analysis of product market share	Product Manager
35)	34	Consultancy	C	W	Statistical analysis	General	
36)	35	Researcher	C	F, J	Financial modelling, forecasting, statistical analysis	Sales/production planning and forecasting	Marketing Executive
37)	36	Researcher	C	F, J	Financial modelling, forecasting, statistical analysis	Production planning and forecasting	Operations Manager
38)	37	Chain store	SU	F	Financial forecasting, statistical analysis	Sales/production forecasting	Sales/Marketing Executive
39)	38	Manufacturing	C		Simulation, financial modelling, forecasting	General	

**PAGE
MISSING
IN
ORIGINAL**

interviewed. But these interviews were short and their number also limited due to time constraints as well as the difficulty of obtaining access to these actors.

In the case studies carried out, the interviewees were initially asked to identify, with some qualification, the contributory success factors to the MINTS project in which they were involved. Usually the interviewees had difficulty in identifying the contributory success factors in specific terms. They had to be prompted by the researcher, using the model of success, to qualify the applicability of the success factors, suggested by the researcher, to their case. The consultants interviewed were also asked to offer comments on the contributory success factors in the model of success and their importance, as well as on the structure of the model. Their comments were based on their general experience in the area of MINTS as well as their involvement in a specific MINTS project. The consultants were also asked to mention the problems they faced in building the MINTS and how they overcome the problem. They were asked about their experience of a MINTS which had failed and the reasons for the failure. In the case of the system users and intermediaries interviewed, more attention was paid to the contributory success factors in the sections of the success model appropriate to their role in the MINTS project.

5.1.5 Results of the Case Studies

As there are a large number of success factors involved in the model of success, as shown in Table 5.2, it was beyond the limits of the research to discuss fully the results of the case studies for each success factor. However, the results of the field study are presented in Appendix A. In this Appendix, against each contributory success factor, the researcher has stated the case study number in which the success factor was reported to have existed. Where necessary some explanation is given. A summary version of the results of the field study is produced in Table 5.4.

Table 5.4: Contributory Success Factors

Supporting Case Studies

A) Ensuring A Right Environment	
1) Organisational Infrastructure	
1.1) Acceptability of MINTS	All cases
1.1.1) Affordability of the MINTS costs	1, 20-22, 24, 25, 31-34
1.1.2) Adaptability of organisation to change	1, 20-22, 24, 25, 31-34
1.1.2.1) Extent of changes required of formal systems	
1.1.2.1.1) Procedures	21, 31, 32
1.1.2.1.2) Operations	All cases
1.1.2.2) Management adaptability to change	3, 5, 13, 18, 20, 22, 24, 34
1.1.2.2.1) Education	
1.1.2.2.2) Exposure to IT	
1.1.3) Place of MINTS within IT strategy	
1.2) Organisational Stability	
1.2.1) Staff turnover	
1.2.1.1) User permanence	All cases
1.2.1.2) Sponsor permanence	None
1.2.1.3) Intermediary permanence	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
1.2.2) Stability of procedures and operations	
1.2.2.1) Frequency of changes	1, 6, 8, 9, 24, 34
1.2.2.2) Extent of changes	1, 6, 8, 9, 24, 34
1.2.3) Political/psychological environment	
1.2.3.1) Consultant's intelligence on the key actors	
1.2.3.1.1) System user	All cases
1.2.3.1.2) MINTS champion	None
1.2.3.1.3) Intermediaries	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
1.2.3.1.4) Sponsor	1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38
1.2.3.1.5) System user's immediate superior	1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38
1.2.3.1.6) Custodians of information	1-3, 5, 8, 9, 15, 18, 20-22, 24, 27, 29, 31, 32, 34-38
1.2.3.1.7) Supporting political actors	20-22, 24, 31, 32, 34, 36, 37
1.2.3.2) Relationship between the key actors	
1.2.3.2.1) Consultant's relationship	
1.2.3.2.1.1) With the system user	All cases
1.2.3.2.1.2) With the system user's immediate superior	1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38
1.2.3.2.1.3) With the intermediaries	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
1.2.3.2.1.4) With the MINTS champion	None
1.2.3.2.1.5) With the sponsor	1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38
1.2.3.2.1.6) With the supporting political actors	20-22, 24, 31, 32, 34, 36, 37
1.2.3.2.1.7) With the custodians of information	1-3, 5, 8, 9, 15, 18, 20-22, 24, 27, 29, 31, 32

- 1.2.3.2.2) System User's relationship
- 1.2.3.2.2.1) With intermediary
- 1.2.3.2.2.2) With system user's immediate superior
- 1.2.3.2.2.3) With sponsor
- 1.2.3.2.2.4) With supporting political actors
- 1.2.3.2.2.5) With custodians of information
- 1.2.3.2.2.6) With MINTS champion
- 1.2.3.2.3) Sponsor' relationship
- 1.2.3.2.3.1) With system user's immediate superior
- 1.2.3.2.3.2) With political actors
- 1.2.3.2.3.3) With custodians of information
- 1.2.3.2.3.4) With intermediaries
- 1.2.3.2.3.5) With MINTS champion
- 1.2.3.2.4) System User's Immediate Superior's relationship
- 1.2.3.2.4.1) With supporting political actors
- 1.2.3.2.4.2) With custodians of information
- 1.2.3.2.4.3) With intermediaries
- 1.2.3.2.4.4) With MINTS champion
- 1.2.3.2.5) MINTS Champion relationship
- 1.2.3.2.5.1) With supporting political actors
- 1.2.3.2.5.2) With custodians of information
- 1.2.3.2.6) Intermediary's relationship
- 1.2.3.2.6.1) With custodians of information
- 1.2.3.2.6.2) With supporting political actors
- 1.2.3.2.7) Supporting political actors
- 1.2.3.2.7.1) With custodians of information
- 2) System Infrastructure
- 2.1) Maturity of the existing systems (MIS/EDP)
- 2.1.1) Software for the MINTS
- 2.1.1.1) Availability
- 2.1.1.2) Suitability for the application area
- 2.1.1.3) Compatibility with existing software
- 2.1.2) Hardware for the MINTS
- 2.1.2.1) Availability
- 2.1.2.2) Suitability for the MINTS software
- 2.1.2.3) Compatibility with the existing hardware
- 2.1.2.4) Accessibility to the existing hardware
- 2.1.3) Data/information for the MINTS
- 2.1.3.1) Availability
- 2.1.3.2) Accessibility
- 2.1.3.3) Validity

1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
 1, 3, 7, 12, 13, 15-17, 19, 21, 25, 27, 28, 31, 32, 35, 38
 1, 18, 20-22, 24, 25, 31, 32, 34-38
 18, 20-22, 24, 25, 31, 32, 34-38
 1, 3-5, 7-9, 12, 13, 15-22, 24, 25, 27, 29, 33
 -35, 38

None

1, 3, 7, 16, 17, 21, 29, 31, 32, 35, 38
 3, 16-18, 20-22, 24, 31, 32, 34, 36-38, 25, 36, 37

None

None

1, 3, 16, 17, 21, 25, 31, 32, 38
 21, 27, 29, 31, 32, 35

None

None

None

None

1, 2, 4, 5, 18, 20-22, 24, 25, 34, 35, 38
 None

None

4, 5, 10, 11, 14, 15, 31-33, 36, 37
 All cases

1, 2, 4, 15, 16, 23-26, 34-39

1-5, 8-15, 17-19, 22, 24, 27-29, 33, 36, 37
 All cases

1, 2, 4, 7, 8, 15, 18-20, 24, 25, 34-38
 1, 2, 4, 7-8, 15, 18-20, 24, 25, 24-38

All cases

All cases

All cases

2.1.3.4) Level of aggregation/disaggregation	1, 4, 6, 7, 10-12, 16-26, 33-38
2.1.4) Performance of the existing systems (MIS/EDP)	1, 2, 4, 7, 8, 15, 18-20, 24, 25, 34-38
2.1.5) Extent of technical expertise available	1, 2, 4, 5, 7-9, 12, 14-18, 20, 22, 24, 25, 27, 29, 31-38
3) Capability and commitment of actors	
3.1) System User	
3.1.1) User's capability	
3.1.1.1) Knowledge of the application area	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.1.1) Knowledge of the problem	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.1.2) Knowledge of a solution	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.2) Knowledge of the MINTS	
- 3.1.1.2.1) Expertise of the analytical technique	None
3.1.1.2.2) Ability to interpret the results	5, 13, 28, 35
- 3.1.1.2.3) Expertise in the MINTS programming language	None
3.1.2) System user's commitment	
3.1.2.1) Perception and urgency of need	All cases
3.1.2.2) System user initiation/involvement in system spec.	All cases
3.1.2.3) Acceptance of the change and efforts required	All cases
3.1.2.4) Acceptance of the MINTS potential and support	All cases
3.1.2.5) Existence of intermediary support	1-5, 18, 20-22, 24, 25, 34-38
3.1.2.6) Acceptance of responsibility for the MINTS	None
- 3.1.2.7) Charge-back method of payment	
3.2) Sponsor	
3.2.1) Commitment to the MINTS	All cases
3.2.1.2) Availability of funds	1, 3, 7, 12, 16-18, 20-22, 24, 25, 27, 30-32, 34, 35, 38
3.2.1.3) MINTS project priority	17, 24, 25
3.2.1.4) Political pressures	1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38
3.2.1.5) Involvement in the MINTS project	1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38
3.2.1.6) Written approval plans for MINTS development	None
3.2.1.7) Benefits from the MINTS	1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38
- 3.2.1.7.1) Personal benefits from the MINTS	
3.2.1.7) Organisational benefits from the MINTS	
3.2.1.8) Attitude to the MINTS	
3.3) Custodians of Information	
3.3.1) Commitment	
3.3.1.1) Ability to cope with additional workload	1, 20, 24, 25, 34, 38
3.3.1.2) Willingness to cooperate	1-3, 5, 7, 12, 14-18, 22, 24, 25, 27, 29-32, 34-38
3.3.1.3) Political pressure	20, 24
3.4) Consultant	
3.4.1) Commitment	
3.4.1.1) MINTS priority	

3.4.1.1.1) Financial and political benefits	All cases	
3.4.1.1.2) Availability of a resource pool	1-13, 16-34, 38	
3.4.2) Consultant's capability/credibility		
3.4.2.1) Familiarity with application area		
3.4.2.1.1) Ability to identify a short-term problem	1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35	
3.4.2.1.1) Ability to identify the long-term implications	1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35	
3.4.2.1.2) Ability to identify the long-term implications	1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35	
3.4.2.2) Technical know-how in building MINTS	All cases	
3.4.2.3) Experience with similar MINTS	All cases	
3.4.2.4) Ability to deliver on time	All cases	
3.4.2.5) Provision of technical support	All cases	
3.4.1.6) Provision of training	All cases	
3.4.1.8) Interpersonal skills	1-3, 6, 7, 9, 10, 12, 20-23, 26, 29, 30-32, 35, 39	
- 3.5) MINTS Champion	None	
- 3.5.1) Commitment		
- 3.5.1.1) Benefits from the MINTS		
- 3.5.1.1.1) Personal benefits from the MINTS	None	
- 3.5.1.1.2) Organisational benefits from the MINTS	None	
- 3.5.1.2) Political pressure	None	
- 3.5.2) Influence	None	
3.6) Intermediaries		
3.6.1) Technical intermediary		
3.6.1.1) Capability		
3.6.1.1.1) Knowledge of the application area	1, 4, 20-22, 24, 34-38	
3.6.1.1.1.1) Knowledge of the problem	1, 4, 20-22, 24, 34-38	
3.6.1.1.1.2) Knowledge of a solution	1, 4, 20-22, 24, 34-38	
3.6.1.1.2) Knowledge of the MINTS		
- 3.6.1.1.2.1) Expertise of the analytical technique	None	
- 3.6.1.1.2.2) Ability to interpret the results	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38	
- 3.6.1.1.2.3) Expertise in the MINTS programming language	None	
3.6.1.2) Commitment		
3.6.1.2.1) Workload	1, 2, 4, 5, 18, 20-22, 24, 34-38	
3.6.1.2.2) Personal benefits from the MINTS	1, 4, 5, 18, 20-22, 24, 25, 34-38	
3.6.1.2.3) Acceptance of responsibility for the MINTS	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38	
3.6.1.2.4) Political pressure	1, 21	
- 3.6.2) Clerical	37	
- 3.6.2.1) Commitment	None	
- 3.6.2.1.1) Level of expertise	None	
- 3.6.2.1.2) workload	37	
3.7) Immediate Superior		
3.7.1) Influence	1, 3, 7, 16, 17, 21, 25, 27, 29, 31, 32, 35, 38	
3.7.2) Commitment		
3.7.2.1) MINTS benefits		
3.7.2.1.1) Personal benefits from the MINTS	1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38	

3.7.2.1.2) Organisational benefits from the MINTS	1, 3, 7, 16, 17, 29, 31, 32, 38
3.7.2.2) System user's need for the MINTS	1, 3, 7, 12, 13, 15-17, 19, 21, 25, 27, 29, 31-35, 38
3.7.2.3) Political pressures	17, 31, 32
3.7.2.4) Involvement in the MINTS project	1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38
3.8) Supporting Political Actors	
3.8.1) Commitment	
3.8.1.1) Benefits	
- 3.8.1.1.1) Personal benefits from the MINTS	None
- 3.8.1.1.2) Organisational benefits from the MINTS	20-22, 24, 31, 32, 34, 38
- 3.8.1.2) Political pressures	None
3.8.2) Influence	1, 3, 16, 17, 20-22, 24, 31, 32, 34, 36, 37
B) Maintaining Relationships	
1) System User	
1.1) User satisfaction	
1.1.1) MINTS support	
1.1.1.1) Match of system and problem	
1.1.1.1.1) Problem limitations	
1.1.1.1.1.1) Portion of variables known	All cases
1.1.1.1.1.2) Quantifiability of the variables	1-18, 20-39
1.1.1.1.1.3) Understanding of relationships	All cases
1.1.1.1.1.4) Scope of problem definition	
1.1.1.1.1.4.1) Extent of short-term requirements defined	All cases
1.1.1.1.1.4.2) Extent of long-term requirements defined	All cases
1.1.1.1.2) System limitations	
1.1.1.1.1.1) Dealing with the "Must haves"	All cases
1.1.1.1.1.2) Dealing with the "Nice to haves"	All cases
1.1.1.1.1.4) Internal adaptability	
1.1.1.1.1.4.1) Supporting different time horizons	4-6, 10-15, 20-22, 24, 25, 28, 33-38
1.1.1.1.1.4.2) Allowing different modes of input	All cases
1.1.1.1.1.4.4) Modification/addition of functions	All cases
1.1.1.1.1.5 External adaptability	
1.1.1.1.1.5.1) Capability to support various decisions	4-6, 8-15, 18-20, 22-28, 30, 33-37
1.1.1.1.1.5.2) Adaptability to additional users' needs	All cases
1.1.2) MINTS benefits	
1.1.2.1) Improved quality of decisions	All cases
1.1.2.2) Improved speed of decisions	All cases
1.1.2.3) More convincing arguments	All cases
1.1.2.4) More use of analytical aids	3, 4, 8, 9, 14-17, 20, 24, 25, 31-33, 35
1.1.2.5) More relevant information	4, 5, 6, 8-15, 19, 20, 22, 24, 25, 27, 28, 33-35
1.1.2.6) Evaluation of more scenarios	All cases
1.1.2.7) Setting priorities better	All cases
1.1.2.8) Help to conceptualise a problem	2, 7, 8, 9, 11, 12, 16, 17, 33 3, 8, 9, 10, 30, 32

1.1.3) Convenience of access	All cases
1.1.4) System user confidence in the MINTS	
1.1.4.1) Confidence in results	All cases
1.1.4.1.1) Currentness of results	All cases
1.1.4.1.2) Validity	All cases
1.1.4.2) System reliability	
1.1.4.3) User confidence in using the tools	
1.1.5) Understanding of the MINTS	
1.1.5.1) System complexity v. user's capability	All cases
1.1.5.2) System user involvement	All cases
1.1.5.3) Effective training	All cases
1.1.5.4) Gradual MINTS development/learning	All cases
1.1.5.5) Documentation	
1.1.5.6) Userfriendliness of user-machine interface	
1.1.5.6.1) Presentation	
1.1.5.6.1.1) Use of familiar representations or verbs	All cases
1.1.5.6.1.2) Amount and relevance of information on screen	All cases
1.1.5.6.2) Ease of use	
1.1.5.6.2.1) Training time	All cases
1.1.5.6.2.2) Time taken to feel confident	All cases
1.1.5.6.2.3) Time taken to recover from errors	17,
1.1.5.6.3) User control	
1.1.5.6.3.1) Ease with which parameters can be changed	4-20, 22-28, 30, 33-38
1.1.5.6.3.2) Context explicit, clear instructions what to do	All cases
1.1.5.6.3.3) User-defined input formats	4, 5, 8-15, 18-20, 22-28, 33-38
1.1.5.6.3.4) User-defined output formats	4, 5, 10-16, 18-20, 22, 24, 25, 28, 33-38
1.1.5.6.3.5) Non-procedural language	None
1.1.5.6.3.6) Different skill levels to suit the user	4, 20, 22-30, 33-38
1.1.5.6.4) English like programming language	4-6, 10-15, 18-20, 22-28, 33-38
1.1.5.6.5) Responsive	All cases
1.1.5.6.6) On-line help/memory aids	
1.1.5.6.6.1) What functions available	1-30, 33-38
1.1.5.6.6.2) What functions do	1-30, 33-38
1.1.5.6.6.3) How to interpret results	5, 8, 9, 13, 28, 34, 35, 38
1.1.5.6.6.4) What is the next step	1-30, 33-38
1.1.5.6.6.5) How to recover from errors	1-30, 33-38
1.1.5.6.6.6) Syntax of commands	4-6, 8-16, 18-20, 22-30, 33-38
1.1.5.6.6.7) Extent of help	1-30, 33-38
1.1.5.6.6.8) Library of programs and databases	4-6, 10-15, 19, 20, 22-25, 28, 34-38
1.1.5.6.8) Interactive model	1, 5, 7-20, 22, 24, 26-38
1.1.6) Level of user support	
1.1.6.1) Short development period	1-20, 22-38
1.1.6.2) Short period of time between deliverables	1, 3, 20, 22, 29, 31, 32, 34, 38

1.1.6.3) Technical support	
1.1.6.4) Responsiveness to new needs	All cases 1-3, 18, 20-22, 24, 31, 32, 34, 35, 38
1.1.7) User expectations	All cases
2) Intermediaries	
2.1) Intermediary satisfaction	
2.1.1) Convenience of access	All cases
2.1.2) Intermediary confidence in the MINTS	
2.1.2.1) Confidence in the results	
2.1.2.1.1) Currentness of information	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.2.1.2) Validity	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.2.2) System reliability	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.2.3) Intermediary confidence in using the tools	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3) Intermediary understanding of the MINTS	
2.1.3.1) System complexity vs. intermediary's capability	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.2) Intermediary involvement in the MINTS development	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.3) Effective training	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.4) Documentation	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.5) Gradual MINTS development/learning	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6) Userfriendliness of man-machine interface	
2.1.3.6.1) Presentation	
2.1.3.6.1.1) Use of familiar representations or verbs.	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.1.1.2) Amount and relevance of information on screen	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.2) Ease of use	
2.1.3.6.2.1) Training time	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.2.2) Time taken to feel confident	1, 2, 18, 20-22, 24, 25, 34-38
2.1.3.6.2.3) Time taken to recover from errors	None
2.1.3.6.3) Intermediary control	
2.1.3.6.3.1) Ease with which parameters can be changed	4, 5, 20, 22, 24, 25, 34-38
2.1.3.6.3.2) Context explicit, clear instructions what to do	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.3.3) User-defined input formats	4, 5, 18, 20, 22, 24, 25, 34-38
2.1.3.6.3.4) User-defined output formats	4, 5, 18, 22, 24, 25, 34-38
2.1.3.6.3.5) Non-procedural language	None
2.1.3.6.4) English like model	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.5) Responsive	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.6) On-line help/memory aids	
2.1.3.6.6.1) What functions available	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.6.2) What functions do	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.6.3) How to interpret results	5, 34-38
2.1.3.6.6.4) What is the next step	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.6.5) How to recover from errors	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
2.1.3.6.6.6) Syntax of commands	4, 5, 20, 22, 24, 25, 34-38

- 2.1.3.6.6.8) Ease of use
- 2.1.3.6.6.9) Library of programs and databases
- 2.1.3.6.8) Interactive model
- 2.1.4) Level of support provided for intermediary
- 2.1.4.1) Technical support
- 2.1.4.2) Responsiveness to new needs
- 3) Sponsor
 - 3.1) Continued commitment to the MINTS
 - 3.1.1) Further development and maintenance costs
 - 3.1.2) Availability of funds
 - 3.1.3) Political pressures
 - 4) System user's immediate superior
 - 4.1) Continued commitment to the MINTS
 - 5) Custodians of Information
 - 5.1) Continued willingness to cooperate
 - 5.2) Ability to cope with workload
 - 6) Supporting Political Actors
 - 6.1) Continued support for the MINTS
 - 7) Consultant
 - 7.1) Commitment
 - 7.1.1) Continued availability of the resource pool
 - 7.1.2) Satisfaction with the MINTS progress
 - 7.1.1.3) Impact on other projects

- 4, 5, 18, 20, 22, 24, 25, 34-38
- 1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
- 1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
- 1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
- 1-3, 18, 20-22, 24, 31, 32, 34, 35, 38
- 1-3, 18, 20-222, 24, 25, 29, 31, 32, 34, 35, 38
- 1-3, 18, 20-222, 24, 25, 29, 31, 32, 34, 35, 38
- 31
- 1-3, 20-22, 29, 31, 32, 38
- 1-5, 13, 18, 20-22, 24, 25, 34-38
- 1-5, 13, 18, 20-22, 24, 25, 34-38
- None
- 1, 3, 21-25, 29, 31-35
- All cases
- All cases

As shown in Table 5.4, a number of success factors were not supported by the field research, and these have to be excluded from the success model. In this table, these factors are marked with a '-' sign in the left hand margin.

Based on the feedback from the field research, a modified version of the success model is presented in Table 5.5. In this table, the success factors that were not supported by the field research have been excluded. During the field research, additional factors were also suggested for inclusion in the success model. These factors are marked with a '+' sign in Table 5.5. The success model as shown in Table 5.5 is the version which will be used in building the Consultant Advisory System.

Table 5.5: Contributory Success Factors

A) Ensuring A Right Environment	
1) Organisational Infrastructure	
1.1) Acceptability of MINTS	All cases
1.1.1) Affordability of the MINTS costs	{1, 20-22, 24, 25, 31-34}
1.1.2) Adaptability of organisation to change	{1, 20-22, 24, 25, 31-34}
1.1.2.1) Extent of changes required of formal systems	{21, 31, 32}
1.1.2.1.1) Procedures	{All cases}
1.1.2.1.2) Operations	{3, 5, 13, 18, 20, 22, 24, 34}
1.1.2.2) Management adaptability to change	
1.1.2.2.1) Education	
1.1.2.2.2) Exposure to IT	
1.1.3) Place of MINTS within IT strategy	
1.2) Organisational Stability	
1.2.1) Staff turnover	
c 1.2.1.1) User permanence	{All cases}
c 1.2.1.2) Intermediary permanence	{1, 2, 4, 5, 18, 20-22, 24, 25, 34-38}
1.2.2) Stability of procedures and operations	
1.2.2.1) Frequency of changes	{1, 6, 8, 9, 24, 34}
1.2.2.2) Extent of changes	{1, 6, 8, 9, 24, 34}
1.2.3) Political/psychological environment	
1.2.3.1) Consultant's intelligence on the key actors	
1.2.3.1.1) System user	
c + 1.2.3.1.1.1) Identity	{All cases}
+ 1.2.3.1.1.2) Political influence	{All cases}
+ 1.2.3.1.1.3) Soft spots	{All cases}
1.2.3.1.2) Intermediary	
c + 1.2.3.1.2.1) Identity	{1, 2, 4, 5, 18, 20-22, 24, 25, 29, 31, 32, 34-38}
+ 1.2.3.1.2.2) Political influence	{1, 2, 4, 5, 18, 20-22, 24, 25, 34-38}
+ 1.2.3.1.2.3) Soft spots	{1, 2, 4, 5, 18, 20-22, 24, 25, 34-38}
1.2.3.1.3) Sponsor	
c + 1.2.3.1.3.1) Identity	{1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38}
+ 1.2.3.1.3.2) Political influence	{1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38}
+ 1.2.3.1.3.3) Soft spots	{1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38}
1.2.3.1.4) System user's immediate superior	
+ 1.2.3.1.4.1) Identity	{1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38}
+ 1.2.3.1.4.2) Political influence	{1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38}
+ 1.2.3.1.4.3) Soft spots	{1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38}
1.2.3.1.5) Custodians of information	
+ 1.2.3.1.5.1) Identity	{1-3, 5, 8, 9, 15, 18, 20-22, 24, 27, 29, 31, 32, 34-38}
+ 1.2.3.1.5.2) Political influence	{1-3, 5, 8, 9, 15, 18, 20-22, 24, 27, 29, 31, 32, 34-38}

+1.2.3.1.5.3) Soft spots
 1.2.3.1.6) Supporting political actors
 +1.2.3.1.6.1) Identity
 +1.2.3.1.6.2) Political influence
 +1.2.3.1.6.3) Soft spots
 1.2.3.2) Relationship between the key actors
 1.2.3.2.1) Consultant' relationship
 c 1.2.3.2.1.1) With system user
 1.2.3.2.1.2) With system user's immediate superior
 c 1.2.3.2.1.3) With intermediary
 1.2.3.2.1.4) With sponsor
 1.2.3.2.1.5) With supporting political actors
 1.2.3.2.1.6) With custodians of information
 1.2.3.2.2) System User's relaty
 c 1.2.3.2.2.1) With intermediary
 1.2.3.2.2.2) With system user's immediate superior

 1.2.3.2.2.3) With sponsor
 1.2.3.2.2.4) With supporting political actors
 1.2.3.2.2.5) With custodians of information
 1.2.3.2.3) Sponsor's relationship
 1.2.3.2.3.1) With system user's immediate superior
 1.2.3.2.3.2) With political actors
 1.2.3.2.3.3) With custodians of information
 1.2.3.2.4) System User's Immediate Superior's relationship
 1.2.3.2.4.1) With supporting political actors
 1.2.3.2.4.2) With custodians of information
 1.2.3.2.5) Intermediary's relationship
 1.2.3.2.5.1) With custodians of information
 2) System Infrastructure
 2.1) Maturity of the existing systems (MIS/EDP)
 2.1.1) Software for the MINTS
 2.1.1.1) Availability
 c 2.1.1.2) Suitability for the application area
 2.1.1.3) Compatibility with existing software
 2.1.2) Hardware for the MINTS
 2.1.2.1) Availability
 c 2.1.2.2) Suitability for the MINTS software
 2.1.2.3) Compatibility with the existing hardware
 2.1.2.4) Accessibility to the existing hardware
 2.1.3) Data/information for the MINTS
 c 2.1.3.1) Availability
 2.1.3.2) Accessibility

{1-3,5,8,9,15,18,20-22,24,27,29,31,32,34-38}
 {20-22,24,31,32,34,36,37}
 {20-22,24,31,32,34,36,37}
 {20-22,24,31,32,34,36,37}
 {20-22,24,31,32,34,36,37}
 {All cases}
 {1,3,7,13,16,17,27,29,31,32,38}
 {1,2,4,5,18,20-22,24,25,34-38}
 {1,3,18,20-22,24,25,29,31,32,34-38}
 {20-22,24,31,32,34,36,37}
 {1-3,5,8,9,15,18,20-22,24,27,29,31,32}

 {1,2,4,5,18,20-22,24,25,34-38}
 {1,3,7,12,13,15-17,19,21,25,27,28,31,32,35,38}

 {1,18,20-22,24,25,31,32,34-38}
 {18,20-22,24,25,31,32,34,35-38}
 {1,3-5,7-9,12,13,15-22,24,25,27,29,33,35-38}

 {1,3,7,16,17,21,29,31,32,35,38}
 {3,16-18,20-22,24,31,32,34,36-38,25,36,37}

 {1,3,16,17,21,25,31,32,38}
 {21,27,29,31,32,35}

 {1,2,4,5,18,20-22,24,25,34,35,38}

 {4,5,10,11,14,15,31-33,36,37}
 {All cases}
 {1,2,4,15,16,23-26,34-39}

 {1-5,8-15,17-19,22,24,27-29,33,36,37}
 {All cases}
 {1,2,4,7,8,15,18-20,24,25,34-38}
 {1,2,4,7-8,15,18-20,24,25,24-38}

 {All cases}
 {All cases}

c 2.1.3.3) Validity	{All cases}
2.1.3.4) Level of aggregation/disaggregation	{1, 4, 6, 7, 10-12, 16-26, 33-38}
2.1.4) Performance of the existing systems (MIS/EDP)	{1, 2, 4, 7, 8, 15, 18-20, 24, 25, 34-38}
2.1.5) Extent of technical expertise available	{1, 2, 4, 5, 7-9, 12, 14-18, 20, 22, 24, 25, 27, 29, 31-38}
3) Capability and commitment of actors	
3.1) System User	
3.1.1) User's capability	
3.1.1.1) Background and expertise	{3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38}
3.1.1.2) Knowledge of the application area	{3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38}
c 3.1.1.2.1) Knowledge of the problem	{3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38}
3.1.1.2.2) Knowledge of a solution	{3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38}
3.1.1.3) Knowledge of the MINTS	
c 3.1.1.3.1) Ability to interpret the results	{5, 13, 28, 35}
3.1.2) System user's commitment	
c 3.1.2.1) Perception and urgency of need	{All cases}
3.1.2.2) System user initiation/involvement in system spec.	{All cases}
c 3.1.2.3) Acceptance of the change and efforts required	{All cases}
c 3.1.2.4) Acceptance of the MINTS potential and support	{All cases}
c 3.1.2.5) Existence of intermediary support	{1-5, 18, 20-22, 24, 25, 34-38}
c 3.1.2.6) Acceptance of responsibility for the MINTS	
3.2) Sponsor	
3.2.1) Commitment to the MINTS	
c 3.2.1.1) Availability of funds	{All cases}
3.2.1.2) MINTS project priority	{1, 3, 7, 12, 16-18, 20-22, 24, 25, 27, 30-32, 34, 35, 38}
3.2.1.3) Political pressures	{17, 24, 25}
3.2.1.4) Involvement in the MINTS project	{1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38}
c 3.2.1.5) Written approval plans for MINTS development	{1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38}
3.2.1.6) Benefits from the MINTS	
3.2.1.6.1) Organisational benefits from the MINTS	{1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38}
3.2.1.7) Attitude to the MINTS	{1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38}
3.3) Custodians of Information	
3.3.1) Commitment	
3.3.1.1) Ability to cope with additional workload	{1, 20, 24, 25, 34, 38}
3.3.1.2) Willingness to cooperate	{1-3, 5, 7, 12, 14-18, 22, 24, 25, 27, 29-32, 34-38}
3.4) Consultant	
3.4.1) Commitment	
3.4.1.1) MINTS priority	
c 3.4.1.1.1) Financial and political benefits	{All cases}
c 3.4.1.1.2) Availability of a resource pool	{1-13, 16-34, 38}
3.4.2) Consultant's capability/credibility	
3.4.2.1) Familiarity with application area	{1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35}

c 3.4.2.1.1) Ability to identify a short-term problem	{1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35}
3.4.2.1.2) Ability to identify the long-term implications	{1-3, 6, 7, 1-12, 17, 20-23, 26, 29-32, 35}
3.4.2.2) Technical know-how in building MINTS	{All cases}
3.4.2.3) Experience with similar MINTS	{All cases}
3.4.2.4) Ability to deliver on time	{All cases}
c 3.4.2.5) Provision of technical support	{All cases}
c 3.4.1.6) Provision of training	{All cases}
3.4.1.8) Interpersonal skills	{1-3, 6, 7, 9, 10, 12, 20-23, 26, 29, 30-32, 35, 39}
3.5) Intermediary	
3.5.1) Technical intermediary	
3.5.1.1) Capability	
3.5.1.1.1) Knowledge of the application area	{1, 4, 20-22, 24, 34-38}
c 3.5.1.1.1.1) Knowledge of the problem	{1, 4, 20-22, 24, 34-38}
3.5.1.1.1.2) Knowledge of a solution	{1, 4, 20-22, 24, 34-38}
3.5.1.1.2) Knowledge of the MINTS	
c 3.5.1.1.2.1) Ability to interpret the results	{1, 2, 4, 5, 18, 20-22, 24, 25, 34-38}
3.5.1.2) Commitment	
3.5.1.2.1) Workload	{1, 2, 4, 5, 18, 20-22, 24, 34-38}
3.5.1.2.2) Personal benefits from the MINTS	{1, 4, 5, 18, 20-22, 24, 25, 34-38}
c 3.5.1.2.3) Acceptance of responsibility for the MINTS	{1, 2, 4, 5, 18, 20-22, 24, 25, 34-38}
3.5.1.2.4) Political pressure	{1, 21}
3.6) System User's Immediate Superior	
3.6.1) Influence	{1, 3, 7, 16, 17, 21, 25, 27, 29, 31, 32, 35, 38}
3.6.2) Commitment	
3.6.2.1) MINTS benefits	
3.6.2.1.1) Personal benefits from the MINTS	{1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38}
3.6.2.1.2) Organisational benefits from the MINTS	{1, 3, 7, 16, 17, 29, 31, 32, 38}
3.6.2.2) System user's need for the MINTS	{1, 3, 7, 12, 13, 15-17, 19, 21, 25, 27, 29, 31-35, 38}
3.6.2.3) Political pressures	{17, 31, 32}
3.6.2.4) Involvement in the MINTS project	{1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38}
3.7) Supporting Political Actors	
3.7.1) Commitment	
3.7.1.1) Benefits	
3.7.1.1.1) Organisational benefits from the MINTS	{1, 3, 16, 17, 20-22, 24, 31, 32, 34, 36, 37}
3.7.2) Influence	
B) Maintaining Relationships	
1) System User	
1.1) User satisfaction	
1.1.1) MINTS support	
1.1.1.1) Match of system and problem	
1.1.1.1.1) Problem limitations	
c 1.1.1.1.1.1) Portion of variables known	All cases

C 1.1.1.1.1.2) Quantifiability of the variables
 C 1.1.1.1.1.3) Understanding of relationships
 C 1.1.1.1.2) System limitations
 C 1.1.1.1.1.1) Dealing with the "Must haves"
 1.1.1.1.1.2) Dealing with the "Nice to haves"
 1.1.1.1.1.4) Internal adaptability
 1.1.1.1.1.4.1) Supporting different time horizons
 1.1.1.1.1.4.2) Allowing different modes of input
 1.1.1.1.1.4.4) Modification/addition of functions
 1.1.1.1.1.5 External adaptability
 1.1.1.1.1.5.1) Capability to support various decisions
 1.1.1.1.1.5.2) Adaptability to additional users' needs
 1.1.2) MINTS benefits
 1.1.2.1) Improved quality of decisions
 1.1.2.2) Improved speed of decisions
 1.1.2.3) More convincing arguments
 1.1.2.4) More use of analytical aids
 1.1.2.5) More relevant information
 1.1.2.6) Evaluation of more scenarios
 1.1.2.7) Setting priorities better
 1.1.2.8) Help to conceptualise a problem
 C 1.1.3) Convenience of access
 1.1.4) System user confidence in the MINTS
 1.1.4.1) Confidence in results
 C 1.1.4.1.1) Currentness of results
 C 1.1.4.1.2) Validity
 1.1.4.2) System reliability
 C 1.1.4.3) User confidence in using the tools
 1.1.5) Understanding of the MINTS
 C 1.1.5.1) System complexity v. user's capability
 C 1.1.5.2) System user involvement
 C 1.1.5.3) Effective training
 1.1.5.4) Gradual MINTS development/learning
 1.1.5.5) Documentation
 1.1.5.6) Userfriendliness of user-machine interface
 1.1.5.6.1) Presentation
 C 1.1.5.6.1.1) Use of familiar representations or verbs
 1.1.5.6.1.2) Amount and relevance of information on screen
 1.1.5.6.2) Ease of use
 1.1.5.6.2.1) Training time
 1.1.5.6.2.2) Time taken to feel confident
 + 1.1.5.6.2.3) Frequency of errors
 1.1.5.6.3) User control

{1-18, 20-39}

All cases

{All cases}

{All cases}

{4-6, 10-15, 20-22, 24, 25, 28, 33-38}

{All cases}

{All cases}

{4-6, 8-15, 18-20, 22-28, 30, 33-38}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 4, 8, 9, 14-17, 20, 24, 25, 31-33, 35}

{All cases}

{All cases}

{All cases}

{2, 7, 8, 9, 11, 12, 16, 17, 33}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

{3, 8, 9, 10, 30, 32}

{All cases}

{All cases}

{All cases}

{All cases}

{All cases}

- 1.1.5.6.3.1) Ease with which parameters can be changed
- 1.1.5.6.3.2) Context explicit, clear instructions what to do
- 1.1.5.6.3.3) User-defined input formats
- 1.1.5.6.3.4) User-defined output formats
- 1.1.5.6.3.5) Different skill levels to suit the user
- 1.1.5.6.4) English like programing language
- 1.1.5.6.5) Responsive
- 1.1.5.6.6) On-line help/memory aids
 - 1.1.5.6.6.1) What functions available
 - 1.1.5.6.6.2) What functions do
 - 1.1.5.6.6.3) How to interpret results
 - 1.1.5.6.6.4) What is the next step
 - 1.1.5.6.6.5) How to recover from errors
 - 1.1.5.6.6.6) Syntax of commands
 - 1.1.5.6.6.7) Extent of help
 - + 1.1.5.6.6.7.1) Relevancy
 - + 1.1.5.6.6.7.2) Adequateness
 - + 1.1.5.6.6.7.3) Comprehensiveness
 - 1.1.5.6.6.8) Library of programs and databases
 - 1.1.5.6.8) Interactive model
- 1.1.6) Level of user support
 - 1.1.6.1) Short development period
 - 1.1.6.2) Short period of time between deliverables
- C 1.1.6.3) Technical support
- 1.1.6.4) Responsiveness to new needs
- 1.1.7) User expectations
- 2) Intermediary
 - 2.1) Intermediary satisfaction
 - C 2.1.1) Convenience of access
 - 2.1.2) Intermediary confidence in the MINTS
 - 2.1.2.1) Confidence in the results
 - C 2.1.2.1.1) Currentness of information
 - C 2.1.2.1.2) Validity
 - 2.1.2.2) System reliability
 - C 2.1.2.3) Intermediary confidence in using the tools
 - 2.1.3) Intermediary understanding of the MINTS
 - C 2.1.3.1) System complexity vs. intermediary's capability
 - 2.1.3.2) Intermediary involvement in the MINTS development
 - C 2.1.3.3) Effective training
 - 2.1.3.4) Documentation
 - 2.1.3.5) Gradual MINTS development/learning
 - 2.1.3.6) Userfriendliness of man-machine interface
 - 2.1.3.6.1) Presentation

{4-20,22-28,30,33-38}
 {All cases}
 {4,5,8-15,18-20,22-28,33-38}
 {4,5,10-16,18-20,22,24,25,28,33-38}
 {4,20,22-30,33-38}
 {4-6,10-15,18-20,22-28,33-38}
 {All cases}

{1-30,33-38}
 {1-30,33-38}
 {5,8,9,13,28,34,35,38}
 {1-30,33-38}
 {1-30,33-38}
 {4-6,8-16,18-20,22--30,33-38}

{1-30,33-38}
 {1-30,33-38}
 {1-30,33-38}
 {4-6,10-15,19,20,22-25,28,34-38}
 {1,5,7,-20,22,24,26-38}

{1-20,22-38}
 {1,3,20,22,29,31,32,34,38}
 {All cases}

{1-3,18,20-22,24,31,32,34,35,38}
 {All cases}

{1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}

{1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}
 {1,2,4,5,18,20-22,24,25,34-38}

6.1.2) Satisfaction with the MINTS progress
7.1.3) Impact on other projects

{All cases}
|
{All cases}

Referring to Appendix A, a number of findings from the field study require further explanation. As previously stated, an assumption was made that different analytical techniques may require a different consultancy approach. The researcher found no evidence in support of such an assumption. In all the cases of MINTS investigated, the analytical technique made available to the system user and/or the intermediary was made very user friendly. This meant that there was no need for previous knowledge about the analytical technique on behalf of the system user and/or the intermediary, especially in terms of how the technique worked internally. The internal workings of the analytical technique were regarded as a 'black box', with which the system user or the intermediary was not required to be concerned. For example, if a system user is given the capability of using some statistical techniques, say producing a probability distribution curve, he is not required to know how to draw such a curve as the system does this automatically. The same applies when a system user is given the capability, through a menu system, to apply, for example, an exponential forecasting technique to a set of data. Again the system user needs not to know how the forecasting technique works. However, it was found that what is crucial is the ability of the system user and/or the intermediary to interpret properly the results produced using an analytical technique. Where the analytical technique used produced results or concepts that were new to the system user or the intermediary, training was regarded as essential on the application of the technique and how the results should be interpreted. In the majority of cases investigated, the ability to interpret the results was dependent upon the system user's or the intermediary's knowledge of the application area - he had to know his job, for which the MINTS was designed to offer support. In all such cases the system user or the intermediary knew his job well and had no difficulty in interpreting the results, even though they did not know about the analytical technique.

Overall support was given to the type of key actors as identified by the researcher, except one. It was found that there existed no such key actor as a MINTS champion. In all the cases investigated the role of the MINTS champion was played by the other key actors, namely system user, sponsor, system user's immediate superior, and intermediary. The system user was the MINTS champion in the majority of the cases. [For details, reference should be made to Table 5.5.]

It was also found that when a MINTS offers the system user or the intermediary the capability and flexibility to deal with more than a single decision problem, there was a more creative use of the MINTS. This was the case when the system users or the intermediaries were offered a MINTS generator, rather than a rigidly specified MINTS.

In the cases where the consultant was approached by the system user, it was found that the system user knew much about the problem area and how it should be tackled and was willing to become involved in the project. The system user became the MINTS champion. When the consultant approached a client, it took a great deal of effort on the part of the consultant to convince the system user of a need for the MINTS. The consultants interviewed believed that they have had less problems when the client had approached them than when they had to approach a client.

Among the 279 contributory success factors identified, 51 success factors were found to be critical for a successful MINTS project. These critical success factors are identified in Table 5.5 by a 'c' mark against the factors in the left hand margin.

1	.	143
1.1	.	143
1.2	.	143
1.3	.	143
2	.	143
2.1	.	143
2.2	.	143
2.3	.	143
3	.	143
3.1	.	143
3.2	.	143
3.3	.	143
4	.	143
4.1	.	143
4.2	.	143
4.3	.	143
5	.	143
5.1	.	143
5.2	.	143
5.3	.	143
6	CHAPTER 6	143
6.1	A Consultant Advisor for Assessing MINTS Success	143
6.1.1	Introduction	143
6.1.2	Identifying a Measurement Instrument	143
6.1.2.1	Criteria Used for the Choice of an Instrum	143
6.1.2.2	Software Packages Considered	144
6.1.3	Dejavu	146
6.1.3.1	An Overall View of Dejavu	146
6.1.3.2	A Hierarchical Tree Structure	147
6.1.3.3	A Method of Eliciting User's Responses	147
6.1.3.4	A Method of Assigning Importance.	148
6.1.3.5	Critical Success Factors	148
6.1.3.6	Internal Workings	149
6.1.3.6.1	Mathematical Calculations	149
6.1.3.6.2	Comparison with Conventional Weighted	152
6.1.4	The Consultant Advisory System	154
6.1.4.1	Scope of a MINTS Project	154
6.1.4.2	The User of the Consultant Advisory System	155
6.1.4.3	Importance Score Assigned to Success Fact	155
6.1.4.4	Performance Score Assigned to the Success	156
6.1.4.5	Dealing with Irrelevant and Currently Unk	156
6.1.4.6	Style and Level of Questions	157
6.1.4.7	Number of Questions Asked	158
6.1.4.8	Questions about Critical Success Factors	158
6.1.4.9	Distinction Between MIS and MINTS	159
6.1.4.10	The Computerised Consultant Advisory Syst	159

6 CHAPTER 6

6.1 A Consultant Advisor for Assessing MINTS Success

6.1.1 Introduction

The requirements from the Consultant Advisory System have been specified in section 4.1.3. This chapter describes (a) the search for a software package to support these requirements, and (b) the Consultant Advisory System itself.

A software package was needed for the following reasons;

- (a) A large number of contributory success factors were needed to be considered in measuring the success likelihood of a MINTS project.
- (b) complex calculations had to be carried quickly.
- (c) the model of success had to be frequently re-structured; as either additional factors were identified, or a richer understanding of the success factors and their inter-relationships was obtained.
- (d) to make the model of success a practicable tool for a consultant to use.

6.1.2 Identifying a Measurement Instrument

6.1.2.1 Criteria Used for the Choice of an Instrument

In search for a suitable software package for computerising the Consultant Advisory System, the following set of criteria were taken into consideration:

- (a) ability to deal with qualitative data.
- (b) ability to deal with a large number of factors.
- (c) offer a programming facility to build a mathematical model or offer a suitable mathematical model, based on a multiplicative as opposed to an additive approach, for calculating system success for any group of success factors
- (d) provide a suitable measurement technique that allows two values, importance and performance, to be assigned to each success factor.
- (e) provide a Likert scale technique for eliciting responses.
- (f) ability to provide a tree structure for presenting a large number of success factors.
- (g) ability to distinguish between critical success factors and non-critical, yet important factors.
- (h) must be user-friendly.
- (i) ability to provide a method of representing the results that allows the consultant to identify any problematic areas.

6.1.2.2 Software Packages Considered

Based on the aforementioned set of criteria, the researcher evaluated the following software packages;

Cope, Crystal, Dejavu, Expert Choice, Priority Decision System, SuperExpert, and XI Plus.

A) Evaluating Expert System Generators

Having already studied a number of expert system generators, such as Xi Plus, Crystal, Super Expert, and Expert Ease, an attempt was made to see whether it was feasible to build the Consultant Advisory System using such packages.

Xi Plus and Crystal, like many of the expert system generators, offer a rule-based (IF x THEN y) approach as a method of codifying a problem. Expert system generators like SuperExpert and ExpertEase deal with multi-attribute problems which have an underlying pattern or structure. The decision problem must be specified and codified into the system in terms of a large number of examples relating to the different attributes of the problem. An attribute is any feature or aspect of the problem which is making a distinction between the examples. A large number of examples is required so that it is possible for the system to identify a pattern.

Using an expert system generator posed some major problems. An expert system approach to a problem requires that the expertise of an expert in dealing with that problem is codified in its knowledgebase in terms of a network of rules or examples which spell out what alternatives are available as well as the consequence of each alternative. This, within the context of the model of success, meant that the researcher was required to identify what combination of success factors and with what values (say, "high", "medium", or "low") result in a certain likelihood of success, say "high", "medium", or "Low".

The above problem was exacerbated by the fact that a large number of success factors had to be considered, each of which was required to have two values for its importance and performance. For example, say for 2 success factors, each having a 3 scale performance value (High, Low, and Medium), meant that the combinations of success factors to be considered was 3 to a power of 2. For four success factors, the number of combinations was 3 to a power of 4. It could easily be imagined the huge number of combinations of success factors that had to be dealt with as the number of success factors increased - just for 10 factors, 59,049

combinations had to be considered. The problem becomes even more complex when an importance value is also required to be assigned to each success factor.

Another problem was that an expert system approach required a prior knowledge of a MINTS project to which a certain combination of success factors was applicable. This is not possible as no certain combination of success factors can be applicable to a MINTS project. This is because the environment within which a MINTS is created is not static but dynamic.

Moreover, the expert system generators had very limited capability in performing complex mathematical calculations. Expert system generators such as SuperExpert and ExpertEase did not offer any means of carrying out mathematical calculations. The other Expert System generators were also poor in carrying out mathematical calculations. Furthermore, to codify a complex mathematical technique into an expert system generator would have required a large number of rules to be specified.

It therefore became obvious that the expert system generators were not suitable for computerising the model of success.

B) Evaluating MINTS Generators

As an expert system approach was not found suitable in computerising the Consultant Advisory System, the researcher then evaluated a number of MINTS generators. These were; Expert Choice, Priority Decision System, Dejavu and Cope.

The Expert Choice and Priority Decision System require a decision problem to be codified in terms of a set criteria/factors which need to be considered in making a decision. These packages offer a pairwise comparison technique in identifying the most important criteria as well as calculating their overall impact on a decision. In the view of the fact that the model of success consisted a large number of success factors, such packages proved to be impractical.

Cope is based on a cognitive mapping technique, and the objective is to facilitate consensus decision-making. It requires a decision problem to be codified in terms of a set of English-like bi-polar concepts/statements that are linked together. Once a set of statements are identified pertaining to a decision problem, Cope helps, through its different functions, to identify those clusters of statements that are more pertinent in dealing with the decision problem. Hence it facilitates focusing on major issues for further consideration in dealing with the

exist conflict of interests or opinion. Cope was not found suitable, as it was not the objective behind computerising the model of success to identify what factors were more important. Also, it was not capable of dealing with performance and importance values for success factors.

An initial evaluation of Dejavu showed that the package had a good potential in satisfying the selection criteria, and further investigation proved the package to be suitable. A major concern was the internal calculations of Dejavu, which had to be investigated and validated, and this was made even more difficult as the researcher did not have access to the internal programs of Dejavu.

6.1.3 Dejavu

6.1.3.1 An Overall View of Dejavu

Dejavu deals with multi-criteria and subjective type problems, based on a tree structure representation.

Dejavu provides a range of capabilities and facilities;

- (a) a problem is codified and presented in a tree structure format using three basic types of screen. These will be discussed further.
- (b) Provides a method of assigning two values to each factor, which is equivalent to an 'importance' value and a 'performance' value.
- (c) Provides a method of eliciting responses and assigning scores to success factors based on Likert scale.
- (d) A distinction can be made between essential/critical factors and important factors, based on what 'importance' value is assigned to them.
- (e) Provides a measurement technique for calculating success which is based on a multiplicative approach. This will be discussed fully in section 7.1.3.6.
- (f) Dejavu is an extremely user-friendly system as it is menu-driven and only a small number of key functions are used in operating the system. It offers on-line help as well as search and sorting facilities. It is therefore very easy to locate any individual success factor within the hierarchy of the tree structure. Dejavu also allows immediate switching from the analyse mode (which is when an application is running) to the edit mode. This is a very helpful facility, especially for the system builder, who can interactively run an application as

well as modifying it. Moreover, the system builder can carry out 'what-if' type analysis in testing the application under consideration.

- (g) A report facility is also provided which assists in the checking of the success factors and their success scores. This allows those factors with low success scores to be identified. In the report provided, those critical success factors which have not been satisfied are marked with a 'ruled out' message which means 'failed'.
- (h) Other facilities include an index facility, which is a library of all the success factors and reply tables. This is very helpful when developing an application such as model of success, as it allows copying and transferring success factors from one part of the model to another. Dejavu also allows an explanatory note to be attached to each success factor, which also serves as a question text.
- (i) Offers automatic and manual modes for running an application. In the automatic mode, the system follows a set procedure until all questions are asked in a systematic and orderly fashion. In the manual mode, the user can decide what part of the application, or what questions he wants to deal with. He therefore has control in how an application is run. Again this is a powerful facility in building an application.

6.1.3.2 A Hierarchical Tree Structure

Dejavu works on the basis of a hierarchical tree structure. This is done through providing three different types of screen; 'subject' screen, 'point' screen, and 'option' screen. The first screen is the 'subject' screen. As the name implies, this is where a name of an application or the name of a model is specified. The next screen is called 'point' screen. In this screen one can include such criteria as success factors. Each factor can be assigned a further 'point' screen, as a method of defining that factor in terms of other factors. This means that any number of parent-factors and child-factors can be specified. The last screen is called an 'option' screen. An 'option' screen allows different options/alternatives to be dealt with. Each option can be evaluated against a 'point' screen, which is basically a list of factors.

6.1.3.3 A Method of Eliciting User's Responses

Dejavu allows a Likert scale for eliciting responses and assigning scores to a set of criteria, such as success factors. The scale ranges from -5 to +5. Semantic values can also be assigned to each numerical value along the scale. Dejavu also offers flexibility in terms of the number of intervals along the scale.

Each success factor requires to have a 'reply table' which gives access to a Likert scale for scoring a performance value. It is appropriate to state at this juncture that against each success factor, three lines of notes or explanation can be attached, which can be in the form of a question. In the case of the factor 'Affordability of MINTS costs', the question might be in the form:

"To what extent would you think the overall costs of the MINTS, including hardware, software, training, programming, maintenance and support, is affordable by the organisation?"

Each reply table in turn presents a 'value table' which is where the Likert scale is shown. Referring to the previous example of a success factor, the value table for the 'MINTS costs' reply table might be of the form;

Affordable	+5
Unaffordable	-5
Don't know	0

6.1.3.4 A Method of Assigning Importance.

Dejavu allows an importance score to be assigned to each success factor. A numerical scale ranging from -10 to +10 can be used in assigning a negative or positive importance to each factor. This scoring system serves as a method of attaching a weighting to each success factor, with negative scores denoting factors that contribute to system failure and positive scores to system success.

6.1.3.5 Critical Success Factors

Dejavu allows the distinction between critical and non-critical factors to be made.

Critical Success factors are identified in Dejavu, by assigning an 'essential' importance value to them. An essential value is the extreme value of an importance scale. In other words, Dejavu uses an importance scale of

Forbidden, -10 to +10, Essential. A forbidden value assigned to a factor makes that factor a critical failure factor.

When a critical success factor is not satisfied, or a failure factor exists, the message 'ruled out' is displayed. Such a message means that the application under consideration will be a failure.

6.1.3.6 Internal Workings

6.1.3.6.1 Mathematical Calculations

As pointed out previously, the researcher did not have access to the internal programs of Dejavu. Much effort had to be invested in understanding the internal workings of the system for the purpose of representation and validation.

The way in which Dejavu carries out its calculations is to deal with the tree branches one at a time. It starts by dealing with the branches at the highest level of the tree structure, one at a time in a systematic manner, as depicted in Figure 6.1. In order to then calculate a score for the

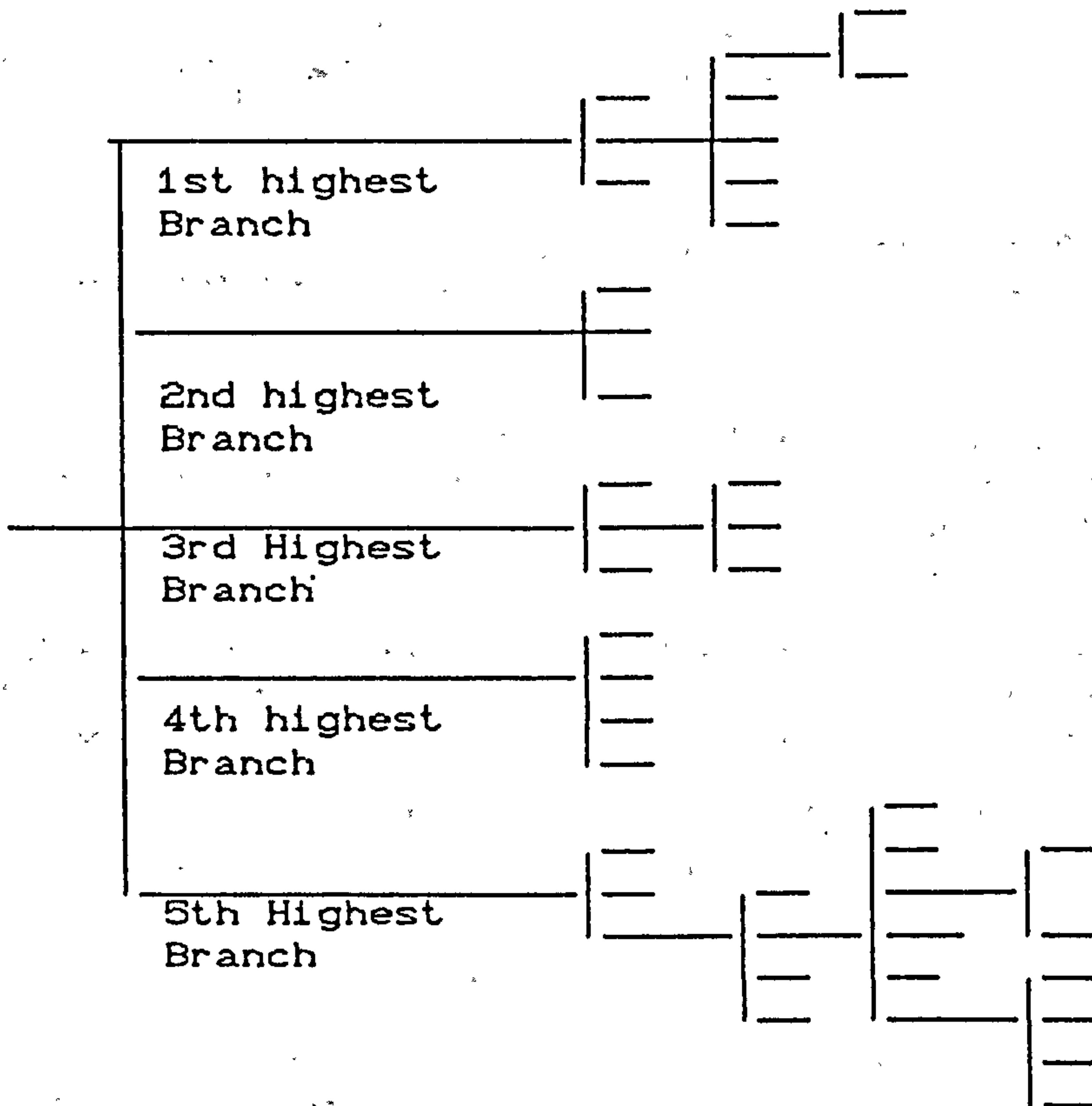


Figure 6.1

branches that are located at the highest level of the structure, it adopts a 'bottom-up' approach. In other words, it starts by calculating the scores for the sub-factors at the lowest level of highest branch, and moves upwards until the calculations for that branch are completed. It then repeats the same procedure in dealing with the next highest branch and so on. It finally combines the scores of the system under consideration.

The calculations in Dejavu are based on a weighted scoring technique that maintains a result in the range -100 to +100. This technique takes into account two types of scores attached to each success factor; importance score and performance score¹.

As already stated, the way in which the mathematical technique in Dejavu works is to start from the lowest level of the tree, and calculate a score for each success factor, by multiplying the importance score of each success factor by its performance score.

The result of importance score multiplied by performance score are calculated separately for positive (Pros) and negative (Cons) factors; using the following formula;

$$\text{Pros Result (R}_i\text{)} = \left(\frac{\text{Pros Importance}_i}{10} \cdot \frac{\text{Pros Performance}_i}{5} \right) \cdot 100$$

$$\text{Cons Result (R}_j\text{)} = \left(\frac{\text{Cons Importance}_j}{10} \cdot \frac{\text{Cons Performance}_j}{5} \right) \cdot 100$$

where Pros are positive child-factors and Cons are negative child-factors of a parent-factor. A parent-factor can be a child-factor itself to another parent-factor higher up in the tree structure.

Once the Results are calculated for each factor at the lowest level, then the next step is to calculate the overall cumulative contribution of these factors to the success of

1) A performance score, a signed number between -5 to +5, is assigned to each child-factor.

All the factors are assigned an importance score, for non-critical factors the score is a number between -10 to +10. Critical factors are assigned an importance score of 'essential' or 'forbidden'. The scores for critical factors are not included in the calculations, as a failure in any such factors results in overall failure.

their immediate parent-factor. This is done by using the following formulae;

$$\text{Overall Pros Success (OPS)} = \left[100 - 100 \prod_{i=1}^n \left(1 - \frac{R_i}{100} \right) \right] \cdot \frac{P}{10}$$

$$\text{Overall Cons Success (OCS)} = - \left[100 - 100 \prod_{j=1}^m \left(1 - \frac{R_j}{100} \right) \right] \cdot \frac{P}{10}$$

where P denotes the importance score assigned to the parent-factor of a set of Pros and Cons factors.

One effect of the above calculations is that as the result (importance multiplied by performance) of a factor approaches +100 (the maximum) or -100 (the minimum), each individual result has a smaller and smaller effect on the Overall Pros or Cons Success. One way of interpreting this is to say that as a conclusion approaches the maximum (say, becoming absolutely certain or approaching the perfect score) so any additional results (say, evidence in favour or additional success factors) change the conclusion by a smaller amount.

Then, using the following formula, the system calculates the weighted average of the Overall Pros Success (OPS) and the Overall Cons Success (OCS) of the child-factors at the lowest level of the tree. This produces an Overall Success (OS) score for the immediate parent-factors to the child-factors;

$$\text{Overall Success}^2(\text{OS}) = \frac{\text{OPS} \cdot \sum_{i=1}^n R_i - \text{OCS} \cdot \sum_{j=1}^m R_j}{\sum_{i=1}^n R_i + \sum_{j=1}^m R_j}$$

If an immediate parent-factor is itself a child-factor to a higher-up parent-factor, then the above overall success score will be carried upward to the next higher-up level. At this higher-up level, the above overall success score will be treated as a Pros or Cons Result of the higher-up parent-factor. This procedure is repeated until it is possible to calculate the overall success score of the first parent-factor on the first level of the tree.

So far the system has calculated an overall success score for the first parent-factor of the first level of the tree.

2) For further detail refer to Appendix B, page 6.

The same procedure, as for the first parent-factor, is repeated for the other parent-factors of the first level, until the overall success scores of all the parent-factors of the first level are calculated.

Finally, using the same formula as for calculating an overall success score, the overall success scores of the parent-factors at the highest level of the tree structure are combined together in deriving an overall success score for the whole system, i.e. a MINTS, under consideration.

6.1.3.6.2 Comparison with conventional weighted average

As discussed in chapter 4, there are some major shortcomings associated with the conventional weighted average as a measurement technique for calculating the ~~of~~ success of a system. Although most of shortcomings have already been explained, the following areas warrant further discussion in explaining the differences between the conventional technique and the one adopted in this study

(a) n out of k factors:

Quite often a combination of contributory success factors (n out of k) is required for achieving success as regards to a system. In the general model of success within the Consultant Advisory System, which is based on a large number of success factors, only n out of k factors may be relevant to a particular MINTS project for its success. In the case, the conventional weighted average cannot be used. This is because a weighted average technique, as shown below, does not adequately deal with the issue of "n out of k" factors.

$$\sum_{i=1}^n \frac{\text{Importance}_i \cdot \text{Performance}_i}{\sum_{i=1}^n \text{Importance}_i}$$

Although, using the above formula, one can assign a zero performance score to those irrelevant factors, hence excluding the irrelevant factors from the numerator, but the problem lies with the denominator (the sum of importance). This is because, the sum of importance includes the importance of all n factors, hence reducing the average result. This is simplified in the example given in Appendix C.

(b) Separate calculations for positive and negative factors

As shown earlier, the cumulative weighted average technique introduced here makes a distinction between positive and negative factors. In other words, the calculations for the Pros and Cons factors are carried out separately, and they are combined at the last stage when calculating the Overall Success of a system.

This distinction between the Pros and Cons factors and separate calculations is crucial when using a multiplicative approach for two reasons. Firstly, a lack of distinction between Pros and Cons in a multiplicative approach will result in the Overall Success being increased by Cons factors, rather than being reduced. Secondly, it is important to take account of the number of Pros and Cons, otherwise, the combined result of a large number of Pros factors can be reduced disproportionately by a small number of Cons factors and vice versa. Referring to the previous example, the Overall Pros Success (OPS) was 74.54% and the Overall Cons Success (OCS) was -34.40%. If the number of the Pros and Cons is ignored, then the combined result of Pros and Cons would be;

$$OPS - OCS = 74.54 - 34.40 = 40.14\%$$

But if the number of the Pros and Cons is used as a weighting score, as it is the case with the technique used in this study, then the combined result of the Pros and Cons would be more realistic;

$$OPS \cdot \sum_{i=1}^n R_i - OCS \cdot \sum_{j=1}^m R_j = 74.54 * 108 - 34.4 * 38 = 67.43\%$$

As shown previously, in order to calculate the Overall Success (OS), the above is divided by the total number of the Pros and Cons as the total weighting score to achieve a score of 46.18%.

6.1.4 The Consultant Advisory System

6.1.4.1 Scope of a MINTS Project

As the Consultant Advisory System deals with the whole process associated with a MINTS project, it should be used for new MINTS projects. A MINTS is regarded as new when it deals with a new application area in which a consultant needs to be involved. A new MINTS does not refer to an already established MINTS, where its user requires relatively small additions to be made to the system.

A MINTS project is more than the consultant simply recommending to the system user what software to purchase in dealing with an application area. The consultant must be involved in the process of building the main body of the MINTS. This is because the objective behind the Consultant Advisory System is to assist a consultant in charge of a MINTS project to identify problematic areas, in order to take early corrective action in improving the project's likelihood of success.

Although it is recommended that the Consultant Advisory System to be used for new MINTS projects, so that the consultant can assess the success likelihood of the system throughout the project, it is however capable of assessing the success likelihood of an already established MINTS, in order to identify the reasons behind its lack of success.

The Consultant Advisory System can also be used for assessing whether or not to go ahead with a MINTS project. This capability of the Consultant Advisory System can also be used for selecting among a group of MINTS projects for the purpose of development and implementation.

The Consultant Advisory System, however, does not advise at the operational level as how a MINTS project should be undertaken step by step. It rather draws attention to the important areas, where special consideration is required if a MINTS project is to succeed.

The Consultant Advisory System is not designed to assess the success likelihood of a MINTS to be used in a group decision-making environment. This is because group decision-making is a complex area, in which organisational and behavioural techniques are needed to deal with many of the political and personality problems associated with group interaction and behaviour. Also, this is an area for which there currently exist very few MINTS that can be applicable.

The Consultant Advisory System is not also aimed at expert systems. Because the current expert system generators are meant to elicit an expert's knowledge primarily for the use by non-experts. In their current form, they offer advice in the form of what the expert would do, hence the non-expert

is assumed to follow the advice. They are basically used to make the expertise of an expert available to a much larger group, rather than assisting the expert himself to make more effective decisions. Currently, they are capable of dealing with routine and structured type decision problems, and as yet not able to deal with unstructured type problems. Moreover, where a MINTS is regarded as an extension of a decision-maker's mind, the principle behind an expert system [500,501,502] is to directly influence or make decisions, hence replacing the expert.

6.1.4.2 The User of the Consultant Advisory System

The Consultant Advisory System is aimed at an internal consultant who is in charge of a MINTS project.

An assumption behind the questions in the Consultant Advisory System is that the consultant is sufficiently experienced in assessing the situation in answering the questions. For example, he must be able to assess the relationship between the key actors in giving his view of the political environment of the MINTS in which he is involved.

6.1.4.3 Importance Score Assigned to Success Factors

Within the Consultant Advisory System, an importance score signifies the impact of a success factor on the success of a MINTS project. Each contributory success factor is assigned an importance score by the researcher. The researcher felt justified in including his judgement in assigning importance scores to the success factors based on;

- (a) an overall perspective gained based on 39 case studies and interviews with consultants.
- (b) a detailed literature survey of a large number of studies on MIS/DSS success.
- (c) a good practical knowledge of a number of MINTS packages, and the way they work.
- (d) six months on-site research at the computer division of a large multinational pharmaceutical company. During which time the researcher, in a consultant capacity, was given the responsibility of building two MINTS for two senior managers, as well as pushing the idea of MINTS among the senior managers and users. During the six months research period, the researcher established contacts with a number of senior managers, users, and the MIS personnel.

It is also possible for the consultant using the Consultant Advisory System to assign importance scores to the success factors. The researcher, however, holds the view that the consultant may be inconsistent in scoring the success factors, due to time limitations, and a lack of general understanding of the success factors involved.

6.1.4.4 Performance Score Assigned to the Success Factors

When the Consultant Advisory System is run, the consultant selects a reply from a 'reply window', which allows the consultant to select one item from a semantic list. The numeric score assigned to the reply selected is used as the performance score for the success factor under assessment.

The researcher himself assigned the numeric scores to each semantic term in each 'reply window'. He felt justified in doing so, for the same reasons that he assigned importance scores as listed in the previous section. From literature survey II, this was seen to be a common practice. Again the consultant could set up his own semantic reply/numeric links if needed.

It was also decided that the number of reply options offered to the consultant for each question should be limited. This helps to increase the difference between the performance scores assigned to the replies for the same question, thus avoiding insignificant changes in the calculations. Furthermore, less time is required in answering the questions, thus making the Consultant Advisory System even a more practical tool in terms of the amount of time taken to run it.

6.1.4.5 Dealing with Irrelevant and Currently Unknown Factors

Only k out of n factors may be relevant to the success of a specific MINTS project. For example, in the case of some MINTS, no intermediary may be involved. In this case the Consultant Advisory System allows the consultant to discard the section of the Advisor concerned with intermediaries.

There are questions included in the Consultant Advisory System which the consultant may not be able to answer unless he has taken certain actions. For example, if the consultant is asked 'Has the sponsor formally approved the project costs?', he will not be able to answer this, until he has obtained formal approval from the sponsor. The Consultant Advisory System allows the consultant to keep a record of the unanswered questions, so that he can at a later stage quickly locate them for re-consideration. For this reason, an additional reply option 'Don't know' is provided in the reply window.

6.1.4.6 Style and Level of Questions

The style of the questions asked by the Consultant Advisory System is general, but not vague. This is because the model of success is a general model meant to be applicable to many different applications. This can be explained by a few examples;

- (a) The Consultant Advisory System does not ask questions that are, for example, specific to any particular analytical technique offered by a MINTS. It does not ask, for example, whether or not the user understands, say, simulation or project scheduling technique. But it asks whether the user understands the application of the technique, its limitations, and how its results should be interpreted properly.
- (b) It does not ask questions about how, for example, a training course is run, and what is included in the training course, but whether the training is believed, in the view of the trainer, to have given the system user or intermediary adequate level of expertise and confidence to operate the system or build decision models efficiently on his own.
- (c) It does not ask whether the budget for the project is \$X, but whether the cost of the project is regarded as affordable and acceptable, and whether the cost of the project has been agreed and authorised. It asks whether the cost estimate is realistic and includes all aspects of the system, in terms of training, software, hardware, maintenance and support. It asks whether the cost of the project is increasing more than expected and whether this will affect the support for the project by the sponsor.

As already discussed, where a success factor is believed to be too general, it has been defined in terms of other success factors. This means that a number of questions are asked at different levels of the tree in order to establish the success score for a parent factor. However, there is a limit as to how many levels one can go down the tree structure. This is decided by considering;

- (a) the importance of a success factor, and
- (b) operationalising the Consultant Advisory System - making sense of the success factors.

6.1.4.7 Number of Questions Asked

Within the Consultant Advisory System there are about 280 questions available to be asked. This does not mean that all the questions are asked for every MINTS project. For example, for a MINTS for which no intermediary is required, the number of questions is reduced by 30.

It may be argued that the Consultant Advisory System must be a practicable tool, in the sense that it does not take an unacceptable amount of time to run it. As already stated, there is a maximum of 280 questions. Assuming that each question may require 20 seconds (which is a very pessimistic figure for the majority of the questions), it takes about 1.5 hour ($280 \times 20 / 60 = 93$ min.), to answer all the questions. It is appropriate to state that the Consultant Advisory System is not meant to be used in one attempt. Indeed, the consultant may not be able to answer a number of questions at the start of a MINTS project, but after he has obtained the necessary information for answering the questions throughout the course of the project.

6.1.4.8 Questions about Critical Success Factors

The objective behind asking a question regarding a critical success factor is twofold; (a) to establish whether or not the minimum condition exists for that factor, below which success is not possible, and (b) to establish the extent to which the critical factor contributes to the success of a MINTS project once above the critical level. In order to deal with (a) a question can be asked in the form of a strong confirmation of the existence or non-existence of the minimum condition required for that factor. As Dejavu does not include the critical factors in the calculations, there is a need for a similar question which establishes the contribution of the critical factor to the success of the project. It needs to be stated that there are some critical success factors (the first 5 critical factors as marked in Table 5.5) to which part (b) above does not apply. For example, it is critical that the identity of the sponsor is known, and there is no need in establishing the extent to which his identity is known.

Based on field research, the researcher identified 51 critical success factors, as marked in Table 5.5. A critical success factor is, for example, 'knowledge of the problem by the system user'. The question for this factor is in the form of;

'To what extent is the system user familiar with the decision problem for which the MINTS is to provide support?

The replies provided are in the form of;

sufficiently	+5
inadequately	-5

The choice of the later reply will result in the message 'Ruled Out' to appear opposite to the success factor.

For the purpose of simplicity, and reducing the time of validating the Consultant Advisory System, the researcher decided to exclude the questions for establishing the contribution of critical success factors to the success of a MINTS project. Moreover, these questions would be very identical to those establishing the minimum condition for the critical success factors, only requiring a different set of replies.

6.1.4.9 Distinction Between MIS and MINTS

As discussed in chapter 3, a distinction is made between MIS and MINTS. The approach adopted in developing and implementing an MIS is generally based on the traditional life cycle approach. MINTS, on the other hand, are developed based on a breadboarding approach. Having said this, within a breadboarding approach, there is an element of life cycle approach though not as rigid as that of an MIS. For example, as in the case of an MIS, there must exist for a MINTS the right environment, the users' needs must be specified, the system must be developed and implemented. However as MINTS evolve, this means that these stages are not only very short lived, but are repeated several times as more is added to the system. Moreover the development and implementation stages of a MINTS take place concurrently, while they are sequential for an MIS.

As regards to the contributory success factors for such systems as an MIS and a MINTS, there are some success factors that are applicable to both MIS and MINTS, but there is a change of emphasis in their importance and applicability.

6.1.4.10 The Computerised Consultant Advisory System

Based on what has been discussed so far, the Consultant Advisory System was computerised using Dejavu. A copy of the system is provided on a floppy diskette in Appendix D. In order to run the advisor a copy of Dejavu must be purchased from the Intelligent Environment.

In order to run the Consultant Advisory System, <DV> must be typed at DOS command level. The initial screen is as shown in Figure 6.2. As can be seen the system is fully menu-driven. Having selected and loaded the appropriate file, the next step is to press the F3 in order to start the advisor. By pressing F3, the next screen is as shown in

Figure 6.2

```
LIBRARY      EDIT      ANALYSE      REPORT      CLEAR      UTILITIES      QUIT      12:54:00
┌──────────┐
│ Load      │
│ Save      │
│ Delete    │
└──────────┘
Select a library file to load from disk into memory
Press F1 for help
```


Figure 6.3. There is on-line help available throughout the advisor. By pressing F1 the help screen will appear as in Figure 6.4. The only function key required, for running the advisor is F3. By pressing F3 once again the advisor begins by asking a series of questions - this is shown in Figure 6.5. A reply window is also provided in each screen, from which the user is expected to select a reply in answering the questions. The set of factors in each screen refer to a higher up parent factor - "user control" in the case of Figure 6.5. Having answered the questions in each screen, the advisor shows the selected replies against the factors as well as showing the Pros/Cons Results for each factor - Figure 6.6. Once all the questions on the screen are answered, F3 must be activated in order to move to the next screen which presents the next set of factors and their associated questions.

When all the child factors under a parent factor in each screen are dealt with, the word "analysed" appears opposite that parent factor, as well as the score for the factors - Refer to Figure 6.7. Once all the questions in the advisor are answered, the advisor calculates the likelihood of success for each stage of MINTS development as shown in Figure 6.8. As shown in this figure, the MINTS Overall Success is derived by combining the likelihood of success for the two stages.

In order to obtain a report of the results, F4 can be activated at any stage and the advisor produces an outline screen as shown in Figure 6.9. Then by moving down the cursor, the rest of the report can be viewed.

A print out of the results can be obtained by pressing <Ctrl> and <P> at the same time when in the outline mode. An example of the report produced by the advisor is shown in Appendices E, F and G.

As regards to the questions with an unknown reply, the user can refer back to these questions at a later stage. The advisor makes this very simple by providing an index facility. By pressing F7, an "INDEX" table appears as in Figure 6.10. This table contains all the factors included in the advisor. By pressing F7 for second time, an "INDEX FIND" table appears, as shown in Figure 6.11. Within the INDEX FIND table the user is expected to type in part or all of the factor (or question) he wants to review. The advisor then finds the factor and by pressing F8, it displays the relevant screen which contains the factor under investigation.

As explained above the Consultant Advisory System is very simple to operate. The advisor also allows the user to modify, add or delete the success factors as well as the reply windows.

Figure 6.3

ANALYSE

12:56:24

SUBJECTS
? OVERALL MINTS SUCCESS

iE

Using the cursor keys move to a subject and press F3 to analyse it

Figure 6.4

ANALYSE

1:03:54

SUBJECTS
? OVERALL MINTS SUCCESS

FUNCTION KEYS

- ESC = Exit help
- F1 = More help
- F2 = Edit
- F3 = Analyse
- F4 = Report
- F5 = Line
- F6 = Footnote
- F7 = Index
- F8 = References
- F9 = Switch
- F10 = Expand
- TAB = Next field
- B.TAB = Last field

iE

Press Enter for more help

Figure 6.5

ANALYSE - AUTOMATIC

12:32:5

iE

User control

E

QUESTIONS

- Easy change of parameters
- Context explicit
- User-defined input format
- User-defined output format
- Different skill levels

REPLY

- Excellent
- Good
- poor
- Not possible
- DON'T KNOW
- IRRELEVANT

How do you rate the ease with which the system user can modify/change the parameters/variables?

Select 'IRRELEVANT' if the system user does not use the MINTS directly.

Figure 6.6

ANALYSE - AUTOMATIC

11

User control

QUESTIONS

Easy change of parameters	Excellent	70%
Context explicit	Good	42%
User-defined input format	Poor	-30
User-defined output format	Good	50
Different skill levels	Yes	50%

REPLY —
 Excellent
 Good
 poor
 Not possi
 DON'T KNO
 IRRELEVAN

How do you rate the ease with which the system user can modify/change the parameters/variables? Select 'IRRELEVANT' if the system user does not use MINTS directly, or no change of variables is needed.

Figure 6.7

2

ANALYSE - AUTOMATIC

MAINTAINING RELATIONSHIP

QUESTIONS

•	System User	-analysed-	76%	||
•	Intermediary *	-analysed-	22%	||
•	Sponsor	-analysed-	30%	||
•	System user's Superior	-analysed-	28%	||
•	Custodians of Information	-analysed-	28%	||
•	Consultant	-analysed-	52%	||

REPLY
-analysed-

Press Enter to select this reply, cursor down to choose another

Press F3 for next page of questions

Figure 6.8

REPORT

3

MINTS PROJECT

RESULTS BY OPTION

• MINTS Overall Success (97%)	
• ENSURING A RIGHT ENVIRONEMNT	86%
• MAINTAINING RELATIONSHIP	85%

This is a result report of the options under MINTS PROJECT
Press F4 to get an outline of this line

Figure 6.9

REPORT

1:02:17

MINTS PROJECT 2

OUTLINE

- ENSURING A RIGHT ENVIRONEMNT
 - Organisational Infrustruture
 - Acceptability of MINTS
 - Affordability of MINTS costs
 - Adaptability of organisation
 - Changes to the formal systems
 - Procedures
 - Operations
 - Mgmt. adaptability to change
 - Education
 - Exposure to IT
 - Place of MINTS in IT strategy
 - Organisational stability
 - Staff turnover
 - User permanence

This is an outline of the points under MINTS PROJECT 2
Use the cursor keys to view the report

Figure 6.10

ANALYSE - AUTOMATIC

12:33:18

iE

User control

QUESTIONS

Easy change of parameters

User-defined input format
User-defined output format
Different skill levels

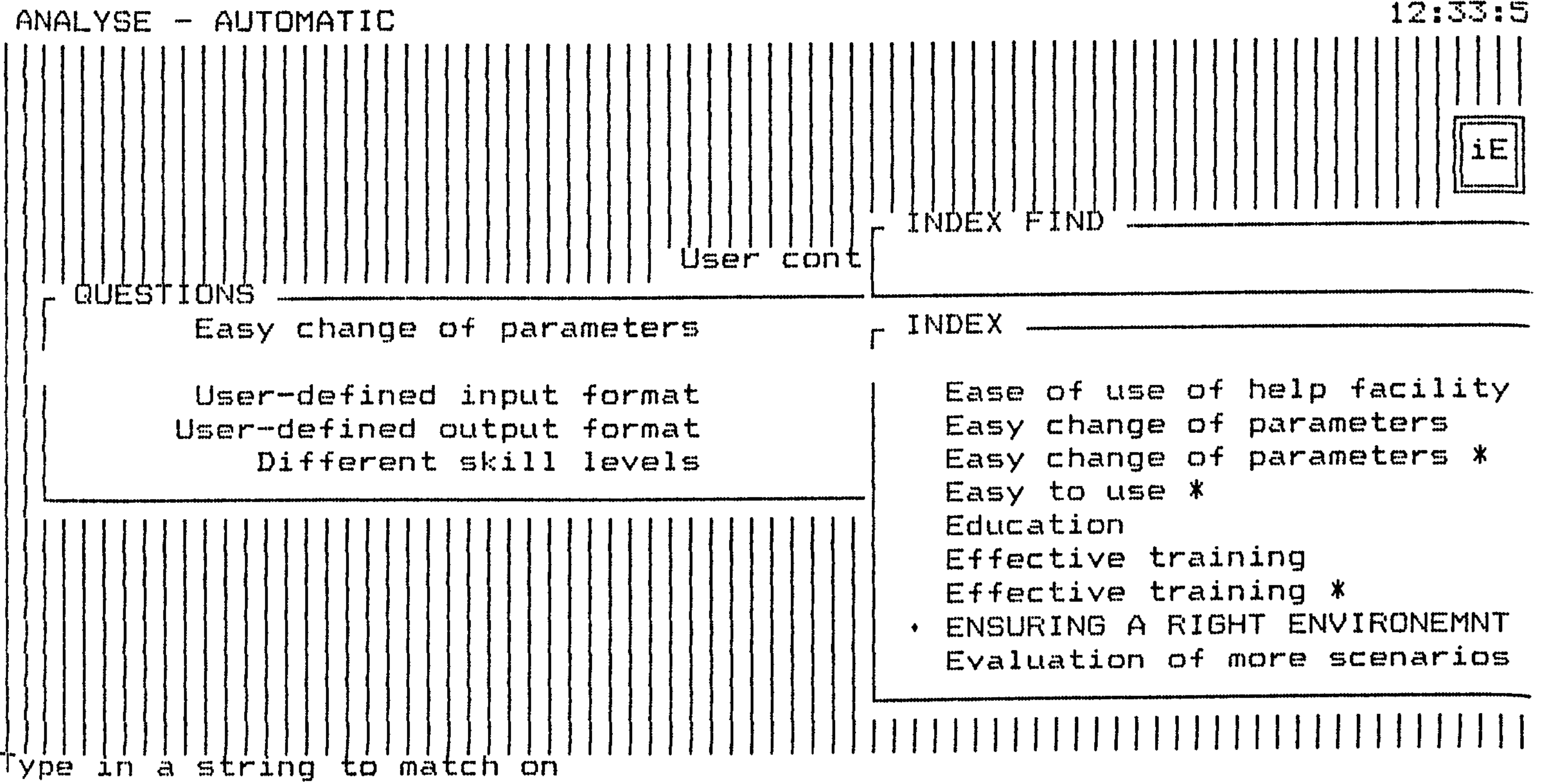
INDEX

Ease of use of help facility
Easy change of parameters
Easy change of parameters *
Easy to use *
Education
Effective training
Effective training *
• ENSURING A RIGHT ENVIRONEMNT
Evaluation of more scenarios

How do you rate the ease with which the system user can modify/change the parameters/variables?

Select 'IRRELEVANT' if the system user does not use the MINTS directl .

Figure 6.11



CHAPTER 6

There are many other facilities available in the advisor, especially for model building. Detailed instructions for this can be found in the manual provided with a copy of Dejavu.

It must be stated that the computerised Consultant Advisory System requires further refinement before the possibility of it as a commercial product could be considered.

7 CHAPTER 7**7.1 Research Validation Methodology****7.1.1 Introduction**

It is the objective of this chapter to discuss a methodology to be used in this study for verifying and validating the Consultant Advisory System. A number of concepts will be reviewed here, but their definitions will be dealt with, where appropriate, when discussing the validation methodology adopted in this study.

A number of studies [52,95,53,83,129] have reported that although validation is an important part of any research methodology, many researchers have failed to address the issue rigorously. Based on a review of a number of studies measuring user involvement and system success, Ives & Olson [83] report that the measures of success proposed by these studies are generally weak. This, they argue, is due to the lack of a conceptual foundation to guide measurement development, and to the absence of a rigorous program of validation. For example, they argue that the type of system investigated by the researchers was not under their control, that the sort of generalizations made by some of these studies is questionable especially when they have investigated a single system, and that these studies did not generally address the validity and reliability of outcome measures. Also an Operational Research Society National Event on validation [61], was reported by Finlay & Wilson [52], to have confirmed the view that the concept of validation, under business conditions, is not well developed and the literature on the subject is scanty.

There exist some disagreement about the definition of validation. Rossi, Wright and Anderson [142] say that validation has different meanings, and they define it as the degree to which an instrument measures the construct under investigation. But such a definition is too general. According to Green et al. [70], the behavioural scientists define validation to mean that the data must be unbiased and relevant to the characteristics being measured. But they fail to include the logic model. Belson [18] and Suchman [163] offer similar definitions, but their definitions are not helpful for the purpose of this research. Belson defines a valid measure as one that accurately measures what it is supposed to measure. Suchman defines validation as the degree to which any measure or procedure succeeds in doing what it purports to do.

In this study validation is defined as the process of checking the extent to which the data and logic models represent the real world. In other words, validation refers to the appropriateness of relationships within the logic model, and the representativeness of the data model.

However, it is more useful for the purpose of this research to consider validation in terms of a methodology based on the components of the validation process and steps required to improve the validity of the Consultant Advisory System.

There is also a lack of agreement as to what constitutes a validation framework, as well as how the framework should be categorized. Sell [153], in the context of expert systems, defines validation in terms of five dimensions which are consistency, completeness, soundness, precision and usability. Bailey & Pearson [14] argue that validation has been traditionally categorised into content validity, predictive validity and construct validity (the same categories are used by Green et al., and Brindberg & McGrath [26]). O'Leary's [126] validation framework includes such components as content validity, criterion validity, construct validity, reliability, objectivity, and systematic variance. The American Psychological Association [10] distinguishes between three components of validation; criterion validation, content validation and construct validation. Rossi, Wright & Anderson use two general categories of validation; theoretical and empirical. They regard theoretical validation as equivalent to construct validation and use empirical validation to refer to criterion validation which they divided into predictive and concurrent validation. Suchman suggests such measures of validation as observer validation, consensual validation (validation by a group of experts), criterion validation, and predictive validation. A distinction has also been made by some researchers [163,18,70,126] between validation and reliability. For example, Suchman, argues that reliability is a necessary condition for validation. Some [53,52,14] have used the term verification to include reliability. Reliability usually refers to the measurement instrument; thus a reliable instrument is defined as one which measures the same object with consistent and error free results [14,163].

Finlay et al. [53] paraphrase Drucker's [188] definition of efficiency and effectiveness to make a distinction between verification and validation. In agreement with O'Keefe et al. [125], Finlay et al. define verification as establishing that the thing is done right, and validation as checking that the right thing is done. As put by Finlay & Wilson [51], this means that verification (or consistency) of a computerised model refers to the correct translation of the relationships into a computer format, and that the appropriateness of the relationships themselves is a matter of concern for validation. Reddy [133] argues that a problem in validating a simulation model is that the model is never a complete representation of the real system, as the real system cannot be completely known. Because of these limitations, he suggests that the validation of simulation models is limited to verification. The purpose of verifying a simulation model, he argues further, is to determine

whether or not the model is properly programmed. The process by which this is done is commonly known as program-debugging.

Generally speaking, when using a ready made measurement instrument or technique, much attention should be paid to the appropriateness of the instrument/technique for the application under consideration. For example, a MINTS Generator is often used to build Specific MINTS. In this case, it is crucial that an appropriate MINTS Generator is adopted. While the researcher agrees that consistency is part of a verification process, he prefers to extend the definition of verification as put by Finlay & Wilson [52] to include the choice of a measurement instrument/technique, as well as testing, where possible and necessary, the internal operation of the instrument/technique adopted for measuring what the model proposes to measure. This means that the instrument/technique used must itself be consistent and accurate in producing the same solution for the same set of data. However, when dealing with unstructured type models, where, by definition, the accuracy and precision of the data and logic models are questionable, then the objective is to achieve a somewhat accurate and realistic, rather than a precise, representation of the real world (The concept of accuracy and precision is dealt with in detail by Finlay, Wilson and Forghani [52]).

7.1.2 Methodology

Before discussing the methodology adopted by the researcher in terms of validation of the Consultant Advisory System, three important points should be stated. The first point concerns the significance of a process approach in validation. In some cases, such as writing a computer program for a stock control system, it may be acceptable to carry out all the validation once the program is completed. However, for a research such as this where the objectives and the means of achieving the objectives cannot be clearly pre-defined, validation should be carried out as a process rather than as a one-off event at the end of the research. This requires a researcher to take appropriate measures throughout his research to improve the validity of the research.

The second point concerns the issues of objectivity and systematic variance. Objectivity is the degree of unbiased (that is the degree to which there is no vested interests in the results achieved) on the part of those involved in a research. Systematic variance can be caused by variation in the experts' responses from trial to trial, guessing, momentary inattention, slight temporary fatigue, lapses of memory, transient emotional states, etc. [93], and also by measurement instrument instability [37]. Although O'Leary [126] uses the issue of objectivity and systematic variance

as separate dimensions of validity, he refers to these two important issues within content validity and criterion validity. The researcher, however, believes that objectivity and systematic variance are not separate dimensions of a validation framework, but important issues need to be addressed throughout a validation exercise. However, these issues are more of importance during the content and criterion validation and for this reason the researcher has included these two issues under these two dimensions within his validation framework.

The third point is that although the researcher developed a methodology for verifying and validating the Consultant Advisory System, he was not able, due to time constraints, to expose the system to as much rigorous validation as he would have wished. It is, therefore, hoped that the methodology adopted here would help future research in further validating the Consultant Advisory System.

The validation methodology adopted in this research is depicted in Figure 7.1. The steps suggested in Figure 7.1 will be fully discussed.

Table 7.1

Validation Methodology

(A) Verification of Measurement Instrument

- (a1) Selection of a suitable instrument
 - (a11) Selection criteria based on theoretical concepts and the existing instruments
 - (a12) Evaluation of ES and MINTS generators
- (a2) Accuracy and consistency of mathematical calculations
 - (a21) Same result for the same set of data
 - (a22) Small changes in the data
 - (a23) Large changes in the data
 - (a24) Order of success factors
 - (a25) n out of k factors
 - (a26) Positive and negative factors

(B) Construct Validation

- literature survey
- empirical survey

(C) Content Validation

- (c1) Extent of conceptual and practical foundation
 - (c11) Literature survey
 - (c12) Empirical survey
- (c2) Objectivity
 - (c21) Selection of case studies
 - (c22) Direct examination by consultants

(D) Criterion Validation

- (d1) Concurrent validation
 - (d11) Testing the system against a failed MINTS project
 - (d12) Testing the system against a successful MINTS project
- (d2) Predictive validation
- (d3) Objectivity
 - balance of successful and failed cases
 - use of external measures of failure/success
- (d4) Systematic variance
 - questions asked
 - distinct replies to questions
 - importance and performance scores

(E) Useability

- (e1) Time required to run the system
- (e2) Acceptance of results by experts
- (e3) Userfriendliness

7.1.3 Verification of Measurement Instrument

The researcher, in agreement with [52,53] regards reliability as part of a verification process. As defined earlier, verification is defined as the choice of an appropriate measurement instrument/technique, as well as testing the internal operation of the instrument/technique adopted for measuring what the model proposes to measure. This means that the instrument/technique used must itself be consistent and precise in producing the same solution for the same set of data.

(a1) Selection of a suitable measurement instrument

(a11) Selection criteria based on theoretical concepts and existing measurement instruments.

As already discussed in chapter 4, the literature survey II was carried out partly in search for a suitable measurement technique for calculating the likelihood of success for a MINTS project. The overall conclusion was that a number of shortcomings were associated with the measurement instruments suggested in the literature. However, based on this literature survey, as discussed in chapter 4 and 6, the researcher extracted a number of criteria which were expected of a suitable measurement instrument for the purpose of this study.

(a12) Evaluation of ES and MINTS generators

Based on the set of criteria identified, a number of Expert System generators and MINTS generators capable of dealing with qualitative problems were evaluated. Among these only one software package, called Dejavu, satisfied the selection criteria, and proved suitable for computerising the model of success.

(a2) Accuracy and consistency of mathematical calculations

As explained in chapter 6, the measurement instrument within the Consultant Advisory System is based on a weighted average technique using a multiplicative approach. The mathematical calculations of this technique have been fully discussed and verified in chapter 6, section 6.1.3.6 and in Appendix B.

Moreover, the researcher sought expert advice on the mathematical calculations used in the Consultant Advisory System. This was done within Loughborough University, by seeking the advice of a senior lecturer in statistics and mathematics, who agreed with the mathematical calculations.

(a21) Same result for the same set of data

As far as the validity of the relationships within the measurement instrument was concerned, the relationships were checked mathematically as shown in Appendix B.

The measurement instrument was also checked for its ability to reinitialize its values once it was rerun. This was checked by using a small model consisting of a small number of success factors. The model was run a few times, with the same set of replies to the same questions. The results produced were exactly the same.

Also the calculations for the same model were carried out manually by the researcher. The results were then checked against the results produced by the Consultant Advisory System. The calculations and the results produced by the Consultant Advisory System matched exactly with the manual calculations and results.

Tests were carried out in the form of "what-if" analysis. The above model was run with a set of replies, then the value of a factor was changed to see whether the calculations were modified accordingly. The same exercise was carried out to more than one factor, and the calculations of the Consultant Advisory System matched those of the manual calculations.

(a22) Small changes in the data

As the weighted average technique within the Consultant Advisory System is based on a multiplicative rather than an additive approach, the effect is that as the Overall Pros or Cons Success (refer to Chapter 6, section 6.1.3.6) approaches the maximum or minimum score, any additional Pros or Cons results changes the Overall Pros or Cons Success by a smaller amount. Although the individual calculations (i.e. Pros/Cons Results) are effected by small changes, the Overall Success is only marginally affected by a small change in the Pros/Cons Results, especially when the Overall Pros/Cons Success approaches the maximum score. However, if there are a number of Pros/Cons which are changed by a small amount, then this can affect the Overall Pros/Cons Success. The number of Pros/Cons which need to be changed by a small amount to affect the Overall Pros/Cons Success depends on how close the score for the Overall Pros/Cons Success is to the maximum score - the closer the score to the maximum, the higher the number of Pros/Cons which need to be changed by a small amount - this is in line with the concept of the multiplicative approach.

(a23) Large changes in the data

In terms of large changes in the data, then the measurement instrument needs to be responsive enough to produce different results.

In the case of the Consultant Advisory System, one of the major changes concerns the critical success factors. If any of such factors is not satisfied, then the overall result remains "ruled-out". The Consultant Advisory System was checked for this, through building a small model with about 5 critical success factors. A check was carried out for all the critical success factors to see if a failure in satisfying any one critical success factor would produce an overall result "ruled-out". The Consultant Advisory System proved consistent with this regard.

Also a test was carried out as regards to the non-critical but yet important factors. The test was carried out with regard to the importance values assigned to the success factors. In this case the importance value of a factor with a relatively low importance value was raised sharply from, say, 3 to 9, this resulted in a change in the Overall Success. This was carried out for more success factors, and the Overall Success was changed accordingly. However, as more and more success factors were assigned a high importance, the Overall Success approached closer to the maximum score. This meant that any additional success factors with a high importance value had a smaller and a smaller effect on the Overall Success. This was to be expected as it was in line with the concept of multiplicative approach adopted underlying the measurement instrument.

(a24) Order of success factors

In a general model, it is very important that the order of inclusion of the success factors does not have any bearing on the results. Otherwise the researcher will have very little control on the effects of the success factors on the overall result, especially when new factors are added or some are deleted. In the case of the Consultant Advisory System, as proven in Appendix B, page 1, the Overall Pros/Cons Success is independent of the order of the pros or cons factors. This is because the factors are multiplied by each other in calculating the Overall Pros/Cons Success.

(a25) n out of k factors

As explained in chapter 6, section 6.1.3.6.1, as the model of success is a general model, different combination of success factors may be relevant to different MINTS projects. The cumulative weighted average technique within the Consultant Advisory System allows factors that are not relevant to a MINTS project to be excluded from the calculations by assigning a zero performance score to the irrelevant factors.

(a26) Positive and negative factors

Referring to chapter 6, section 6.1.3.6.1, a distinction had to be made between positive (Pros) and negative (Cons) factors. Otherwise the overall success would be increased by an increase in the number of negative factors, as well as being affected disproportionately by the number of positive and negative factors.

The measurement instrument used in the Consultant Advisory System carries out the calculations for the Pros and Cons factors separately, and they are combined at the last stage when calculating the Overall Success. The technique also takes into consideration the number of Pros and Cons factors as a weighting score, thus the effect on the Overall Success is proportional to the number of the Pros and Cons.

7.1.4 Construct Validation

A construct is a theoretical idea developed to explain and to organize some aspects of existing knowledge [10]. Also experts' feelings, intuition and beliefs that are based on their practical experience and wide knowledge of their area of expertise can be regarded as constructs, especially when they are intended for the purpose of generalization.

According to O'Leary [126] construct validation refers to those constructs or factors that the test is designed to discover. Such a definition is vague and not helpful for the purpose of research. The significant point about construct validity, as argued by Kerlinger [93], that makes it different from other types of validation is its preoccupation with theory. Construct validation indicates, therefore, the importance of the existence of a theory or a set of theories on which a model is based. Construct validation suggests that a purely empirical approach, without a theoretical basis, may be inappropriate. Davis [39,40] argues that an empirical approach is not as efficient as an approach based on a theory (or at least on an understanding of the problem at hand) when developing a model. One problem with using construct validity, however, is that conflicting or alternative theories or concepts may be available.

As regards to this study, the researcher has based the success model within the Consultant Advisory System on 279 success factors, the majority of which were extracted from literature survey II, as shown in Table 4.1. Moreover, the theoretical concepts and the findings of other researchers have been tested, in terms of their completeness and appropriateness, through 39 field studies carried out by the researcher (full discussion is given in chapter 5 and Appendix A).

An overall theoretical concept in this study is the definition of success as discussed in chapter 4, which is based on the findings concluded from the literature surveys. It is the aim of this study, to establish through field research the applicability of the model to MINTS success.

7.1.5 Content Validation

Rossi et al. [142] suggests that content validation refers to the degree that one has representatively sampled from that domain of meaning. In carrying out content validation, Bohrnstedt [20] recommends that the researcher needs to search the literature carefully to determine how various authors have used the concepts in the area of his study. Moreover, he argued that the researcher should rely on his own observation and experiences and ask whether they yield any new facets to the concept under consideration.

In terms of this study, content validation means checking that the domain of the study includes sufficient ingredients of the real world concerning the constructs under investigation. In other words, content validation refers to the completeness and the appropriateness of the proposed model. Checking whether the overall model behaves as the real world, is an area for criterion validation which will be discussed at a later stage.

As far as content validity for this study is concerned, the researcher has taken the following steps to improve the content validity of the Consultant Advisory System.

(c1) Extent of theoretical empirical foundation

As a method of improving content validity of the model of success within the Consultant Advisory system, extensive literature and field studies were carried out - within the constraints found in every research. These constraints include; time, availability of material, and obtaining access to the required sources for field research.

(c11) Literature Survey

As discussed in chapter 4, a detailed literature survey was carried out in search for a set of contributory success factors that could be applicable to MINTS success, as well as for a suitable measurement technique. The researcher also used an On-line Search facility which is linked to two major databases (ABI/Inform and Management Contents) relevant to the research area. A list of the success factors based on literature survey II is produced in Table 4.1. These factors were modified and extended, based on the field research, as shown in Tables 5.2, 5.3 and 5.4.

A spreadsheet package was used for compiling the list of the contributory success factors and checking the list for repetition and completeness. Everytime new material was obtained, the content of the list was checked against the new material for the purpose of adding references, modifications and additions to the success factors. This was done through the use of the search function of the software package.

Brinberg and McGrath [26] argue that, in a most general sense, every afterthought and second glance is an act of validation. They further found that towards the end of the study, most of the researcher's time is devoted towards a search for additional evidence for his work. His watching then is intensely focused, and organized differently from the way it was in early phases of the research.

As the researcher obtained a better understanding of the area of study, based on a continual literature survey as well as field studies, he used his own understanding of the area of the study to reappraise the model of success from time to time and carry out modifications as seemed to be necessary.

Although the researcher carried out an intensive literature survey to include all the relevant contributory success factors, the model of success developed is not regarded as exhaustive. As a better understanding of the domain of study is obtained in future, additional contributory success factors may be identified by other researchers.

(c12) Field Research

The researcher carried out 39 field studies to investigate the appropriateness of the success factors extracted from the literature survey, and to identify other success factors not mentioned in the literature. The results of the field research are discussed in Appendix A.

Once a working version of the Consultant Advisory System was produced, further content validation was carried out by interviewing additional consultants;

- (i) re-interviewing two consultants (cases 7 and 31) who had been interviewed previously. The first case dealt with scheduling, the second with linear programming.
- (ii) interviewing two consultants not previously interviewed. One consultant dealt with simulation, and the other dealt with networking.

During these interviews the consultants' comments were sought inter alia on the following issues, for the purpose of content validation;

- (i) appropriateness of the factors in the success model
- (ii) completeness of the success model
- (iii) relationships between success factors

Prior to the interview, the consultants were sent a copy of the model of success. They were asked to consider a specific MINTS in which they were involved as well as considering the model of success in general terms. One consultant had considered 4 different specific MINTS in evaluating the model of success. The objective behind the interviews was twofold, validating the model of success, and gathering additional field support for the model of success.

Based on a specific MINTS project and their general experience, all the consultants interviewed found that the contributory success factors and the structure of the model of success were appropriate. They all found the model to have included a wide range of issues and did not offer any additions to the model. There were, however, some comments made about the phrasing of some of the success factors, but no major criticism was made. The comments on phrasing arose because the contributory success factors within the model of success given to the consultants were not accompanied with an explanatory note. However, within the Consultant Advisory System, a few lines of explanation is attached to each success factor for further clarification. Based on the feedback received, only a few minor modifications were needed to the phrasing of the success factors in the model of success.

Time was a constraint in carrying out the interviews for the purpose of content validation. For this reason a detailed validation was not possible. This was recognised by the researcher prior to the interviews, and for this reason the intention was to test whether the model of success was generally acceptable, and whether the consultants could offer any major criticism of the model.

(c2) Objectivity

As already explained, objectivity is the degree of unbiased on the part of those involved in a research. This is an issue that needs to be considered throughout a validation process.

The researcher considered the following measures in dealing with the issue of objectivity in building the Consultant Advisory System.

(c21) Selection of case studies

As discussed in chapter 2, a successful and most used technique for obtaining access to companies was through software suppliers. The researcher was aware of the possibility that the software suppliers approached may be

biased in giving the researcher a list of their most successful clients. Although, this was out of the researcher's control, he took steps in reducing the inclusion of bias in the selection of the case studies.

Two important points need to be stated here. The researcher was usually given a list of clients to contact. He, therefore, had a choice in terms of which ones to contact. However, it still remains very likely that the list itself was biased. It is also important to state that the researcher made contacts with quite a number of software suppliers which gave him a good choice of MINTS applications based on different analytical techniques.

During the interviews carried out, the researcher always prompted the consultants interviewed to discuss their involvement in any MINTS projects which had failed. Moreover, no project is without problems. The researcher, therefore, continually tried to find out about the problems encountered and how they were dealt with in every case study. The researcher also sought the interviewees' general opinion as to what they regard as contributory factors to success and failure.

(c22) Direct examination by consultants

As already discussed, once a working version of the Consultant Advisory System was produced, its content was exposed to a small group of consultants for their examination and comments.

(c3) Systematic variance

As already discussed, systematic variance can be caused by variation in the experts' responses from trial to trial, guessing, momentary inattention, slight temporary fatigue, lapses of memory, transient emotional states, and also by measurement instrument instability.

As regards system variance within the context of content validation for the purpose of this study, it was not possible, due to time constraints, to ask the same consultants to reconsider the content of the model of success for the same problem.

However, as a source of systematic variance could be due to a complex measurement instrument, the researcher adopted a number of steps in reducing this source of systematic variance. A factor causing systematic variance can be the complexity of the questions asked of the respondents. The researcher invested much effort in terms of the phrasing of the success factors within the model of success, and further

explanation to reduce a misunderstanding of the success factors and their associated questions is provided within the Consultant Advisory System.

Another consideration was that, as the Consultant Advisory System includes a large number of success factors, systematic variance could take place due to a lack of adherence to the concept of "orthogonality". The concept of orthogonality requires as little overlapping between the contributory success factors as possible, so that multiple scoring of success factors is minimised in calculating an overall system success.

The researcher found out that the concept of orthogonality is a difficult concept to adhere to, especially when dealing with subjective issues. However, an effective method of doing this was to reduce the degree of generality of the contributory success factors. Indeed, as already stated, many of the success factors referred to in the literature are very general. A major problem with success factors which are too general, is that it makes it more difficult to ask unambiguous questions. The action to be taken was, where possible, to break down and divide the general factors into a set of other factors which were more meaningful and specific. This is why a tree structure proved very crucial in organising the contributory success factors. A tree structure offers the flexibility of redefining any success factor at a later stage.

A further source of systematic variance may be due to the method in which data is collected. In terms of collecting data, the researcher decided against using a questionnaire technique, and instead opted for an interviewing technique. In this way he reduced the inclusion of some systematic variance which is usually associated with a questionnaire technique, where the questions as well as some of the concepts and definitions can be complex to the respondents and misunderstood by them.

As discussed earlier, 4 consultants were interviewed for the purpose of content validation of the model of success. An objective behind this exercise was to establish the extent to which the phrasing of the success factors may be misunderstood by the consultants. Although few minor changes were suggested, but in general the consultants interviewed felt happy understanding the model of success.

7.1.6 Criterion Validation

According to Suchman [163] and Rossi et al. [142] criterion validation is the use of one or more external variables, or criteria, known or believed to measure what a model proposes to measure.

In the area of expert systems, the primary criterion for system validation, according to O'Leary [126], is the extent to which the decisions developed by a system match the decisions developed by human experts. Bringberg and McGrath [26] also suggest host verification as an external measure of validation.

As the Consultant Advisory System proposes to assist a consultant in making a MINTS project more successful, it is, therefore, appropriate to use, as an external variable for criterion validity, a consultant's opinion of the likelihood of success for a MINTS project. An implication of using an expert's opinion is, however, his level of expertise and the validity of his opinion which are very difficult to measure. Especially as experts tend to have differing views, even within the same field of expertise. They may also form a different point of view at different points in time and under different working and psychological conditions.

O'Leary uses the term criterion validation to refer to what is termed by others [14,26,18,70] predictive/external validation. Predictive validation is defined by Suchman [163] as the correlation of a present measure with something that takes place in the future. This definition is also agreed by Smith [157], Rossi et al. [142] and Finlay et al. [53]. Finlay et al., for example, regard a model to be predictively valid when the data produced by the model matches those subsequently produced by the real world system. Moreover, Smith, Finlay et al. and Rossi et al. add another dimension to criterion validation, that is concurrent validation as put by Smith [157] and Rossi et al. (Finlay et al. use the term replicative validation to mean the same as concurrent validation). Concurrent validation is defined as correlating a measure and a criterion of interest at the same point in time. The researcher also takes the view that concurrent and predictive validations are two overall measures of criterion validation, and deals with them separately.

(d1) Concurrent validation

The problem with validating a system such as the Consultant Advisory System is that it is based on subjective rather than on "hard" data. In the case of a MINTS project, any views on its success or failure, or the extent of its success or failure, is a matter of judgment and may vary from person to person.

However, in checking the concurrent validation of the Consultant Advisory System, the researcher decided to involve the four consultants who were interviewed for the purpose of content validation, to also run the Consultant Advisory System for the purpose of criterion validation. However, due to time constraint, only two of the consultant agreed to do so.

The first consultant was asked to consider two MINTS projects in which he had been involved; a MINTS which had been a failure, and a MINTS which had been a success.

As an independent measure of validity, before using the Consultant Advisory System, the consultant was asked to state the reasons for which the failed MINTS had not succeeded. As regards to the successful MINTS he was asked to state the degree to which he believed the project was a success.

The same procedure was followed in the case of the second consultant. However, as he had not been involved in a failed MINTS project, the validation was carried out for the successful MINTS project in which he had been involved.

(d11) Testing the system against a failed MINTS project.

Testing of the Consultant Advisory System for a failed MINTS project was very limited. This was because the MINTS project had failed during the initial stage of ensuring the right environment.

The consultant identified, prior to the running of the system, the following reasons for which he believed the project failed;

- (a) the system user would not accept the changes required in his working procedures.
- (b) the system user was not convinced of a need for the MINTS.
- (c) The consultant and the system user had a poor working relationship.

The consultant was asked to run the Consultant Advisory System for the failed MINTS project. The Consultant Advisory System regarded the MINTS project as a failure due to the same reasons as mentioned by the consultant. Moreover, the consultant was asked to carry on answering the rest of the questions. The Consultant Advisory System identified further reasons for the project's failure with which the consultant was in full agreement. These were;

- (a) there existed a poor working relationship between the system user and the intermediary.
- (b) the data provided to the MINTS was not sufficiently valid.
- (c) the system user had a poor knowledge of the problem area, as he had not been with the organisation for relatively a short period of time.
- (d) The intermediary lacked confidence, despite two days training, using the MINTS.
- (e) the project did not offer sufficient financial benefits to the consultant.

- (f) the system user was not expected to remain in his position for long.

A copy of the report produced by the Consultant Advisory System on the above project is produced in Appendix E.

- (d12) Testing the system against a successful MINTS project.

Both consultants were asked to run the Consultant Advisory System against a MINTS project which was regarded as successful. They were asked, prior to the running of the system, to state the degree to which they believed the MINTS project under assessment was a success. In order to avoid a misunderstanding of the terminology of success the researcher explained what he meant by MINTS success.

Both consultants regarded the project under assessment as highly successful. The first consultant was not quite certain about a success score and believed the success of the project was above 85%, and stressed that the score was based on his 'gut' feeling. The second consultant decided on a score of 90%.

The system was, however, run and a copy of the report produced by the Consultant Advisory System is presented in Appendices F and G for the projects respectively.

All the critical success factors were satisfied, which meant that the projects under assessment were not regarded as one that would have failed. The degree to which the projects were successful were also calculated based on the replies provided by the consultants. The Overall Success calculated by the Consultant Advisory System was 94% for the first project and 93% for the second project.

As argued earlier, it is difficult to validate the accuracy of an independent measure of success given by a consultant. The important points are; (i) the Consultant Advisory System had considered the MINTS project under consideration as a success, and (ii) the success of the MINTS project as calculated by the Consultant Advisory System was very high (about 90%), and this matched the view of each consultant who regarded the MINTS project under assessment as extremely successful.

The consultants were asked to make comments on the degree of meaningfulness of the questions. They reported no difficulty in understanding and relating to the questions. This was further supported by the fact that none of the consultants asked the researcher any question, while running the Consultant Advisory System. After the initial instructions as to how to use the Consultant Advisory System, the consultants were left to themselves to carry on answering the questions. However, the researcher was present while the

Consultant Advisory System was run and both consultants had been asked to refer to the researcher in case of any difficulties with the system.

It needs to be stated that the researcher was not able to carry out a more rigid validation of the Consultant Advisory System. A more detailed validation can be carried out by checking the results produced by the system against a consultant's opinion at lower levels of the model of success. For example, how satisfied each key actor is with a MINTS project, or how the user-friendliness of a MINTS project is viewed by a consultant and so on.

Further validation can also be carried out for a range of MINTS projects with different likelihood of success. But this is a major task, and a major difficulty is identifying such projects.

(d2) Predictive validation

Predictive validation refers to the capability of a model or a measure to predict the future. In other words, the model is run to produce data about the future. However, to check the validity of the model, there must be an elapsed period of time, the real system offering results which can then be compared with the results produced by the model.

Exposing the Consultant Advisory System to a predictive validation in terms of predicting the future proved impractical. This was because, firstly MINTS are evolutionary systems and secondly the environment within which a MINTS is built is very dynamic and unpredictable. By definition, therefore, the real world as far as a MINTS is concerned produces different results at different points in time. Any prediction by the Consultant Advisory System about the success/failure of a MINTS may be very different from that produced by the real world in some point in the future simply because the circumstances may have changed drastically. Indeed, as argued in chapter 7, the Consultant Advisory System measure the success/failure likelihood of a MINTS project based on the degree to which the success factors are satisfied at the time. Moreover, a consultant using the Consultant Advisory System is expected to modify his replies as and when he notices changes in the MINTS environment under consideration.

(d3) Objectivity

In the case of the field validation, the researcher holds the view that the issue of objectivity was taken into consideration. Firstly, the case study in which the consultant was previously involved formed only part of the success model. Secondly, it was the first time that the consultant had seen the Consultant Advisory System.

Moreover, the consultant was asked to run the system for two MINTS projects, one failed and one successful. Prior to running the system he had been asked to state the reasons for the failed project, as well as giving his opinion of the likelihood of success for the project which was viewed as successful.

(d4) Systematic variance

The researcher took a number of steps to reduce the systematic variance in the Consultant Advisory System. Firstly, as already explained, he tried to further define some of the success factors in order to reduce the complexity in asking a question regarding such factors, also taking into account the concept of orthogonality.

Secondly, the set of replies provided to each questions were designed in such a manner as to make it possible for the respondents to make a clear distinction between the replies available. This would reduce the chance of the respondents choosing a different reply when using the Consultant Advisory System for a second or third time.

Thirdly, it was felt that the chance of a consultant introducing systematic variance when assigning importance and performance scores to the success factors was more than that of the researcher himself. The reasons against a consultant scoring the importance and performance of the success factors were; time pressure, having interests in making the project a success, not being familiar with the internal operation of the Consultant Advisory System and how the calculations are carried out, and not having considered other MINTS projects. The researcher felt justified to assign the importance and performance scores himself because of the reasons explained in Chapter 7. Moreover, it must be stated that it is common practice that when using a Likert scale, both the range of numeric values and the choice of semantic values are decided upon by the researcher. The respondents are asked to select their replies based on the semantic values provided for the questions.

7.1.7 Useability

Sell [153] has used usability as an element of his validation framework. The same approach has been adopted by O'Leary [126] who deals with the issue of useability under the heading of cost/benefit in his validation framework. The researcher, has also taken the view that useability requires special attention. When building a system, it is important that the system is of practical use and of value to its

user, else it would not be used at all. Measures must, therefore, be taken into consideration in building a useable system.

The researcher took the following steps to improve the useability of the Consultant Advisory System;

(e1) Time required to run the system

If the Consultant Advisory System is to be used by a consultant it is important that it does not take a long time for the consultant to review the success model and obtain results. This was checked in two different ways.

Firstly, the number of questions within the Consultant Advisory System was minimized. For example, a rule adopted was that the lower the importance value of a parent success factor the fewer the child factors for the parent factor, and hence fewer questions asked.

Secondly, much consideration was paid to make the questions very simple to understand, thus reducing the time taken to answer the questions.

Thirdly, as discussed in chapter 6, an average maximum time limit of 20 seconds was assumed by the researcher for answering each question and this was multiplied by the number of the questions within the Consultant Advisory System. Based on this the system was assumed to take about a maximum 90 minutes. However, as the Consultant Advisory System deals with the whole process of a MINTS project, it is often not possible for a consultant to know the answers to all the questions, especially in the early stages of the project. This does not, however, mean that the rest of the success model cannot be reviewed. In fact the success model can be reviewed in any order, as an automatic and manual facility is provided within the Consultant Advisory System to offer control in the way the system operates. Moreover, a "not known" reply is provided for each question, to allow a consultant to know which questions have not been answered. The index and search facilities within the Consultant Advisory System can be used to immediately find such questions when the answer is unknown.

It is important to point out that the pre-specified replies to each question appear in one single table for selection of the appropriate reply, rather than individually which would take more time.

During the field validation, the running time of the Consultant Advisory System was checked, which was 55 minutes. This was well below the maximum time assumed.

A further point which needs to be considered is that a consultant, in real life, needs to review the Consultant Advisory System a number of times throughout a MINTS project. This is because he may not know the answers to a number of questions, which means that it takes him less time running the system at the initial review, and much less time during the later reviews as fewer questions need to be answered.

(e2) Acceptance of results by experts

During the field research, the consultants who ran the Consultant Advisory System were asked to state their overall view of the results produced by the Consultant Advisory System. The consultants showed complete agreement with the results produced by the Consultant Advisory System. In fact they were quite impressed with the Consultant Advisory System which had, in the case of the failed project, identified additional reasons why the project was a failure, and issued the warning during the initial stage of 'Ensuring a Right Environment'.

Again, due to time constraints, the objective was not to carry out a rigorous test on the results produced for the individual success factors.

(e3) Userfriendliness

The Consultant Advisory System is a userfriendly system because of the following;

- (i) only about 10 minutes training is needed to familiarise with the Consultant Advisory System.
- (ii) it is menu driven and no programming is required.
- (iii) there is limited use of the keyboard: only function keys are needed to be used.
- (iv) there is an on-line help facility.
- (v) presentation is simple.
- (vi) there are automatic and manual operation modes
- (viii) there is an automatic reporting facility, by subject and options.

Referring to the field validation, the consultants who ran the Consultant Advisory System were given few minutes of instruction as to how to use the system. The fact that they did not refer to the researcher for help, while running the system, meant that they were happy using the system. The consultants also stated that the system was very userfriendly, as they were required to use very few keys, and because the screen displays were self explanatory.

CONCLUDING REMARKS

Concluding Remarks:

Summary and Conclusions

Many studies have been undertaken to identify the factors contributing to the success of a computer-based information system. However, there is a great deal of confusion and disagreement as to the different measures of success adopted by these studies and the results obtained in terms of the contributory success factors. One problem is definitional. Although a number of studies have purported to have measured the success of a DSS, they may have measured the success of an MIS. The term DSS has been used to refer to any system that provides support in decision making. Moreover, these studies have measured success from a product viewpoint, with the success of a system measured after implementation.

This research was undertaken to clarify some of the definitional and measurement problems in the area of computer-based information systems. After some investigation, the research focused on investigating the factors of success throughout the process of a class of DSS called MINTS. A 'Consultant Advisory System', a computerised model of success, was built to assist internal consultants in assessing the likelihood of success for a MINTS project. The Consultant Advisory System identifies areas of concern throughout the course of a MINTS project which might lead to a low likelihood of success for the project, so that corrective action can be taken.

Since all computer-based information systems can in different ways provide support in the decision-making process, the researcher was led to the view that the term 'Decision Support System' was too general and could legitimately be applied to any such systems. The crucial element of DSS lies in the type of support it offers its user. The term DSS is, therefore, used in this study in a general sense to refer to all systems that help in dealing with any part or stage of a decision problem.

The researcher regards the type of support provided by an MIS to be in the form of producing "alerting information". Such "alerting information" is overwhelmingly "hard" information, as to how an organisation has performed at the operational level in the past, and how it is performing currently. The information produced is mainly from an organisational perspective, and which is not intended to assist a decision-maker in how to deal with the problem.

MINTS, on the other hand, produce "Intelligence", which is the interpretation obtained from the meshing and reconciliation of a set of information carrying inferences. This information can be "soft" and/or "hard", coming from an internal and/or external sources, and with different time horizon (present and future). Intelligence is specific

CONCLUDING REMARKS

rather than general; in the sense that it is related to a specific problem within a decision-maker's scenario. This means that "intelligence" is context dependent; in that it is obtained as a result of investigating and analysing a specific problem and interpreting the consequences of the different ways of tackling that problem within a decision-maker's scenario.

The researcher has chosen the term "MINTS" for that type of system that provides support in dealing with a decision issue, which is inherently somewhat unstructured, in specific terms, and which necessitates valuable judgemental input from the part of the decision-maker in dealing with it. This implies that the area of concern is neither completely unstructured, nor completely structurable. In other words, the prime application of a MINTS is to bring some degree of structuredness to decision problems that are partly unstructured.

Although for the purpose of building the Consultant Advisory System, the emphasis is on a computer-based MINTS, A MINTS can be a system that acts as a focus - for thought or debate - and promotes learning and compromise by reducing uncertainty in the nature of a decision issue as well as means of tackling the decision issue.

The different characteristics of EDP, MIS and MINTS were compared in Chapter 4. In the same chapter, a breadboarding (an adaptive and evolutionary) approach was discussed as a most suitable way of developing and implementing MINTS. Different key actors were also identified in this chapter with whom a consultant needs to establish and maintain a good working relationship for a successful project.

Based on a literature survey, a list of contributory success factors was identified. The list of factors were used in building an initial model of success which was organised using a hierarchical tree structure approach. It was the aim of the research to identify which factors from this list was applicable to MINTS. Based on 39 field studies, the initial model of success was modified as feedback was obtained from the field and a better understanding of the MINTS was obtained. This meant that certain factors were removed and others added to the model of success. Moreover the structure of the model of success underwent a number of changes. Eventually, about 280 contributory success factors were identified, 51 of which were regarded as critical, and formed the model of success. A critical factor is regarded as one which can lead, if not above a certain level, to an overall MINTS project's failure. The model of success used in the Consultant Advisory System was shown in Table 5.5.

In building the Consultant Advisory System, some MINTS and Expert System generators were evaluated based on a set of criteria. A software package called Dejavu satisfied the

CONCLUDING REMARKS

requirements and was used for computerising the model of success. A Likert scale is used as a method of eliciting a consultant's perception of the factors affecting the success/failure of a MINTS project. The measurement technique is a weighted average technique which is based on a multiplicative/non-linear approach. In other words, unlike an additive approach, the success factors are not considered in isolation, but their effects on each other is also taken into consideration.

In defining the success of a MINTS project, a process approach as opposed to a product approach was adopted. Particular emphasis was given to the political/psychological environment of a MINTS. The success of a MINTS project was defined in terms of accomplishing two stages of a MINTS project; (A) Ensuring a right environment - including establishing relationships, and (B) Maintaining relationships. Each of the two stages was further divided into sub-stages, which meant that the contributory success factors were organised in a tree structure format for the purpose of representation and measurement.

The above two stage development approach to MINTS is based on a breadboarding approach. Unlike EDP or MIS, the development and implementation stages of a MINTS take place concurrently. This is because the type of problems for which MINTS are designed is very different from those of EDP and MIS. By definition, MINTS deal with semistructured to unstructured problems, where the user requirements can not be prespecified clearly and in detail. It is a function of MINTS to help the system user to define his problem, as he usually has trouble describing his decision-making process and rely on conceptualization. Moreover, the system user is unlikely to have a detailed understanding of the total problem area facing him. In this case, only a portion of the total problem can be defined at a time. This means that an adaptive and evolutionary development approach is required as opposed to a traditional system approach with rather clearly defined phases.

The researcher undertook a number of steps in improving the validity of the Consultant Advisory System. A validation framework was offered, within which the advisor was validated. Once a working version of the advisor was available, further field validation was carried out. The content and structure of the model of success were seen by the consultants interviewed as appropriate and representative of the process they go through in building a MINTS. In terms of criterion validation, the Consultant Advisory System was tested using three MINTS projects. The results produced by the advisor matched very closely the perception of the consultants as to the success of their MINTS projects. However, further and more rigid validation of the Consultant Advisory System was not possible due to time constraints and obtaining access to consultants.

CONCLUDING REMARKS

The key actors in the successful development of MINTS were found to be; system user, intermediary, system user's immediate superior, sponsor, custodians of information, and supporting political actors. It was found that there existed no such key actor as a MINTS champion.

It was also found that when a MINTS offers the system user or the intermediary the capability and flexibility to deal with more than a single decision problem, there was a more creative use of the MINTS. This was the case when the system users or the intermediaries were offered a MINTS generator, rather than a rigidly specified MINTS.

Further Research

a) Validation

Due to time constraints and difficulty in obtaining access to consultants, the Consultant Advisory System was not rigidly tested. A more detailed validation can be carried out by checking the results produced by the system against a consultant's opinion at lower levels of the model of success. For example, how satisfied each key actor is with a MINTS project, or how the user-friendliness of a MINTS project is viewed by a consultant and so on.

Further validation can also be carried out for a range of MINTS projects with different likelihood of success. But this is a major task, and a major difficulty is identifying such projects.

b) MINTS for Group Decision Making

The Consultant Advisory System was not designed to deal with MINTS that provide support in group decision-making. A potential area of research would be to consider the application of the Consultant Advisory System to MINTS built for group decision making. An advantage of the Consultant Advisory System is that it can be used as a computerised questionnaire for future research.

c) Longitudinal Study

Further research could be carried out in applying the Consultant Advisory System to assessing the success of a number of MINTS projects which are about to be undertaken. One way of doing this would be to identify a group of consultants as participants and provide them with a copy of

CONCLUDING REMARKS

the Consultant Advisory System to run on their own as they go through the stages of the project. Feedback could be collected according to a predefined time table.

REFERENCES

References

- [1] Ackoff R.L. : "The Art and Science of Mess Management", Interfaces, Vol. 11, No. 1, 1981, pp. 22-25.
- [2] Alavi Maryam : "An Assessment of DSS as Viewed by Senior Executives", MIS Quarterly, December 1982,
- [3] Alavi Maryam and Henderson John C. : "An Evolutionary Strategy For Implementing A Decision Support System", Management Science, Vol. 27, No. 11, November 1981, pp. 1309-1323.
- [4] Alloway Robert M. and Quillard Judith A. : "Top Priorities for the Information Systems Function", CISR Working Paper No. 79, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, Massachusetts, September 1981, PP. 1-40.
- [5] Alter Steven. : "Why is Man-Computer Interaction Important for Decision Support Systems?", Interfaces, Vol. 7, No. 2, 1977, PP. 109-115.
- [6] Alter Steven : "Development Patterns for Decision Support Systems", MIS Quarterly, Vol. 2, No. 3, Sept. 1978, PP. 33-42.
- [7] Alter Steven : "A Taxonomy of Decision Support Systems", Sloan School of Management, Fall 1987, PP. 39-56.
- [8] Alter Steven : "Implementation Risk Analysis", TIMS studies in the Management Sciences 13 (1979), PP. 103-119.
- [9] Alter Steven : "Decision Support Systems: Current Practice and Continuing Challenges", Addison-Wesley, Reading, Mass. 1980.
- [10] American Psychological Association : "Standards for Educational and Psychological Tests". Washington: American Psychological Association, 1974.
- [11] Anderson N.H. and Shanteau J.C. : "Weak Inference with Linear Models", Psychological Bulletin", 1984, PP. 1135-1170.
- [12] Anderson N.H. : "Foundations of Information Integration Theory", New York: Academic Press, 1981.
- [13] Andriole S. : "The Design of Microcomputer-Based Personal Decision-Aiding Systems", IEEE Transactions on Systems, Man, and Cybernetics, SMC-12, 1982, PP. 463-469.

REFERENCES

- [14] Bailey J.E. and Pearson S.W. : "Development of a Tool for Measuring and Analysing Computer User Satisfaction", *Management Science*, Vol. 29, No. 5, May 1983, PP. 530-545.
- [15] Baroudi Jack J., Olson Margretge H., and Ives Blake : "An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction", *Communications of the Association for Computing Machinery (ACM)*, Vol. 29, No. 3, March 1986, PP. 232-238.
- [16] Bean A.S., Neal R.D., and Radnor M. : "Structural and Behavioral Correlates of Implementation in U.S. Business Organisations, in *Implementing Operations Research/Management Science*, Schultz R. and Slevin D.P. (eds.), American Elsevier, New York, 1975.
- [17] Belohlav J.A. and Raho L.E. : "Successful Planning in the Management Information Maze", *Managerial Planning*, May-June, 1984, PP. 30-3,37.
- [18] Belson William A. : "Validity in Survey Research", Gower Publishing Company, 1986.
- [19] Bennett John L. : "Building Decision Support Systems", Reading, MA: Addison-Wesley Publishing Co., 1983.
- [20] Bohrnstedt, G. W. : "Reliability and validity assessment in attitude measurement", PP. 80-89 in G.F. Summers (ed.), *Attitude Measurement*. Chicago: Rand McNally, 1970.
- [21] Boland R.J. Jr., : "The Process and Product of System Design", *Management Science*", Vol. 24, No. 9 (1978), pp. 887-898.
- [22] Bonczek Robert H., Holsapple Clyde W. and Whinston Andrew B. : "The Evolving Roles of Models in DSS", *Decision Sciences*, Vol. 11, No.2, 1980, PP. 339-356.
- [23] Bonczek Robert H., Holsapple Clyde W. and Whinston Andrew B.: "Representing Modelling Knowledge with First Order Predictive Calculus", *Operations Research*, forthcoming.
- [24] Brabander B. De and Thiers G. : "Successful Information System Development In Relation To Situational Factors Which Affect Effective Communication Between MIS-Users and EDP-Specialists.
- [25] Bradgen , Hubert E, and Erwin K. Taylor : "The Theory and Classification of Criterion Bias", *Educational and Psychological Measurement*, Vol. 10, Summer, 1950, PP. 159-186.

REFERENCES

- [26] Brinberg David and McGrath Joseph E. : "Validity and the Research Process", SAGE Publications, 1985.
- [27] Brookes C.H. P. : "Guidelines for Developing Effective Decision Support Systems", Department of Information Systems, University of New South Wales, Australia. (Date unknown).
- [28] Brown M. : "DSS for Micro and Mainframe", Data Processing, Vol 26, No. 1, 1984, p. 23.
- [29] Bruggere T.H. : "Business Graphics: Making Computers Work for Management", Proceedings IEEE Computer Software and Applications Conference, 1978, P. 744.
- [30] Carlin J.W. : "A Steering Committee for Equal Representation", Management World, April 1978, PP. 32-33.
- [31] Carlson Eric. D. : "An Approach For Designing DSS", in Building Decision Support Systems, by John L. Bennett, Addison-Wesley Publishing Company, Reading, Massachusetts, 1983, PP. 15-41.
- [32] Carlson Walter M. : "A Management Information System Designed by Managers", Datamation, Vol. 13, No. 5, May 1967, pp. 37-43.
- [33] Cata-Baril William L. and Huber George P. : "Decision Support Systems For Ill-Structured Problems: An Empirical Study", Decision Sciences, Vol 18. 1987, PP. 351-371.
- [34] Checkland P.B. : "Systems Thinking; Systems Practice", John Wiley and Sons, 1981.
- [35] Cheney P.H. and Dickson G.W. : "Organisational characteristics and information systems: An exploratory investigation," Academy of Management Journal, Vol. 25, No.1, March 1982, PP. 170-184.
- [36] Cheriton D.R. : "Man-Machine Interface Design for Time-Sharing Systems", in Proceedings of the Association for Computing Machinery National Conference, New York, 1976, PP. 362-380.
- [37] Currie L.A. and Devoe J.R. : "Systematic Error in Chemical Analysis", in "Validation of the Measurement Process" by Devoe J.R., ACS Symposium Series 63, 1977.
- [38] Damodaran Leela : " User Involvement in System Design: How to Make Sure Users Get the System and Support They Need", Data Processing, Vol. 25, No. 6, July/August 1983, PP. 6-13.

REFERENCES

- [39] Davis R. : "Reasoning from first principles in electronic troubleshooting", International Journal of Man-Machine Studies, Vol. 19, 1983, pp. 403-423.
- [40] Davis R. : "Diagnostic Reasoning based on structure and behavior", Artificial Intelligence, 1984, Vol. 24, pp. 347-410.
- [41] Doll William J. : "Avenues for Top Management Involvement in Successful MIS Development", MIS Quarterly, March 1985, PP. 17-35.
- [42] Doll William J. and Ahmed M.U. : "Diagnosing and Treating the Credibility Syndrome", MIS Quarterly, Vol. 7, No. 3, Sept. 1983, PP. 21-32.
- [43] Donovan J.J. and Madnick S.E.: "Institutional and Ad Hoc Decision Support Systems and Their Effective Use", Data Base, Vol. 8, No. 3, Winter 1977, pp. 79-88.
- [44] Drucker P.F. : "Management Tasks, Responsibilities, Practices", Heinemann, London, 1974.
- [45] Earl M. J. : "Management Information Systems and Management Accounting" - a MISalliance", In Thompson J.D. et al. (eds.), Comparative Studies in Administration, University of Pittsburgh Press, 1959.
- [46] Eason K.D. : "Understanding the Naive Computer User", Computer Journal, Vol. 19, 1976, PP. 3-7.
- [47] Edleman F. : "Managers, Computers, and Productivity", MIS Quarterly, Vol. 5, No. 3, September 1981, PP. 1-19.
- [48] Edstrom A. : "User Influence and Success of MIS projects", Human Relations, Vol. 30 (1977), pp. B550-B561.
- [49] Ein-Dor Phillip and Segev Eli : "A Paradigm for Management Information Systems", New York: Praeger Publications, 1981.
- [50] Ein-Dor Pillip and Segev Eli : "Information System Responsibility", MSU Business Top, Vol. 25, No. 3, Autum 1977.
- [51] Ein-Dor Phillip and Segev Eli : "Organisational Context and the Success of Management Information Systems", Management Science, Vo. 24, No. 10, PP. 1064-1077, June 1978.
- [52] Finlay Paul N. and Wilson John M. : "The Paucity of Model Validation in Operational Research Projects", Journal of Operational Research Society, Vol. 38, No. 4, 1987, PP. 303-308.

REFERENCES

- [53] Finlay Paul N., Forsey Gareth J. and Wilson John M. : "The Validation of Expert Systems - Contrasts with Traditional Methods", Journal of Operational Research Society, Vol. 39, No. 10, 1988, PP. 933-938.
- [54] Finlay Paul .N., Forghani Morteza S., and Wilson John M.: "A Logical Way of Controlling the Cost of Data Acquisition", British Accounting Review, Vol. 19, 1987, PP. 123-132.
- [55] Finlay Paul N. and Forghani Morteza S. : "The Concept of Management Intelligence Systems", Journal of Applied Systems Analysis", Vol. 14, 1987, PP. 41-51.
- [56] Foley J.D. : "The Human Factors-Computer Graphics Interface", In Symposium Proceedings, Human Factors and Computer Science, Washington, D.C.: Protomac Chapter of the Human Factors Society, June 1, 1978, PP. 103-114.
- [57] Freyenfeld W.A. : "Decision Support Systems", NCC Publications, 1984, PP. 9-12.
- [58] Fuerst W.L. : "Characteristics Affecting DSS Usage", National AIDS Conference Proceedings, 1979, P. 172.
- [59] Fuerst William L. and Martin Merle P. : "Effective Design And Use Of Computer Decision Models", MIS Quarterly, March 1984, PP. 17-25.
- [60] Garrity, John T. : "Top Management and Computer Profits", Harvard Business Review, Vol. 41, No. 4, July-August 1963, pp. 6-12, 172-174.
- [61] Gass Saul : Operational Research Society, , speaker in a one-day national event, University of Sheffield, 12 January 1983.
- [62] Gibson H.L. : "Determining User Involvement", Journal of Systems Management, August 1977, PP. 20-22.
- [63] Ginzberg Michael J. : "DSS Success: Measurement and Facilitation", Center for Research On Information Systems. Working Paper No. 20, NYU, 1981b.
- [64] Ginzberg Michael J.: "Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions", Management Science, Vol. 27, No. 4, 1981a, pp. 459-478.
- [65] Ginzberg M.J. "Redesign of Managerial Tasks: A Requisite for Successful Decision Support Systems", MIS Quarterly, Vol. 2, No. 7, March 1978, pp.39-52.
- [66] Ginzberg Michael J. : "Key Recurrent Issues in the MIS Implementation Process", MIS Quarterly, June 1981, PP. 47-59.

REFERENCES

- [67] Ginzberg M. J. : "A Process Approach to Management Science Implementation", Ph.D. dissertation, M.I.T., 1975.
- [68] Ginzberg M.J. "An Organisational Contingencies View of Accounting and Information Systems Implementation", Accounting, Organisations and Society, Vol 5, No. 4, 1980, PP. 369-382.
- [69] Ginzberg Michael J. and Stohr Edward A. : "Decision Support Systems: Issues and Perspectives", Decision Support Systems, Ginzberg Michael J., Reitman W. and Stohr Edward A. (eds.), North-Holland Publishing Company, DSS, 1982, PP. 9-31.
- [70] Green Paul E., Tull Donald S. and Albanm Gerlad : "Research for Marketing Decisions", Prentice-Hall International Editions, 1988, PP. 240-313.
- [71] Hall J.A. : "Management Information Systems", Management Accounting", Vol. 12, December 1983, P. 69.
- [72] Hall J.A. : "Management Information Systems", Management Accounting", Vol. 10, July 1983, P. 23.
- [73] Hamilton S. and Chervany N.L. : "Evaluating Information Systems Effectiveness", MIS Quarterly, Vol. 5, No. 4, December 1981, PP. 79-86.
- [74] Henderson J.C. and Ingraham R.S. "Prototyping for DSS: A Critical Appraisal", Proceedings of the NYU Symposium on DEcision Support Systems, New York, May 21-22, 1981.
- [75] Henderson John C., and Ingraham Robert S. : "Prototyping For DSS: A Practical Appraisal", in Decision Support Systems by Ginzberg M.J., Reitman W., and Stohr E.A., North Holland Publishing Company, DSS 1982, PP. 79-96.
- [76] Henderson John C, and Alavi Maryam : "An Evolutionary Strategy For Implementing A Decision Support System", Management Science, Vol. 27, No. 11, November 1981, PP. 1309-1323.
- [77] Hoffman P.J., Slovic P. and Rorer L.G. : "AN Analysis of Variance Model for the Assessment of Configural and Utilization in Clinical Judgment", Psychological Bulletin 69, pp. 338-349, 1968.
- [78] Holsapple C.W. and Whinston A.B. " A Decision Support System for Are-wide Water Quality Planning", Socio-Economic Planning Sciences, Vol 10, 1976.
- [79] Hopkinson John : "Prototyping in Computer Systems Development", Management Services, December 1986, pp. 18-21.

REFERENCES

- [80] Huber George : "Managerial Decision Making", Glenview, Illinois: Scott. Foresman and Company, 1980.
- [81] Ives Blake, Hamilton Scott and Davis Gordon : "A Framework for Research in Computer-Based Management Information Systems", Management Science, Vol. 26, No. 10, 1980, PP. 910-933.
- [82] Ives Blake, Olson Margrethe H. and Baroudi Jack J. : "The Measurement of User Information Satisfaction", Communications of the ACM, Vol. 26, No. 10, October 1983, PP. 785-793.
- [83] Ives Blake and Olson Margrethe H. : "User Involvement and MIS Success: A review of Research", Management Science, Vol. 30, No. 5, May 1984, PP. 586-603.
- [84] Johnson G. and Scholes K. : "Exploring Corporate Strategy", Prentice-Hall International, 1984.
- [85] Kaiser K.M. and Srinivasan A. : "The Relationship of User Attitudes Toward Design Criteria and Information System Success", Proceedings of the National AIDS Conference, November 1980, PP. 201-203.
- [86] Keen Peter G.W.: "Computer-based Decision Aids: The Evaluation Problem", Sloan Management Review", Vol. 16, Spring 1975, PP. 17-29.
- [87] Keen Peter G.W. : "Decision Support Systems: A Modest Proposal", Sloan Management Review, Vol. 18, No. 1, 1976, PP. 1-17.
- [88] Keen Peter G.W. "Adaptive Design for DSS", Data Base, Vol. 12, Nos. 1 & 2, Fall 1980.
- [89] Keen Peter G.W. : "Decision Support Systems: A Research Perspective", in Decision Support Systems: Issues & Challenges", Pergamon Press, Oxford, England, 1981.
- [90] Keen Peter G.W. : "Value Analysis: Justifying Decision Support Systems", MIS Quarterly, March 1981, PP. 1-15.
- [91] Keen Peter G. W. and Scott-Morton M.S. : "Decision Support Systems: An Organisational Perspective", Addison-Wesley, Reading, Mass., 1978.
- [92] Keim Robert T.: "Assessing Implementation Attitudes in Traditional Versus Behavioural Model Building: A Longitudinal Investigation with the MAPS Design Technology", Unpublished PhD. Dissertation, University of Pittsburg, 1976.
- [93] Kerlinger F. : "Foundations of Behavioral Research", New York: Holt, Rinehart & Winston, 1973.

REFERENCES

- [94] King William R. and Rodriguez Jamie I. : "Evaluating MIS", MIS Quarterly, Vol. 2, No. 3, Sept. 1978, PP. 43-52.
- [95] Landry M., Malouin K.L. and Oral M. : "Model Validation in Operations Research", Eur. J. Opl Res. Vol 14, 1983, PP. 207-220.
- [96] Leonard Adelman : "Involving Users in the Development of Decision-Analytic Aids: The Principal Factor in Successful Implementation", Journal of Operational Research Society, Vol. 33, 1982, PP. 333-342.
- [97] Lewin K. : "Group Decision and Social Change", Readings in Social Psychology, T.M. Newcomb and E. L. Hartley (eds.), Holt, New York, 1947, pp. 330-344.
- [98] Little J.D.C. " Models and Managers: The Concept of A Decision Calculus", Management Science, Vol 16, No. 8, April 1970, PP. B466-B485.
- [99] Lonnstedt L. : "Factors Related to the Implementation of Operations Research Solutions", Interfaces, Vol. 5, No. 2, 1975, PP. 23-30.
- [100] Lovie Alexander : "Multiple Cue Person Perception", In Issues in Person Perception, edited by Cook Mark, 1984, PP. 87-113.
- [101] Lucas Henry C.: "Empirical Evidence for a Descriptive Model of Implementation", MIS Quarterly, Vol. 2, 1978, PP. 27-41.
- [102] Lucas H.C. : "Information System Concepts for Management", 2nd edition, McGraw-Hill, New York, New York, 1982.
- [103] Lucas H.C. Jr. : "System Quality, User Reactions, and the Use of Information Systems", Management Informatics, Vol. 3, No. 4, 1974, PP. 207-212.
- [104] Lucas H.C. Jr. : "Behavioural Factors in System Implementation", in R.L. Schultz and D.P. Slevin (Eds.), Implementing Operations Research/Management Science, American Elsevier, New York, 1975.
- [105] Lucas H.C., Jr.: "The Implmentation of Computer-Based Models", National Association of Accountants, New York, 1976.
- [106] Lucas H.C., Jr.: "The Use of an Interactive Information Storage and Retrievan in Medical Research", Comm. ACM, Vol. 21 (1978), PP. 197-205.

REFERENCES

- [107] Lucas H.C., Jr.: "Empirical Evidence for a Descriptive Model of Independence/Dependence", J. Accounting Res. Vol. 11, 1973 supplement, PP. 191-201
- [108] Lucas Henry C. Jr. : "Performance and the Use of an Information System", Management Science, Vol. 21, No. 8, April 1975, PP. 908-919.
- [109] Maish A.M. : "A User's Behaviour Toward his MIS", MIS Quarterly, Vol. 3, No. 1, March 1979, PP. 39-52.
- [110] Martin E.W. : "Critical Success Factors of Chief MIS/DP Executives", MIS Quarterly, Vol. 6, No. 2, June 1982, PP. 1-9.
- [111] Mason R.O. and Mitroff I. : "A Program for Research on Management Information Systems", Management Science, Vol. 19, No. 5, 1973, PP. 475-487.
- [112] Mason R.E.A. and Carey T.T.: "Prototyping Interactive Information Systems", Communications of the ACM, Vol. 26, No. 5, May 1983, pp. 347-354.
- [113] McKeen J.D. and Guiraraes Tor : "Selecting MIS Projects By Steering Committee", Communications of the ACM, Vol. 28, No. 12, December 1985, PP. 1344-1352.
- [114] Meador Lawrence C., Guyote Martin J. and Keen Peter G.W. : "Setting Priorities for DSS Development", MIS Quarterly, June 1984, PP. 117-129.
- [115] Miller J. and Doyle B.A. : "Measuring the Effectiveness of Computer-Based Information Systems in the Financial Services Sector", MIS Quarterly, March 1987, PP. 107-124.
- [116] Miller R.B. : "Human ease of use criteria and their tradeoffs. TR 00.2185. Poughkeepsie, N.Y.: IBM Corporation, April 12, 1971.
- [117] Mitroff I.I., Betz F., Pondy L.R., and Sagasti F. : "On Management Science in the Systems Age: Two Schemes for the Study of Science as a Whole Systems Phenomenon", Interfaces, Vol. 4, No. 3 (1974), pp. 46-58.
- [118] Moore Jeffrey H. and Chang Michael G.: "Meta-Design Considerations in Building DSS", in Building Decision Support Systems, edited by John L. Bennett, Reading, MA: Addison-Wesley Publishing Co., 1983, PP. 173-204.
- [119] Murdick R.G. : "MIS Development Procedures", Journal of Systems Management, Vol. 21, No. 12, December 1970, PP. 22-26.

REFERENCES

- [120] Murray Thomas J. : "Data, Information and Intelligence in a Computer Based Management Information System", Journal of Applied Systems Analysis", Vol. 6, 1979, PP. 101-105.
- [121] Naylor T.H. : "Decision Support Systems or Whatever Happened to M.I.S.?", Interfaces, Vol 12, No. 4, 1982, PP. 92-94.
- [122] Nolan R.L. : "Managing Information Systems by Committee", Harvard Business Review, Vol. 60, No. 4, July-August 1982, PP. 72-79.
- [123] Nolan R.L. and Wetherbe J.C.: "Towards a Comprehensive Framework for MIS Research", MIS Quarterly, Vol. 4, No. 2, 1980, PP. 1-19.
- [124] Norgaard B. : "Pitfalls to Avoid With Modelling Languages", Management Decision, Vol. 22, No. 2, 1984, PP. 25-30.
- [125] O'Keef Robert M., Balci Osman and Smith Eric P. : "Validating Expert System Performance", IEEE Expert, Winter 1987, PP. 81-90.
- [126] O'Leary Daniel E. : "Validation of Expert Systems - With Applications to Auditing and Accounting Expert Systems", Decision Sciences, Vol. 18, 1987, pp. 468-486.
- [127] Organ Dennis and Hamner Clay : Organisational Behaviour: An Applied Psychological Approach, Plano, Texas: Business Publications, Inc., 1982.
- [128] Osgood C.E. : "Studies on the Generality of Affective Meaning Systems", American Psychology, Vol. 17, No. 1, January 1974, PP. 10-28.
- [129] Phelps R. I. : "Artificial Intelligence - An Overview of Similarities with OR", J. Opl Res. Soc., Vol. 37, pp. 13-20, 1986.
- [130] Powers R.F., and Dickson G.W. : "MIS Project Managment: Myths, Opinions, and Reality", California Managment Review, Spring 1973, PP. 147-156.
- [131] Radnor M. and Bean A.S. : "Top Management Support for Management Sciences", Omega, Vol. 2, No. 1, 1974, PP. 63-75.
- [132] Raymond Louis : "Organisational Characteristics and MIS Success in the Context of Small Business", MIS Quarterly, March 1985, PP. 37-52.
- [133] Reddy Y.V. : "The Role of Introspective Simulation in Managerial Decision-Making".

REFERENCES

- [134] Robey D. and Farrow D. : "User Involvement In Information System Development: A Conflict Model and Empirical Test", Management Science, Vol. 28, No. 1, 1982, PP. 73-85.
- [135] Robey Daniel and Markus M. Lynne: "Rituals in Information System Design", MIS Quarterly, March 1984, pp. 5-15.
- [136] Robey D. and Farrow D. : "Information System Development: Some Dynamics of User Involvement", National AIDS Conference Proceedings, Nov. 1979, PP. 149-151.
- [137] Robey D. : "Attitudinal Correlates of MIS user", Proceedings, National AIDS Meeting, Vol. 10, 1978, PP. 170-172.
- [138] Robey D and Zeller R.F. : "Factors Affecting The Success and Failure of an Information System for Product Quality", Interfaces, Vol. 8, No. 2, 1978, PP. 70-78.
- [139] Robey Daniel : "User Attitudes and Management Information Use", Academy of Management Journal, Vol. 22, No. 3, 1979, PP. 527-538.
- [140] Rockart J.F. : "The Changing Role of the Information Systems Executive : A Critical Success Factor Perspective", Sloan Management Review, Vol. 24, No. 1, Fall 1982, PP. 3-13.
- [141] Rockart J.F. : "Chief Executives Define Their Own Needs", Horward Business Review, Vol. 57, No. 2, March-April 1979, PP. 81-93.
- [142] Rossi, Peter H., Wright James D. and Anderson Andy B.: "Handbook of Survey Research", Academic Press, New York, London, 1983, PP. 97-115.
- [143] Sackman H. : "Advanced Research in Online Planning", in H. Sackman and R.L. Citrenbaum (Eds.), Online Planning: Towards Creative Problem Solving. Prentice-Hall, Englewood Cliffs, N.J., 1972.
- [144] Sanders G.L.: "MIS/DSS Success Measure", Systems, Objectives, Solutions, Vol. 4, 1984, PP. 29-34
- [145] Sanders G. Lawrence and Courtney James F. : "A Field Study of Organisational Factors Influencing DSS Success", MIS Quarterly, March 1985, PP. 77-89.
- [146] Schatzman Leonard and Strauss Anslem L. : "Field Research : Strategies for a Natula Sociology", Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1973.

REFERENCES

- [147] Schein E. H. : "Management Development as a Process of Influence", *Industrial Management Rev.*, Vol. 2, No. 2 (1961), PP. 59-77.
- [148] Schewe Chalres D. : "The Management Information System User: An Exploratory Behavioural Analysis", *Academy of Management Journal*, Vol. 19, No. 4, 1976, PP. 577-590.
- [149] Schewe C.D., Wiek J.L. and Dann R. : "Advanced Marketing Information Systems: AN Empirical Investigation of System User Problems", *Proceedings, AIDS National Meeting*, Vol. 6, 1974, PP. 356-359.
- [150] Schmitt John W., and Kozar Kenneth A. : "Management's Role In Information System Development Failures: A Case Study", *MIS Quarterly*, June 1978, PP. 7-16.
- [151] Schultz R.L. and Slevin D.P. : "Implementation and Organisational Validity: An Empirical Investigation", *Implementing Operations Research/Management Science*, New York, American Elsevier, 1975, PP. 153-182.
- [152] Scott Morton.
- [153] Sell P.S.: "Expert Systems: A Practical Introduction", Macmillan, London, 1985.
- [154] Senn James A. : "Essential Principles of Information Systems Development", *MIS Quarterly*, June 1978, PP. 17-26.
- [155] Shanteau James and Nagy Geraldine F. : "Information Integration in Person Perception: Theory and Application", In *Issues in Person Perception*, edited by Cook Mark, 1984, PP. 49-86.
- [156] Simon Herbert A. : "The New Science of Management Decision", Rev. ed., Englewood Cliffs, N.J., Prentice-Hall, 1977.
- [157] Smith H.W. : "Strategies of Social Research: The Methodological Imagination", Second edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, PP. 327-354, 1981.
- [158] Smithin Tim and Eden Colin : "Computer decision support for senior maangers: encouraging exploration", *International Journal of Man-machine Studies*, Vol. 25, pp. 139-152, 1986.
- [159] Sprague R.H. : "A Framework for the Development of Decision Support Systems", *MIS Quarterly*, December 1980, PP. 1-26.
- [160] Sprague R.H. and Carlson E.D. : "Building Effective Decision Support Systems", Prentice-Hall, Englewood Cliffs, N.J., 1982.

REFERENCES

- [161] Srinivasan Ananth : "Alternative Measures of System Effectiveness: Associations and Implications", MIS Quarterly, September 1985, PP. 243-253.
- [162] Stabell Charles B. : "A Decision-Oriented Approach To Building DSS", in "Building Decision Support Systems", Bennett John L. (ed.), IBM Research Laboratory, San Jose, California, Addison-Wesley, 1983, pp.221-259.
- [163] Suchman Edward A. : "Evaluative Research: Principles and Practice in Public Service & Social Action Programs", Russell SAGE Foundation, New York, 1967.
- [164] Swanson E.B. : "Management Information Systems: Appreciation and Involvement", Management Science, Vol. 21, No. 2, October 1974, PP. 178-188.
- [165] Thierauf R.J. : "Decision Support Systems for Effective Planning and Control: A Case Study Approach", Prentice-Hall, 1982, PP. 79-80.
- [166] Thompson J.D. and Tuden A. : "Strategies, Structures and Processes of Organisational Decision", in Thompson J.D. et al. (Eds.), Comparative Studies in Administration, University of Pittsburgh Press, 1959.
- [167] Urban G. and Karash R. : "Evolutionary Model Building", Journal of Marketing Research, Vol. 8, 1971.
- [168] Vazsonyi A. : "Decision Support Systems: The New Technology of Decision-Making?", Interfaces, Vol. 9, No. 1, 1978, PP. 72-77.
- [169] Vickers G. : "The Poverty of Problem Solving", Journal of Applied Systems Analysis, Vol. 8, 1981, PP.15-21.
- [170] Vickers G.: "Human Systems Are Different", Harper & Row, publishers, London, 1983.
- [171] Wagner G.R. : "Decision Support Systems: The Real Substance", Interfaces, Vol. 11, No. 2, 1981, PP. 77-86.
- [172] Wagner G.R. : "Decision Support Systems: Computerised Mind Support for Executive Problems", Managerial Planning, Sept.- Oct., 1981, PP. 9-16.
- [173] Wahi Pran N., Popp Kenneth, and Stier Susan : "Applications Systems Planning at Weyerhaeuser", Journal of Systems Management, March 1983, PP. 12-21.
- [174] Ward S.C. : "Arguments for Constructively Simple Models", accepted to appear in Journal of Operational Research Society, early 1989.

REFERENCES

- [175] Watson H.J. and Hill M.M. : "Decision Support Systems or What Didn't Happen with MIS", Interfaces, Vol. 13, No. 5, 1983, PP. 81-88.
- [176] Welsch Gemma M. : "A Multidimensional Measure of Perceived Decision Support System Implementation Success", DSS-81 Transactions, Atlanta, Georgia, 1981.
- [177] Welsch Gemma M.: "Successful Implementation of Decision Support Systems: The Role of The Information Transfer Specialist", 13th Annual Meeting of the American Institute for Decision Sciences, Boston, Massachusetts, Nov. 18-20, 1981, Vol. 1, PP. 206-208.
- [178] Willoughby T.C. and Pye A. : "Top Management's Computer Role", Journal of Systems Management, Vol. 28, No. 9, September 1977, PP. 10-13.
- [179] Wynne B. : "Decision Support Systems: A New Plateau of Opportunity or More Emperor's Clothing?", Interfaces, Vol. 12, No. 1, 1982, PP. 89-91.
- [180] Yaverbaum Gayle J. : "Critical Factors in the User Involvement: An Experimental Study of Users, Organisations and Tasks", MIS Quarterly, March 1988. pp. 75-88.
- [181] Zahedi Fatemeh : "Reliability of Information Systems Based on the Critical Success Factors - Formulation", MIS Quarterly, June 1987, PP. 187-203.
- [182] Zetterberg Hans L : "On Theory and Verification in Sociology", The Bedminster Press, Totowa, N.J., 1963.
- [183] Zmud Robert W. : "Individual Differences and MIS Success: A Review of Empirical Literature", Management Science, Vol. 25, No. 10, 1979, PP. 966-979.
- [184] Zmud Robert W. : "Supporting Senior Executives Through Decision Support Technologies: A Review and Directions For Future Research", Decision Support Systems: A Decade in Perspective, Elsevier Science Publishers B.V. (North-Holland), IFIP, 1986, PP. 87-101.
- [185] Zmud R.W. and Cox J.F. : "The Implementation Process: A Change Approach", MIS Quarterly, Vol. 3, No. 2, June 1979, PP. 35-43.
- [186] Zmud R.W. & Cain D.D. : "Conceptual Framework and Systems Analyst Job-Fit", Working Paper, Department of Information Systems, Georgia State University, 1979.
- [187] Zmud R.W. : "An Empirical Investigation of the Dimensionality of the Concept of Information", Decision Sciences, Vol. 9, 1978, PP. 187-195.

REFERENCES

- [188] Barrett G.V., Thornton C.L. & Cabe P.A. : "Human Factors Evaluation of a Computer Based Information Storage and Retrieval System", Human Factors, Vol. 10, 1968, pp. 431-436.
- [189] Dickson G.W., Senn J.A and Chervany N.L. : "Research in Management Information Systems: The Minnesota Experiments", Management Science, Vol. 23, 1977, PP. 913-923.
- [190] Gerrity T.P., Jr. "Design of Man-Machine Decision Systems: An Application to Portfolio Management", Sloan Management Review, Vol. 12, No. 2, Winter 1971, PP. 59-75.
- [191] Gorry G.A. & Scott Morton M.S. : "A Framework for Management Information Systems", Sloan Management Review, Vol. 13, No. 1, 1971, PP. 55-70.
- [192] Kolb D.A. and Frohman A.L. : "An Organisation Development Approach to Consulting", Sloan Management Review, Vol. 12, 1970, PP. 273-290.
- [193] Likert R. : "A Technique for the Measurement of Attitudes", Arch. Psychology, Vol. 104, 1932.
- [194] Carlson E.D., Grace B.F. and Sutton J.A. : "Case Studies of End User Requirements for Interactive Problem Solving Systems", MIS Quarterly, Vol. 1, No. 1977, PP. 3-7.
- [195] Franz C.R. : "Organisational Factors Affecting User Involvement in Information Systems Design". Unpublished Working Paper, University of South Carolina, Columbia, No. 1979.
- [196] Gallagher C.A. : "Perceptions of the Value of a Management Information System". Academy Management Journal, Vol. 17, No. 1, 1974, PP. 46-55.
- [197] Guthrie A.A. : "Survey of Canadian Middle Managers' Attitudes Toward Management Information Systems. Carleton University, Ottawa, Ontario, Dec. 1972.
- [198] Igersheim R.H. : "Management Response to an Information System". In AFIPS Conference Proceedings, National Computer Conference, 1976, pp. 877-882.
- [199] Lucas H.C. : "Why Information Systems Fail", Columbia University Press, New York, 1975.
- [200] Miller R.B. : "Response Times in Man-Computer Conversational Transactions", Proceedings, AFIPS Fall Joint Computer Conference, Vol. 33, 1968, PP. 267-277.

REFERENCES

[201] Nickerson R.S. : "Man-Computer Interaction: A Challenge for Human Factors Research", Ergonomics, Vol. 12, 1969, pp. 501-517.

[202] Paisley W.J. : "Information Needs and Uses", Annual Rev. Information Sci. and Technology, Vol. 3 , 1968), PP. 1-30.

[203] Vasarhelyi M.A. : "Man-Machine Planning Systems: A Cognitive Style Examination of Interactive Decision Making", J. Accounting Res., Vol. 15, 1977, pp. 138-153.

Bibliography

Srinivasan, Ananth : "Alternative Measures of System Effectiveness: Associations and Implications", MIS Quarterly, Sept. 1985, PP. 243-253

Belew Richard K. : "Evolutionary Decision Support Systems: An Architecture Based On Information Structure", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 147-160.

Mann, Robert I. : "A Contingency Model for User Involvement in DSS Development", MIS Quarterly, March 1984, PP. 27-37.

Hulbert James, Farley John U., and Howard John A. : "Information Processing and Decision Making in Marketing Organisations", Journal of Marketing Research, Vol. IX, February 1972, PP. 75-77.

Menkus Belden : "Practical Considerations in Decision Support System Design", Journal of Systems Management, June 1983, PP. 32-33.

Multinovich Jugoslav S. and Valhovich Valdimir : "A Strategy for a Successful MIS/DSS Implementation", Journal of Systems Management, August 1984, PP. 8-16.

Ackoff Russell L. "Optimization + Objectivity = Opt Out", European Journal of Operational Research, 1977, PP. 1-7.

Smithin Tim and Colin Eden "Computer Decision Support for Senior Managers: Encouraging Exploration", Int. J. Man-Machine Studies, 1986, 11006-26040.

Coelho Helder : "DSS Versus Expert Systems: The Case of R&D Management", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 103-111.

Larichev O.I. : "Problem of Man-Machine Interactions in Decision Support Systems", Knowledge Representation for Decision Support Systems, L.B. Methlie and R.H. Sprague (Editors), Elsevier Science Publishers B.V. (North-Holland), IFIP, 1985, PP. 27-39.

Brookes Cyril H.P. : "A Corporate Intelligence System for Soft Information Exchange", Knowledge Representation for Decision Support Systems, L.B. Methlie and R.H. Sprague

(Editors), Elsevier Science Publishers B.V. (North-Holland), IFIP, 1985, PP. 161-166.

Paton Bill : "New Technology - What are the Rules?", Management Services, October 1986, PP. 16-18.

Kozar Kenneth A. and Mahlum John M. : "A User Generated Information System: An Innovative Development Approach", MIS Quarterly, June 1987, PP. 163-173.

Virgo Philip : "Taking a User View of IT Strategy", Management Services, December 1987, PP. 8-10.

Heap John P. : "Evaluating Software Packages", Management Services, January 1986, PP. 24-25.

McLoughlin Peter : "Soft Systems Methodology - its Role in Management Services; or Finding a Nut to fit the Spanner", Management Services, August 1986, PP. 16-20.

Patching David : "Soft Systems Methodology & Information Technology", Management Services, August 1987, PP. 16-19.

Thierauf Rober J. and Reynolds George W. : "Effective Information Systems Management", 1982, PP. 91-92.

Synnott William R. : "The Information Weapon, Winning Customers & Markets with Technology", John Wiley & Sons, New York, 1987, PP. 10-17, 126-131, 145-151.

Henderson John C. : "Finding Synergy Between Decision Support Systems and Expert Systems Research", Decision Sciences, Vol. 18, 1987, PP. 333-349.

Vedder Richard G. : "An Expert System Application for Decision Support in Law Enforcement", Decision Sciences, Vol 18, 1987, PP. 401-413.

Elam Joyce J. : "Using Artificial Intelligence Techniques to Enhance the Capabilities of Model Management Systems", Decision Sciences, Vol 18, 1987, PP. 487-501.

Austin Noel C. : "A Management Support Environemnt", ICL Technical Journal, November 1986, PP. 196-194.

Eden Colin, Williams Huw, and Smithin Tim : "Synthetic Wisdom: The Design of a Mixed-Mode Modelling System for Organisational Decision Making", Journal of Operational Research Society, Vol. 37, No. 3, 1986, PP. 233-241.

Elam Joyce J., Huber George P., and Hurt Mimi E. : "An Examination of the DSS Literature (1975-1985)", Decision Support Systems: A Decade in Perspective, E.R. McLean,

H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 1-17.

Sprague Ralph H. : "DSS In Context", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 19-39.

Wuwongse Vilas and Paulo Reynaldo de Veyra : "A Microcomputer Based DSS for Scholarship Allocation", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 41-49.

Widmeyer George R. and Lee Ronald R. : "Preference Elicitation in Decision Aiding: Application to Electronic Shopping", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 51-85.

Stabell Charles B : "Decision Support Systems: Alternative Perspectives and Schools", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 173-203.

Brookes Cyril H.P. : "Requirements Elicitation doe Knowledge Based Decision Support Systems", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 129-155.

Gray Paul : "Group Decision Support Systems", Decision Support Systems: A Decade in Perspective, E.R. McLean, H.G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 157-171.

Carlson Sven and Stabell Charles B. : "Spreadsheet Programs and Decision Support: A Keystroke-Level Model of System Use", Decision Support Systems: A Decade in Perspective, E.R. McLean, H. G. Sol (Editors), Elsevier Science Publishers B.V. (North-Holland) IFIP, 1986, PP. 113-127.

Finlay Paul N. and Forghani Morteza S. : "The Concept of Management Intelligence Systems", Journal of Applied Systems ANalysis, Vol. 14, 1987, PP. 41-51.

Finaly Paul N. and Forghani Morteza S. : "A Korner That Can Be Cut", The Health Service Journal, May 8, 1986, PP. 630-631.

Finaly Paul N. and Forghani Morteza S. : "Preparing For Korner", Public Finance and Accountancy, September 5, 1986, PP. 15-17.

Voich Dan Jr, Mottice Homer J., and Shrode William A. : "Information Systems for Operations and Management", 1975, PP. 2-11.

Triker and Richard : "Management Information and Control Systems", 1982, PP. 2-11.

Liang Ting-Peng : "Integrating Model Management with Data Management in Decision Support Systems", Decision Support Systems 1, 1985, PP. 221-232.

Frank Poole : "Microcomputers and Distributed Databased Management Systems", Data Processing, Vol. 26, No. 6, July/August 1984, PP. 20-21.

Williams Adrian J. : "Decisions, Decisions....", Journal of Operational Research Society, Vol. 34, No. 4, 19??, PP. 319-330.

Alter Steven : "Decision Support Systems for Manufacturing", Data Processing, Vol 25, No. 10, December 1983, PP. 37-38.

Byars Lloyd L. : "The Strategic Management Process: A Model and Terminology", Managerial Planning, May/June 1984, PP. 38-44.

Burkhard Donald Larmee : "An Examination of Decision Support Systems' Effectiveness: An Empirical Investigation", PhD Thesis, University of Georgia, Athens, Georgia, 1984, PP. 20-100

Munro Malcolm and Wheeler Basil R. : "Planning, Critical Success Factors, and Management's Information Requirements", MIS Quarterly, December 1980, PP. 27-?? see if you have it?

Martin Merle P. : "Determining Information Requirements for DSS", Journal of Systems Management, December 1982, PP. 14-21.

Dryden David : "Packaged Software Versus Inhouse Development": The Case for the Software House", Data Processing, Vol. 24, No.8, October 1982, PP. 20-21.

Frank Werner L : "Over-friendly Software", Data Processing, Vol. 26, No. 4, May 1984, PP. 28-30.

Frank Jonathan and Schnabel Jacques : "Timing of Borrowing Decisions - A Decision Support System", Journal of Systems Management, April 1983, PP. 6-9.

Buckham Chris : "Micro Packages that Spell Success", Data Processing, February 1982, PP. 22,23.

Probert David E. : "The Development of a Long-range Planning Model for the British Telecommunications Business: From Initiation to Implementation", Journal of Operational Research Society, Vol. 32, 1981, PP. 695-719.

Dery David and Mock Theodore J. : "Information Support Systems for Problem Solving", Decision Support Systems The International Journal, Vol. 1, No. 2, April 1985, PP. 103-109.

Migliarese Piero G. : "Knowledge Representation and Organisational Noise: An Organisational Framework About Decision Support Systems ()", Knowledge Representation for Decision Support Systems, Methlie L.B. and Sprague R.H. (Editors), Elsevier Science Publishers B.V. (North-Holland), IFIP, 1985, PP. 237-244.

Mintzberg Henry : "The Manager's Job: Folklore and Fact", Harvard Business Review, July-August 1975, PP. 49-61.

King William R. : "Planning for Strategic Decision Support Systems", Long Range Planning, Vol. 16, No. 5, 1983, PP. 73-78.

Brown Marlene : "DSS for Micro and Mainframe", Data Processing, Vol. 26, No. 1, January/February 1984, PP. 23, 32.

Farwell David C. : "A Model Based Approach to Decision Support System Flexibility", Interfaces, Vol. 12, No. 5, October 1982, PP. 79-86.

Rector Robert L. : "Decision Support Systems - Strategic Planning Tool", Managerial Planning, May/June 198, PP. 36-40.

Hirschheim R. Klein H.K. : "Fundamental Issues of Decision Support Systems: A Consequentialist Perspective", Decision Support Systems The International Journal, Vol. 1, No. 1, January 1985, PP. 5-24.

Farwell David C. and Farwell Ted : "Decision Support System for Ski Area Design", Journal of Systems Management, March 1982, PP. 32-37.

Pendse Nigel : "Designing DSS for Users", Data Processing, Vol. 26, No. 3, April 1984, PP. 25-26.

Landry Maurice, Pascot Daniel and Briolat Dominique : "Can DSS Evolve Without Changing Our View of the Concept of 'Problem'?", Decision Support Systems The International Journal, Vol. 1, No. 1, January 1985, PP. 25-36.

Summers Graham : "Financial Modelling Packages for Microcomputers: Comparing Spreadsheets with more Complex Packages", Data Processing, Vol. 24, No. 9, November 1982, PP. 15-17.

Finlay Paul N. : "Process Considerations and the Choice of a Financial Planning Package for Microcomputers", NCC, Microsystems Centre, November 1985.

Alter Steven L. : "Decision Support Systems: Current Practice and Continuing Challenges", Addison-Wesley Publishing Co., 1980.

Earl Michael J. : "Management Information Systems and Management Accounting", A paper presented to the SSRC, ICAW, ICMA Conference on Management Accounting Research, 16th-17th December 1980, Manchester Business School.

Goul Michael : "Project IPMA: Applying Decision Support System Design Principles to Building Expert-Based Systems", Decision Sciences, Vol. 18, 1987, PP. 448-467.

Alter Steven L. : "What Do you Need to Know to Develop Your Own DSS?", DSS-82 Transactions, June 1982.

Benjamin Robert I. : "Information Technology in the 1990s: A Long-Range Planning Scenario", MIS Quarterly, Vol. 6, No. 2, June 1982.

Bonczek Robert H., Holsapple Clyde W. and Whinston Andrew B. : "Computer-based Support of Organisational Decision Making", Decision Sciences, April 1979a.

Bonczek Robert H., Holsapple Clyde W. and Whinston Andrew B. : "Future Directions for Developing DSS", Decision Sciences, Vol. 11, 1980b.

Bonczek Robert H., Holsapple Clyde W. and Whinston Andrew B. : "The Evolution From MIS to DSS: Extension of Data Management To Model Management", in Decision Support Systems, by Ginzberg M.J., Reitman W. and Stohr E.A. (editors), North-Holland Publishing Company, DSS, 1982, PP.62-78.

Brightman Harvey J., Harris Sydney C. and Thompson William J. : "Empirical Study of Computer-based Financial Modeling Systems: Implications for Decision Support Systems", DSS-81 Transactions, June 1981.

Briggs Warren G. : "An Evaluation of DSS Packages", Computerworld, March 1982.

Chung Chen-Hua : "Implementation Issues in Problem Processing of DSS", in Proceedings of the Sixteenth Annual Hawaii International Conference on System Sciences, June 1983.

Vasant Dhar and Ronald Daniels : "A Process Model of Information Requirements Analysis for Strategic Decision Support", in the American Institute for Decision Sciences, Thirteenth Proceedings, 1981.

Dickson Gary : "Issues for the Future in DSS" (Report of Discussion Group 1), DSS: Issues and Challenges, Proceedings of the International Institute for Applied Systems Analysis (IIASA), June 1980.

Fuerst William and Cheney Paul : "Factors Affecting and Facilitation", New York University, Center for Research on Information Systems Working Paper 20, 1981.

Gorry Andrew and Scott Morton Michael S. : "A Framework for Management Information Systems", Sloan Management Review, Vol. 13, No. 1, Fall 1971.

Gary Gulden : "A Framework for Decisions", Computerworlds, December 1982.

Hackathorn Richard D. : "Issues for the Future in DSS" (Report of Discussion Group 4), in DSS: Issues and Challenges, Proceedings of the IIASA, June 1980.

Hamilton, Scott, Ives Blake and Davis Gordon B. : "Organisational Strategies for Personal Computing in Decision Support Systems", MIS Quarterly, September 1981.

Huber George : "Organisational Science Contributions to the Design of DSS", in DSS: Issues and Challenges, Proceedings of the IIASA, June 1980.

Huber George : "The Design of Group DSS", in Proceedings of the Sixteenth Annual Hawaii International Conference on System Sciences, June 1983.

Keen Peter G.W. : "Decision Support Systems and Managerial Productivity Analysis", Massachusetts

Institute of Technology, CISR Working Paper 60, October 1980a.

Keen Peter G.W. : "DSS: Lessons for the 80's", Massachusetts Institute of Technology, CISR Working Paper 70, June 1981a.

Keen Peter G.W. : "Adaptive Design for DSS", Data Base, Vol. 12, No. 1-2, Fall 1982.

Kingston Paul : "Generic DSS", Managerial Planning, Vol. 29, No. 5, March 1981.

Lindgren Richard : "Justifying a Decision Support System", Data Management, Vol. 19, May 1981.

Monypenny Richard : "Person/Role Conflict in the DSS-Corporate Interface", DSS-82 Transactions, June 1982.

Moore J.H and Chang M.G. : "Design of DSS", in Proceedings of the Thirteenth Annual Hawaii International Conference on System Sciences, Data Base (USA), Vol. 12, No. 1-2, Fall 1980.

Moscowitz Robert : "DSS/F: Paving the Way for Sophisticated Software", Interface Age, June 1982.

Neumann Seev and Hadass Michael : "DSS and Strategic Decisions", California Management Review, Vol. 22, No. 2, Spring 1980.

Louis Paul : "DSS: An Idea in Search of an Identity", Computerworld, Vol. 16, No. 44, November 1982.

Morecroft John : "Strategy Support Models", Massachusetts Institute of Technology, Draft Article, July 1982.

Sanders G. Larry : "A DSS For Identifying Critical Success Factors", in the American Institute for Decision Sciences, Thirteenth Proceedings, 1981.

Seils Harlod L. : "Do DSS Really Support?", Computerworld, Vol. 16, No. 26, June 1982.

Sheinin Roman L. : "The Structure of Decision Support Systems", in DSS: Issues and Challenges, Proceedings of the IIASA, June 1980.

Sprague Ralph H., and Carlson Eric : "Building Effective Decision Support Systems (Englewood Cliffs, N.J.: Prentice-Hall, 1982).

Sprague Ralph H. and Panko Raymond : "Criteria for a DSS Generator", in the American Institute for Decision Sciences, Thirteenth Proceedings, 1981.

Studer R. : "An Adaptable User Interface for DSS", in Proceedings of the Sixteenth Annual Hawaii International Conference on System Sciences, June 1983.

Treacy Michael : "Where DSS Technology us Going", from a Discussion, April 1983.

Tucker J.H. : "Implementation of Decision Support Systems", in Proceedings of the 1981 IEEE International Conference on Cybernetics and Society (New York: Institute of Electrical and Electronic Engineers, 1981).

Vierck Robert K. : "Decision Support Systems: An MIS Manager's Perspective", MIS Quarterly, December 1981, PP. 35-48.

Wagner G.R. : "DSS: Dealing with Executive Assumptions in the Office of the Future", Managerial Planning, Vol. 30, No. 5, March-April 1982.

Wang Michael S.Y. and Yu Keh-Chiang : "A Hierarchical View of Decision Support Software", in Proceedings of the Sixteenth Annual Hawaii International Conference on System Sciences, June 1983.

Watkins Paul R. : "Perceived Information Structure: Implications for Decision Support Design", Decision Sciences, Vol. 13, 1982.

Welsch Gemma : "Successful Implementation of DSS: The Role of the Information Transfer Specialist", in the American Institute for Decision Sciences, Thirteenth Proceedings, 1981.

Alavi Maryam and Henderson John C. : "Evolutionary Strategy for Implementing a Decision Support System", Management Science, November 1981, PP. 1309-23.

Alter Steven L. : "Development Patterns for Decision Support Systems", MIS Quarterly, September 1978, PP. 33-42.

Bennett John L. : "Building Decision Support Systems", Reading, Massachusetts: Addison-Wesley Publishing Company, 1983.

Carlson Eric D. : "Developing the User Interface for Decision Support Systems", In Building Decision Support

Systems, ed. John L. Bennett. Reading, Mass.: Addison-Wesley, 1983.

Carlson Eric D., Grace Barbara F. and Sutton Jimmy A. : "Case Studies of End-User Requirements for Interactive Problem-Solving Systems", MIS Quarterly, March 1977, PP. 51-63.

Chowdhury D.K.N. : "An Exploratory Study of Manager-Developed Decision Support Systems", Unpublished Doctoral Dissertation, Simon Fraser University, Vancouver, Canada, 1983.

Ginzberg Michael J. : "A Study of the Implementation Process", In the Implementation of Management Science, ed. R. Doktor, R.L. Schultz and D.P. Slevin, Amsterdam: North_Holland, 1979.

Dos Santos and Brian L. : "Aids for Model-oriented Decision Support Systems", Unpublished Doctoral Dissertation, Case Western Reserve University, 1982.

Gorry Anthony G. and Krumland Rand B. : "Artificial Intelligence Research and Decision Support Systems", In Building Decision Support Systems, ed. John L. Bennett. Reading, Mass.: Addison-Wesley, 1983.

Hurst Gerald E, Ness David N., Gambino Thomas J. and Johnson Thomas H. : "Growing DSS: A Flexible, Evolutionary Approach", In Building Decision Support Systems, ed. John L. Bennett. Reading, Mass.: Addison-Wesley, 1983.

Keen Peter G.W. and Gambino Thomas J. : "Building a Decision Support System: The Mythical Man-Month Revisited", In Building Decision Support Systems, ed. John L. Bennett. Reading, Mass: Addison-Wesley, 1983.

William King R. and Rodriguez J.I. : "Participative Design of Strategic Decision Support Systems: An Empirical Assessment", Management Science, June 1981, PP. 717-726.

Lucas Henry C. : "Empirical Evidence for a Descriptive Model of Implementation", MIS Quarterly, June 1978, PP. 27-42.

Robey Daniel and Farrow Dana : "User Involvement in Information System Development", Management Science, January 1982, PP. 73-85.

Maister David H. : "The One-Firm Firm: What Makes it Successful", Sloan Management Review, Vol. 27, No. 1, Fall 1985, PP. 3-13.

Lauenstein Milton C. : "SMR Forum: Diversification - The Hidden Explanations of Success", Sloan Management Review, Vol. 27, No. 1, Fall 1985, PP. 49-55.

Ginzberg M.J. : "DSS Success: Measurement & Facilitation", Centre for Research on Information Systems, Working Paper No. 20, NYU [1981b).

Jenkins, A.M. and Ricketts, J.A. "Development of an instrument to measure users satisfaction with management informations systems", unpublished discussion paper, Indiana University, Bloomington, Indiana, 1979.

EPS, Inc. "Selecting and Evaluating a Decision Support System", Promotion brochure, 1981.

Ginzberg, M.J. "A study of the implementation process", Management Sciences, Vol. 13, 1979, PP. 85-102.

Huber, G.P. "The Nature of Organisation Decision Making and the Design of Decision Support System", MIS Quarterly, Vol.5, No. 2, 1985, PP. 1-10.

Huber George P. : "Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing?", Management Science, Vol. 29, No. 5, May 1983, PP. 567-579.

Lindgren, Richard "Justifying a Decision Support System" Data Management, Vol. 19, May 1981.

Kammire, L.L. "Construction and statistical analysis of an instrument that measures attitudes toward computers", Georgia State University, 1984 (85-25631).

Maxwell, P.D. "A critical analysis of the personal characteristics of successful information systems analysts", Boston University, 1986 (86-15131).

Beatty, W.A. "Middle Management and the personal computer: An analysis of the effects of personal computer satisfaction", Florida State University, 1986 (86-12211).

Bialac, R.N. "Analysis of the effectiveness and efficiency of business decision-making using computer graphics", University of Cincinnati, 1985 (85-26522).

Buffington, J.R. "The impact of subcultures on Decision Support System Usage", University of Nebraska-Lincoln, 1986 (86-14442).

Garceau, L.R. "The relationship of cognitive style and usage of a group decision support system", University of Minnesota", 1985, (86-06231).

Greenhall, N.C. "Using a fuzzy expert system for decision support of the strategic planning process", Georgia State University, 1985 (86-18217).

Lee, J.K. "Solving semi-structured problems and the design of decision support systems: Post-model analysis approach", University of Pennsylvania, 1985 (85-15401).

Wang Michael S.Y. and Yu Keh-Chiang: "A Hierarchical View of Decision Support System Software", Proceedings of the Sixteenth Annual Hawaii International Conference on System Science, Vol, 1, 1983, PP. 482-489.

Studer R. : "An Adaptable User Interface For Decision Support Systems", Proceedings of the Sixteenth Annual Hawaii International Conference on System Science, Vol, 1, 1983, PP. 490-499.

Chung Chen-Hua : "Implementation Issues in Problem Processing", Proceedings of the Sixteenth Annual Hawaii International Conference on System Science, Vol, 1, 1983, PP. 523-532.

Rockart John F. and Flannery Lauren S. : "The Management of End User Computing", Communications of the ACM, Vol. 26, No. 10, October 1983, PP. 776-784.

Ariav Gad and Ginzberg Michael J. : "DSS Design: A Systemic View of Decision Support", Communications of the ACM, Vol. 28, No. 10, October 1985, PP. 1045-1052.

Markus M. Lynne : "Power, Politics, and MIS Implementation", Communications of the ACM, Vol. 26, No. 6, June 1983, PP. 430-444.

Franz Charles R. and Robey Daniel : "An Investigation of User-Led System Design: Rational and Political Perspectives", Communications of the ACM, Vol. 27, No. 12, December 1984, PP. 1202-1209.

Coelho Helder : "DSS Versus Expert Systems: The Case of R&D Management", in Decision Support Systems: A Decade in Perspective, by McLean E.R. and Sol H.G. (editors), Elsevier Science Publishers B.V. (North-Holland), IFIP, 1986, PP. 103-112.

Lucas Henry C. : "An Experimental Investigation of the Use of Computer-Based Graphics in Decision Making",

Management Science, Vol. 27, No. 7, July 1981, PP. 757-768.

McKeen James D. : "Successful Development Strategies for Business Application Systems", MIS Quarterly, September 1983, PP. 47-65.

Olson Margrethe H. and Ives Blake : "Chargeback Systems and User Involvement in Information Systems - An Empirical Investigation", MIS Quarterly, June 1982, PP. 47-60.

Robey Daniel and Taggart William : "Human Information Processing in Information and Decision Support Systems", MIS Quarterly, June 1982, PP. 61-73.

King William R. : "Strategic Planning for Management Information Systems", MIS Quarterly, March 1978, PP. 27-37.

Hackathorn Richard D. and Keen Peter G. : "Organisational Strategies for Personal Computing in Decision Support Systems", MIS Quarterly, September 1981, PP. 21-27.

Senn James A. : "A Management View of Systems Analysis: Failures and Shortcomings", MIS Quarterly, September 1978, PP. 25-32.

Shenolikar Ashok : "An Approach to Structured MIS Development", MIS Quarterly, December 1981, PP. 19-33.

Ives Blake and Olson Margreth H.: "Manager or Technician? The Nature of the Information Systems Manager's Job", MIS Quarterly, December 1981, PP. 49-63.

Ives Blake and Olson Margrethe H. : "User Information Satisfaction: Three Measures", Working Paper Series CRIS # 66, November 1983.

Glennon John T. : "MIS Systems: The Role of Authority and Responsibility", MIS Quarterly, June 1978, PP. 1-6.

Marrison Perry R. : "A Survey of Attitudes Toward Computers", Communications of the ACM, Vol. 26, No. 12, December 1983, PP. 1051-1057.

Bodly Samuel E. : "Spreadsheet Modelling as a Stepping Stone", Interfaces, Vol. 16, No. 5, September-October 1986, PP. 34-52.

Shycon Harvey N. : "All Around The Model: Perspectives on MIS Applications", Interfaces, Vol. 9, No. 1, November 1978, PP. 51-54.

Meredith Jack R. : "Reconsidering the Decision-Making Approach to Management", Omega International Journal of Management Science, Vol. 12, No. 4, 1984, PP. 347-352.

Zand Dale E. and Sorensen Richard E. : "Theory of Change and the Effective Use of Management Science", Administrative Science Quarterly, Vol. 20, December 1975, PP. 532-545.

Avramovich Dan, Cook Thomas M., Langston Gary D., and Sutherland Frank : "A Decision Support System For Fleet Management: A Linear Programming Approach", Interfaces, Vol. 12, No. 3, June 1982, PP. 1-8.

Beswick Charles A. : "20/30 Hindsight: What the General Really Wanted", Interfaces, Vol. 13, No. 6, December 1983, PP. 62-67.

Igor Aleksander : "Information Technology and the Management of Change", Journal of Information Technology, Vol. 1, No. 1, February 1986, PP. 7-13.

Roland Roland J. : "A Model of Organisational Variables for DSS", Data Base, Vol. 12, No. 1,2, 1980, PP. 63-72.

Ligeza Antoni : "Expert Systems Approach to Decision Support", European Journal of Operational Research, Vol. 37, 1988, PP. 110-110.

Hayes Rober H. and Nolan Richard L. : "What Kind of Corporate Modeling Functions Best?", Harvard Business Review, May_june 1974, PP. 102-112.

Fuerst William L. and Zeithaml Carl P. : "A Theoretical Basis for the Design of MIS in Strategic Management", American Institute for Decision Sciences, Vol. 1, November 1981, PP. 188-190.

Hough John : "In Search of the Golden Fleece", NCC Seminar, October 22nd 1987, PP. 1-7

Tricker R.I. and Boland Richard : "Management Information and Control Systems", 2nd edition, 1982, John Wiley and Sons.

Fripp John : "How Effective are Models?", Omega The International Journal of Management Science, Vol. 13, No. 1, PP. 19-28.

Walker Warren E. : "Models in the Policy Process: Past, Present, and Future", Interfaces, Vol. 12, No. 5, October 1982, PP. 91-100.

Douglas A. S. : "Systems Analysis and the Computer", Journal of Operational Research Society, Vol. 34, No. 8, 1983, PP. 779-785.

McCosh Andrew M. and Scott Morton Michaels : "Management Decision Support Systems", the Macmillan Press Ltd., 1978,

Hickson David J., Butler Richard J., Cray David, Mallory Geoffrey R., and Wilson David C. : "Top Decisions: Strategic Decision-Making in Organisations", Basil Blackwell Ltd., 1986.

Fuld Leonard M. : "Competitive Intelligence : How to Get it; How to Use it", John Wiley & Sons, 1985.

Renyard J.C. and Blewitt R.A. : "O.R. and Personal Computing", Sixth European Congress on "O.R.", Vienna, Austria, July 18-23, 1983.

Shanteau J. : "The Concept of Weight in Judgment and Decision Making", Report No. 228, University of Colorado Institute of Behavioural Sciences, 1980.

Keller L.R. and Farquhar P.H. : "Decision Under Uncertainty, Assessment Methods for Value Functions", University of California, 1983.

Pitz G.I. and Reidel S. : "The Content and Structure of Value Tree Representation", Acta Psychol, Vol. 56, 1984, PP. 59-70.

Barbarie A.J. : "A DSS Based on Mental Representations", Working Paper, WP81-25, Laxenburg, Austria: 11ASA, 1981.

Bryant J. and Corner L. : "Training Service Managers Using a Micro-Computer", Journal of the OR Society, Vol. 33, 1982, PP. 977-982.

Power D.J. : "Case Study of the Design and Development of a DSS", Working Paper, College of Business and Management, University of Maryland at College Park, U.S.A., 1982.

Phillip L.D. : "Decision Support for Top Managers", In The Managerial Challenge of New Office Technology, by Otway, H.J. and Pelta M. (editors), London, Butterworth, 1984.

Tracz C. : "Computer Conferencing: An Aye-Opening Experience with EIES", Canadian Journal of Information Science, Vol. 5, 1980, PP. 11-20.

Withers S. and Hurrion S.J. : "The Interactive Development of Visual Simulation Models", Journal Of the Operational Research Society, Vol. 33, 1982, PP. 973-975.

Turban Efraim and Watkins Paul R. : "Integrating Expert Systems and Decision Support Systems", MIS Quarterly, June 1986, PP. 121-135.

Remus William E. : "Toward Intelligent Decision Support Systems: An Artificially Intelligent Statistician", MIS Quarterly, December 1986, PP. 403-419.

Jeske John W. Jr. : "Designing A Decision Support System For A CHanging Bell System", in Decision Support Systems, by Ginzberg M.J., Reitman W., and Stohr E.A. (editors), North-Holland Publishing Company, DSS, 1982, PP. 133-153.

Gould John D. and Lewis Clayton : "Designing for Usability: Key Principles and What Designers Think", Communications of the ACM, Vol. 28, No. 3, March 1983, PP. 300-311.

Keen Peter G.W. : "Decision Support Systems : The NExt Decade", June 1986.

Steers Richard M. : "Problems in the Measurement of Organisational Effectiveness", Administrative Science Quarterly, Vol. 20, December 1975, PP. 546-558.

Sauder Richard L. and Westerman William M. : "Computer Aided Train Dispatching: Decision Support Through Optimization", Interfaces, Vol. 13, No. 6, December 1983, PP. 24-37.

Martin Christopher John : "A Behavioural; Analysis of the Adoption and Use of Interactive Computer Systems by Senior Managers", Ph.D. Thesis, University of Durham, September 1986.

Hollocks Brian : "Interactive Modelling", ISTEEL Ltd., Date not available.

Mason Richard O. and Mitroff Ian I. : "A Program for Research on Management Information Systems", Management Science, Vol. 19, No. 5, January 1973, PP. 475-487.

Liebman Judith S. : "Implementation Issues For Operations Research Software", Computing & Operational Research, Vol. 13, No. 2/3, 1986, PP. 347-358.

Landry Maurice, Malouin Jean-Louis, and Oral Muhittin : "Model Validation in Operations Research", European

Journal of Operational Research, Vol. 14, 1983, PP. 207-220.

Taylor A.J. : "The Verification of Dynamic Simulation Models", Journal of Operational Research Society, Vol. 34, No. 3, 1983, PP. 233-242.

Golden Bruce L., Hevner A. and Power D. : "Decision Insight Systems For Microcomputers: A Critical Evaluation", Computing & Operational Research, Vol. 13, No. 2/3, 1986, PP. 287-300.

Gruhl James : "Model Credibility and Independent Evaluation - Three Case Studies", Omega The International Journal of Management Science, Vol. 10, No. 5, 1982, PP. 525-537.

Willis Robert J. and Hastings Nicholas A.J. : "Decision Analysis Using an Enumerative Approach", Journal of Operational Research Society, Vol. 34, No. 10, 1983, PP. 999-1005.

Ayati M.B. : "A Unified Perspective On Decision Making and Decision Support Systems", Information Processing & Management, Vol. 23, No. 6, 1987, PP. 616-628.

Roy Geoffrey G. : "The Use of Multi-Dimensional Scaling in Policy Selection", Journal of Operational Research Society, Vol. 33, 1982, PP. 239-245.

Brennan J.J. and Elan Joyce : " Understanding and Validating Results in Model-Based Decision Support Systems", Decision Support Systems 2, North-Holland, 1986, PP. 49-54.

Gibson Michael L. and Vedder Richard G. : "Tools and Techniques for Use in Decision Support Systems", Journal of Information Systems Management, Spring 1989, PP. 42-50.

Davies D.G.S. : "R&D Tactics: Applications of RPD Decision Analysis", R & D Management, Vol 12, No. 2, 1982, PP. 73-78.

Higgins J.C. : "Decision-Making at Board Level Using Decision Analysis : Two Case Studies", Journal of Operational Research Society, Vol. 33, 1982, PP. 319-326.

Necco Charles R., Gordon Carl L., and Tasi Nancy W. : "Systems Analysis and Design: Current Practices", MIS Quarterly, Decmber 1987, PP. 461-476.

APPENDIX A : Results of Field Research

Contributory Success Factors	Supporting Case Studies
A) Ensuring A Right Environment	
1) Organisational Infrastructure	
1.1) Acceptability of MINTS	
1.1.1) Affordability of the MINTS costs	All cases
<p>In all the cases investigated, the MINTS cost was well within the organisation's financial ability. However, in some cases (1,20,21,24,32,34,35) the original system cost, including the maintenance cost exceeded the original estimates. A major reason was additional changes required by the system users or/and the intermediaries. In the case 17, for example, the system user pointed out that he had initially considered another MINTS generator, but the costs were well above the approved budget and he had no choice but to look for another option.</p>	
1.1.2) Adaptability of the organisation to change	
1.1.2.1) Extent of changes required of formal systems	
1.1.2.1.1) Procedures	1, 20-22, 24, 25, 31-34
1.1.2.1.2) Operations	1, 20-22, 24, 25, 31-34
<p>In the cases (1,20-22,24,25,31-34) procedural and operational changes were required of the existing systems, causing varying technical problems, though they were ironed out eventually. The changes required also affected others associated with the existing systems, which caused some resistance to change. Moreover, the development and implementation time scale was delayed. In the case 21, political pressure had to be imposed to obtain cooperation of the intermediaries. In the rest of the cases investigated, the MINTS fitted in within the existing procedures and operations and the development and implementation of the MINTS took place smoothly.</p>	
1.1.2.2) Management adaptability to change	
1.1.2.2.1) Education	1-20, 22-30, 33-38

<p>In the cases (21,31,32) due to a lack of formal education, the consultant involved had some difficulty in overcoming management apathy that the MINTS could provide help. In all the other cases (1-20,22-30,33-38) the managers had received formal education. In the case 5, for example, a number of the senior managers had degrees. There was, in this case, a very positive management attitude to IT, in the sense that they all had a personal computer on their desk.</p>	All cases
<p>1.1.2.2) Exposure to IT</p> <p>In all the cases studied, the management had varying degrees of exposure (ranging from being to a demonstration to having had hands-on experience) to computers.</p>	
<p>1.1.3) Place of MINTS within IT strategy</p> <p>In some cases (3,5,13,18,20,22,24,34) there existed an overall IT strategy. This resulted in a faster and smoother acceptance of the MINTS proposal. Also the sponsor was easily identifiable. In these cases there also existed a resource pool for IT development. In a number of the cases (4,7-12,17,19,28), however, the MINTS came about on an ad hoc basis, simply because the companies concerned had recently come to use IT, and had found the potential of IT in dealing with their decision requirements.</p>	3,5,13,18,20,22,24,34
<p>1.2) Organisational Stability</p>	
<p>1.2.1) Staff turnover</p>	
<p>1.2.1.1) User permanence</p> <p>In all the cases mentioned the system user stayed with the system. Moreover, when the consultants gave their general view on this issue, they believed that system user permanence was critical because MINTS systems are based on the specific requirements of the system user. They further argued that in their experience, usually a successor is reluctant to use his predecessor's MINTS. This is particularly the case when there was a single system user for whom the MINTS was developed.</p>	All cases
<p>1.2.1.2) Sponsor permanence</p>	None

In a number of cases (2,5,10,11,28,33) no sponsor was involved as the system user had financed the MINTS. In a number of cases (4,8,9,12-15,19) the involvement of the sponsor in the MINTS project was irrelevant as the cost was relatively small and a requisition form was quickly approved. Moreover, in the cases (7,16,17,25,27-30,33) the costs were incurred once and no further development costs were involved. In these cases the approval of the sponsor was required at the start of the project, and his support was not required thereafter. In the cases (20,35) the initial sponsor was replaced by someone else, and yet the further development and maintenance costs were met by the new sponsor. One consultant reported that he had been involved in a MINTS project in which the sponsor was also the initiator and the champion of the MINTS. Once the sponsor left, the MINTS was not used. However, the system user in this case had not been keen to use the system from the start and only done so under political pressure.

1.2.1.3) Intermediary permanence

1,2,4,5,18,20-22,24,25,34-38

Technical intermediaries were involved in many of the MINTS investigated (1,2,4,5,18,20-22,24,25,34-38). In all these cases the importance of the intermediary was critical. Also in all these cases, the intermediaries had stayed on with the MINTS. The experience of the researcher himself who designed two MINTS for two senior managers showed that his continual support in modifying and further developing the MINTS was crucial. Once he left the organisation concerned the MINTS were not used. This was because the system user in both cases neither had sufficient time to maintain the MINTS, nor had the training to become involved in building and modifying decision models. Also the researcher is of the opinion that it would have required a great deal of time of another intermediary to have understood the programs written by the researcher, before modifications could have been carried out. The consultants also mentioned cases in which they knew of the technical intermediaries leaving a MINTS, which had resulted in the system user not using the MINTS. Moreover another important aspect of an intermediary was said to be his understanding of the system user's requirements through his close association with the system user, and which cannot be replaced immediately.

1.2.2) Stability of procedures and operations

1.2.2.1) Frequency of changes

1,6,8,9,24,34

1.2.2.2) Extent of changes

1,6,8,9,24,34

When the system user's decision environment is dynamic and changing, he requires a very flexible and adaptable MINTS which allows simple and quick modifications to the programs, relationships and the variables involved, otherwise it would be very time consuming and expensive to maintain the system. In the cases (1,6,8,9,24,34) the consultants interviewed stressed the importance of flexibility and adaptability of the MINTS involved due to the frequency and extent of changes with which the decision maker had to cope.

1.2.3) Political/psychological environment

1.2.3.1) Intelligence on the key actors by the consultant

All the consultants interviewed attached high importance to the fit between a MINTS and its political environment for its success. They believed that the more people associated and affected by a MINTS the more difficult it would be to ensure a favourable political context for the MINTS. They agreed with the type of key actors as identified by the researcher. They believed that a consultant's knowledge of the key actors associated with a MINTS project is highly important in understanding and dealing with the political context effectively to ensure the acceptance of the MINTS. When asked what type of intelligence they had and sought about the actors in the MINTS projects they were involved, such factors as 'identity', 'political influence', and 'soft spots' were extremely helpful in dealing with the people involved in a MINTS project. In the case 1, for example, the consultant knew the system user but not the sponsor. He had to involve another colleague of his who knew the sponsor before further progress could be made in putting forward a proposal for the MINTS. In the case 3, the consultant interviewed stated that a major reason for his success in pushing MINTS capability within the company successfully was his long standing association with the people within the company and his knowledge of what made the key people tick. A number of the consultants (1,2,3,6,22,23,35) argued that the right person should be sent to communicate with the key actors. For example, a person with business-oriented experience should be the one to talk to the system user, the sponsor, the system user's immediate superior and the supporting political actors and that a more technical-oriented person should be sent to talk to the technical people such as the technical intermediaries from the system user's side. The researcher's own experience in the cases 36 and 37 also supported the above. During the initial month of a six-months research within a company, he became involved in building a MINTS for a senior manager. Solid progress was made in terms of agreeing on the terms of the proposal and the go ahead was obtained from the system user. Soon the researcher was introduced to a new member who had just joined the company as the assistant to the senior manager. The researcher not only failed to notice the importance and the authority of the new comer, but also failed to involve him into the project. To the researcher's surprise the project was soon after stopped. Later on, it was found out that the new comer had found the presence of the researcher as threatening to his territory and had influenced the reversal of the go-ahead decision. Lessons were learnt which helped the researcher to initiate another two MINTS projects. As shown below in the cases investigated the consultants had or had to obtain intelligence about the key actors involved in the MINTS project; the system user (all cases), the sponsor (1,3,18,20-22,24,25,29,31,32,34-38), the technical intermediary (), the system user's immediate superior (1,3,7,13,16,17,27,29,31,32,38), the custodians of information (1-3,5,8,9,15,18,20-22,24,27,29,31,32,34-38), and the supporting political actors (20-22,24,31,32,34,36,37). As regards the MINTS champion, it was found that the role of MINTS champion was played by the other key actors; by the system user (2,3,5,7-20,24,27-29,33,38), by the technical intermediary (4,22,25,37), by the system user's immediate superior (31,32), and by the sponsor (1,21,36). This

meant that the MINTS champion as an actor did not exist, but as a role played by the other actors. The consultants interviewed believed that it was critical that the identity of the system user, the intermediary and the sponsor was known during the initial stage of the project.

1.2.3.1.1) System user	All cases
1.2.3.1.2) MINTS champion	None
1.2.3.1.3) Intermediary	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
1.2.3.1.4) Sponsor	1, 3, 18, 20-22, 24, 25, 29, 31, 32, 34-38
1.2.3.1.5) System user's immediate superior	1, 3, 7, 13, 16, 17, 27, 29, 31, 32, 38
1.2.3.1.6) Custodians of information	1-3, 5, 8, 9, 15, 18, 20-22, 24, 27, 29, 31, 32, 34-38
1.2.3.1.7) Supporting political actors	20-22, 24, 31, 32, 34, 36, 37

1.2.3.2) Relationship between the key actors

Having identified and gathered intelligence about the key actors in a proposed MINTS project, it is very important that the consultant understands the relationships between the different actors and that he not only establishes a working relationship with all the actors but also brings the actors together and deals with any bad feelings or conflicts that may affect the project. Indeed establishing relationships with the actors of a MINTS project is about manipulating the existing political environment in a manner that it facilitates a more favourable working environment for developing the MINTS. The interpersonal aspect of a MINTS project was regarded as very important by all the consultants interviewed (1-3, 6-8, 10-12, 19-23, 26, 29-32, 35). Again the examples given in the case of section (1.2.3.1) is applicable to here. Another example, is the case 21, when the consultant had failed to fully consult and involve the intermediaries he noticed a lack of resistance to change from certain planners to the proposed changes by the system user and the system user. Subsequently the consultant arranged for management meetings involving the planners and presentations were made as to the , despite the fact that they had been asked to become involved in the project. The planners were to act as the technical intermediaries to the system user. However, it was required to bring political pressure from higher management upon the planners to cooperate. As shown below the key actors had to have a working relationship in order for the MINTS to succeed.

1.2.3.2.1) Consultant's relationship

1.2.3.2.1.1) With system user

All cases

In all the cases the consultant had to work with the system user, and close cooperation and a good working relationship were regarded as critical.

1.2.3.2.1.2) With system user's immediate superior 1,3,7,13,16,17,27,29,31,32,38

In a number of cases (1,3,7,13,16,17,27,29,31,32,38) the system user's immediate superior was involved in the MINTS project to the extent that he was notified from time to time, mainly by the system user, of the MINTS progress. In the same cases the consultant either knew or was introduced to the immediate superior at the start of the project and the immediate superior was present in the presentation given by the consultant.

1.2.3.2.1.3) With intermediary 1,2,4,5,18,20-22,24,25,34-38

Only in the cases (1,2,4,5,18,20-22,24,25,34-38) was an intermediary involved in the MINTS project, with whom the consultant established a good working relationship. The consultants believed that a good working relationship with the intermediary was a critical factor.

1.2.3.2.1.4) With MINTS champion

None

As already discussed, the role of the MINTS champion was played by the other key actors, and there existed no individual in the cases investigated who played only the role of a MINTS champion. The role of the MINTS champion was played by the system user (2,3,5,7-20,24,27-29,33,38), by the technical intermediary (4,22,25,37), by the system user's immediate superior (31,32), and by the sponsor (1,21,36).

1.2.3.2.1.5) With sponsor

1,3,18,20-22,24,25,29,31,32,34-38

In a number of cases (1,3,18,20-22,24,25,29,31,32,34-38) the sponsor was involved in the MINTS project to the extent that he had to be notified of the MINTS progress. In these cases the consultant had also given a presentation to the sponsor.

1.2.3.2.1.6) With supporting political actors

20-22,24,31,32,34,36,37

In the majority of the cases studied the system user or his immediate superior had already involved at least one political supporter in obtaining sponsor's approval, before approaching the consultant. In these cases the consultant did not meet the political supporters. However, in the cases (20-22,24,31,32,34,36,37) the consultant had contacts with the supporting political actors which were regarded as important in obtaining the go ahead for the MINTS project.

1.2.3.2.1.7) With custodians of information

1-3,5,8,9,15,18,20-22,24,27,29,31,32,

In a number of cases (4,7,12-17,19,25,27,29) the system user either had the information required for the MINTS or had already obtained access to the required information and there was no interaction between the consultant and the custodians of information required. In the cases (1-3,5,8,9,15,18,20-22,24,27,29,31,32) the consultant had to establish a working relationship with the custodians of information. For example, in the cases (31,32) the relationship between the custodians of information and the system user was not good because of the problems with the existing system. In these cases the consultant had to step in and deal with the bad feelings. In the cases (36,37) the consultant had already established excellent relationship with the custodians of information and had access to the data.

1.2.3.2.2) System User's relationship

1.2.3.2.2.1) With intermediary

1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

The consultants, system users and the intermediaries interviewed believed that a good working relationship between the system user and the intermediary was a critical factor.

1.2.3.2.2.2) With system user's immediate superior

1, 3, 7, 12, 13, 15-17, 19, 21, 25, 27, 28, 31, 32, 35, 38

1.2.3.2.2.3) With sponsor

1, 18, 20-22, 24, 25, 31, 32, 34-38

1.2.3.2.2.4) With supporting political actors

18, 20-22, 24, 25, 31, 32, 34, 35-38

1.2.3.2.2.5) With custodians of information

1, 3-5, 7-9, 12, 13, 15-22, 24, 25, 27, 29, 33-35, 38

In a number of cases, the system user had established a working relationship with the custodians of information whom were regarded as highly important. In the cases (31,32) there was some degree of resentment between the system user and the custodians of information because of the problems with the existing system not providing the system user with the support required. In these cases, the consultant had to deal with the bad feelings and create a more favourable working condition.

1.2.3.2.2.6) With MINTS champion

None

1.2.3.2.3) Sponsor's relationship

1.2.3.2.3.1) With system user's immediate superior

1, 3, 7, 16, 17, 21, 29, 31, 32, 35, 38

1.2.3.2.3.2) With political actors

3, 16-18, 20-22, 24, 31, 32, 34, 36-38

1.2.3.2.3.3) With custodians of information	25, 36, 37
1.2.3.2.3.4) With intermediaries	None
1.2.3.2.3.5) With MINTS champion	None
1.2.3.2.4) System User's Immediate Superior's relationship	
1.2.3.2.4.1) With supporting political actors	1, 3, 16, 17, 21, 25, 31, 32, 38
1.2.3.2.4.2) With custodians of information	21, 27, 29, 31, 32, 35
1.2.3.2.4.3) With intermediary	None
1.2.3.2.4.4) With MINTS champion	None
1.2.3.2.5) MINTS Champion's relationship	
1.2.3.2.5.1) With supporting political actors	None
1.2.3.2.5.2) With custodians of information	None
1.2.3.2.6) Intermediary's relationship	
1.2.3.2.6.1) With custodians of information	1, 2, 4, 5, 18, 20-22, 24, 25, 34, 35, 38
1.2.3.2.6.2) With supporting political actors	None
1.2.3.2.7) Supporting political actors	
1.2.3.2.7.1) With custodians of information	None
2) System Infrastructure	
2.1) Maturity of the existing systems (MIS/EDP)	
2.1.1) Software for the MINTS	
2.1.1.1) Availability	4, 5, 10, 11, 14, 15, 31-33, 36, 37

In a number of cases investigated (4,5,10,11,14,15,31-33,36,37) the software for the MINTS was already available before the consultant was called in. This was considered by the consultants interviewed to have given the system users the initial impetus to consider having a MINTS, without a push from the consultant's direction. Also, in a number of other cases (1-3,16-18,29,23-26,29-32,34,35) the consultants had software design capability required for building MINTS.

2.1.1.2) Suitability for the application area

All cases

In all the cases the MINTS generator, including the analytical technique, was regarded as very suitable. In the cases (17,18,24,25,30,34) much effort had to be put into selecting a suitable MINTS generator. In the case 25, for example, the system user and the intermediary were reaching the deadline for dealing with the decision problem and as yet had not found a suitable MINTS generator, when suddenly through unsolicited mailshot they were introduced to a suitable MINTS generator for their application. All those interviewed were of the view that having a MINTS generator which was capable of dealing with the major requirements of the application under consideration was critical.

2.1.1.3) Compatibility with the existing software

1,2,4,15,16,23-26,34-39

In the cases (1,2,4,15,16,23-26,34-39) the consultants as well as the system users and intermediaries believed that when a MINTS requires access to the existing systems, especially in terms of transfer of databases and programs, it is critical that the MINTS software is compatible with that of the existing systems.

2.1.2) Hardware for the MINTS

2.1.2.1) Availability

1-5,8-15,17-19,22,24,27-29,33,36,37

Hardware availability was regarded as very important as it forms a large portion of a MINTS cost, if not the most of it. Again the issue of incurring less costs, and the attitude of taking advantage of what is already available, provided a good impetus for the system user and the sponsor contemplating having a MINTS (1-5,8-15,17-19,22,24,27-29,33,36,37). In the case (8), the system user said that he would have not considered having a MINTS had there been no hardware already available.

2.1.2.2) Suitability for the MINTS software

All cases

In all the cases investigated the hardware used was said to be suitable for the software and the application area, but this was because serious attention had been paid to the choice of the hardware. In the case 25, for example, MINTS Generator could not run on the existing hardware. New hardware had to be purchased. Serious consideration was paid to the short-term and long-term manipulation and performance power required of the hardware. Also in all the cases reported the ability of the software to run on a personal computer and/or mainframe was a major consideration. For example, in the case 31, a major reason for the need for the MINTS was that the existing system was based on a mainframe, and the Engineer Managers had major problems with the existing system and required greater control/independence.

2.1.2.3) Compatibility with the existing hardware

1, 2, 4, 7, 8, 15, 18-20, 24, 25, 34-38

For the same reason as for the software compatibility, MINTS hardware compatibility with the existing hardware was regarded as very important (1, 2, 4, 7, 8, 15, 18-20, 24, 25, 34-38). In the cases 24 and 34, for example, the MINTS software could have not run on the existing hardware, so new hardware was required which could not only communicate with the existing software but also support the MINTS generator. In the case 34 this meant a complete new hardware strategy. In the case 24, a major requirement was hardware compatibility. In this case, although the MINTS generator was suitable for the application area it could not run on the existing hardware which hosted the database. New hardware had to be purchased for the MINTS generator and though initially there was some hardware compatibility problems, they were soon overcome by purchasing a communication package. In the case 34, even hardware compatibility between the same model mini-computers supporting the same MINTS generator posed a technical challenge for the hardware engineers when the mini-computers were needed to be linked together.

2.1.2.4) Accessibility to the existing hardware

1, 2, 4, 7-8, 15, 18-20, 24, 25, 24-38

When a MINTS depends on the existing systems, it is very important for it to have access to the existing systems. This can be in the form of being allowed to use the existing hardware, or having the appropriate communication links. In the cases (1, 2, 4, 7-8, 15, 18-20, 24, 25, 24-37), the MINTS had access to the existing systems, though there were initially some problems. In the cases 36 and 37, for example, the researcher experienced a long delay before the system user could use the MINTS developed. This was because the system users did not have the communication links available in their offices to the mainframe which was needed for having access to the corporate database. Communication problems were also reported in the case 25 which was soon sorted out. In the case 8, the system user had to borrow a personal computer from the IT department.

2.1.3) Data/information for the MINTS

2.1.3.1) Availability

All cases

Obviously it is crucial that there exist a strong base of data/information in the acceptable format to the MINTS software. It is also important that the different sources of data are identifiable. In all the cases sufficient base of data/information was available. The consultants interviewed also stated that they had on many occasions refused to go ahead with a MINTS project due to a lack of sufficient data. For the cases where MINTS only require qualitative type information, again they argued that information must be available. In the cases 7 and 8, basically qualitative information was required for the MINTS. In both cases the system users had the required information.

2.1.3.2) Accessibility

All cases

Building specific MINTS may require security clearance or/and being allowed access to the data by the data owner/custodian. For example, in the case 25, the MINTS developed could only survive and be used if a group of General Practitioners were willing to cooperate and provide the system user with the necessary data. The researcher also experienced in the cases 36 and 37 that without security clearance to access the corporate database, he could have not built the MINTS.

2.1.3.3) Validity

All cases

Validity of data/information is crucial, if the system user is to have confidence in the results. Different dimensions of data validation were pointed out by those interviewed. Data validation refers to the actual accuracy of the data to the extent demanded by the system user, the reliability/credibility of data source, the currentness and the relevance of the data. In the case 18, 8 and 9 all the data was qualitative and provided by the system user himself. In the case 18, validity of the marketing intelligence provided to the system user depended upon the marketing managers' knowledge of the bidding contracts they were involved in and the correct input of the data to the system. At the time of installing the system, the existing files were simply transferred into the new system in creating its database, without validating the existing files. At a later stage, the evaluation of a set of options in dealing with a lucrative bidding contract was based on certain invalid data which resulted in the choice of an option costing the company the contract. Doubts were raised about the credibility of the whole system. Later examination, however, revealed the source of the error, which had it not occurred would have resulted in the choice of an option that would have won the company the contract. A major effort had to be put into validating the database, as well as including certain data validation procedures in the system to avoid similar errors taking place in future. In the researcher's own experience, cases 36 and 37, it was essential for the system user that he had up-to-date information. The researcher had to include in the system an automatic program that extracted the relevant data from the corporate database everytime the system was switched on. Also the system user was provided with a menu option which allowed him to update his personal database.

2.1.3.4) Level of aggregation/disaggregation

1, 4, 6, 7, 10-12, 16-26, 33-38

Level of data aggregation/disaggregation refers to the detailedness of the data required by the MINTS. An example of disaggregated data, is, say, the price per unit parts of a product, or the expected increase in share price of an specific investment on hourly/daily basis. Examples of different levels of aggregated data are; average price per product, or expected average increase in share prices of a portfolio of investments on hourly/daily basis. The consultants believed that much attention must be paid to the short-term as well as long-term requirements of the system user in determining what level of detailed data is needed to meet those requirements (1,4,6,7,10-12,16-26,33-38). For example, in the case 34, the database for the MINTS was not built at the detailed level as it was found out to be required at a much later stage. A reassessment of the requirements had to be carried out and the database had to be rewritten completely, which proved very frustrating and resource consuming.

2.1.4) Performance of the existing systems (MIS/EDP)

1,2,4,7,8,15,18-20,24,25,34-38

When a MINTS is to be dependent upon an existing system then it is important that the existing system is performing well and that it is reliable to provide support to the MINTS. In the cases (1,2,4,7,8,15,18-20,24,25,34-38) the MINTS had to rely upon an existing system. At times, certain problems with the existing system as well as its reliability had a direct effect on the MINTS. For example, in the case 15, the MINTS relied upon having access to the main database of the DP department. However, there was a high rate of down time associated with the existing system, which frustrated the system user and stopped his work for long periods of time. In the case 34, the existing system had a very bad response time which was unacceptable to those trying to access the system. Additional hardware were purchased in this case which improved the response time greatly. In the cases (3,5,9-13,16,17,21) the MINTS was independent of any existing system. It was agreed by the consultants interviewed that there are less implications associated with a MINTS which is stand-alone, than with a MINTS that needs to rely upon another system.

2.1.5) Extent of technical expertise available

1,2,4,5,7-9,12,14-18,20,22,24,25,27,29,
31-38

When there exist technical expertise within the system user's department capable of assisting the system user, then the system user feels more confident of having more immediate help and assistance than reaching for help outside the department. Moreover, having local technical capability means that the system user may consider having a MINTS knowing that the technical support is readily available. Having technical capability is also an indicator of the level of maturity of the system user's department in IT. It is also an advantage to the system user to have someone technical who can spell out the technical requirements of the system user to the consultant. In a number of cases there existed some level of technical expertise which was available to the system user (1,2,4,5,7-9,12,14-18,20,22,24,25,27,29,31-38).

3) Capability and commitment of actors

3.1) System User	
3.1.1) System user's capability	
3.1.1.1) Knowledge of the application area	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.1.1) Knowledge of the problem	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.1.2) Knowledge of a solution	3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38
3.1.1.2) Knowledge of the MINTS	
3.1.1.2.1) Expertise of the analytical technique	None

The consultants interviewed believed that it is critical that the system user has a good understanding of the problem area and that it would be advantageous if he has considered the way in which the problem should be dealt with. This they believed puts the system user in a stronger position to specify his requirements. It was also believed that when a system user has a knowledge of the problem area and how it should be tackled that it reduces the burden of convincing him of a need for the MINTS. Such system users tend to approach the consultant than the other way round. In the cases (3-5, 7-22, 24, 25, 27-30, 33, 34, 37, 38), the consultants were approached by the client. In the cases (1, 2, 20, 21, 31, 32, 35, 36) the consultants approached the client. These consultants had to put a great deal of effort into convincing the people involved of the need for the MINTS and the support that such system could provide. Although the cases reported here had eventually received their go ahead, the consultants admitted that on many occasions when they had approached the client, there were unable to obtain the support of the system user or the sponsor for the proposed MINTS. In the cases (21, 31, 32, 35) the consultant had to carry out further modifications to the system because the system specification had to be changed as the system user had more time evaluating the application area. These resulted in additional expenses, delays in the time table and problems with the sponsor and the system user that were eventually dealt with. The same consultants mentioned cases in which the MINTS was imposed upon the system user and it had failed. The researcher also experienced in the case 36 a great deal of initial unwillingness from the part of the system user to cooperate as it took sometime before he could appreciate the MINTS support. In contrast in the case 37, the system user had a need for the MINTS and the researcher was asked to help, which meant full cooperation from the part of the system user and the intermediary involved.

In all the cases investigated the importance of the system user's knowledge of the analytical techniques offered in the MINTS was regarded low. This was because of the user-friendly nature of these systems that had greatly reduced the need for technical expertise from the part of the system users or the intermediaries. In all the cases the internal calculations of the analytical technique was part of the "black box". The system users and the intermediaries were provided with a system that was either fully menu-driven or access was allowed to the command level, but the use of the analytical techniques made available was very simple. For example, in the case 34, there was no need to know how to do forecasting. The system user was simply provided through a menu with a choice of selecting different analytical techniques such as trend or exponential forecasting methods, or a menu offering the choice of a time series or cross sectional regression and whether or not a Durbin-Watson method should be used when applying a time series analysis. However, in offering the use of these techniques, the system user is required to know about their application areas and how to interpret the results produced. It was pointed out that when a system user is familiar with the analytical techniques available to him, his use of the MINTS becomes rather immediate, as he avoids the need for training on the application areas and the interpretation of the results, and also he tends to be more creative in their use (13). Many of the MINTS generators available have further reduced the need for training as they come with a comprehensive user manual or on-line help that explains the different applications of the techniques available and how to interpret the results.

3.1.1.2.2) Ability to interpret the results

5,13,28,35

The ability to interpret the results was regarded as critical when the analytical technique used produced results or concepts with which the system user or the intermediary was not familiar (5,13,28,35). For example in the case 28, although the Managing Director was enabled, due to the very user-friendly MINTS software, to do modelling and use different analytical techniques such as simulation, risk analysis, and statistical and financial techniques very simply, he initially had difficulty in interpreting certain results such as the probability distribution curves which he had easily created in assessing the risks involved in taking certain courses of action, or what different statistical analysis such as standard deviation meant. However, this was rectified through a two days training course. In the other cases (1-4,6-12,14-27,29-34,36-38), the ability to interpret the results was dependent upon the system user's or the intermediary's familiarity with the application area - he had to know his job. For example, in the case 32, the system user was a mine engineer and knew his job. In this case, what the MINTS had done was to simply allow him to consider more alternatives and include more constraints in his decision model much faster. The MINTS did not produce any concepts that were new to the system user.

3.1.1.2.3) Expertise in the MINTS programming language

None

In the cases (3,7-9,16,17,27,29,30,31,32,36,37) the MINTS was built by the consultant and the system user was delivered a menu-driven MINTS. In the cases (10-15,19,24,28,33) the system user was involved in model building and this was made possible due to the very userfriendly programming language.

3.1.2) System user's commitment

3.1.2.1) Perception and urgency of need

All cases

It is critical that the system user has a real need for the MINTS. This is because the use of MINTS is discretionary and the system user must be convinced of his need for such a system, otherwise he will not use the MINTS. In all the cases investigated by the researcher either the system user had approached the consultant with a need for a MINTS or the consultant had to draw the attention of the system user and the sponsor to the existence of a problem which needed to be tackled. The consultants also admitted that on many occasions they had failed to convince the system user and the sponsor of the support that the proposed MINTS could provide and these projects did not receive the go ahead. The need for the MINTS was mainly in the form; a problem with the existing system (1,3,4,18,19,20,21,22,27,29,31,32,34,35), inability to consider adequately the amount of information in the process of decision making (10,12-16,33), a crisis problem (8,25), or an opportunity (9,13,17,28,30,36) was realised.

3.1.2.2) System user initiation/involvement in system spec.

All cases

All the consultants interviewed believed that the involvement of the system user in identifying the system requirements was highly important. The same view was expressed by the system users interviewed. This was because without the cooperation of the system user it would be difficult to identify what the system user needs, as well as obtaining his commitment to using the system. It was also stated by the consultants both with regard to the case studies mentioned in this study as well as their general experience of other MINTS that when a system user initiates the proposal for his MINTS he will be more committed to making the system a success than when he has to be persuaded to do so. In the cases (2,3,5,7-20,24,27,28,30,33) the system users initiated the proposal for their requirements. In all these cases the system users had a good understanding of the problem and what sort of support they required. Moreover, the same system users were found to have championed the MINTS. The consultants interviewed also stressed the view that generally when system users were the initiator of the MINTS, they invested more efforts and time into making the MINTS work.

3.1.2.3) Acceptance of the change and efforts required

All cases

This was regarded as critical by all the consultants and the system users interviewed. This was also backed by the consultants' general experience. They believed that the system users were needed to accept the changes required by the MINTS in their decision-making process, or the time and effort required of them in making the system work. The other issue which was found was that many of the MINTS investigated were a success due to the additional efforts invested in the MINTS by the system user in working with and understanding the system (5,7,8-17,19,24,25,27,28,33). These system users were all regarded as being the MINTS champion. The researcher also found, during the course of interviewing a number of senior managers, that there existed an attitude among many senior managers that the time and effort required for learning how to use a MINTS was not worth the support such systems provide. They also believed that such systems as yet do not fit within their decision environment.

3.1.2.4) Acceptance of the MINTS potential and support

All cases

Again the system user's acceptance of the MINTS support was regarded as critical, otherwise the MINTS will not be used. In all the cases the system user had accepted the MINTS potential and support. The researcher also during the course of interviewing a number of senior managers found out that some senior managers had no confidence or trust in new technology. They believed that the sort of support they need cannot be provided by a computer. It was also argued that they deal with a wide range of interrelated problems and decisions that require immediate action, something that they believed the current MINTS are not as yet able to offer.

3.1.2.5) Existence of intermediary support

1-5,18,20-22,24,25,34-38

Many decision-makers do not wish to use a computer directly for a variety of reasons (e.g. lack of time or confidence) but accept the need for such systems and the support they can offer. In such cases, it is crucial that an intermediary is available to interact between the system user and the system. In the cases (1-5,18,20-22,24,25,34-38) an intermediary was used. In the cases (1,2,18,20-22,24,25,34-38) the system user would have not committed himself to having the MINTS had it not been because of an intermediary. This was also backed by the general experience of the consultants interviewed. Again the researcher's experience in the case 36 was that once he left the company, there was no other technical intermediary available to replace him. The researcher has since then understood that the MINTS designed has not been used.

3.1.2.6) Acceptance of responsibility for the MINTS

5,10,11,24,28,33

In the cases (5,10,11,24,28,33) the system user had accepted full responsibility for the MINTS. In all these cases the system user was also the sponsor of the MINTS. The consultants interviewed were also of the opinion that it is critical that someone, the system user or the intermediary, accepts the responsibility of maintaining the MINTS.

3.1.2.7) Charge-back method of payment	None
<p>This means that when the system user is kept responsible for the costs of the system that he will be more committed to the MINTS. In 22 cases (2,3,5,7-20,24,25,27,28-30,33) the user was the MINTS champion. Out of these cases, in 6 cases (2,5,10,11,28,33) the system user was also the sponsor. It appears that even when the system user is not responsible for the MINTS costs he accepts the role of the champion. However, it was found that it takes longer to obtain finance for a MINTS when the system user needs to obtain approval. Also when system users wanted to obtain finance for their MINTS, they were required to give some justification of the costs (1,3,7-9,16-18,20-22,24,25,27,29-32,34,35,38). For example, in the case (8), the system user had reluctantly filled in a requisition form because of the lengthy approval procedure and the sponsor's negative attitude to the use of IT. There seems that there is some evidence that when the system user has the budget to pay for the MINTS he can avoid the political issues and justifying the MINTS to another source, hence more committed to having a MINTS.</p>	
3.2) Sponsor	
3.2.1) Commitment to the MINTS	
3.2.1.1) Availability of funds	All cases
<p>In the cases (1,3,4,7-9,12-22,24,25,27,29-32,34,35,38) the MINTS costs had to be approved by the sponsor and sufficient funds were available. In all the cases investigated funds were available.</p>	
3.2.1.2) MINTS project priority	1,3,7,12,16-18,20-22,24,25,27,30-32,34,35,38
<p>In the cases (1,3,7,12,16-18,20-22,24,25,27,30-32,34,35,38) the MINTS projects were given high priority by the sponsor.</p>	
3.2.1.3) Political pressures	17,24,25
<p>In the cases (17,24,25), the sponsor was reported to have been under political pressure. In the cases 24 and 25 the pressure was from the government. In the case 17, the system user's immediate superior had to use his influence to obtain the finance for the MINTS concerned.</p>	
3.2.1.4) Involvement in the MINTS project	1,3,18,20-22,24,25,29 31,32,34-38
<p>In the cases (1,3,18,20-22,24,25,29 31,32,34-38) the sponsor was involved in the project and had to be consulted on the MINTS progress. In the case 21 without the sponsor's involvement and political pressure on the intermediaries, the MINTS would have not succeeded.</p>	

3.2.1.5) Written approval plans for MINTS development	1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38
In the cases (1,3,7,16-18,20-22,24,25,29-32,34,35,38) the sponsor required written plans for the MINTS development. The consultants also believed that it was critical that they obtain written authorisation to go ahead with a project.	
3.2.1.6) Benefits from the MINTS	
3.2.1.6.1) Personal benefits from the MINTS	None
Excluding the system users as the sponsor of their MINTS (2,5,10,11,28,33), there was no personal benefits for the sponsor from the MINTS.	
3.2.1.6.2) Organisational benefits from the MINTS	1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38
In a number of the MINTS projects the benefits could not be quantified. However, in the cases (1,3,7,16-18,20-22,24,25,29-32,34,35,38) some cost saving was associated with the MINTS. In the case 1, for example, not only the service level was increased from 88% to 93%, but also a cost saving of £2.5 was reported by better management of the spare parts inventory. In this case the organisational savings were a major factor for the sponsor authorising the MINTS costs.	
3.2.1.7) Attitude to the MINTS	1, 3, 7, 16-18, 20-22, 24, 25, 29-32, 34, 35, 38
In the cases (1,3,7,16-18,20-22,24,25,29-32,34,35,38) the sponsors had a positive attitude towards the MINTS. In the same cases organisational benefits were associated with the MINTS, which indicates that sponsors tend to have more positive attitude when there are cost savings involved. In the cases (4,8,9,12-15,19) the sponsors were only required to finance the MINTS and had no involvement in the MINTS project, and their attitude towards the MINTS was regarded as irrelevant. A major reason for this is due to low MINTS cost that did not concern the sponsor at all.	
3.3) Custodians of Information	
3.3.1) Commitment	
3.3.1.1) Ability to cope with additional workload	1, 20, 24, 25, 34, 38
In the cases (1,20,24,34,38), the DP/MIS staff needed to be increased to cope with the additional requirements put upon them by the MINTS. In the case 25 the general practitioners who were needed to supply the system user with certain information were unhappy about the workload imposed upon them.	

3.3.1.2) Willingness to cooperate	1-3,5,7,12,14-18,22,24,25,27,29-32,34-38
In all the cases (1-3,5,7,12,14-18,22,24,25,27,29-32,34-38) in which the custodians of information were involved, their cooperation was regarded as important to the success of the MINTS.	
3.3.1.3) Political pressure	20,24
In the cases 20 and 24, some political pressures were imposed upon the custodians of information to obtain their cooperation.	
3.4) Consultant	
3.4.1) Commitment	
3.4.1.1) MINTS priority	
3.4.1.1.1) Financial and political benefits	All cases
The consultants interviewed believed that there must exist either a financial benefits or a combination of financial and political benefits in carrying out a MINTS project. In the cases (1,2,4-13,16-20,24,25,27,28,30,33-35,38) the financial benefits were taken into consideration in accepting the MINTS project. In the cases (3,21,22,29,31,32) both financial and political benefits were taken into consideration. In the cases (14,15,36,37) only political benefits were the reason for accepting the MINTS project.	
3.4.1.1.2) Availability of a resource pool	1-13,16-34,38
In all the cases, except (14,15,36,37) the availability of a resource pool for the MINTS costs was regarded as critical.	
3.4.2) Consultant's capability/credibility	
3.4.2.1) Familiarity with application area	
3.4.2.1.1) Ability to identify a short-term problem	1-3,6,7,1-12,17,20-23,26,29-32,35
3.4.2.1.2) Ability to identify the long-term implications	1-3,6,7,1-12,17,20-23,26,29-32,35

All the consultants interviewed (1-3,6,7,1-12,17,20-23,26,29-32,35) strongly believed that familiarity with the application area is highly important. They also stressed the importance of not only being able to identify short term applications for the MINTS, "quick and dirty" approach in order to gain credibility and overcome user's and sponsors' apathy but also being able to see the long term requirements of the system user. For example, in the case 1, the consultant approach was to avoid talking about long term problems which usually sound theoretical and with which the client can not immediately associate, but to deal with an immediate problem which the client needs to pay immediate attention. In this specific case, the consultant first identified that there existed 8000 stock items that had zero level of inventory and zero level of value for the previous two years. The question put to the client was why these items were still on the list. The fact that the consultant could ask such a question meant that he was taking at practical level and not at theoretical level and knew their existing system. This attracted the client's attention and soon the discussion led into long-term MINTS requirements.

3.4.2.2) Technical know-how in building MINTS

All cases

It is critical that the consultant has the technical know-how about the proposed MINTS. All the consultants interviewed had specific technical know-how. In a number of cases the consultant had specialised in only specific area, in the sense that he had a pet analytical technique or MINTS generator (4,5,6,8-15,18-20,22-28,30,33,34,38). In a number of cases there existed a team of consultants, each specialised on a specific analytical technique or MINTS generator (1-3,7,16,17,21,29,31,32,35,39).

3.4.2.3) Experience with similar MINTS

All cases

In the cases (6,16,20,,23-25,34,38) the consultant had gained experience in a very limited range of application areas. In the case 16, for example, the application areas for which the MINTS generator was used were limited to brewing and oil companies. In the cases (3,21,31,32) the consultant had been involved in the same MINTS but worked to apply it to the same application area but in different parts of the organisation.

3.4.2.4) Ability to deliver on time

All cases

It was regarded, by all the consultants and system users interviewed, as highly important to have the proposed MINTS delivered on time. Otherwise, it was said, the credibility of the consultant and the MINTS project would be at risk. However, it was argued that often on-going modifications/additions to the MINTS is requested by the system user or the intermediaries. The consultants were of the view that in such cases the availability of resources (finance and staff) is critical as well as an agreed time table for the up-dates. For example in the case 31, the system users had requested additional modifications to the user interface of the MINTS, but there was political pressure on the sponsor to keep the costs down, which had delayed the required modifications to be made to the MINTS.

3.4.2.5) Provision of technical support

All cases

The ability to provide an acceptable level of technical support was regarded, by all those interviewed, as critical. In all the cases the consultants provided technical support. In the cases investigated, although the technical support was not regarded as ideal, but the system users and the intermediaries were satisfied with the technical support given to them. In a number of cases the consultant provided the system user or the intermediary with extra technical support outside the normal working hours (10,11,17,24,25). This was because there existed a deadline and the system user or the intermediary could have not met the deadline without the consultant's special attention. In the case 25, the consultant was also trying to make a success of the system as there was a great potential for having many more potential system users for a similar MINTS within the same organisation. Technical support was regarded by the consultants as two types; answering system users/intermediaries queries and problems and responding to the changes required by the system users and the intermediaries. Both types of support were regarded as critical. The system users and the intermediaries interviewed mentioned cases that they knew about their colleagues that had selected a MINTS generator which later was not backed up by good technical support and which had resulted in major problems, and eventually the system user had to give up using the MINTS. In the case 16, for example, it was mentioned that during the process of selecting the MINTS generator, they were very much taken by other MINTS software which suited their requirements much better than the one they went for eventually. The major reason for the decision was that they had heard of the poor technical support offered by the software supplier.

3.4.1.6) Provision of training

All cases

<p>In all the cases the system users and the intermediaries had been to a training course lasting a few days, as well as being given hands-on training on site. In the cases (1-5,7-13,16,20-22), the system users and the intermediaries were given training which was specifically geared toward their application area. In the cases (17,24,25) the training given was not geared towards the application area, and the system users and the intermediaries were not happy, subsequently further training was requested which was geared to their problems. All those interviewed stressed upon the high importance of hands-on training which was geared toward the system user's application area. The consultants interviewed believed that it is critical that they provide the system user and/or the intermediary with adequate training to understand and operate the system.</p>	
3.4.1.8) Interpersonal skills	1-3,6,7,9,10,12,20-23,26,29,30-32,35,39
<p>The consultants interviewed (1-3,6,7,9,10,12,20-23,26,29,30-32,35,39) believed that their ability to communicate successfully with the key actors involved in a MINTS project was very important. This was defined in terms of the ability to get on with the actors, the ability to deal with bad feelings among the actors, the ability to express complex concepts in a language understood by the key actors. It was also argued that a business-oriented consultant should be sent to such actors as the system user and sponsor, and a technical-oriented consultant to such actors as the technical intermediaries and the custodians of information such as EDP/MIS staff. Emphasis was put upon having a good mix of technical, business, and interpersonal skills.</p>	
3.5) MINTS Champion	None
<p>In all the cases investigated there existed a MINTS champion. In the cases (2,3,5,7-20,24,25,27-30,33,34,38) the system user was the MINTS champion. In the cases (4,22,37) the intermediary was the MINTS champion. In the cases (31,32) the system user's immediate superior was the MINTS champion. In the cases (1,21,36) the sponsor was the MINTS champion. It was found that the role of the MINTS champion was played by the other key actors and there was no MINTS actor who played only the role of a MINTS champion. This meant an elimination of the MINTS champion as an actor</p>	
3.5.1) Commitment	None
3.5.1.1) Benefits from the MINTS	None
3.5.1.1.1) Personal benefits from the MINTS	None
3.5.1.1.2) Organisational benefits from the MINTS	None
3.5.1.2) Political pressure	None
3.5.2) Influence	None

3.6) Intermediary	
3.6.1) Technical intermediary	
3.6.1.1) Capability	
3.6.1.1.1) Knowledge of the application area	1, 4, 20-22, 24, 34-38
3.6.1.1.1.1) Knowledge of the problem	1, 4, 20-22, 24, 34-38
3.6.1.1.1.2) Knowledge of a solution	1, 4, 20-22, 24, 34-38
In the cases (1, 4, 20-22, 24, 34-38) the intermediary had a good understanding of the problem and had come up with suggestions as to how it should be tackled. For example, in the cases 3 and 24, the intermediary was actually the major contributor in identifying the system requirements and had built most of the decision model.	
3.6.1.1.2) Knowledge of the MINTS	
3.6.1.1.2.1) Expertise of the analytical technique	None
In all the cases investigated the importance of the intermediary's knowledge of the analytical techniques offered in the MINTS was regarded as low. This was because of the user-friendly nature of the MINTS that had greatly reduced the need for technical expertise from the part of the intermediary. In all the cases the internal calculations of the analytical technique was part of the "black box". The intermediaries were provided with a system that was either fully menu-driven or access was allowed to the command level, but the use of the analytical technique was made very simple. For example, in the case 34, what was needed was to call a procedure either from the command level or from a menu on the analytical technique required. There was no need for the intermediary to know the internal calculations of, say, a forecasting technique, or whether he required a time series or cross sectional regression and whether or not a Durbin-Watson method should be used when applying a time series analysis. However, in offering the use of these techniques, the intermediary was required to know about their applications and how to interpret the results produced. It was pointed out that when an intermediary is familiar with the analytical techniques available to him, his use of the MINTS becomes rather immediate, as he avoids the need for training on the applications of the analytical technique and the interpretation of the results. Also the intermediary tends to be more creative in the use of the analytical technique (22).	
3.6.1.1.2.2) Ability to interpret the results	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

<p>In all the cases involving intermediaries (1,2,4,5,18,20-22,24,25,34-38), they were, some after training, able to interpret the MINTS results. The ability to interpret the results was regarded as critical when the analytical technique used produced results or concepts with which the intermediary was not familiar (4,5,35). In these cases the intermediaries were given some training on the applications of the analytical technique and how the results should be interpreted. In the other cases (1,2,18,20-22,24,25,34,36-38), the ability to interpret the results was dependent upon the intermediary's familiarity with the application area - he had to know his job. For example, in the case 21, the planners knew their job. In this case, what the MINTS had done was to simply allow them to consider more alternatives and include more constraints in the decision model much faster. The MINTS, in this case, did not produce any concepts that were new to the intermediary.</p>	None
<p>3.6.1.1.2.3) Expertise in the MINTS programming language</p> <p>In the cases (1,2,4,5,18,20-22,24,25,34-38) the intermediary was expected to know how to operate the MINTS. In the cases (4,5,18-20,22,24-26,33-38) the intermediary was also expected to build decision models. In none of these cases prior programming language was required as training was provided. In the cases (1,2,21) the system was menu driven. In the case 25, the intermediary did not have any previous computing experience, yet she carried out most of the model building herself after having sufficient training. This was achieved through a very user-friendly programming language, a great deal of effort on the part of the intermediary, and a high level of technical support provided by the consultant. In the cases (1,2,21) the consultant carried out all the necessary programming and did not allow the intermediaries access to the command level.</p>	
3.6.1.1.2) Commitment	
3.6.1.2.1) Workload	1,2,4,5,18,20-22,24,34-38
<p>In the cases (1,2,4,5,18,20-22,24,34-38) the workload on the intermediaries was regarded as important. For example, in the case 21, the intermediaries had resisted the acceptance of the MINTS because of the amount of workload that they had to deal with everyday which made it difficult for them to have time to become involved in the MINTS project.</p>	
3.6.1.2.2) Personal benefits from the MINTS	1,4,5,18,20-22,24,25,34-38
<p>In the cases (1,4,5,18,20-22,24,25,34-38) the intermediary had personally benefited from the MINTS, in the sense that it had made his job much easier and had gained him a firmer position within the company, as the MINTS was dependent upon his expertise.</p>	
3.6.1.2.3) Acceptance of responsibility for the MINTS	1,2,4,5,18,20-22,24,25,34-38

<p>In the cases (1,2,4,5,18,20-22,24,25,34-38) the intermediaries were responsible for maintaining the MINTS. It was regarded by the consultants interviewed that the intermediary accepted the responsibility of maintaining the system.</p>	1,21
<p>3.6.1.2.4) Political pressure</p> <p>In the cases 1 and 21, it was important to exert political pressure upon the intermediaries to become involved in the MINTS project.</p>	37
<p>3.6.2) Clerical</p>	
<p>3.6.2.1) Commitment</p>	
<p>3.6.2.1.1) Level of expertise</p>	None
<p>3.6.2.1.2) workload</p>	37
<p>Only in the case 37 a clerical intermediary was involved. The MINTS had actually reduced her workload, and it did not require her having any expertise.</p>	
<p>3.7) System User's Immediate Superior</p>	
<p>3.7.1) Influence</p>	1,3,7,16,17,21,25,27,29,31,32,35,38
<p>In the cases (1,3,7,16,17,21,29,31,32,35,38) the immediate superior used his influence to convince the sponsor to finance the MINTS project. In the cases (1,3,16,17,21,25,31,32,38) he convinced some colleagues to act as supporting political actors for the MINTS. In the cases (21,27,29,31,32,35) he used his influence on the custodians of information to obtain access to the data required for the MINTS.</p>	
<p>3.7.2) Commitment</p>	
<p>3.7.2.1) MINTS benefits</p>	
<p>3.7.2.1.1) Personal benefits from the MINTS</p>	1,3,7,13,16,17,27,29,31,32,38
<p>In the cases (1,3,7,13,16,17,27,29,31,32,38) the immediate superior benefited from the MINTS either politically or received better support from the system user.</p>	
<p>3.7.2.1.2) Organisational benefits from the MINTS</p>	1,3,7,16,17,29,31,32,38

<p>In the cases (1,3,7,16,17,29,31,32,38) the immediate superior believed there were some organisational benefits associated with the MINTS. For example, in the case 1 large savings were reported. In the case 7, the MINTS covered its costs in about six months, as well as improved customer service.</p>	
<p>3.7.2.2) System user's need for the MINTS</p>	<p>1,3,7,12,13,15-17,19,21,25,27,29,31 -35,38</p>
<p>In the cases (1,3,7,12,13,15,16,17,19,21,25,27,29,31-35,38), the immediate superior was either involved in the MINTS project or were contacted by the system user to obtain his support. In all these cases the immediate superior had supported the MINTS partly because the system user had a need for having the MINTS.</p>	
<p>3.7.2.3) Political pressures</p>	<p>17,31,32</p>
<p>In the cases (17,31,32) there were political pressures on the immediate superior to achieve better performance from his department.</p>	
<p>3.7.2.4) Involvement in the MINTS project</p>	<p>1,3,7,13,16,17,27,29,31,32,38</p>
<p>In a number of cases (1,3,7,13,16,17,27,29,31,32,38) the system user's immediate superior was involved in the MINTS project to the extent that he was notified from time to time, mainly by the system user, of the MINTS progress. In the cases 31 and 32, his commitment was such that he actually championed the MINTS.</p>	
<p>3.8) Supporting Political Actors</p>	
<p>3.8.1) Commitment</p>	
<p>3.8.1.1) Benefits</p>	
<p>3.8.1.1.1) Personal benefits from the MINTS</p>	<p>None</p>
<p>No personal benefits were reported from the MINTS for the supporting political actors</p>	
<p>3.8.1.1.2) Organisational benefits from the MINTS</p>	<p>20-22,24,31,32,34,38</p>
<p>Supporting political actors were involved in the MINTS project in the cases (20-22,24,31,32,34,36-38). In the cases (20-22,24,31,32,34,38) the MINTS was believed to have organisational benefits associated with it. This was believed to have influenced the political supporters of the importance of the MINTS.</p>	

3.8.1.2) Political pressures	None
3.8.2) Influence	1, 3, 16, 17, 20-22, 24, 31, 32, 34, 36, 37
<p>In the cases (20-22, 24, 31, 32, 34, 36, 37) the political supporters were involved in the MINTS project, and were given a presentation of the proposed MINTS by the consultant. In the cases (1, 3, 16, 17, 38), although the supporting political actors were not involved in the MINTS project, but they had been approached by the immediate superior to support the MINTS. In these cases the finance for the MINTS had been approved before the consultant became involved. In all the cases, the influence of the political supporters was what was required in supporting the MINTS.</p>	
B) Maintaining Relationships	
1) System User	
1.1) User satisfaction	
1.1.1) MINTS support	
1.1.1.1) Match of system and problem	
1.1.1.1.1) Problem limitations	
1.1.1.1.1.1) Portion of variables known	
<p>All the consultants and the system users interviewed, regarded it as critical that the MINTS should be capable of dealing with at least a major part of the application/problem area which the system user finds as worthwhile for which to use the MINTS. In other words, the decision models must include at least the most important variables which the system user needs to consider in tackling a problem. For example, In the cases 7 and 17, the consultants mentioned cases where they refused delivering a MINTS to a system user because they believed that the MINTS generator was not capable of dealing with the application area sufficiently. For example, in the case 17, the method used in calculating the capacity of the delivery vans required that the packages for delivery had to be within certain dimensions and shapes, otherwise the MINTS could not cope with the problem adequately. In the case 21, initially the MINTS could not deal with short-term problems facing the planners, but built to cope with long-term mining operations. The planners refused to use the system, until modification were made to enable them to deal with short term scheduling of mining operations.</p>	
1.1.1.1.1.2) Quantifiability of the variables	1-18, 20-39

The consultant believed that the variables needed for building the decision models had to be quantifiable. They believed that when there exist a great deal of uncertainty, in the sense that either the data for important variables or constraints do not exist, or where there exist a great deal of uncertainty in terms of assigning a quantitative value to important decision variables, then the results would not be valid enough to justify the use of the MINTS. For example, in the cases 8 and 9, the MINTS was designed to accept qualitative data, but the system user was required to assign a quantitative value to each item of information. After the completion of the data input, the system would inform the system user of his inconsistencies in assigning preferences and values to each item of information. Where the inconsistencies were above an acceptable limit, then the system user was expected to revise his judgement. This meant that when the system user was uncertain about quantifying his judgement within an acceptable degree of consistency, then the MINTS was not useful. In the case 19, however, the MINTS dealt mainly with text and to a small degree with quantitative data.

1.1.1.1.3) Understanding of relationships

All cases

It was regarded as crucial, by all the consultants, that the relationship between the variables in a decision model had to be understood sufficiently to allow the building of a meaningful decision model. The more uncertainty about the relationships the less, it was said to be, the confidence in the results. The consultants pointed out that they always try to deal with application areas that are not very unstructured. They must understand a good part of the decision problem, and the interrelationships between the variables in order to build a decision model which could provide the system user with worthwhile decision support. In all the cases investigated, the relationships between all the major variables were generally known, though there existed certain few variables which were not understood and on which the MINTS was expected to offer some insight.

1.1.1.1.2) System limitations

In all the cases investigated all the immediate and essential system requirements (the "Must haves") had been satisfied and this had enabled the system user to use the system in practical terms. In the cases (4,5,7-17,19,28,30,33) the MINTS was completed after a very short period of development and no major additions were required afterwards. In the other cases, although the initial system user's essential requirements had been satisfied, further modifications and additions had to be carried out to the system as the system user was able to further identify his requirements. The non-major requirements (the "Nice to haves") were basically in the form of further improvements to the user interface or further updates to the system carried out by the consultant in terms of ironing out certain problems such as debugging the system or making the system more flexible and with further additions to it, which were usually requested by the system users or the intermediaries.

1.1.1.1.2.1) Dealing with the "Must haves"

All cases

All those interviewed believed that it was critical that the major system requirements were satisfied.	
1.1.1.1.2.2) Dealing with the "Nice to haves"	All cases
1.1.1.1.2.3) Internal adaptability	
1.1.1.1.2.3.1) Supporting different time horizons	4-6, 10-15, 20-22, 24, 25, 28, 33-38
In the cases (4, 5, 6, 10-15, 20, 22, 24, 25, 28, 33-38), the decision problem required the MINTS to be very flexible in terms of allowing the problem to be represented in different time horizons. For example, in the case 4, the problem had to be presented on an hourly/daily/weekly/monthly/yearly basis. In this case the MINTS allowed the problem to be dealt with easily as it understood time.	
1.1.1.1.2.3.2) Allowing different modes of input	All cases
The modes of input provided to the system users and the intermediaries varied; 'choice box', 'reply box', 'tables', 'graphs', 'worksheets', 'formulae'. In the cases (20, 22, 34, 36-38) a combination of a choice box, reply box, worksheet, and formulae was offered which allowed great deal of flexibility in terms of data input. In the cases (4, 10-12, 19, 33) the MINTS offered all the different modes of data input mentioned above. In the case 31, the graphic mode of input greatly assisted the project manager. As a civil engineer he had an idea of the cash flow for a station refurbishment which is in the form of an 'S' curve. He simply had to draw the curve using quick draw facilities provided by the software and the software automatically translated that curve into a set of figures. In the majority of the cases, although it was possible to provide different modes of input, only a single method of input was provided and the system users and the intermediaries would have been happier if they were given greater flexibility. The limiting factor here was the additional cost and time involved in providing different modes of input. In the case 31, for example, the system users were unhappy about inputting a great deal of data through a table. After complaints from the system users, eventually plans were approved to provide the system users with a scanning device to input the data more easily into the system.	
1.1.1.1.2.3.3) Modification/addition of functions	All cases
In all the cases the MINTS was capable of being modified or extended. However these modifications had to be carried out by the consultant or the vendors. A number of MINTS generators were available in modules, which meant that only the modules required by the system user were included in the MINTS, and as the system user's requirements increased, other modules were added to cope with his needs.	
1.1.1.1.2.4) External adaptability	

1.1.1.1.2.4.1) Capability to support various decisions	4-6, 8-15, 18-20, 22-28, 30, 33-38
<p>In many cases (4-6, 8-15, 18-20, 22-28, 30, 33-37), those interviewed argued that the fact that they had a MINTS generator gave them flexibility and capability in dealing, if they wished, with other applications. Another major consideration in going for a MINTS generator was the reduced costs in building other MINTS. In other cases (1-3, 7, 16, 17, 21, 29, 31, 32), the specific MINTS dealt with a major decision problem.</p>	
1.1.1.1.2.4.2) Adaptability to additional users' needs	All cases
<p>It was regarded by all those interviewed as critical to have a MINTS that is capable of responding to the changing and additional needs of the system users and the intermediaries. In a number of cases (1-3, 7, 16, 17, 21, 29, 31, 32), although the system users or the intermediaries were not allowed to change the MINTS, the system had the capability of responding to the changing needs which had to be carried out by the consultant. In the case of the MINTS generators, the consultant involved offered up-dates of the software on a regular basis in response to user demands and problems with the system. This type of technical support was regarded as highly important.</p>	
1.1.2) MINTS benefits	All cases
1.1.2.1) Improved quality of decisions	All cases
<p>In all the cases investigated the system users and the intermediaries were enabled to make a better quality decision by using the MINTS.</p>	
1.1.2.2) Improved speed of decisions	All cases
<p>Again in all the cases the system users had become more efficient in their process of decision making, hence saving time. For example, in the case 32 the time of going through the process of preparing the information and making a decision had been cut down from more than a week to few hours.</p>	
1.1.2.3) More convincing arguments	3, 4, 8, 9, 14-17, 20, 24, 25, 31-33, 35

<p>In the cases (3,4,8,9,14,15,16,17,20,24,25,31,32,33,35) the MINTS had been used by the system user to put forward a more convincing case of his plan of action. For example, in the case 24, the system user felt more confident and able to back up his financial projection more strongly during his presentation to the Board of Directors. This was because he was enabled to make more accurate projections as well as taking into consideration more constraints than he had previously been able to do. In the case 16, the system user had used the results to draw the attention of the managing director to the need for the purchase of more vans to cope with the future increases in the number of contracts accepted.</p>	<p>4, 5, 6, 8-15, 19, 20, 22, 24, 25, 27, 28, 33-38</p>
<p>1.1.2.4) More use of analytical aids</p> <p>In the cases (1,2,3,16,17,21,29-32), although the decision problem had been tackled using an analytical technique, but the system users or the intermediaries were not concerned with the technique used. In the cases (4,5,6,8-15,19,20,22,24,25,27,28,33-38) the system users and the intermediaries had actually used the analytical techniques made available to them in dealing with their decision problems. In these cases it was believed that more use of the analytical techniques were made</p>	<p>All cases</p>
<p>1.1.2.5) More relevant information</p> <p>In all the cases the system users had received better and more relevant information on the decision problem. In many cases, the argument was that prior to the use of the MINTS, the system user did not and could not have the sort of information that was made available by the MINTS. For example, in the case 2, the number of applications for credits rejected or approved wrongly was reduced substantially. Also due to a better understanding of the clients' debt payment behaviour, a better customer service was provided and pressure was exerted on selective clients.</p>	<p>All cases</p>
<p>1.1.2.6) Evaluation of more scenarios</p> <p>Evaluation of more scenarios was reported in all the case studies investigated. For example, in the case 1, the system user was enabled to consider different alternatives for different levels of stock, different demand levels, and the costs involved in maintaining different stock levels.</p>	<p>2, 7, 8, 9, 11, 12, 16, 17, 33</p>
<p>1.1.2.7) Setting priorities better</p> <p>In the cases (2,7,8,9,11,12,16,17,33) a benefit of the MINTS was to allow the system user to set his priorities better. For example in the case 9 the deputy divisional director had identified, using his MINTS, the priorities for services in the mentally handicapped field for a presentation to the members of the County Council who had to decide on allocating next year budget.</p>	<p>3, 8-10, 30, 32</p>

In the cases (3,8-10,30,32) the MINTS helped the system user to better understand the problem under investigation. For example in the case 32, the Mine manager was able to investigate, through use of graphics, the effect of different alternative by changing the face design.

1.1.3) Convenience of access

All cases

Convenience of access to the MINTS was regarded as critical by all those interviewed. In all the cases the intermediaries and the system users had easy access to the MINTS, which was basically located in their office. The argument put forward by the system users and the intermediaries was that it would be pointless to have a MINTS if they could not access it conveniently. In the case 8, for example, the hardware was borrowed from the IT department and the system user believed that if he had his own personal computer at his office, he would have then made more use of the MINTS generator. He also was of the view that once he has a number of applications, then he will have to put a proposal for purchasing his own personal computer.

1.1.4) System user confidence in the MINTS

1.1.4.1) Confidence in results

1.1.4.1.1) Currentness of results

All cases

All interviewed agreed that it was critical that the MINTS results were based on up-to-date information. For example in the case 7, the distribution and planning manager had to know, for example, how many drivers and vehicles were available each day, or any changes from the clients as to the time and the point of delivery. Another example was the case 22, where the marketing manager required up-to-date information on, for example, the price list for a group of products, to be used in a decision model which allowed him to investigate the required advertising expenditure for a given sales target for certain products at regional level.

1.1.4.1.2) Validity

All cases

In all cases, the system user relied upon the validity of his decision models. In some cases the system user or the intermediary had done the validation (4,10-15,19), but in the other cases the consultant had carried out the validation and given demonstrations to the system users to convince them of the validity of the results. For example, in the case 32, the MINTS was tried on different sites using historical data to convince the system user of the validity of the system results. Also in the case 31, the system user accepted the MINTS only after a trial period during which the system proved the validity of its results. It was argued by the consultants as critical that the system users had confidence in the validity of the results produced by the MINTS

1.1.4.2) System reliability

All cases

All those interviewed agreed that it is important that the system users and intermediaries feel confident that the MINTS is reliable in the sense that there is an efficient back-up system that protects their work, that their system has a reliable security system, where required, to deny unauthorised access, and that the rate of computer down-time is minimized. The system users interviewed did not have any complaint in terms of their system reliability.

1.1.4.3) User confidence in using the tools

All cases

All those interviewed believed that it is crucial that the system users have confidence in using the facilities and the tools provided for operating the system and obtaining results

1.1.5) Understanding of the MINTS

1.1.5.1) System complexity vs. user's capability

All cases

It was believed by all those interviewed that it is crucial that the level of MINTS sophistication/complexity matches the system user's ability to understand and work with the MINTS. The consultants argued that a MINTS must be kept simple and enhanced according to the system users' ability and needs. In a number of cases investigated (17,20,22,24,25,34,35,38), the MINTS generators were available in modules. This meant that only the modules required by the system user were included in the MINTS, and as the system user's requirements and understanding of the MINTS increased, other modules were added.

1.1.5.2) System user involvement

All cases

All interviewed believed that it is critical that the system user is involved throughout the process of MINTS development. In the cases (21,31,32) the consultants had initially failed to involve the system users as much as they should have done. In these cases the consultants believed that they knew what the system users needed. However, they were proven wrong and lessons were learnt. In all these cases major modifications had to be carried out, during which the system users were closely involved. This meant that the development period had been unnecessarily prolonged, and costs incurred that could have been avoided. In these cases the consultants themselves had gone through a phase of modifying their attitude to user involvement.

1.1.5.3) Effective training

All cases

In all the cases the system users were given few days training. In the cases (1-5,7-13,16,20-22), the training was regarded as effective as it was geared towards the system user's application area. In the cases (4,5-17,19,24,25,27,28,33) the system users were actually involved in building the decision models, and the training was on a one-to-one basis. In the cases (17,25) the training given was not geared towards the application area, and the system user had to request for further training. For example, in the case 17, the Operations Manager was given 3 days general training, in which a number of system users had attended. The Operations Manager did not find this training as helpful in dealing with his application area. However, he was allowed to work on the MINTS for few days on a free trial basis. The Operations Manager had found this trail period as most useful, as he had spent some time finding out how the system worked. After the trail period, the Operations Manager requested for another 3 days on-site training which he specifically geared towards his application area and dealt with his numerous questions that he had not been able to answer during the trial period. The consultants interviewed believed that it was critical that sufficient training was provided for the system user.

1.1.5.4) Gradual MINTS development/learning

All cases

In the cases (21,31,32) the consultant had developed the MINTS with not much time given to the system user to learn the system and suggest modifications. This meant that the system user delayed his acceptance of the MINTS, until a better understanding of the system was obtained and modifications were suggested. In the other cases, the MINTS was developed in line with the system user's capability and understanding.

1.1.5.5) Documentation

All cases

It was regarded as highly important that comprehensive documentation was provided. In all the cases documentation existed, though the system users and the intermediaries showed certain dissatisfaction with its presentation and a lack of clear examples as how to carry out certain tasks.

1.1.5.6) Userfriendliness of user-machine interface

1.1.5.6.1) Presentation

1.1.5.6.1.1) Use of familiar representations or verbs

All cases

In all the cases it was seen as critical that the decision problem and the way in which it is tackled are represented in terms that are familiar to the system user and which helps the understanding and conceptualisation of the problem. For example the use of graphs was regarded as an excellent method of condensing a great deal of information in a manner which was quickly understood. In the cases (1,4-6,8-15,19,20,22,24,28,31,33-37), graphics were used by the system users and the intermediaries to great effect. In the case 31, for example, previously the information was represented in a tabular format, and this had proved unpopular with the system user. Once graphic facilities were provided the system user felt he could understand the problem much better as it made more sense to him. In the case 31, the project manager had found the use of easy drawing facilities as an excellent method of inputting the cashflow curve, and was a major reason in his choice of the MINTS generator. In the case 1, the decision maker was presented with a family of curves, representing the current level of spare parts, changing demands for the spare parts and the cost of maintaining certain stock level. This graphical and clear method of representation had made conceptualisation of the decision problem and the different alternatives much easier for the system user. The use of an spreadsheet type presentation was a quite popular method of presentation which had enabled the system users and the intermediaries to become involved in building decision models in a very short space of time (4,5,10-15,19). In the cases 3 and 31, the decision problem had been presented to the system users using interactive simulation. Icons had been used to a great effect to enable the system users to conceptualise complex problems. In the case 3, for example, a number of integrated plants carrying out complex tasks were simulated, greatly enhancing the system user's understanding of the complex processes and tasks. In the case 31, different colours were used in representing the different types of airflow which had made it much easier for the system user to relate to the problem. The consultants much emphasised the existence of high calibre and creative experts in their team, capable of presenting complex problems in the simplest way.

1.1.5.6.1.2) Amount and relevance of information on screen

All cases

It was also agreed by all the consultants that much attention should be paid to the amount of and the relevance of the information given to the system user to digest on each individual computer screen. In the case 17, for example, the consultant had carried out much modifications to the system in terms of reducing the complexity of the menu system and the amount of information shown to the system user. In the cases 8 and 9, the system users had found understanding of the menu system and the instructions rather complex to digest. Subsequent modifications to the system, had made it much easier for the system users to know how to go about the system. One of the problems, in this cases, with the earlier version of the MINTS was said to be that once the system user was at a low level menu, it became a matter of guessing where in the system he was and how he could return to a required menu screen. The consultants interviewed pointed out that a major part of the modifications made to the MINTS in which they had been involved was to further simplify the system; in terms of providing just sufficient information to the system user to carry out a task as well as breaking down complex tasks into manageable sizes which were presented in more than one screen. Again use of graphics, as pointed out earlier was a method of condensing a great deal of information onto a screen.

1.1.5.6.2) Ease of use

1.1.5.6.2.1) Training time

All cases

In all the cases the training required for learning the system ranged between half-day to few days. The system users and the intermediaries interviewed believed that they would have not been prepared to accept long training.

1.1.5.6.2.2) Time taken to feel confident

All cases

In all the cases in which the system user needed to interact with the MINTS, the system user was said to have been confident using the MINTS after the training given by the consultant. Only in the case 17, the system user needed more time to feel confident with the system. This was because his training was not geared to his application area. He was allowed by the consultant 3 days free trial period, during which he gained confidence in the system and which allowed him to commit himself to the MINTS.

1.1.5.6.2.3) Time taken to recover from errors

17,

Only one major error was reported (17). The problem was due to a lack of emphasis from the part of the consultant on the way a large scheduling problem had to be split for the system to be able to handle. Few days after the system had been delivered, the Managing Director had requested a demonstration of the system to be given to him at the Head Office. As the system user was on holiday, his assistant who had a one day training had reluctantly taken the system to the Head Office. It took him few hours before he managed to input the data given to him for the demonstration. He then tried to tackle a large scheduling problem (679 deliveries) without splitting it into manageable sizes for the system. It took the system until the next day before it announced that it couldn't do it. This caused chaos and a political issue was made of it, and the system was almost returned to the consultant. The next day when the system user was back, in his horror found out what had happened. The matter was rectified the same day. Although the system has been used quite successfully since then, the initial stigma still remains and causes the system user some embarrassment. There were minor errors associated with some of the other MINTS investigated, but recovery was immediate. It was pointed out by those interviewed that the frequency of errors to be more important than the recovery time period.

1.1.5.6.3) User control

1.1.5.6.3.1) Ease with which parameters can be changed

4-20, 22-28, 30, 33-38

In the cases (4-20, 22-28, 30, 33-38) the variables/parameters could be changed easily. This gave greater degree of confidence and flexibility to the system user in using the MINTS. In the other cases the modifications to the parameters had to be carried out by the consultant, which meant the system user or the intermediary was dependent upon the consultant.

1.1.5.6.3.2) Context explicit, clear instructions what to do

All cases

In all the cases, clear instructions were provided which allowed the system user to find his way round the system. However, in a number of cases this had been achieved through a series of modifications to the system. Those interviewed believed that it is highly important that the system user is provided with explicit and sufficient information on each screen as to what he is expected to do and how he should carry out the task.

1.1.5.6.3.3) User-defined input formats

4-6, 8-15, 18-20, 22-30, 33-38

In the cases (4-6, 8-15, 18-20, 22-30, 33-38) the system users were given the capability of defining how they wished to input the information into their MINTS. In the other cases (1-3, 7, 16, 17, 21, 31-33) the system users were limited by the inability of the system to provide flexibility in terms of data input, even to the extent that their existing data format did not match the format required by the system.

1.1.5.6.3.4) User-defined output formats	8-17,19,24,28,33-38
In the cases (8-17,19,24,28,33-38) the system users were given the capability of defining the format and the type of the MINTS output.	
1.1.5.6.3.5) Non-procedural language	None
1.1.5.6.3.6) Different skill levels to suit the user	4,20,22-30,33-38
<p>The system users require a MINTS which offers different skill levels to match their knowledge of and confidence in the system. This can be achieved through providing a fully menu-driven system, with minimum input required from the system user, or a combination of menus and commands to suit the system user's and/or the intermediary's needs. In the cases (1-3,7,17,21,30-32) the MINTS was menu-driven and no access was given to the command level. In the case 30, for example, the Managing Director was presented with a set of simple menus. An infra-red wired pad with digits, "-" and "+" was all he needed to operate the MINTS. In the cases (7,17,31,32) the system users wished to have had access to the command level to carry out certain modifications and reduce their dependence upon the consultant. The problem, however, was that the programming language used in the MINTS was not userfriendly and the consultant who had the responsibility of modifying and up-grading the system could not afford allowing anybody else expertise with the programs. In these cases it was found out that the resource constraints he could not create a system to allow user-friendly programming that under resource constraints he could not create a system to allow user-friendly programming capability to the system users and the intermediaries. Another finding was that in all these cases the MINTS dealt with a single problem and did not provide decision support for dealing with other problems for which the system users required. In all other cases (4,5,10-15,19-20,22-25,28,29,33-35,38) a MINTS generator was used, which offered the system users the option of using menus or commands. In all these cases the system users were much happier and had actually, at some stage, built their own decision models at their own path and tended to be more creative in finding applications for the MINTS. The consultants involved in using MINTS generators (4,20,22-30,33-38) had come across many system users and intermediaries that had been very creative in using the MINTS generating capability of their system to deal with a range of interrelated decision problems as well as different applications. The case (28) was an interesting one, in that the Managing Director had obtained a program that offered a simple use of goal-seeking technique. He had found by trial and error a simple method of including this program in his MINTS, which then allowed him to have access to an additional technique which he found most useful to him. Had he not had the MINTS generating capability that made it possible to call in external programs, he would have not had access to another technique that gave him the capability of obtaining certain results that he always wanted to know. The fact that he was able to carry out such an exercise had actually reinforced his need for the MINTS. The lesson to be learnt here is that decision makers deal with a wide range of interrelated decisions and a MINTS that can offer support for a range of decisions, rather than a single decision, has a stronger chance of survival.</p>	

1.1.5.6.4) English like programming language

4-6, 10-15, 18-20, 22-28, 33-39

In a number of cases (4-6, 10-15, 18-20, 22-28, 33-39) the use of an English-like and user-friendly programming language was regarded as highly important, especially when the system user was involved in the building of the decision models. In the cases (20, 22-26, 34-38) the MINTS generator was very sophisticated and offered a wide range of capabilities for dealing with different applications. In these cases the use of an intermediary was very important, otherwise the system user had to spend a great deal of time learning the wide range of facilities provided. In the case of some MINTS generators (20, 22, 34) the later versions of the MINTS generator offered a limited, but very user-friendly version of the MINTS generator which was fully menu driven and which allowed the system user to build his own decision models without a need for a knowledge of the command level. In the other cases, the MINTS did not allow access to the command level as the programming language was regarded as not userfriendly. In these cases all the programming were carried out by the consultant. These MINTS were regarded as rigid and their range of application was basically limited to a single decision problem.

1.1.5.6.5) Responsive

All cases

It was regarded by those interviewed as very important that the response is within the limits acceptable to the system user. In all the cases the system users were generally satisfied with the MINTS response time, and effort were made to further improve upon the response time. In the case 17, when the MINTS was tested for the first time, it took the system many hours before it completed its operations, and it was nearly returned the consultant, but the problem was soon sorted out. In the case 24, the initial decision model built took about two hours before it completed its operations. This was regarded as unacceptable. Improvements were made to the decision model and the response time was reduced to about 45 minutes. This was acceptable to the system user as that particular decision model was needed to be run few times a year. In the cases where a decision model is required to be used frequently it was expected that the response time had to be very short, within few minutes, and often in the majority of the cases less than a minute. A major reason in the case 31 for having a MINTS was that the previous system took a long time to provide the system user with results, as the mainframe was used for processing data for many other users.

1.1.5.6.6) On-line help/memory aids

In the cases (1-30,33-38) the MINTS offered on-line help. In the cases 31 and 32 the system users had to refer to a user manual and wished they were offered on-line help. However, there were other more urgent requirements that had to be dealt with within the budget constraints. The on-line help provided by the MINTS were in the form of what functions are available and what they do, what is the next step expected of the user, how to recover from errors, syntax of commands (except in the cases (1-3,7,17,21). In the cases (5,8,9,13,28,34,35,43) the MINTS generator also offered help in terms of interpreting the results to some extent. For example in the case 8 and 9 the system would inform the system user of the overall level of inconsistency in his judgement in dealing with a decision problem and would identify the areas of concern for further consideration. When dealing with a group decision, it would also inform the user of the level of agreement or disagreement among the team member and the decision was left to the system user to whether or not go ahead with the given results or carry out the necessary modifications suggested by the system. In the case, for example, 28, there existed some help, though not adequate, about what some statistical terminologies meant and how some of the probability distributions curves should be interpreted. The consultant admitted there is much room for improving the help facilities and modifications were planned to be implemented.

1.1.5.6.6.1) What functions available

1-30, 33-38

1.1.5.6.6.2) What functions do

1-30, 33-38

1.1.5.6.6.3) How to interpret results

5, 8, 9, 13, 28, 34, 35, 43

1.1.5.6.6.4) What is the next step

1-30, 33-38

1.1.5.6.6.5) How to recover from errors

1-30, 33-38

1.1.5.6.6.6) Syntax of commands

4-6, 8-16, 18-20, 22-30, 33-38

1.1.5.6.6.7) Extent of help

1-30, 33-38

Generally there was satisfaction about the extent of help provided by the MINTS. However, the system users asked for more relevant help. For example in the cases 8 and 9, the same help screen was repeated at different stages, most of which was not relevant to the problem for which help was called. The help screen was designed to help with a number of issues which was found not helpful by the system users. There was general agreement by those interviewed that on-line help should be relevant to the task at hand, and adequate to offer sufficient help taking into consideration the expertise of the system user. It was also agreed that on-line help should be comprehensive in terms of offering help to deal with all system user's queries.

1.1.5.6.6.8) Easy to use

4-6, 10-15, 19, 20, 22-25, 33, 34-38

It was regarded as highly important that the on-line help is easy to use. In the cases (4-6, 10-15, 19, 20, 22-25, 33, 34-38) 'help index' was provided to guide the system user to be more specific. In the same cases context sensitive help was provided, in the sense that in the help screens, certain words were highlighted which once activated, another help screen would be displayed. In the same cases, the system user was given the option of referring to the next or previous help screen as well as returning to the initial help screen. In the same cases the help screen was activated by the function key F1 at any stage of the decision model. In the case 16 and 17, the system user was not happy with the help screen as it used symbols or names which were confusing and not very meaningful. In the same cases, although the F1 key was assigned to help, it would activate other programs at different parts of the system.

1.1.5.6.6.9) Library of programs and databases

4-6, 10-15, 19, 20, 22-25, 28, 34-38

In the cases (4-6, 10-15, 19, 20, 22-25, 28, 34-38) a list of file names, databases, mathematical, statistical or financial functions were made available to the system user for selection. This reduced the reliance upon the system user's memory. For example in the case 34, a list of products was available to the system user to select from and this was very helpful as there existed a large number of different product names.

1.1.5.6.8) Interactive model

1, 5, 7-20, 22, 24, 26-38

In the cases (1, 5, 7-20, 22, 24, 26-38), the system user used the MINTS interactively.

1.1.6) Level of user support

1.1.6.1) Short development period

1-20, 22-38

All the consultants believed that it is very important that the MINTS development time is short, otherwise the system user may lose interest and confidence in the MINTS and the consultant. In some cases (5, 7-13, 16, 17, 24, 25, 34, 38) the consultants had to meet a deadline during which the decision problem had to be tackled. In the case 17, for example, the system user was under political pressure to meet a deadline in having a fully operational MINTS within 2 months. In the cases 24 and 25 there also existed a deadline imposed by the government. In the case 10, the entrepreneur was presented with an opportunity to purchase a chain of stores, and had to make a decision within two weeks. In the case 21, the consultant had failed to involve some of the intermediaries in developing the MINTS, and this meant a long delay in completing the MINTS. The delay had given the intermediaries additional excuse in not having confidence in the MINTS.

1.1.6.2) Short period of time between deliverables

1, 3, 20, 22, 29, 31, 32, 34, 38

It was regarded as highly important that the consultant does not take a long time in between delivering different parts of a MINTS. In the cases (1,20,22,34,38) the MINTS was delivered in different phases and the consultants managed to meet the time table. In the cases (3,29,31,32,34) where modifications to the system were required, the consultants had to respond quickly.

1.1.6.3) Technical support

All cases

In the cases (3,7,8-17,19,27-29,31-33) where no intermediary was involved, the consultant provided the technical support required by the system user. The availability of technical support was regarded by the consultants and the system users as critical. In the other cases where an intermediary existed, again the technical support for the system user was provided by the intermediary. The consultants had to provide technical support for the intermediaries as well.

1.1.6.4) Responsiveness to new needs

1-3,18,20-22,24,31,32,34,35,38

In the cases (1-3,18,20-22,24,31,32,34,35,38) the MINTS involved further development as the system users understood the MINTS better and were able to suggest modifications or additions to their system. In these cases the consultants responded to the system users' demands. In the cases (21,31,32) delays were reported as the further additions to the MINTS had to be approved by the sponsor. Because of these delays the system users were greatly dissatisfied as the new additions and modifications to the system were regarded as important to their work. However, once approval for additional costs were obtained, the MINTS were enhanced by the consultant.

1.1.7) User expectations

All cases

It was regarded by all those interviewed that the system user must have reasonable expectations from the MINTS. They believed that the system user must be told of the capabilities and the limitations of the system. They argued that if the system user is led to believe that the MINTS can carry out certain tasks and it is found otherwise, then the credibility of the system and the consultant would be at stake. In the case 17, for example, the consultant mentioned that often he had to refuse giving the system to potential system users who had seen the system used by someone else or seen a demonstration of it and simply wanted to have exactly the same system to be delivered to them. In these cases the consultant had to establish what the system user wanted from the system and to what extent they could support the system. He believed in being objective and professional in pointing out the limitations of the system in plain terms. Generally, the consultants believed against delivering a system to a potential system user simply because the system user thinks the system suits his application.

2) Intermediary

2.1) Intermediary satisfaction

2.1.1) Convenience of access	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
<p>In all the cases involving intermediaries, they had convenient access to the MINTS. The consultants and the intermediaries interviewed believed that it was critical that access to the system was reasonably convenient.</p>	
2.1.2) Intermediary confidence in the MINTS	
2.1.2.1) Confidence in the results	
2.1.2.1.1) Currentness of information	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
<p>All interviewed agreed that it is critical that the MINTS results are based on up-to-date information. In the cases (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38) the intermediaries were expected to maintain the MINTS in terms of the currency of its information. This meant that, either they had to have access to the main database, where one existed, or had to be able to maintain the MINTS when changes were required. For example, in the case 5, the intermediaries had to carry out a survey of the properties and identify the potential for its use (whether suitable for a restaurant, or office block, etc.) and the costs of converting the property for the proposed use as well as its potential value and risk for the company. As information was gathered during the course of the survey, the MINTS had to be kept up-to-date in terms of its data as well as any additional proposals, before the most suitable proposals could be passed on to the system user for further evaluation</p>	
2.1.2.1.2) Validity	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
<p>All the intermediaries (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38) relied upon the validity of the decision models. In some cases the intermediary had done the validation (4, 5, 18), but in the other cases the consultant had carried out the validation and given demonstrations to show validity of the results. For example, in the case 21, the MINTS was tried on different sites using historical data. In the case 1, the consultant had to use the existing data to convince the intermediaries and the system user that the system worked. The validity of results was regarded as critical by all those interviewed.</p>	
2.1.2.2) System reliability	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
<p>In all the cases involving an intermediary (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38) it was argued that the MINTS must be reliable, in the sense that it offered an efficient back-up system, security system against unauthorised access, and minimum rate of computer down-time.</p>	
2.1.2.3) Intermediary confidence in using the tools	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

It was regarded by all the consultants that it is critical that the intermediaries have confidence in using the facilities and the tools provided for operating the system and obtaining results. They believed that the training provided offered the intermediaries the confidence required to operate the system effectively.

2.1.3) Intermediary understanding of the MINTS

2.1.3.1) MINTS complexity vs. intermediary's capability

1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

It was believed by all those interviewed that it is crucial that the level of MINTS sophistication/complexity matches the intermediary's ability to understand and work with the MINTS. The consultants argued that a MINTS must be kept simple and enhanced according to the intermediaries' ability and needs. In a number of cases investigated (20, 22, 24, 25, 34, 35, 38), the MINTS generators were available in modules. This meant that only the modules required by the intermediary and the system user were included in the MINTS. An intermediary was involved in the cases (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38) and in all these cases the intermediaries were happy with the level of the MINTS complexity. However, in few cases (24, 25, 34) the intermediaries had to, during the initial stage of the MINTS development, rely heavily upon the consultant's support. This was because the intermediaries had to deal with a complex application. Had the MINTS generator been user-friendly, the intermediaries, who had very little or no prior computer experience, would have not been able to cope with the problems.

2.1.3.2) Intermediary involvement in the MINTS development

1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

All the consultants believed that it is highly important that the technical intermediaries are involved throughout the process of MINTS development (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38). In the cases (21, 31, 32) the consultants had initially failed to involve the intermediaries as much as they should have done. However, they were proven wrong and lessons were learnt. In all these cases major modifications had to be carried out, during which the intermediaries were closely involved. Two major problems mentioned in these cases arising from a lack of intermediary involvement were prolonged development period and increased development costs which could have been avoided. In these cases the consultants themselves had gone through a phase of modifying their attitude to intermediary involvement.

2.1.3.3) Effective training

1, 2, 4, 5, 18, 20-22, 24, 25, 34-38

In all the cases the intermediaries were given training (1,2,4,5,18,20-22,24,25,34-38). In the cases (24,25), the training given was not geared towards the application area, and the intermediary had to request for further training. For example, in the case 24 the intermediary did not find the initial training as very useful in dealing with his application and she was not confident using the system. She therefore requested for additional training which was specifically geared towards her needs. The consultants interviewed believed that it was critical that the intermediary had sufficient training in understanding and operating the system.

2.1.3.4) Documentation

1,2,4,5,18,20-22,24,25,34-38

It was regarded as highly important that comprehensive documentation was provided. In all the cases documentation existed, though the intermediaries showed certain dissatisfaction with its presentation and a lack of clear examples as how to carry out certain tasks.

2.1.3.5) Gradual MINTS development/learning

1,2,4,5,18,20-22,24,25,34-38

In the case 21 the consultant had developed the MINTS with not as much attention as he should have paid to allowing the intermediaries going through a gradual phase of learning. In this case, the consultant had failed to give adequate time to the intermediaries to work on the system and define their requirements. The MINTS had been developed before the intermediaries spent adequate time to learning what had been built. This had meant that the intermediaries did not have enough time to define their requirements. A great deal of further modifications were required until the intermediaries were happy and confident to use the system. However, in all cases involving an intermediary, the MINTS was accepted and used only after the intermediary had obtained hands-on experience with the MINTS through his involvement in the MINTS development.

2.1.3.6) Userfriendliness of man-machine interface

2.1.3.6.1) Presentation

2.1.3.6.1.1) Use of familiar representations or verbs.

1,2,4,5,18,20-22,24,25,34-38

In all the cases (1,2,4,5,18,20-22,24,25,34-38) it was seen as critical that the decision problem and the way in which it is tackled are represented in terms that are familiar to the intermediary and which helps the understanding and conceptualisation of the problem. For example the use of graphs was regarded as an excellent method of condensing a great deal of information in a manner which was quickly understood. In the cases (1,2,4,5,20,22,24,34-38), graphics facilities were used by the intermediaries to great effect. The decision models and the menus and commands were also made very English like and use of technical jargons was avoided as much as possible. The use of an spreadsheet type presentation in the cases (4,5,20,22,24,25,34-38) was a quite popular method of presentation which had enabled the intermediaries to become involved in building decision models in a very short space of time. Also in these cases, except 1 and 2, a worksheet format was used for writing decision models easily.

2.1.3.6.1.1.2) Amount and relevance of information on screen 1,2,4,5,18,20-22,24,25,34-38

It was also agreed by all the consultants that much attention should be paid to the amount of and the relevancy of the information given to intermediaries to digest on each individual screen. In the case 21, for example, the consultant had carried out much modifications to the system in terms of reducing the complexity of the menu system and the amount of information shown to the intermediary. The consultants interviewed pointed out that a major part of the modifications made to the MINTS in which they had been involved was to do with further simplifying the system, in terms of providing just sufficient information to the intermediary to carry out a task and that complex task were simplified by being broken down into manageable sizes. Again use of graphics, as pointed out earlier was a method of condensing a great deal of information onto a screen.

2.1.3.6.2) Ease of use

2.1.3.6.2.1) Training time

1,2,4,5,20-22,24,25,34-38

In all the cases involving an intermediary (1,2,4,5,18,20-22,24,25,34-38) the training required for learning the system ranged between half-day to few days. The consultants and the intermediaries interviewed believed that long training periods were not acceptable as it requires much effort from the part of the trainees, as well as being expensive. It was also argued by the consultants that the MINTS was made very user-friendly to minimize the need for training.

2.1.3.6.2.2) Time taken to feel confident

1,2,20-22,24,25,34-38

In the cases (1,2,20-22,24,25,34-38) the intermediaries after having the training, needed to spend additional time using their system before they had sufficient confidence in using the system. In the cases 4 and 5, the initial training was sufficient in terms of giving the intermediaries confidence in using the system.

2.1.3.6.2.3) Time taken to recover from errors	None
No major error was reported in the case of intermediaries. There were minor errors associated with some of the MINTS investigated, but recovery was immediate. It was pointed out by those interviewed that the frequency of errors to be more important than the recovery time period.	
2.1.3.6.3) Intermediary control	
2.1.3.6.3.1) Ease with which parameters can be changed	4, 5, 20, 22, 24, 25, 34-38
In the cases (4, 5, 20, 22, 24, 25, 34-38) the variables/parameters could be changed easily. This gave greater degree of confidence and flexibility to the intermediaries in using the MINTS. In the other cases (1, 2, 21) the modifications to the parameters had to be carried out by the consultant, which meant the intermediaries were dependent upon the consultant.	
2.1.3.6.3.2) Context explicit, clear instructions what to do	1, 2, 4, 5, 18, 20-22, 24, 25, 34-38
In the cases (1, 2, 4, 5, 18, 20-22, 24, 25, 34-38) involving an intermediary, the MINTS offered clear instructions to the intermediaries how to find their way round the system. However, in a number of cases this had been achieved through a series of modifications to the system. Those interviewed believed that it is highly important that the intermediary is provided with explicit and sufficient information on each screen as to what he is expected to do and how he should carry out the tasks required of him.	
2.1.3.6.3.3) User-defined input formats	4, 5, 18, 20, 22, 24, 25, 34-38
In the cases (4, 5, 18, 20, 22, 24, 25, 34-38) the intermediary was given the capability of defining how he wished to input the information into the MINTS. In the other cases (1, 2, 21) the intermediary was limited by the inability of the system to provide flexibility in terms of data input, even to the extent that the existing data format did not match the format required by the system. In the case 34, for example, the intermediaries had the data in an spreadsheet format and wished to transfer a selected portion of the spreadsheet, say specific rows and columns, into the MINTS. The MINTS, however, required the intermediary to write different complex conversion programs to carry out the task. This was a task that had to be carried out quite frequently and had made life very difficult for the intermediaries. However, a great deal of the consultant's time was taken in helping the intermediaries in writing conversion programs. The consultant had to eventually respond to the intermediaries' demand and complaints by fully automating the transfer of data from an spreadsheet into the MINTS. This allowed communication between the MINTS and an spreadsheet and the intermediaries soon found different applications for using the MINTS.	
2.1.3.6.3.4) User-defined output formats	4, 5, 18, 20, 22, 24, 25, 34-38

<p>In the cases (4,5,18,20,22,24,25,34-38) the intermediaries were given the capability of defining the format and the type of the MINTS output.</p>	
<p>2.1.3.6.3.5) Non-procedural language</p>	None
<p>2.1.3.6.4) English like model</p>	1,2,4,5,18,20,22,24,25,34-38
<p>In a number of cases (4,5,18,20,22,24,25,34-38) the use of an English-like and user-friendly programming language was regarded as highly important, especially when the intermediaries were involved in the building of the decision models. In the cases (20,22,24,25,28,34-38) the MINTS generator was very sophisticated and offered a wide range of capabilities for dealing with different applications. In these cases the use of an intermediary was very important, otherwise the system user had to spend a great deal of time learning the wide range of facilities provided. In the case of some MINTS generators (20,22,34,35-38) the later versions of the MINTS generator offered a limited, but very user-friendly version of the MINTS generator which was fully menu driven and which allowed the system user to build his own decision models without a need for a knowledge of the command level. In the other cases, the MINTS did not allow access to the command level as the programming language was regarded as not userfriendly. In these cases all the programming were carried out by the consultant. These MINTS were regarded as rigid and their range of application was basically limited to a single decision problem.</p>	
<p>2.1.3.6.5) Responsive</p>	1,2,4,5,18,20-22,24,25,34-38
<p>It was regarded as very important that the response time is within the limits acceptable to the intermediaries. In all the cases involving an intermediary, the response time was regarded as satisfactory. In the case 24, the initial decision model built took about two hours before it completed its operations. This was regarded as unacceptable. Improvements were made to the decision model and the response time was reduced to about 45 minutes. This was acceptable to the intermediaries as that particular decision model was needed to be run few times a year. In the cases where a decision model is required to be used frequently it was expected that the response time had to be very short, within few minutes, and often in the majority of cases less than a minute.</p>	
<p>2.1.3.6.6) On-line help/memory aids</p>	1,2,4,5,18,20,22,24,25,34-38
<p>In all the cases involving an intermediary, except case 21, the MINTS offered on-line help. The on-line help provided by the MINTS was in the form of what functions are available and what they do, what is the next step expected of the intermediary, how to recover from errors, syntax of commands (except in the cases (1,2,31,32)). In the cases (5,34-38) the MINTS generator also offered help in terms of interpreting the results to some extent. For example, in the case 5, some explanation of the statistical technique were made available.</p>	

2.1.3.6.6.1) What functions available	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38
2.1.3.6.6.2) What functions do	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38
2.1.3.6.6.3) How to interpret results	5, 34-38
2.1.3.6.6.4) What is the next step	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38
2.1.3.6.6.5) How to recover from errors	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38
2.1.3.6.6.6) Syntax of commands	4, 5, 20, 22, 24, 25, 34-38
2.1.3.6.6.7) Extent of help	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38
<p>In all the cases involving an intermediary (1,2,4,5,18,20,22,24,25,34-38), there was a general satisfaction about the extent of help provided by the MINTS. However, in a number of cases the extent of help provided had much room for improvement. intermediaries asked for more relevant help. was not relevant to the problem for which help was called. The help screen was designed to help with a number of issues which was found not helpful by the system users. There was general agreement by those interviewed that on-line help should be relevant to the task at hand, adequate to deal with the problem taking into consideration the expertise of the system user, preferably with a clear example. It was also agreed that on-line help should be comprehensive in terms of offering help to deal with all system user's queries.</p>	
2.1.3.6.6.8) Ease of use	4, 5, 18, 20, 22, 24, 25, 34-38
<p>It was regarded as highly important that the on-line help is easy to use. In the cases (1,2,4,5,18,20,22,24,25,28,34-38) 'help index' was provided to guide the system user to be more specific. In the same cases context sensitive help was provided, in the sense that in the help screens, certain words were highlighted which once activated, another help screen would be displayed. In the same cases, the system user was given the option of referring to the next or previous screen help as well as returning to the initial help screen. In the same cases the help screen was activated by the function key F1 at any stage of the decision model.</p>	
2.1.3.6.6.9) Library of programs and databases	1, 2, 4, 5, 18, 20, 22, 24, 25, 34-38

In the cases (1,2,4,5,18,20,22,24,25,34-38) a list of file names, databases, mathematical, statistical or financial functions were made available to the system user for selection. This reduced the reliance upon the intermediaries' memory. For example in the case 5, a list of statistical functions was available to the intermediaries to select from and this was very helpful as it was difficult to remember the exact name for the statistical functions available. In the case 34, for example, the intermediaries were given access to different personal databases and a list of them, with some explanation, was available to select from.

2.1.3.6.7) Interactive model

1,2,4,5,18,20-22,24,25,34-38

In all cases involving an intermediary (1,2,4,5,18,20-22,24,25,34-38), the MINTS was used interactively.

1,2,4,5,18,20-22,24,25,34-38)

2.1.4) Level of support provided for the intermediary

2.1.4.1) Technical support

1,2,4,5,18,20,21,24,25,,30,34-38

In the cases (1,2,4,5,18,20,21,24,25,,30,34-38) where an intermediary was involved, the consultant provided the technical support required by the intermediary. The availability of technical support was regarded by the consultants and the intermediaries as critical. For example, in the case 25, the intermediary would have not been able to build the decision models without the technical support provided by the consultant.

2.1.4.2) Responsiveness to the needs of the intermediary

1-3,18,20-22,24,31,32,34,35,38

In the cases (1,2,18,20,21,24,34,35,38) the MINTS involved further development and the consultant involved was required to respond quickly to the demands of the intermediaries. For example, in the case 21, the consultant had initially build the MINTS based on the system user's requirement for making strategic decisions. However, the intermediaries required the MINTS to allow them to deal with short term scheduling problems before they could provide strategic support to the system user. The intermediaries did not cooperate with the consultant until the appropriate modifications and additions demanded by them were carried out.

3) Sponsor

3.1) Continued commitment to the MINTS

3.1.1) Further development and maintenance costs

1-3,18,20-22,24,25,29,31,32,34,35,38

In the cases (4,5,7-17,19,25,27-30,33) the MINTS costs incurred only once. In these cases, further financial support was not required. However, in the cases (1-3,18,20-22,24,25,29,31,32,34,35,38) further development costs were involved. In all these cases, the sponsor continued financing the MINTS costs. However, in the case 31, although the sponsor had accepted to continue sponsoring the development costs, the sponsor was under pressure to reduce his overall expenditure and stay within the constraints imposed upon him.

3.1.2) Availability of funds 1-3,18,20-22,24,25,29,31,32,34,35,38

In all the cases (1-3,18,20-22,24,25,29,31,32,34,35,38) involving further MINTS development, funds were made available to support the further development and maintenance costs associated with an on-going MINTS. Referring back to the case 31, the pressure on the sponsor to reduce the overall expenditure, had affected his further support for the MINTS. Although he had eventually accepted to finance the further development costs, it took sometime before he was convinced of the need for enhancing the MINTS.

3.1.3) Political pressures 31

In the case 31, the political pressures on the sponsor to reduce costs had nearly affected his decision not to finance the MINTS further development costs.

4) System user's immediate superior

4.1) Continued commitment to the MINTS 1-3,20-22,29,31,32,38

In the cases involving an immediate superior and further MINTS development (1-3,20-22,29,31,32,38), the immediate superior had continued supporting the MINTS. In the cases 31 and 32, for example, he had championed the MINTS, and used his influence to not only obtain finance for the MINTS project, but also in influencing the sponsor to carry on financing the further development costs.

5) Custodians of Information

5.1) Continued willingness to cooperate 1-5,13,18,20-22,24,25,34-38

In the cases (1-5,13,18,20-22,24,25,34-38) custodians of information were required to continue providing the MINTS with the required data and information.

5.2) Ability to cope with workload (1-5,13,18,20-22,24,25,34-38)

In the cases (20,22,34), although the custodians of information continued supporting the MINTS, they were not quite happy as their workload had increased, as further demands were made in terms of additional information to be processed for the system users. However, in all the cases (1-5,13,18,20-22,24,25,34-38) requiring continued support from the custodians of information, they had managed to support the MINTS.

6) Supporting Political Actors

6.1) Continued support for the MINTS

None

In none of the cases investigated the supporting political actors had not been involved beyond the initial requirement to support the MINTS.

7) Consultant

7.1) Commitment

7.1.1) Continued availability of the resource pool

1,3,21-25,29,31-35

The consultants believed that the continued availability of resources for further development of the MINTS and continued provision of training and technical support was crucial. This was the case especially in the cases (1,3,21,22,23,24,25,29,31,32,33,34,35).

7.1.2) Satisfaction with the MINTS progress

All cases

In all the cases reported the consultants were satisfied with the MINTS progress, though at times there was some delay before the further development costs were approved.

7.1.3) Impact on other projects

All cases

The consultants interviewed were involved in a number of projects and their commitments to each project depended upon the availability of resources. The overall problem of managing a portfolio of project within the existing resources was regarded as highly important. The consultants pointed out that they have to be careful not to overstretch their resources and responsibilities.

The Mathematical Calculations in Consultant Advisory System

$$\text{Overall Pros Success}^1 \text{ (OPS)} = \left[100 - 100 \prod_{i=1}^n \left(1 - \frac{R_i}{100} \right) \right] \cdot \frac{P}{10}$$

$$\text{Overall Cons Success}^1 \text{ (OCS)} = - \left[100 - 100 \prod_{j=1}^m \left(1 - \frac{R_j}{100} \right) \right] \cdot \frac{P}{10}$$

Where P denotes the importance assigned to a parent-factor.

$$\text{Overall Success}^2 \text{ (OS)} = \frac{\text{OPS} \cdot \sum_{i=1}^n R_i - \text{OCS} \cdot \sum_{j=1}^m R_j}{\sum_{i=1}^n R_i + \sum_{j=1}^m R_j}$$

Where;

$$\text{Pros Result } (R_i) = \left(\frac{\text{Pros Importance}_i}{10} \cdot \frac{\text{Pros Performance}_i}{5} \right) \cdot 100$$

$$\text{Cons Result } (R_j) = \left(\frac{\text{Cons Importance}_j}{10} \cdot \frac{\text{Cons Performance}_j}{5} \right) \cdot 100$$

P = Importance of the parent factor

Pros/cons = Pros are positive sub-factors (children) of a parent factor and Cons are negative sub-factors (children) of a parent factor. Parent factors can be sub-factors themselves.

1) The Overall Pros/Cons Success are independent of the order of Pros or Cons factors. Because the factors are multiplied by each other in calculating the Overall Pros/Cons Success;

e.g.
$$\prod_{i=1}^n \left(1 - \frac{R_i}{100} \right) = \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \left(1 - \frac{R_3}{100} \right) \left(1 - \frac{R_4}{100} \right) \dots \left(1 - \frac{R_n}{100} \right)$$

2) This is the overall success for a parent factor, where its children are then pros and cons factors below it.

Calculations for Cumulative Pros/Cons Result³

1) R_1

2)
$$\frac{(100 - R_1) R_2}{100}$$

3)
$$\frac{\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} \right] \right\} R_3}{100}$$

4)
$$\frac{\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} + \frac{\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} \right] \right\} R_3}{100} \right] \right\} R_3}{100}$$

:
:

etc.

Therefore the Overall Cumulative Pros/Cons Result is the sum of the ab items. Assuming N Pros or Cons results, then;

$$\text{Overall Cumulative Pros/Cons}^4 \text{ Result} = 1 + 2 + 3 + 4 + \dots + N$$

3) The term Overall Pros/Cons Success, as referred to earlier, is used in place of Overall Cumulative Pros/Cons Result.

Items 2, 3, 4, etc. below are normalised to 100.

4) As the Cons Result is a negative number, then the Overall Cumulative Cons Result is also a negative number.

**TEXT BOUND
INTO
THE SPINE**

General Formula For Overall Cumulative Pros/Cons Result

R_1

$$= 100 - (100 - R_1) = \boxed{100 - 100\left(1 - \frac{R_1}{100}\right)}$$

$$\frac{(100 - R_1) R_2}{100}$$

$$= \frac{R_2}{100} (100 - R_1) = \boxed{R_2 \left(1 - \frac{R_1}{100}\right)}$$

$$\frac{\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} \right] \right\} R_3}{100}$$

Substitute 1 & 2 in 3;

$$= \frac{\left\{ 100 - \left[100 - 100\left(1 - \frac{R_1}{100}\right) + R_2 \left(1 - \frac{R_1}{100}\right) \right] \right\} R_3}{100}$$

$$= \frac{100\left(1 - \frac{R_1}{100}\right)\left(1 - \frac{R_2}{100}\right) R_3}{100}$$

$$= \boxed{R_3 \left(1 - \frac{R_1}{100}\right)\left(1 - \frac{R_2}{100}\right)}$$

$$\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} + \frac{\left\{ 100 - \left[R_1 + \frac{(100 - R_1) R_2}{100} \right] R_3}{100} \right\} R_4 \right] \right\} R_4$$

100

Substitute 1, 2 & 3 in 4;

$$= \frac{\left\{ 100 - \left[100 - 100 \left(1 - \frac{R_1}{100} \right) + R_2 \left(1 - \frac{R_1}{100} \right) + R_3 \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \right] \right\} R_4}{100}$$

$$= \frac{\left[100 \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) - R_3 \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \right] R_4}{100}$$

$$= \frac{100 \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \left(1 - \frac{R_3}{100} \right) R_4}{100}$$

$$= \boxed{R_4 \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \left(1 - \frac{R_3}{100} \right)}$$

etc.

In general therefore the formula for all the above items except item 1, is;

$$\boxed{R_n \left(1 - \frac{R_1}{100} \right) \left(1 - \frac{R_2}{100} \right) \left(1 - \frac{R_3}{100} \right) \left(1 - \frac{R_4}{100} \right) \dots \left(1 - \frac{R_{n-1}}{100} \right)}$$

where $n > 1$

Overall Cumulative Pros/Cons Result =

$$\begin{aligned}
 & 100 - 100 \left(1 - \frac{R_1}{100}\right) & + & & 100 - 100 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \\
 & R_2 \left(1 - \frac{R_1}{100}\right) & + & & 100 - 100 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) \\
 & R_3 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) & + & & 100 - 100 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) \left(1 - \frac{R_4}{100}\right) \\
 & R_4 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) & + & & \vdots \\
 & \vdots & & & 100 - 100 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) \left(1 - \frac{R_4}{100}\right) \left(1 - \frac{R_5}{100}\right) \\
 & \vdots & & & \vdots \\
 & R_n \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) \dots \left(1 - \frac{R_{n-1}}{100}\right) & & & \left(1 - \frac{R_n}{100}\right)
 \end{aligned}$$

Therefore the Overall Cumulative Pros/Cons⁵ Result

$$= 100 - 100 \left(1 - \frac{R_1}{100}\right) \left(1 - \frac{R_2}{100}\right) \left(1 - \frac{R_3}{100}\right) \left(1 - \frac{R_4}{100}\right) \dots \left(1 - \frac{R_n}{100}\right)$$

$$= \boxed{100 - 100 \prod_{i=1}^n \left(1 - \frac{R_i}{100}\right)}$$

5) The same formula is true for Overall Cumulative Cons Result, but with a negative sign, also replacing i by j, and n by m.

A General Formula for Overall Success

Having calculated the Overall Pros/Cons Success, the final stage is to calculate the overall success. As shown in the above formulae, the calculations for the Pros and Cons success factors are done separately. As shown in the following formula, in combining the Overall Pros Success and the Overall Cons Success, the total Pros Result and the total Cons Result are used as weighting factors;

$$\text{Overall Success (OS)} = \frac{\text{OPS} \cdot \sum_{i=1}^n R_i - \text{OCS} \cdot \sum_{j=1}^m R_j}{\sum_{i=1}^n R_i + \sum_{j=1}^m R_j}$$

Where the weighting factors are calculated as follow;

$$\text{Total Pros Result } \left(\sum_{i=1}^n R_i \right) = R_1 + R_2 + \dots + R_n$$

$$\text{Total Cons Result } \left(\sum_{j=1}^m R_j \right) = R_1 + R_2 + \dots + R_m$$

$$\text{Total Pros and Cons Result} = \sum_{i=1}^n R_i + \sum_{j=1}^m R_j$$

Appendix C

n out of k factors

For the purpose of exposition, suppose that the general model of success comprises only seven contributory success factors. Also let us assume that the first three factors have a positive performance score and the next two a negative performance score, and the last two have zero performance, as they are regarded as irrelevant to the success of the system under assessment. The importance and performance scores are shown in the following table.

Factors	<u>Importance(%)</u>	<u>Performance(%)</u>
A	70	40
B	80	60
C	40	80
D	50	- 40
E	30	- 60
F	50	0
G	20	0

Using the conventional weighted average technique shown earlier, the weighted average is calculated as follow:

$$\begin{aligned} \text{Weighted Average} &= \frac{70*40+80*60+40*80+50*(-40)+30(-60)+50*0+20*0}{70 + 80 + 50 + 30 + 50 + 20} \\ &= \frac{10800-3800}{300} = 23.33 \end{aligned}$$

As can be seen the importance scores of the two irrelevant factors are still included in the denominator. In order to completely exclude the effect of the irrelevant factors from the above calculations, their importance should also be excluded. In other words, the weighted average should be:

$$\begin{aligned} \text{Weighted Average} &= \frac{70*40+80*60+40*80+50*(-40)+30(-60)+50*0+20*0}{70 + 80 + 50 + 30} \\ &= \frac{10800-3800}{230} = 30.43 \end{aligned}$$

This bias in the calculations will increase as the number of irrelevant factors increases.

The above shortcoming of the conventional weighted average technique is, however, avoided in the weighted average technique used in the Consultant Advisory System. Simply because R_i and R_j in the numerator and the denominator of

the overall success formula, as shown below, are the product of the overall importance and performance scores.

$$\text{Overall Success (OS)} = \frac{\text{OPS} \cdot \sum_{i=1}^n R_i - \text{DCS} \cdot \sum_{j=1}^m R_j}{\sum_{i=1}^n R_i + \sum_{j=1}^m R_j}$$

where R_i and R_j are:

$$\text{Pros Result (R}_i\text{)} = \left(\frac{\text{Pros Importance}_i}{10} \cdot \frac{\text{Pros Performance}_i}{5} \right) \cdot 100$$

$$\text{Cons Result (R}_j\text{)} = \left(\frac{\text{Cons Importance}_j}{10} \cdot \frac{\text{Cons Performance}_j}{5} \right) \cdot 100$$

In other words, a zero performance score for an irrelevant factor, will overwrite the importance score of that factor to zero. This applies to the calculations carried out in the numerator as well as in the denominator. Hence the calculations correspond only to those relevant factors to the overall success of the system under consideration.

Referring to the previous example, then using the above formulae for calculating Pros and Cons Results, the answers will be as follow;

$$\text{Pros Result (R}_1\text{)} = 28$$

$$\text{Pros Result (R}_2\text{)} = 48$$

$$\text{Pros Result (R}_3\text{)} = 32$$

$$\text{Cons Result (R}_1\text{)} = 20$$

$$\text{Cons Result (R}_2\text{)} = 18$$

$$\text{Pros Result (R}_4\text{)} = 0$$

$$\text{Pros Result (R}_5\text{)} = 0$$

Now the Overall Pros Success and Overall Cons Success are calculated as follow;

$$\text{Overall Pros Success (OPS)} = \left[100 - 100 \prod_{i=1}^n \left(1 - \frac{R_i}{100} \right) \right] \cdot \frac{P}{10}$$

$$= \left[100 - 100 \left(1 - \frac{28}{100} \right) \left(1 - \frac{48}{100} \right) \left(1 - \frac{32}{100} \right) \left(1 - \frac{0}{100} \right) \left(1 - \frac{0}{100} \right) \right] = 74.54\%$$

$$\text{Overall Cons Success (OCS)} = - \left[100 - 100 \prod_{j=1}^m \left(1 - \frac{R_j}{100} \right) \right] \cdot \frac{P}{10}$$

$$= - \left[100 - 100 \left(1 - \frac{20}{100} \right) \left(1 - \frac{18}{100} \right) \right] = - 34.40\%$$

And finally the Overall Success is calculated using the following formula;

$$\text{Overall Success (OS)} = \frac{\text{OPS} \cdot \sum_{i=1}^n R_i - \text{OCS} \cdot \sum_{j=1}^m R_j}{\sum_{i=1}^n R_i + \sum_{j=1}^m R_j}$$

Where:

$$\sum_{i=1}^n R_i = 28 + 48 + 32 + 0 + 0 = 108$$

$$\sum_{j=1}^m R_j = 20 + 18 = 38$$

$$\sum_{i=1}^n R_i + \sum_{j=1}^m R_j = 108 + 38 = 146$$

$$\text{Therefore Overall Success} = \frac{74.54 * 108 - 34.4 * 38}{146} = 46.18\%$$

The Overall Success score calculated here is more than that calculated using the conventional weighted average

3) For the sake of simplicity, the success factors are assumed to have no parent-factor. This means that $p/10$ will be redundant or alternatively is assigned a value of 10 which makes $p/10=1$.

technique. This is because a stepwise rather than a linear relationship is assumed to exist between the success factors.

Appendix D

Due to copy right restrictions, a copy of the Consultant Advisory System cannot be provided. A copy of Dejavu must first be purchased. Once a copy of Dejavu is obtained, a written request for the Consultant Advisory System must be sent to the researcher.

SE - AUTOMATIC

1:53:11 pm

iE

OVERALL MINTS SUCCESS

OPTIONS

• MINTS PROJECT 1

Ruled out

Use cursor key to select an option and press F3 to continue

iE

MINTS PROJECT 1

QUESTIONS

- ENSURING A RIGHT ENVIRONEMNT
- MAINTAINING RELATIONSHIP

Ruled out
Ruled out

REPLY

in your reply and then press Tab to score it

Press F3 for next page of questions

ENSURING A RIGHT ENVIRONEMNT

- * Organisational Infrastruture
 - * Acceptability of MINTS
 - Affordability of MINTS costs (Affordable)
 - * Adaptability of organisation
 - * Changes to the formal systems
 - Procedures (Sometimes)
 - Operations (Rarely)
 - * Mgmt. adaptability to change
 - Education (No)
 - Exposure to IT (None)
 - Place of MINTS in IT strategy (Yes)
- * Organisational stability
 - * Staff turnover
 - User permanence (No)
 - Intermediary permanence (Yes)
 - * Stability of procedures/optns
 - Frequency of changes (Rarely)
 - Extent of changes (Little)
 - * Political environment
 - * Intelligence on key actors
 - * System user 1
 - Identity 1 (Known)
 - Political influence 1 (High)
 - Soft spots 1 (Some)
 - * Intermediary 2
 - Identity 2 (Known)
 - Political influence 2 (Moderate)
 - Soft spots 2 (Not at all)
 - * Sponsor 3
 - Identity 3 (Known)
 - Political influence 3 (High)
 - Soft spots 3 (Some)
 - * System user's superior 4
 - Identity 4 (Not Known)
 - Political influence 4 (DON'T KNOW)
 - Soft spots 4 (DON'T KNOW)
 - * Custodians of information 5
 - Identity 5 (IRRELEVANT)
 - Political influence 5 (IRRELEVANT)
 - Soft spots 5 (IRRELEVANT)
 - * Supporting political actors 6
 - Identity 6 (Known)
 - Political influence 6 (Moderate)
 - Soft spots 6 (Some)
 - * Relationship among key actors
 - * Consultant's relationship
 - With system user 1 (Poor)
 - With user's superior 1 (Don't know)
 - With intermedairy 1 (Good)
 - With Sponsor 1 (Good)
 - With supporting actors 1 (Good)
 - With custodians of info. 1 (IRRELEVANT)
 - * System user's relationship
 - With intermediary 2 (Poor)
 - With user's superior 2 (Excellent)
 - With Sponsor 2 (Good)

- With Supporting actors 2 (Good)
- With Custodians of info. 2 (IRRELEVANT)
- * Sponsor's relationship
 - With user's superior 3 (Good)
 - With political actors 3 (Good)
 - With custodians of info. 3 (IRRELEVANT)
- * User's superior's relationship
 - With supporting actors 4 (Good)
 - With custodians of info. 4 (IRRELEVANT)
- * Intermediary's relationship
 - With custodians of info. 5 (IRRELEVANT)
- * System Infrastructure
 - * Maturity of existing systems
 - * Software for the MINTS
 - Availability of software (No)
 - Suitability for the applicatio (Quite)
 - Compatability with existing SW (Not quite)
 - * Hardware for the MINTS
 - Availability of hardware (Yes)
 - Suitability for MINTS software (Quite)
 - Compatability with existing HW (Very much)
 - Accessibility to existing HW (Difficult)
 - * Information for the MINTS
 - Availability (Yes)
 - Accessibility (Not quite)
 - Validity (Not quite)
 - Level of aggregation/disaggreg (Easy)
 - Performance of existing system (Acceptable)
 - Extent of expertise available (Little)
 - * Actors' Capability/Commitement
 - * Consultant d
 - * Commitment d
 - * MINTS priority
 - Financial/political benefits d (Insufficient)
 - Availability of resource pool (Sufficient)
 - * Capability/Credibility d
 - * Familiarity with application
 - Short-term problem d (Yes)
 - Long-term problem/implications (Yes)
 - Technical know-how in MINTS (Adequate)
 - Experience with similar MINTS (Very high)
 - Ability to deliver on time (Certain)
 - Provision of technical support (Good)
 - Provision of training (Adequate)
 - Interpersonal skills (Very much)
 - * System User a
 - * System user's capability
 - * Knowledge of the application
 - Knowledge of the problem (Inadequate)
 - Knowledge of a solution (Ignorant)
 - * Knowledge of the MINTS
 - Ability to interpret results (Sufficient)
 - * System user's commitment
 - Perception and urgency of need (Rather low)
 - User's initiation/involvement (Little)
 - Acceptance of changes/efforts (Badly)
 - Acceptance of MINTS support (Badly)

Existence of intermediary (Yes)
Responsibility for the MINTS (IRRELEVANT)

* Sponsor b

* Commitment to the MINTS b

Availability of funds b (sufficient)
MINTS project priority b (Rather high)
Political pressures b (IRRELEVANT)
Involvement in MINTS project b (Some)

* Benefits from the MINTS b

Organisational benefits b (Substantial)
Attitude to the MINTS b (V. positive)
Written Approval (Yes)

* Intermediary e

* Intermediary's capability

* Knowledge of the application e
Knowledge of the problem e (Inadequate)
Knowledge of a solution e (Ignorant)

* Knowledge of the MINTS e

Ability to interpret results e (Sufficient)

* Intermediary's commitment

Workload e (Some)
Personal benefits from MINTS e (None)
Responsibility for the MINTS e (Yes)
Political pressure e (None)

* Custodians of information c

* Custodians of info. Commitment

Increase in workload (IRRELEVANT)
Willingness to cooperate (IRRELEVANT)

* System user's superior f

Influence f (Very)

* User's superior's commitment f

* MINTS benefits

Personal benefits f (None)
Organisational benefits f (Substantial)
System user's need for MINTS (High)
Political pressure f (None)
Involvement in the MINTS f (Little)

* Supporting political actors g

* Political actors' commitment g

Organisational benefits (Substantial)
Influence (Some)

MAINTAINING RELATIONSHIP

* System User

* User satisfaction

* MINTS support

* Match of system and problem

* Problem limitations

Portion of variables known (Yes)
Quantifiability of variables (Quite small)
Understanding of relationships (Quite small)

* System limitations

Dealing with "Must haves" (Yes)
Dealing with "Nice to haves" (Moderate)

* Internal adaptability

* External adaptability

* MINTS benefits !

Improved quality of decisions (DON'T KNOW)

- Improved speed of decisions (DON'T KNOW)
- More convincing arguments (DON'T KNOW)
- More relevant information (DON'T KNOW)
- Evaluation of more scenarios (DON'T KNOW)
- Setting priorities better (DON'T KNOW)
- help problem conceptualisation (DON'T KNOW)
- Convenience of access (Quite)
- * User confidence in the MINTS
 - * Confidence in MINTS results
 - Currentness of information (Good)
 - Validity of results (Acceptable)
 - * System reliability
 - Hardware reliability (Rarely)
 - Software reliability (Very high)
 - Confidence in using the tools (Very little)
- * Understanding of the MINTS
 - Complexity v user's capability (Good)
 - User's involvement (Little)
 - Effective training (Yes)
 - Gradual development/learning (Not quite)
 - Documentation (Excellent)
- * Userfriendliness of interface
 - * Presentation
 - Use of familiar repres./verbs (Familiar)
 - Amount of information (Adequate)
 - * Ease of use
 - Training time (Days/hours)
 - Time taken to feel confident (Weeks)
 - Frequency of errors (DON'T KNOW)
 - * User control
 - Easy change of parameters (Excellent)
 - Context explicit (Excellent)
 - User-defined input format (Bad)
 - User-defined output format (Bad)
 - Different skill levels (No)
 - High level prog. language (IRRELEVANT)
 - Responsive (Reasonable)
 - * On-line help/memory aids
 - What functions available (Yes)
 - What functions do (Yes)
 - How to interpret results (IRRELEVANT)
 - What is the next step (Yes)
 - How to recover from errors (Yes)
 - Syntax of commands (IRRELEVANT)
 - * Extent of help
 - Library of programs/databases (No)
 - Ease of use of help facility (Very easy)
- * Level of user support
 - Short development period (Rather short)
 - Time between deliverables (Short)
 - Technical support (Satisfactory)
 - Responsiveness to new needs (Average)
 - User expectations (Some)
- * Intermediary *
 - * Intermediary satisfaction
 - Convenience of access * (Acceptable)
 - * Confidence in the MINTS *

- * Confidence in MINTS results *
 - Currentness of information * (Good)
 - Validity of MINTS results * (Acceptable)
- * System reliability *
 - Hardware reliability * (Rarely)
 - Software reliability * (Very high)
 - Confidence in using the tools* (Reasonable)
- * Understanding of the MINTS *
 - Complexity v. capability (Good)
 - Involvement in MINTS devlpmnt (Some)
 - Effective training * (Yes)
 - Documentation * (Excellent)
 - Gradual development/learning * (Yes)
- * Userfriendliness of interface*
 - * Presentation *
 - Use of familiar repres./verbs* (Familiar)
 - Amount of information * (Adequate)
 - * Ease of use *
 - Training time * (Weeks)
 - Time taken to feel confident * (Days/hours)
 - Frequency of errors * (Rarely)
 - * Intermediary control *
 - Easy change of parameters * (Not required)
 - Context explicit * (Excellent)
 - User-defined input format* (Bad)
 - User-defined output format* (Bad)
 - Different skill levels * (No)
 - High level prog. language * (IRRELEVANT)
 - Responsiveness * (Reasonable)
 - * On-line help/memory aids *
 - What functions available * (Yes)
 - What functions do * (Yes)
 - How to interpret the results * (IRRELEVANT)
 - What is the next step * (Yes)
 - How to recover from errors * (Yes)
 - Syntax of commands * (IRRELEVANT)
 - * Extent of help *
 - Easy to use * (Yes)
 - Library of programs/databases* (No)
 - Interactive model (Yes)
- * Level of support provided *
 - Technical support * (Satisfactory)
 - Responsiveness to new needs * (Average)
- * Sponsor !
 - * Continued commitment!
 - Development/maintenance costs! (Large)
 - Availability of funds! (Sufficient)
- * System User's Superior !
 - Continued commitment to MINTS! (Very)
- * Custodians of Information !
 - Willingness to cooperate ! (IRRELEVANT)
 - Increase in workload! (IRRELEVANT)
- * Consultant !
 - * Commitement !
 - Availability of resource pool! (Good)
 - MINTS progress ! (Low)
 - Impact on other projects ! (Some)

IE

OVERALL MINTS SUCCESS

OPTIONS

• MINTS PROJECT 2

94% | | | | | | | |

the cursor key to select an option and press F3 to continue

IBM Corporation
© 1988 IBM Corporation
Model 486/586/686/786/886/986
Series 100/200/300/400/500/600/700/800/900

iE

MINTS PROJECT 2

QUESTIONS

ENSURING A RIGHT ENVIRONEMNT	-analysed-	78%	|||
MAINTAINING RELATIONSHIP	-analysed-	77%	|||

REPLY

-analysed- ||

Enter to select this reply, cursor down to choose another

F3 for next page of questions

ENSURING A RIGHT ENVIRONEMNT

* Organisational Infrastruture

* Acceptability of MINTS

Affordability of MINTS costs (Affordable)

* Adaptability of organisation

* Changes to the formal systems

Procedures (Rarely)

Operations (Rarely)

* Mgmt. adaptability to change

Education (Yes)

Exposure to IT (Some)

Place of MINTS in IT strategy (Yes)

* Organisational stability

* Staff turnover

User permanence (Yes)

Intermediary permanence (Yes)

* Stability of procedures/optns

Frequency of changes (Rarely)

Extent of changes (Little)

* Political environment

* Intelligence on key actors

* System user 1

Identity 1 (Known)

Political influence 1 (High)

Soft spots 1 (Some)

* Intermediary 2

Identity 2 (Known)

Political influence 2 (High)

Soft spots 2 (Not at all)

* Sponsor 3

Identity 3 (Known)

Political influence 3 (High)

Soft spots 3 (Some)

* System user's superior 4

Identity 4 (Known)

Political influence 4 (Moderate)

Soft spots 4 (Some)

* Custodians of information 5

Identity 5 (IRRELEVANT)

Political influence 5 (IRRELEVANT)

Soft spots 5 (IRRELEVANT)

* Supporting political actors 6

Identity 6 (Known)

Political influence 6 (Moderate)

Soft spots 6 (IRRELEVANT)

* Relationship among key actors

* Consultant's relationship

With system user 1 (Good)

With user's superior 1 (Don't know)

With intermedairy 1 (Good)

With Sponsor 1 (Good)

With supporting actors 1 (Good)

With custodians of info. 1 (IRRELEVANT)

* System user's relationship

With intermediary 2 (Good)

With user's superior 2 (Excellent)

With Sponsor 2 (Good)

With Supporting actors 2 (Good)
With Custodians of info. 2 (IRRELEVANT)

- * Sponsor's relationship
 - With user's superior 3 (Good)
 - With political actors 3 (Good)
 - With custodians of info. 3 (IRRELEVANT)
- * User's superior's relationship
 - With supporting actors 4 (Good)
 - With custodians of info. 4 (IRRELEVANT)
- * Intermediary's relationship
 - With custodians of info. 5 (IRRELEVANT)

* System Infrastructure

* Maturity of existing systems

* Software for the MINTS

Availability of software (No)
Suitability for the applicatio (Quite)
Compatability with existing SW (Very much)

* Hardware for the MINTS

Availability of hardware (No)
Suitability for MINTS software (Quite)
Compatability with existing HW (Very much)
Accessibility to existing HW (Easy)

* Information for the MINTS

Availability (Yes)
Accessibility (Inconvenient)
Validity (Yes)
Level of aggregation/disaggreg (Easy)
Performance of existing system (Very good)
Extent of expertise available (Sufficient)

* Actors' Capability/Commitement

* Consultant d

* Commitment d

* MINTS priority

Financial/political benefits d (Sufficient)
Availability of resource pool (Sufficient)

* Capability/Credibility d

* Familiarity with application

Short-term problem d (Yes)
Long-term problem/implications (Yes)
Technical know-how in MINTS (Adequate)
Experience with similar MINTS (Very high)
Ability to deliver on time (Certain)
Provision of technical support (Good)
Provision of training (Adequate)
Interpersonal skills (Very much)

* System User a

* System user's capability

* Knowledge of the application

Knowledge of the problem (Adequate)
Knowledge of a solution (Reasonably)

* Knowledge of the MINTS

Ability to interpret results (Sufficient)

* System user's commitment

Perception and urgency of need (Quite high)
User's initiation/involvement (Great deal)
Acceptance of changes/efforts (Rather well)
Acceptance of MINTS support (Rather well)

Existence of intermediary (Yes)
Responsibility for the MINTS (IRRELEVANT)

* Sponsor b

- * Commitment to the MINTS b
 - Availability of funds b (sufficient)
 - MINTS project priority b (Rather high)
 - Political pressures b (IRRELEVANT)
 - Involvement in MINTS project b (Some)
- * Benefits from the MINTS b
 - Organisational benefits b (Substantial)
 - Attitude to the MINTS b (V. positive)
 - Written Approval (Yes)

* Intermediary e

- * Intermediary's capability
 - * Knowledge of the application e
 - Knowledge of the problem e (Adequate)
 - Knowledge of a solution e (Little)
 - * Knowledge of the MINTS e
 - Ability to interpret results e (Sufficient)
- * Intermediary's commitment
 - Workload e (None)
 - Personal benefits from MINTS e (Little)
 - Responsibility for the MINTS e (Yes)
 - Political pressure e (Some)

* Custodians of information c

- * Custodians of info. Commitment
 - Increase in workload (IRRELEVANT)
 - Willingness to cooperate (IRRELEVANT)

* System user's superior f

- Influence f (Some)
- * User's superior's commitment f
 - * MINTS benefits
 - Personal benefits f (None)
 - Organisational benefits f (Substantial)
 - System user's need for MINTS (High)
 - Political pressure f (None)
 - Involvement in the MINTS f (Some)

* Supporting political actors g

- * Political actors' commitment g
 - Organisational benefits (Substantial)
 - Influence (Some)

MAINTAINING RELATIONSHIP

* System User

- * User satisfaction
 - * MINTS support
 - * Match of system and problem
 - * Problem limitations
 - Portion of variables known (Yes)
 - Quantifiability of variables (None)
 - Understanding of relationships (Quite small)
 - * System limitations
 - Dealing with "Must haves" (Yes)
 - Dealing with "Nice to haves" (Moderate)
 - * Internal adaptability
 - * External adaptability
- * MINTS benefits !
 - Improved quality of decisions (Some)

- Improved speed of decisions (Very much)
 More convincing arguments (Very much)
 More relevant information (Very much)
 Evaluation of more scenarios (Very much)
 Setting priorities better (Little)
 help problem conceptualisation (Very much)
 Convenience of access (Quite)
- * User confidence in the MINTS
 - * Confidence in MINTS results
 - Currentness of information (Good)
 - Validity of results (Acceptable)
 - * System reliability
 - Hardware reliability (Rarely)
 - Software reliability (Very high)
 - Confidence in using the tools (Reasonable)
 - * Understanding of the MINTS
 - Complexity v user's capability (Good)
 - User's involvement (Adequately)
 - Effective training (Yes)
 - Gradual development/learning (Yes)
 - Documentation (Good)
 - * Userfriendliness of interface
 - * Presentation
 - Use of familiar repres./verbs (Familiar)
 - Amount of information (Adequate)
 - * Ease of use
 - Training time (Days/hours)
 - Time taken to feel confident (Weeks)
 - Frequency of errors (Rarely)
 - * User control
 - Easy change of parameters (Excellent)
 - Context explicit (Excellent)
 - User-defined input format (Bad)
 - User-defined output format (Bad)
 - Different skill levels (No)
 - High level prog. language (IRRELEVANT)
 - Responsive (Reasonable)
 - * On-line help/memory aids
 - What functions available (Yes)
 - What functions do (Yes)
 - How to interpret results (IRRELEVANT)
 - What is the next step (Yes)
 - How to recover from errors (Yes)
 - Syntax of commands (IRRELEVANT)
 - * Extent of help
 - Library of programs/databases (IRRELEVANT)
 - Ease of use of help facility (Very easy)
 - * Level of user support
 - Short development period (Rather short)
 - Time between deliverables (Short)
 - Technical support (Satisfactory)
 - Responsiveness to new needs (Average)
 - User expectations (Some)
 - * Intermediary *
 - * Intermediary satisfaction
 - Convenience of access * (Acceptable)
 - * Confidence in the MINTS *

- * Confidence in MINTS results *
 - Currentness of information * (Good)
 - Validity of MINTS results * (Acceptable)
- * System reliability *
 - Hardware reliability * (Rarely)
 - Software reliability * (Very high)
 - Confidence in using the tools* (Reasonable)
- * Understanding of the MINTS *
 - Complexity v. capability (Good)
 - Involvement in MINTS devlpment (Some)
 - Effective training * (Yes)
 - Documentation * (Excellent)
 - Gradual development/learning * (IRRELEVANT)
- * Userfriendliness of interface*
 - * Presentation *
 - Use of familiar repres./verbs* (Familiar)
 - Amount of information * (Adequate)
 - * Ease of use *
 - Training time * (Days/hours)
 - Time taken to feel confident * (Weeks)
 - Frequency of errors * (Rarely)
 - * Intermediary control *
 - Easy change of parameters * (Excellent)
 - Context explicit * (Excellent)
 - User-defined input format* (Bad)
 - User-defined output format* (Bad)
 - Different skill levels * (DON'T KNOW)
 - High level prog. language * (IRRELEVANT)
 - Responsiveness * (Reasonable)
 - * On-line help/memory aids *
 - What functions available * (Yes)
 - What functions do * (Yes)
 - How to interpret the results * (IRRELEVANT)
 - What is the next step * (Yes)
 - How to recover from errors * (Yes)
 - Syntax of commands * (IRRELEVANT)
 - * Extent of help *
 - Easy to use * (Yes)
 - Library of programs/databases* (IRRELEVANT)
 - Interactive model (Yes)
- * Level of support provided *
 - Technical support * (Satisfactory)
 - Responsiveness to new needs * (Average)
- * Sponsor !
 - * Continued commitment!
 - Development/maintenance costs! (Large)
 - Availability of funds! (Sufficient)
- * System User's Superior !
 - Continued commitment to MINTS! (Very)
- * Custodians of Information !
 - Willingness to cooperate ! (IRRELEVANT)
 - Increase in workload! (IRRELEVANT)
- * Consultant !
 - * Commitement !
 - Availability of resource pool! (Good)
 - MINTS progress ! (Average)
 - Impact on other projects ! (None)

Appendix G

PORT

12:24:45 am

R

iE

SUBJECTS

RESULTS BY OPTION

• MINTS PROJECT 3 (93%)

- ENSURING A RIGHT ENVIRONEMNT
- MAINTAINING RELATIONSHIP

75%
72%

R

is a result report of the options under OVERALL MINTS SUCCESS
is F4 to get an outline of this line

ENSURING A RIGHT ENVIRONEMNT

- * Organisational Infrastructure
 - * Acceptability of MINTS
 - Affordability of MINTS costs (Affordable)
 - * Adaptability of organisation
 - * Changes to the formal systems
 - Procedures (Rarely)
 - Operations (Sometimes)
 - * Mgmt. adaptability to change
 - Education (Yes)
 - Exposure to IT (Some)
 - Place of MINTS in IT strategy (Yes)
- * Organisational stability
 - * Staff turnover
 - User permanence (Yes)
 - Intermediary permanence (Yes)
 - * Stability of procedures/optns
 - Frequency of changes (Rarely)
 - Extent of changes (Little)
 - * Political environment
 - * Intelligence on key actors
 - * System user 1
 - Identity 1 (Known)
 - Political influence 1 (Moderate)
 - Soft spots 1 (very well)
 - * Sponsor 3
 - Identity 3 (Known)
 - Political influence 3 (High)
 - Soft spots 3 (Very well)
 - * System user's superior 4
 - Identity 4 (Known)
 - Political influence 4 (High)
 - Soft spots 4 (Very well)
 - * Custodians of information 5
 - Identity 5
 - Political influence 5
 - Soft spots 5
 - * Supporting political actors 6
 - Identity 6
 - Political influence 6
 - Soft spots 6
 - * Relationship among key actors
 - * Consultant's relationship
 - With system user 1 (Good)
 - With user's superior 1 (Good)
 - With intermedairy 1 (IRRELEVANT)
 - With Sponsor 1 (Good)
 - With supporting actors 1 (IRRELEVANT)
 - With custodians of info. 1 (IRRELEVANT)
 - * System user's relationship
 - With intermediary 2 (IRRELEVANT)
 - With user's superior 2 (Good)
 - With Sponsor 2 (IRRELEVANT)
 - With Supporting actors 2 (IRRELEVANT)
 - With Custodians of info. 2 (IRRELEVANT)
 - * Sponsor's relationship
 - With user's superior 3 (Good)

- With political actors 3 (IRRELEVANT)
- With custodians of info. 3 (IRRELEVANT)
- * User's superior's relationship
 - With supporting actors 4 (IRRELEVANT)
 - With custodians of info. 4 (IRRELEVANT)
- * Intermediary's relationship
 - With custodians of info. 5 (IRRELEVANT)
- * System Infrastructure
 - * Maturity of existing systems
 - * Software for the MINTS
 - Availability of software (No)
 - Suitability for the applicatio (Quite)
 - Compatability with existing SW (IRRELEVANT)
 - * Hardware for the MINTS
 - Availability of hardware (No)
 - Suitability for MINTS software (Quite)
 - Compatability with existing HW (IRRELEVANT)
 - Accessibility to existing HW (IRRELEVANT)
 - * Information for the MINTS
 - Availability (Yes)
 - Accessibility (Very)
 - Validity (Yes)
 - Level of aggregation/disaggreg (Not required)
 - Performance of existing system (IRRELEVANT)
 - Extent of expertise available (None)
 - * Actors' Capability/Commitement
 - * Consultant d
 - * Commitment d
 - * MINTS priority
 - Financial/political benefits d (Sufficient)
 - Availability of resource pool (Sufficient)
 - * Capability/Credibility d
 - * Familiarity with application
 - Short-term problem d (Yes)
 - Long-term problem/implications (Yes)
 - Technical know-how in MINTS (Adequate)
 - Experience with similar MINTS (Adequate)
 - Ability to deliver on time (High)
 - Provision of technical support (Good)
 - Provision of training (Adequate)
 - Interpersonal skills (Very much)
 - * System User a
 - * System user's capability
 - * Knowledge of the application
 - Knowledge of the problem (Adequate)
 - Knowledge of a solution (Little)
 - * Knowledge of the MINTS
 - Ability to interpret results (Sufficient)
 - * System user's commitment
 - Perception and urgency of need (Quite high)
 - User's initiation/involvement (Great deal)
 - Acceptance of changes/efforts (Rather well)
 - Acceptance of MINTS support (Rather well)
 - Existence of intermediary (IRRELEVANT)
 - Responsibility for the MINTS (Yes)
 - * Sponsor b
 - * Commitment to the MINTS b

- Availability of funds b (sufficient)
 - MINTS project priority b (Rather high)
 - Political pressures b (None)
 - Involvement in MINTS project b (Throughout)
 - * Benefits from the MINTS b
 - Organisational benefits b (Substantial)
 - Attitude to the MINTS b (V. positive)
 - Written Approval (Yes)
 - * Intermediary e
 - * Intermediary's capability
 - * Knowledge of the application e
 - Knowledge of the problem e (IRRELEVANT)
 - Knowledge of a solution e (IRRELEVANT)
 - * Knowledge of the MINTS e
 - Ability to interpret results e (IRRELEVANT)
 - * Intermediary's commitment
 - Workload e (IRRELEVANT)
 - Personal benefits from MINTS e (IRRELEVANT)
 - Responsibility for the MINTS e (IRRELEVANT)
 - Political pressure e (IRRELEVANT)
 - * Custodians of information c
 - * Custodians of info. Commitment
 - Increase in workload (IRRELEVANT)
 - Willingness to cooperate (IRRELEVANT)
 - * System user's superior f
 - Influence f (Very)
 - * User's superior's commitment f
 - * MINTS benefits
 - Personal benefits f (Substantial)
 - Organisational benefits f (Substantial)
 - System user's need for MINTS (High)
 - Political pressure f (IRRELEVANT)
 - Involvement in the MINTS f (Some)
 - * Supporting political actors g
 - * Political actors' commitment g
 - Organisational benefits (IRRELEVANT)
 - Influence (IRRELEVANT)
- MAINTAINING RELATIONSHIP
- * System User
 - * User satisfaction
 - * MINTS support
 - * Match of system and problem
 - * Problem limitations
 - Portion of variables known (Yes)
 - Quantifiability of variables (Quite small)
 - Understanding of relationships (None)
 - * System limitations
 - Dealing with "Must haves" (Yes)
 - Dealing with "Nice to haves" (Major)
 - * Internal adaptability
 - * External adaptability
 - * MINTS benefits !
 - Improved quality of decisions (Very much)
 - Improved speed of decisions (Very much)
 - More convincing arguments (Very much)
 - More relevant information (Some)
 - Evaluation of more scenarios (Very much)

Setting priorities better (Little)
help problem conceptualisation (Some)
Convenience of access (Quite)

* User confidence in the MINTS

* Confidence in MINTS results

Currentness of information (Good)

Validity of results (Acceptable)

* System reliability

Hardware reliability (DON'T KNOW)

Software reliability (Good)

Confidence in using the tools (Reasonable)

* Understanding of the MINTS

Complexity v user's capability (Good)

User's involvement (Adequately)

Effective training (Yes)

Gradual development/learning (Yes)

Documentation (Good)

* Userfriendliness of interface

* Presentation

Use of familiar repres./verbs (Familiar)

Amount of information (Adequate)

* Ease of use

Training time (Days/hours)

Time taken to feel confident (Days/hours)

Frequency of errors (Rarely)

* User control

Easy change of parameters (Not required)

Context explicit (Good)

User-defined input format (Not required)

User-defined output format (Good)

Different skill levels (No)

High level prog. language (IRRELEVANT)

Responsive (Fast)

* On-line help/memory aids

What functions available (IRRELEVANT)

What functions do (IRRELEVANT)

How to interpret results (IRRELEVANT)

What is the next step (Yes)

How to recover from errors (Yes)

Syntax of commands (IRRELEVANT)

* Extent of help

Library of programs/databases (Yes)

Ease of use of help facility (IRRELEVANT)

* Level of user support

Short development period (Long)

Time between deliverables (Short)

Technical support (Satisfactory)

Responsiveness to new needs (High)

User expectations (Fully)

* Intermediary *

* Intermediary satisfaction

Convenience of access * (IRRELEVANT)

* Confidence in the MINTS *

* Confidence in MINTS results *

Currentness of information * (IRRELEVANT)

Validity of MINTS results * (IRRELEVANT)

* System reliability *

- Hardware reliability * (IRRELEVANT)
- Software reliability * (IRRELEVANT)
- Confidence in using the tools* (IRRELEVANT)
- * Understanding of the MINTS *
 - Complexity v. capability (IRRELEVANT)
 - Involvement in MINTS devlpment (IRRELEVANT)
 - Effective training * (IRRELEVANT)
 - Documentation * (IRRELEVANT)
 - Gradual development/learning * (IRRELEVANT)
- * Userfriendliness of interface*
 - * Presentation *
 - Use of familiar repres./verbs* (IRRELEVANT)
 - Amount of information * (IRRELEVANT)
 - * Ease of use *
 - Training time * (IRRELEVANT)
 - Time taken to feel confident * (IRRELEVANT)
 - Frequency of errors * (IRRELEVANT)
 - * Intermediary control *
 - Easy change of parameters * (IRRELEVANT)
 - Context explicit * (IRRELEVANT)
 - User-defined input format* (IRRELEVANT)
 - User-defined output format* (IRRELEVANT)
 - Different skill levels * (IRRELEVANT)
 - High level prog. language * (IRRELEVANT)
 - Responsiveness * (IRRELEVANT)
 - * On-line help/memory aids *
 - What functions available * (IRRELEVANT)
 - What functions do * (IRRELEVANT)
 - How to interpret the results * (IRRELEVANT)
 - What is the next step * (IRRELEVANT)
 - How to recover from errors * (IRRELEVANT)
 - Syntax of commands * (IRRELEVANT)
 - * Extent of help *
 - Easy to use * (IRRELEVANT)
 - Library of programs/databases* (IRRELEVANT)
 - Interactive model (IRRELEVANT)
- * Level of support provided *
 - Technical support * (IRRELEVANT)
 - Responsiveness to new needs * (IRRELEVANT)
- * Sponsor !
 - * Continued commitment!
 - Development/maintenance costs! (Large)
 - Availability of funds! (Sufficient)
- * System User's Superior !
 - Continued commitment to MINTS! (Very)
- * Custodians of Information !
 - Willingness to cooperate ! (IRRELEVANT)
 - Increase in workload! (IRRELEVANT)
- * Consultant !
 - * Commitement !
 - Availability of resource pool! (High)
 - MINTS progress ! (High)
 - Impact on other projects ! (Some)