An Innovative Methodology for the Development of Information Systems with an Application to the Teachers Training College in Makkah Al-Mukkaramah, Saudi Arabia

By

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ABSTRACT

The main aim of the Teachers' Training College (TTC) in Makkah Al-Mukkaramah, Saudi Arabia, is to develop an interest in scientific research and reading, and to conduct meaningful conversations so that pupils are trained to be good housewives, experienced researchers and professional educators in order to use their abilities to develop the Saudi community scientifically, socially, mentally and physically. The information system at TTC has a number of problems, particularly difficulties which are connected to the rapid increase in student records, the duplication of records, the fact that student information is distributed in different departments, the lack of information control, the insufficient number of information professionals, the lack of training, the shortcomings in satisfying user needs, deficiencies in the ICT infrastructure, and the absence of security planning. The senior management of the Teachers' Training College knows that the organisation has information-related problems, with information overload being a particularly prominent issue. However, these managers seem powerless to identify the root causes, being neither able to identify the source of the problems nor the people responsible for them.

This research aims to study the methodological context in which recommendations for change can be made, and to apply an appropriate methodology (or multi-methodology) to the development of an information system for use in the Teachers' Training College in Makkah Al-Mukkaramah. This information system can help to control TTC information overall and can provide quality services to users, offering them accurate information when it is needed and a quick response time.

The Mandoora Iterative Multi-methodology (MIM) combines a functionalist paradigm (VSM) with an interpretive paradigm (SSM and ETHICS). MIM is classified as a pluralism Multi-methodology because it uses two different methodological approaches (SSM and ETHICS) and one model (VSM) in combination, and respected the different strengths of the various strands of systems thinking. Therefore, MIM was developed: to explore different worldviews relevant to a real world situation and contrast them in a process of debate (SSM, Mode 1); to improve job satisfaction (the social system), work efficiency (the technical system),

and cultural support and political approval (ETHICS); and to use the cybernetic principle of viability to design new organisational structures and processes (VSM). MIM deals with complex problems related to soft issues (social and human activities), hard issues (computers and networks), and the environment (culture and political). Furthermore, MIM utilises the knowledge of people who essentially work with the system, as well as the users who benefit from it, to improve the quality of the final system. MIM can also help to develop a new or improved information system in a large or medium organisation.

This study applied MIM to develop an information system at TTC. The main result of the research was the development of a wider information system at TTC which consisted of a strategic policy system, an organisational resources system, a human resources system, and an ICT resources system. The wider information system needs to be implemented in a specific order to obtain an effective information system which will satisfy the expectations of users. In addition, a students' office, a records centre, and a help desk should be established at TTC to control the overall information management so that accurate information can be retrieved and accessed by the right person, from the right resource, in the right form, as quickly as possible, and at the lowest cost.

ACRONYMS

AECT	The Association for Educational Communications and Technology
ALU	Arithmetic and Logic Unit
AS	Academic Staff
CM	Conceptual Model
CPU	Central Processing Unit
CSH	Critical Systems Heuristics
CST	Critical Systems Thinking
CT	Contingency Theory
DAFA	Dean for Administrative and Financial Affairs
DBMS	Database Management System
DSA	Dean for Student Affairs
ETHICS	Effective Technical and Human Implementation of Computer-based Systems
GST	General Systems Theory
HD	Help Desk
HTML	Hyper Text Mark-up Language
ICT	Information and Communication Technologies
IM	Information Management
IMS	Information Management System
IP	Interactive Planning
IP	Internet Protocol
IRM	Information Resource Management
IS	Information System
ISCL	The International System Institute for Computer and Languages
ISIM	Information System Implementation Model
ISJ	Information Systems Journal
IT	Information Technology
LVSM	Large Viable System Model
MIM	Mandoora Iterative Multi-methodology
MoHM	Ministry of Health in Malaysia
MWL	Muslim World League
OR	Operations Research

OS	Operational Staff
PC	Personal Computer
RD	Root Definitions
RP	Rich Picture
SA	Systems Analysis
SAST	Strategic Assumptions Surfacing and Testing approaches
SD	Systems Dynamics
SE	Systems Engineering
SOSIG	Social Sciences Information Gateway
SOSM	Systems of Systems Methodologies
SPSS	Statistical Package for the Social Science
SSD	Social System Design
SSM	Soft Systems Methodology
ST	Students at Teachers' Training College
STS	Socio-Technical Systems
SVSs	Smaller Viable Systems
TCP	Transmission Control Protocol
TIS	The Information Society
TSI	Total Systems intervention
TTC	Teachers' Training College
UAE	United Arab Emirates
UK	United Kingdom
USA	United Stats of America
VSM	Viable Systems Model
WWW	World Wide Web
χ^2-test	Chi-Squared test

Contents

List of Tables

List of Figures

Chapter 1
Introduction and Background

1.1 *Introduction*

Information is very important for any organisation. it is an important resource needed to develop and improve other resources. Information management is a concern with the use of accurate information which lead to achieve better planning and decision making in the right time. Best (1988) defines information management as the economic, efficient and effective co-ordination of the production, control, storage and retrieval and dissemination of information from external and internal sources, in order to improve the performance of the organization. However, the goals of information management are getting the right information to the right person, at the right time, from the right source, in the right amount, in the right order, in the right form, in the right medium, with optimal accuracy, as quickly as possible and at the lowest reasonable cost (Information Management Associates, 2003).

The general education in Saudi Arabia consist of four levels to precedes higher education that are pre-school primary school, intermediate school, and high school. This prepares students wishing to continue their studies at university level. Over the past 20 years, there has been no greater evidence of the Kingdom's commitment to the education of its people than the huge investments it has made in these four levels of education. Girls' education was a separate endeavour, organised under the General Presidency of Girls' Education. It was always linked to the Ministry of Education since the curriculum was the same. In March 2002, the General Presidency was fully merged into the Ministry of Education. Within the Ministry, the General Presidency is also responsible for girls' junior colleges, for women's teacher colleges throughout the Kingdom, and for nurseries and kindergartens where children of both sexes are taught together.

In 1979 the General Presidency of Girls' Education established a number of Middle Colleges in the cities of the Kingdom of Saudi Arabia. In 1982 a Middle College was established in Makkah Al-Mukarramah number of departments include: Holy Quran and Islamic Studies; Arabic Language and Social Science; Science and Maths; Home Economics and Art; Education and Psychology; and Children's Care. Additionally there is Administrative Affairs Department. Study in college took two years, after which the student obtained a Middle College Certificate for primary school. In 1994 the College was changed to a Teachers' Training College (TTC) with four study years. The number of students attending the TTC rose rapidly from 648 students in year 1994 to 2284 students in year 2003. The specific aim of the TTC is to provide teachers with a qualification so that they are able to improve the level of education in Saudi Arabia.

1.2 Scope of the study

Information and the system within which it sits is a vital component of any organisation. The management of information is also critical, allowing delivery of the right information in the correct form, directed to the right person, at the right time and in the correct place. In applications where complexity is high (i.e. when the number of 'nodes' and number of 'links' are both high), the management of information becomes problematic, with duplication, omission, mal-distribution and lack of control being identified features. The management of information in the Teachers' Training College in Makkah Al-Mukkaramah, Saudi Arabia constitutes such a problem. Student records have increased fourfold in less than ten years (from 500 students enrolled to over 2300 students). The senior management of the Teachers' Training College know they have information-related problems, with information overload being a particularly prominent issue. However, they seem powerless in identifying root causes, being neither able to identify the source of the problems nor the people responsible for them.

The central theme of the research is the comparison of the methodological approaches adopted to design, implement and evaluate a novel information system that is capable of passing to the staff more accurate information in a more timely manner. The methodological approaches adopted are Soft System Methodology (SSM) (Checkland, 1981), Effective Technical and Human Implementation of

Computer-based Systems (ETHICS) (Mumford, 1983), and Viable System Model (VSM) (Beer, 1972). These can be treated as 'information-based' methodologies.

The SSM methodology was developed by Peter Checkland in 1981 (Checkland and Scholes, 1990). SSM derives information from what is called the 'problem situation' and relies heavily on the concept of 'human activity systems'. SSM is classified as an 'issues-oriented' methodology by Jayaratna (1988), although Checkland and Scholes indicate that the Root Definitions (a model component of the SSM) can be issue-based or task-based, and give examples of each (Checkland and Scholes, 1990). The ETHICS methodology was developed by Enid Mumford (1983a, 1983b). The objective of ETHICS is to design new systems with the dual objectives of improving job satisfaction (social system) and work efficiency (technical system). ETHICS is well known for its emphasis on, and interest in, the 'human' aspects of systems design. ETHICS was classified as 'process-oriented' in the methodology classification by Jayaratna (1988). The VSM was developed by Stafford Beer (1972, 1979). The VSM can be used to diagnose organisational problems, and to design new organisational structures and processes (Liber, 2004).

The main reasons for the chosen two methodological approaches are that both methodologies have been used successfully in numbers of studies and projects, particularly issues related to education, government services, information systems, and information management. Both methodologies are considered to involve the human element to be incorporated into the design of information systems. Both of them have a step by step approach that keeps the research moving forward. It also gives the researcher a logic of achievement as each stage is completed. In addition, SSM and ETHICS are flexible methodologies that can be used in many different ways according to the wishes of the participations (users, mangers, operations staff, and stakeholder). SSM and ETHICS have powerful methods: SSM has rich pictures, root definitions and conceptual models while ETHICS has social and technical design aspects. The main reason for choosing the VSM approach is that it consists of a set of five deeply interacting sub-systems which must support any organisation.

The main weaknesses of SSM include: it is too flexible and too general; it does not provide any checklists for each stage; SSM process could be costly in term of time resources; SSM doe not help to develop or implement a system; It is impossible to manage all peoples views; and, SSM does not provide advice about the success or a failure of a problem scenario. In addition, the main weaknesses of ETHICS include: it takes time to implement, as it requires design group members to learn new analytical and design skills; may only suitable for large organizations; this methodology is very expensive in terms of man-hours and thus money; this is very time consuming due to a lack of objectivity; and, there is no clear definition of when each stage is complete and it is appropriate to move on to the next stage. With regard to VSM its main weaknesses include: it does not reflect richness, diversity, and interdependence of most real-life situation; it is complex and needs professional skill to apply; it dose not adequately address the social and political factors in designing system; to the extent that it is classified as hard system thinking as a consequence of the limited concern with soft issues.

In the light of the weaknesses identified above in existing methodologies, a new multi-methodology (the Mandoora Iterative Multi-methodology: MIM) was developed to explore different worldviews relevant to a real world situation and then contrast them in a process of debate (SSM, Mode 1). This is in order to: improve job satisfaction (the social system); improve work efficiency (the technical system); gain cultural support and political approval (ETHICS); and apply the cybernetic principle of viability to design new organisational structures and processes (VSM).

The process-oriented and evaluation were the main strands of MIM. The process-oriented strand consist of five stages: planning, analysis, design, implementation, and maintenance. While, the evaluation strand aimed to provide the most suitable and reliable information to middle and lower management about the information system at TTC. Needs evaluation, formative evaluation, and summative evaluation were the main stages of the evaluation strand.

Five methods were used to collect primary data sources compatible with the structure and culture of the TTC. Firstly, document analysis were aimed to provide a general background of the TTC environment and was a useful starting point for analysing the current situation, as well as providing a sound overview of the uses of the TTC system. Secondly, semi-structured interviews were used to understand the experience of other people; they also provided access to the context of people's behaviour which would probably not have been accessible using other techniques. Thirdly, the aim of the focus group was to gather more in-depth qualitative data in order to clarify and add meaning to the interviews, as well as exploring people's opinions, attitudes, beliefs, values, discourses and understanding of things as valid in their own right. Fourthly, an obtrusive observation was used to understand and explore the current processes and uses of the information system by watching, describing and analysing. Finally, questionnaires were used to collect quantitative data from a large number of people in a relatively short period of time; these also allowed them to express honestly their opinions relating to information system services and resources, as well as to their own information use behaviour. It was found that these five methods could express the problem situation from different angles in order to give an holistic view and in order to build the Rich Picture.

1.3 Aims of the Research

Aim 1: To understand the systemic issues involved in developing an information system within Teachers' Training College in Makkah Al-Mukkaramah .

Aim 2: To study the methodological context in which management of change is a component part.

Aim 3: To apply an appropriate methodology (or multi-methodology) to the development of an information system for use in the Teachers' Training College in Makkah Al-Mukkaramah.

1.4 Objectives of the Research

This research was conducted to achieve the following objectives:

1. To investigate the use and limitations of established systems methodologies for application to the management of change. (Aims 1 and 2)

2. To review the systems literature to provide an insight into the problem issues. (Aim 1)
3. To develop a novel systems-based multi-methodology to accommodate the change processes at Teachers' Training College in Makkah Al- Mukkaramah. (Aim 3)
4. To complete an information audit in the Teachers' Training College in Makkah Al- Mukkaramah. (Aim 1)
5. To establish a roadmap for further work. (Aim 3)

1.5 General background

1.5.1 Saudi Arabia and Makkah Al-Mukarramah

The Kingdom of Saudi Arabia is situated in the south-western part of Asia. It is bordered to the northwest by Jordan, to the north by Iraq and Kuwait, to the west by the Red Sea and to the east Qatar, the United Arab Emirates (U.A.E) and the Sultanate of Oman, and to the south by the Republic of Yemen (see Figure 1.1). Saudi Arabia covers an area of about 2,250,000 square kilometres (868,730 square miles) and Riyadh is the capital city. The national language is Arabic. The religion of Saudi Arabia is Islam. The population of Saudi Arabia was 16.9 million in 1992 and was estimated in 1999 at 21.4 million (The Saudi Arabian Information Resource, 2003).

According to Makky (1978), Makkah Al-Mukarramah is located on 21° 25' north of the Equator and 39° 44' 30" east of Greenwich. It is located in the Sirat Mountains, inland from the Red Sea, and is set in a rugged landscape consisting mostly of solid granite, with rocks sometimes reaching 300 metres (1,000 feet) above sea level (see Figure 1.1).

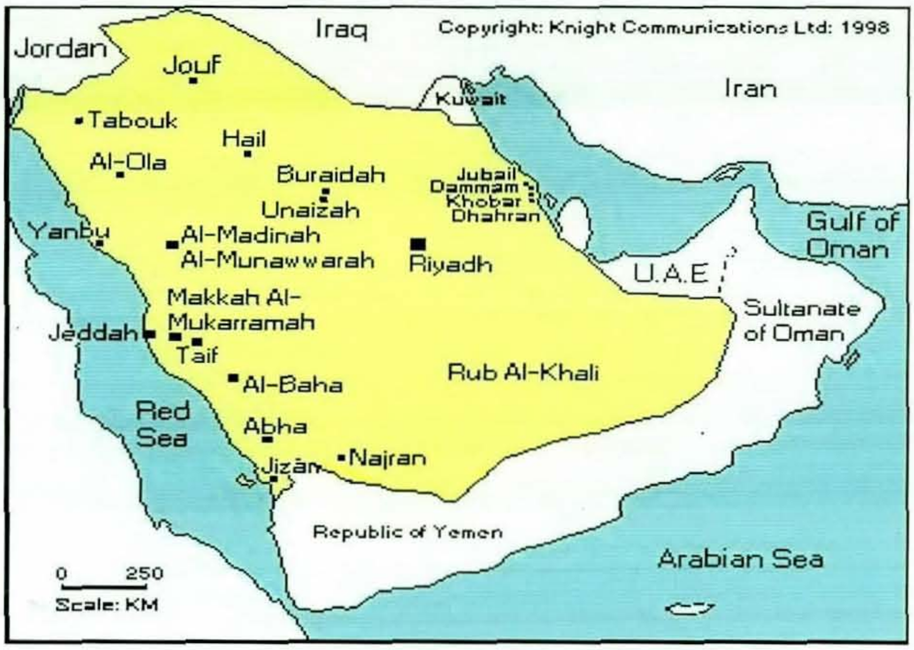


Figure 1.1 Map of the Kingdom of Saudi Arabia
(The Saudi Arabian Information Resource, 2003)

1.5.2 History of Education in Saudi Arabia

According to the Information Office, The Royal Embassy of Saudi Arabia (2003), when the Kingdom of Saudi Arabia was founded in 1932, education was not accessible to everyone, being limited to individualized instruction at religious schools in mosques in urban areas. These schools taught Islamic law and basic literacy skills. Some 70 years later, Saudi Arabia now has a nationwide educational system that provides free training from pre-school through to university to all citizens. While the study of Islam remains at its core, the modern Saudi educational system provides quality instruction in diverse fields of modern and traditional arts and sciences. This diversity helps meet the Kingdom's growing need for highly educated citizens to build on its rapid progress of the past few decades.

In 1951, the country had 226 schools with 29,887 students. In 1954, the Ministry of Education was established, headed by then Prince Fahd bin Abdulaziz as the first Minister of Education. Girls' education did not begin officially until 1960. A royal decree was issued to open schools for girls' education and to form an institution to supervise this type of education called, "The General Presidency for Girls' Education" (The Royal Embassy of Saudi Arabia, 2003).

1.5.3 General Education in Saudi Arabia

The Information Office, The Royal Embassy of Saudi Arabia (2003) states that the objectives of Saudi educational policy are to ensure that education becomes more efficient, to meet the religious, economic and social needs of the country, and to eradicate illiteracy among Saudi adults. Ain Al-Yageen (1997) states that there are four levels of education that precede higher education in the Kingdom. The first level is pre-school, a small sector currently limited to larger cities in the first instance. The second level is primary school for children aged 6 to 12. The third level is intermediate schools for pupils aged 12 to 15 and the fourth level is high school for pupils aged 15 to 18. This prepares students wishing to continue their studies at university level. Over the past 20 years, there has been no greater evidence of the Kingdom's commitment to the education of its people than the huge investments it has made in these four levels of education.

1.5.4 Girls' Education in Saudi Arabia

The goal of girls' education, as stated in official policy, is ideologically tied to religion:

> *"the purpose of educating a girl is to bring her up in a proper Islamic way so as to perform her duty in life, be an ideal and successful housewife and a good mother, ready to do things which suit her nature such as teaching, nursing and medical treatment."*

The policy also recognizes a woman's right to obtain suitable education on an equal footing with men in light of Islamic laws. In practice, educational options for girls at the pre-college level are almost identical to those for boys. One exception is that, at all levels of pre-college education, only boys take physical education, and only girls take home economics.

According to statistics published by the General Presidency of Girls' Education, in 2000 there were more than 2 million female students and 200,000 female teachers and administrators at more than 13,000 educational institutions. The statistics also showed that there were 6,206 primary schools, with more than 1 million students and 177,000 teachers. There were 1,716 intermediate schools, with 491,000 students and 43,565 teachers. The number of high schools reached 1,571 with 365,560 students and 30,516 teachers.

Until recently, girls' education was a separate endeavour, organised under the General Presidency of Girls' Education. It was always linked to the Ministry of Education since the curriculum was the same. In March 2002, the General Presidency was fully merged into the Ministry of Education. Within the Ministry, the General Presidency is also responsible for girls' junior colleges, for women's teacher colleges throughout the Kingdom, and for nurseries and kindergartens where children of both sexes are taught together. Women's literacy programmes also fall under its supervision. It should be noted that female students are educated in separate branches of Saudi universities.

1.5.5 The Teachers' Training College in Makkah Al-Mukkaramah

In 1979 the General Presidency of Girls' Education established a number of Middle Colleges in the cities of the Kingdom of Saudi Arabia. In 1982 a Middle College was established in Makkah Al-Mukarramah with the following departments:

1. Holy Quran and Islamic Studies;
2. Arabic Language and Social Science;
3. Science and Maths;
4. Home Economics and Art; and
5. Education and Psychology.

In 1989 a Children's Care Department was established. Additionally there is Administrative Affairs Department. Study in college took two years, after which the student obtained a Middle College Certificate for primary school. In 1994 the College was changed to a Teachers' Training College (TTC) with four study years.

The number of students attending the TTC rose rapidly from 648 students in year 1994 to 2284 students in year 2003. The specific aim of the TTC is to provide teachers with a qualification so that they are able to improve the level of education in Saudi Arabia (See chapter 6).

TTC consists of two main buildings (A and B) with four levels in the one surrounding area. Building A contains of the Dean's office, her operational staff office, and the Chemistry and Physics laboratories on the ground floor. On the first level, there are the Education and Physiology Departments, Deputy DAFA's office and her operational staff office, the Science and Maths Department, the library and classrooms. On Level Two, there is a control room for examinations and classrooms while on Level Three there are the Home Economics and Art Departments and classrooms. Building B contains classrooms on the ground floor. Situated on the first level is the Department of the Holy Quran and Islamic Studies, and classrooms. On Level Two, there is Deputy DSA's office, her operational staff office, the Child Care Department, and the Department of the Arabic Language and Social Science while on Level Three there are classrooms.

Most of Department offices consist of a room for the Head of Department and another for staff. Every Department office contains a copy machine, two PCs with two printers, fourteen tables with chairs, and a number of different types of cupboard and shelves. The total size of each Department office was $50m^2$ (10mx5m). The major needs in the Department offices include: increasing the number of offices and equipping these with suitable tables and PCs, decreasing the number of cupboards, supplying better lighting and air conditioning, and offering spacious classrooms, provided with proper ICT facilities, to cope with the increased number of students.

1.5.6 Saudi Arabia's 7th Plan

The Ministry of Planning of the Kingdom of Saudi Arabia (2000) issued 16 general objectives and strategic objectives for the Seventh Development Plan 2000-2004. The 14th strategic objective is to establish a national science and technology base capable of innovating and inventing, as well as adapting existing technologies through the following:

1. Providing the basic services, infrastructure and systems necessary for the development of science and technology;
2. Enhancing scientific and technological awareness on the part of society and students at all levels of education, along with providing appropriate incentives in this respect;
3. Providing opportunities for specialists and researchers to undertake scientific and technological research;
4. Encouraging technological invention and development by individuals and national institutions along with enhancing their innovative capabilities;
5. Preparing a national plan that utilizes information and other technologies to promote knowledge and support economic development;
6. Encouraging national industries to establish laboratories for research and development, and monitoring quality control and linkages among them.

1.5.7 The Ministry of Education Ten - Year plan in Saudi Arabia

The Deputy Ministry for Planning and Administrative Development (2005) established The Ministry of Education Ten - Year plan in Saudi Arabia. The vision for this plan is

> *'By Allah's will, at the end of year 1435H, the Ministry of Education's vision will be realized in: The graduation of male and female students with Islamic values and the appropriate knowledge and practice. These students will have acquired practical knowledge, skills, and attitudes; they will be able to positively react to and face modern changes; they will be able to apply advanced technologies with efficiency and flexibility and to deal with international competition in scientific and practical fields. Their positive participation in an efficient educational system will allow them to develop appropriate abilities and attitudes and to spread the positive spirit of work at school environments that encourage learning and social education'.*

The goals of the ten-year plan accommodate the following:

1. The education of 4 to 6-year-old children and the consideration of kindergarten as an independent stage in terms of its buildings and syllabi from other education stages;
2. Accommodation of all age categories from 6-18-year-olds at various stages of education;
3. Deepening the spirit of loyalty and proud of the country through intellectual awareness based on recognizing issues of the country;
4. To prepare students academically, and culturally at a local and international level to be able to achieve advanced posts internationally in the fields of maths and sciences for the various age categories, taking into account International tests' standards;
5. To organise girls' technical education;
6. To develop the educational system for students with special needs;
7. Development and growth of the Ministry's personnel educational and administrative training;
8. Improvement of internal and external sufficiency for the educational system;
9. To develop syllabi based on Islamic values leading to the development of male and female students' personality and to their integration in society as well as to the achievement of scientific and thinking skills and life characteristics resulting in self education and lifelong learning;
10. To improve the quality of male and female teachers and to increase the citizens' rate in the education sector to achieve the full use of Saudi human resources;
11. To develop the educational structure and to update the school map to meet the expected quantitative and qualitative changes in the next stage;
12. To develop the infrastructure of information and communication technology and its employment in education and learning;
13. To develop male and female adults' education and to eradicate illiteracy;
14. The Ministry's comprehensive administrative development;
15. Expansion of social participation in education; and
16. To establish integrated systems for accountability.

1.6 Outline of the Research

This research is organised into nine chapters:

Chapter **1** introduces the importance of information management in an organisation, together with the research problem; it then determines the aims and objectives of the research. The final part offers a general background of the education system in Saudi Arabia.

Chapter **2** introduces the methods of the research. The chapter begins with an identification of sources of primary data such as document analysis, interviews, questionnaires, focus groups and observation studies. In the next part, a number of secondary data sources are identified, including journals, electronic sources, dissertations and books. The final part outlines the research process.

Chapter **3** contains a review of the literature. This chapter is divided into four main parts. Part one describes the basic elements of system theory, part two demonstrates the key elements in system practice, and part three considers methodology and multi-methodology. The final part outlines the previous studies related to the research issues.

Chapter **4** describes an overview of SSM, ETHICS and VSM. This chapter is divided into five parts. Part one presents an intervention of Systems Thinking while part two introduces SSM. Part three introduces ETHICS and part four introduces VSM. The final part makes comparisons between SSM, ETHICS and VSM.

Chapter **5** introduces the MIM. This chapter consists of four parts. Part one offers the definition and an historical overview of the MIM while part two describes its philosophy and theory. Part three outlines the components of the MIM and also includes two main sections which cover the process and evaluation. The final part is a summary.

Chapter **6** presents an analysis of the findings and is divided into five main parts. Part one consists of a document analysis, the second part offers an analysis of the interviews, part three analyses the focus groups, part four is an analysis of the observations, and the final part comprises the questionnaire analysis.

Chapter 7 aims to design an IS at TTC by applying the MIM. This chapter is divided into two main parts, with the first covering the process-oriented strand while the second is the evaluation strand.

Chapter 8 discusses and summarises several issues related to the design of the information system at TTC using the MIM. This chapter is divided into three, with the first part discussing the various threads that run through the thesis. Part two suggests actions that could be taken to improve the information system at TTC while the final part identifies the contribution that the methodology and findings have brought to the wider knowledge base.

Chapter 9 presents the main conclusions of the study, the recommendations for designing an information system at TTC, and suggestions for further studies.

Chapter 2
Research Methods

2.1 Introduction

The aim of this chapter is to outline the methods adopted in the research. This chapter begins with an identification of primary data sources which include: document analysis, interviews, questionnaires, focus groups, and observation studies. The main reasons for using these methods are briefly described below: document analysis is an officials document effective way of gathering information about current systems. For example, policies, general statistics, official and historical reports, charts, report files and system documents which together provide important background information. Interviews provide data essential to understand the experience of the other people and provide access to the context of people's behaviour which would not be readily accessible using techniques such as observation or questionnaires. Questionnaires are a very important tool to collect quantitative data to gather information directly by asking people questions and analysing the data collected. Focus groups enable more in-depth qualitative data to be collected in order to clarify and add meaning to the interviews and observations. Observation techniques offer a systematic way of identifying and monitoring the current processes and uses of the information system by watching, describing and analysing and raising questions to follow up using other methods in the study.

In addition, a number of secondary data sources are identified and were used, including journals, electronic sources, dissertations and books. The final part outlines the research process to be undertaken.

Quantitative research is concerned with the collection and analysis of data in numeric form. It tends to emphasize relatively large-scale and representative sets of data and is often falsely in our view presented or perceived as being about the gathering of ‘facts’. Qualitative research on the other hand, is concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible. It tends to focus on exploring, in as much detail as possible, smaller numbers of instances or examples which are seen as being interesting or illuminating, and aims to achieve 'depth' rather than 'breadth' (Blaxter, *et al.*, 2001).

Quantitative and qualitative methods would be beneficial to this area of research in helping the researcher to establish facts about the existing information system. These might include information about staff and equipment resources, manual and automated procedures, and an outline of current problems. The use of questionnaires constitutes a quantitative method, whereas document analysis, interviews, focus groups, and observations are usually qualitative methods.

2.2 Primary Data Sources

In order to achieve the aims of this research it is important to select an appropriate method to explore the problem situation and to offer suggestions to improve or develop a new information system. The data collection methods should be compatible with the structure and culture of the TTC. Therefore, this research study uses document analysis, interviews and focus groups, questionnaires, and observation studies as primary data sources. Each of these primary data sources is discussed in the further detail below.

2.2.1. Document Analysis

Most business organisations, particularly large ones, have documentation that is of help to the analyst in understanding the way the organisation works. This typically includes instruction manuals and procedure manuals that provide a statement of the way that tasks are to be performed. There are different types of documents such as document blanks that are filled in by personnel within the organisation and are then passed between departments or stored for reference give the analyst an indication of the formal data flows and data stores. Job descriptions define the responsibilities of the personnel. Statements of company policy provide information on overall objectives and likely changes. Publicity and information booklets for external bodies provide a useful overview of the way that a company works (Curtis, 1998).

Therefore, document analysis can play a vital role in gathering information about the current status of the system at the TTC. A search for management structures, policies, strategies, information booklets, job descriptions, formal data flows and data stores, and reports of the ICT currently used were included in the document analysis. This information provided a general background of the TTC environment. Document analysis was a very good starting point for analysing the current situation and provided a sound overview of the uses of the TTC system.

The researcher collected number of documents and official statistics provided by TTC include:

- System Structures and management for Girls Colleges, 2002;
- Girls Colleges Policy, 1992;
- Description of Teachers Training College at Makkah Al-Mukkaramah, 2000;
- Official Statistics for Teachers Training College at Makkah Al-Mukkaramah, 2001;
- Student's information book for Teachers Training Colleges, 1993;
- Official Statistics for Griles Education at Makkah Al-Mukkaramah, 2000; and,
- The general goals and strategic bases of The Seventh Development Plan (2000/2001-2004/2005). By The Ministry of Planning of the Kingdom of Saudi Arabia.

The documents in TTC have been analysed based on six elements: general objectives, hierarchy management, managerial structure, student affairs, library, and information infrastructure (see section 6.2).

2.2.2. Interviews

Interviewing is an extremely flexible research tool that can be used at any stage of the research process (Brewerton and Millward, 2001). Yeates *et al.* (1994) define an interview as a conversation with a specific purpose. The researcher requires the opinions of the interviewee and his or her feelings about the current system, a view of organisational and personal goals, and an idea of informal procedures in order to build up a picture of the current system and to record the requirements for a new one (Kendall & Kendall, 1999). Curtis (1998) and Kendall & Kendall (1999) indicate several guidelines that are recognized as being essential to successful interviewing including: (1) reading background material about the organisation, (2) establishing a clear purpose for each interview undertaken, (3) deciding how to interview, (4) preparing thoroughly for the interview by becoming familiar with technical terms that are likely to be used by the interviewees and with their positions and general responsibilities, and (5) outlining a list of questions to be asked during the interview.

Brewerton & Millward (2001) outline the numbers of interview types including structured, unstructured and semi-structured interviews.
Structured interviews involve a prescribed set of questions which the researcher asks in a fixed order, and which generally require the interviewee to respond by selecting one or more fixed options. This method ensures rapid data coding and analysis, easy quantification of data and consequent comparability of responses, and guaranteed coverage of the area of interest to the research.

Unstructured interviews allow the researcher *carte blanche* to address any or all of a given number of topics that may be of interest to the research. Questions and their order are not fixed and are allowed to evolve during the interview process. Here, comparability and ease of analysis and quantification are secondary to obtaining rich, salient data from each individual using open-ended, rather than forced-choice, questions.

Semi-structured interviews, incorporate elements of both quantifiable, fixed-choice responding and the facility to explore and probe in more depth, certain areas of interest. Thus, this type of interview carries with it the advantages of both approaches (it is generally easy to analyse, quantify and compare data, allowing interviewees to explain their responses and to provide more in-depth information where necessary).

However, the interview can help to understand the experience of the other people and provides access to the context of people's behaviour which would probably not be accessible using techniques such as observation or questionnaires. There are several points that the researcher should be aware of before doing semi-structured interview, such as planning the interview sequences using a top-down approach. In this research, the researcher began with interviews with the Dean and Deputy Dean, worked down through Heads of Department, and then interviewed operational staff at the TTC. Semi-structured interview appointments were made before the interviews took place. An awareness of interpersonal communication, for example, hand movement, eye contact and facial expression, is very useful. Open questions were used which can create an atmosphere for more effective communication. Also, open questions are the best way to explore the experience of the interviewees (Brookers, 1982). Finally the researcher must control the interview time.

The purpose of the semi-structured interview in this research was to collect information about information systems (ISs) at the TTC and to take advantage of any information that the interviewee could provide. The information collected included data about current IS functions and activities, the existing use of ICT and barriers to its use, and suggestions about improving the use of ICT at the TTC. Thus, interviews were conducted with the Dean and Deputies Dean (3 interviews), Heads of Department (4 interviews), and Supervisors (3 interviews) to establish the situation with regard to the current use of IS at the TTC (see Table 2.1).

	Interviewees	**Hours**
1	Dean	2
2	Deputy Dean for Administrative and Financial Affairs (DAFA)	2
3	Deputy Dean for Student Affairs (DSA)	2
4	Head of Holy Quran and Islamic Studies Department	2
5	Head of Children Care Department	2
6	Head of Arabic Language and Social Science Department	2
7	Head of Home Economics and Art Department	2
8	Supervisor of Student Affairs	2
9	Supervisor of Staff and Financial Affairs	2
10	Supervisor of ICT	2

Table 2.1 Interviewees

The interview questions of this research contain four main parts (see Appendix 1) and include the following content in each part.

Part I: General Background about the department (TTC) includes: department's aims and currents function to achieve the aims; the activities to these functions, and the relation of these activities with other activities in TTC.

Part II Current Information System includes: the formal responsible for the records management at the department such as created, store, or disposal martial; the records management process in the department; and the start time of the current system.

Part III Current Problems facing the department (TTC) comprise: records and files management, Information communication Technologies (Hardware and Software), Information security, and information management.

Part IV: Suggestions for improving IS at TTC including centralising information provision and Help desk at TTC.

2.2.3. Questionnaires

Questionnaires are used to gather information directly by asking people questions and analysing the data collected. Questionnaires are often used to gather information about attitudes, behaviours, activities and responses to events; they usually consist of a list of written questions (Gina, 2001). The College of St. Scholastica (2003) states that the advantages of administering a questionnaire are: it can be used to collect data from a large number of people in a relatively short period of time, it can be used to collect data from geographically dispersed groups and it can offer recipients a level of anonymity that allows them to be frank and honest about their opinions relating to information services and resources, and their own information use behaviour.

Brace (2004) notes that the questionnaire should conform to the following general rules:

- It should not be too long. The longer the questionnaire, the less likely people are to complete it;
- Confidentiality of responses (where necessary) should be ensured and communicated to the respondents; and,

- The use and purpose of the questionnaire should be explained to the respondents.

The questionnaire used in this research contains four main parts (see Appendix 2), as indicated below.

Part I: General Information which aims to collect basic data about the responds related to occupation, departments, academic qualification, have a Personal Computer (PC), learn to use the PC, and years of using PC.

Part II: Current Information System, the purposes of this part are to obtain the respondent's impressions about staff dealing, information process, time to process and exchange information between departments, computer lab(s), operational IT skills, training courses at TTC, and comments in current information system.

Part III: Current Information Technology (IT) Skills, this part aims to investigate the respondent's IT skills in using software packages includes Word Processing, Spreadsheets (Excel), Presentation (Powerpoint), and Databases (Access). Further in depth use of IT will also be investigated including use of E-mail, search engines, and searching databases. Respondents also have the opportunity to comment on how they think they can improve their own IT skills.

Part IV: The purpose of this part is to obtain information about the respondents' opinions on wider issues of adopting IT system within TTC. For example, how the efficient of TTC is affected by the staff knowledge of English language.

2.2.3.1 Population and sample

The population refer to the total set of factors that the researcher aims to investigate or examine within a specific time in a particular setting (Frankfort-Nachmias, 1996). It is important for the researcher to identify the target population, taking into account the aims and objectives of the research. The researcher should locate a list of target population and select the correct sample. A sample can be defined as a subset of elements from the population selected according to sample design, which specifies the rule and operations by which the sample is to be chosen from population (Pedhazur and Schmelkin,1991). The main reasons for using sampling are that to access all elements of the population is too expensive in terms of financial and time resources.

Generally, there are two processes to obtain a sample. The first process is non-probability (non- random) sampling which can be described as a rational approach that typically gives the researcher no clear indication of who will be selected and excluded. In this method subjective judgment is used to choose elements that seemed more suitable for the research or easier to reach than others. The major form of the non-probability sampling are quota sampling, multi-purpose sampling, network or snowball sampling, outcropping sampling, and advertising sampling (Black 1999). The second process is probability (random) sampling which gives each member of the target population an identical probability to be selected in the sample. In other words, every element in the target population has a chance of being selected which is known in advance. Normally this is an equal chance of being selected. According to Bryman (2004) there are several types of probability (random) sampling as included below.

1) Simple random sampling

This type of sampling is the most basic form of probability that every element of the population has an equal and known chance of being selected (equality). Furthermore, the selection of one element is not affected by the selection of previous elements (independence).

2) Systematic random sampling

In this method the first sample element is selected from the list by a random number and subsequent elements are selected according to a fixed sampling interval. The interval is calculated by dividing the total number of population by the required sample size. The random starting number must lie within the sampling interval.

3) Stratified random sampling

The process of this method is to divide the population to be sampled into distinct groups or strata and selecting a separate sample from each stratum. A stratum is a subset of the population that shares at least one common characteristics (male and females, student and staff for example). The research first identifies the relevant stratum and their actual representation in the population. Random sampling is then used to select a sufficient number of elements from each stratum.

4) Cluster random sampling

This method allows the researcher to divide the target population into clusters (usually counties, census tracts, or other boundaries). Random sampling is then used to select a sufficient number of elements from each clusters .

2.2.3.2 Sample Selection and Questionnaires Distribution

One of the aims of this research is to develop a novel methodology to accommodate human, technical and social aspects and apply this methodology to develop IS at TTC in Makkah Al-Mukkaramah, Saudi Arabia. The scope of the novel methodology, which is made up of stages from published work (see chapter 5) is such that it becomes fit for purpose. Thus the target population of this research is limited to all academic staff, operational staff, and students at TTC. The main reasons for the selection of this target population is that their views about the current information system and their expectation from the new system is important to the success and running of the new IS.

A stratified random sampling method was selected to ensure that the resulting sampling will be distributed in the same way as the population in terms of the stratifying criterion. Moreover, stratified random sampling is feasible because the data of TTC are available which allow the researcher to identify the members of the population in terms of the stratifying criterion.

In order to apply stratified random sampling, the researcher divided the target population (academic staff, operation staff and students) under investigation into seven main groups:

Group (1) Department of Holy Quran and Islamic Studies

Group (2) Department of Arabic Language and Social Science

Group (3) Department of Science and Math

Group (4) Department of Home Economics and Art

Group (5) Department of Children Care

Group (6) Department of Education and Physiology

Group (7) Management Affairs

Table 2.2 shows the make up of the population at TTC: total academic staff (153), operation staff (44), and students (2284). The total population of this research was 2481. To demonstrate the stratified sampling method used, 620 members of TTC in three main categories represented the total population of 2481. Thus, 25% (620/2481) of the population were used in the sample comprising 90 academic staff, 30 operational staff, and 500 students.

Elements of Population	Population	Sample	Percentages
Academic	153	90	59%
Operation	44	30	68%
Student	2284	500	22%
Total	2481	620	100%

Table 2.2 Elements of population and simple size

Table 2.2 also shows that the highest percentage of sampling was operational staff (68%), followed by academic staff (59%), while student was the lowest percentage (22%). The main reasons for the distribution is that both academic and operational staff have more understanding about the current system, considering the requirement of the new system, and they are more available than students.

2.2.4 Focus Groups Interviews

Denscombe (2003) defines a focus group interview as a free-flowing interview with a small group of people; it is named as such because the discussions start out broadly and gradually narrow down to the focus of the topic discussed. Focus group methods can be used to explore people's opinions, attitudes, beliefs, values, discourses and understanding of things as valid in their own right (Brewerton & Millward, 2001). The group consists of an interviewer (known as a moderator) and six to eight participants. The moderator introduces the topic and encourages the group members to discuss it. Focus groups allow members to express themselves in their own words as they discuss issues of common interest with the other group members under the guidance of the moderator. Group members should be selected because of their experience and knowledge about a certain subject, or due to their ability to represent the views of some interest group (Henczel, 2001).

Young (1993), and Krueger and Casey (2000) summarise a number of advantages of focus groups as follows: firstly, focus group is a socially oriented research procedure. People are social creatures who interact with others. Focus groups can elicit contributions from interviewees who might otherwise be reluctant to contribute. Also, focus groups can lead to insights that might not otherwise have come to light through the one-to-one conventional interview. Secondly, a focus group is a more flexible way to explore unanticipated issues not possible using more structured questioning. Thirdly, the entire focus group process usually takes less time than a written survey. The main disadvantages of this method, according to Kueger (1998) are that the researcher has less control in the group interview as compared to the individual interview. The focus group allows the participants to influence and interact with each other and as a result, group member are able to influence of the course of the discussion. This sharing of group control results in some inefficiency such as detours in the discussion, and the raising of irrelevant issues, thus requiring the interviewer to keep the dissection focused.

Henczel (2001) provides an example for conducting a focus group. This includes: welcoming the participants and introducing everyone; reviewing the agenda and explaining the agenda items; clearly stating the purpose of the meeting and its objectives; explaining how the meeting will be conducted and the rules of discussion; listing the questions that will be asked so that group members have an opportunity to consider their responses; ending with a summary of the meeting. The data and information collected in a focus group are either in the form of a written report (undertaken by the moderator), a tape recording, or video-based materials.

The aim of conducting focus groups in this research is to gather more in-depth qualitative data in order to clarify and add meaning to the interviews and observations. Moreover, the researcher used focus group to explore people's opinions, attitudes, beliefs, values, discourses and understanding of things as valid in their own right. The questions of the focus group were grouped into four parts. These parts are:

Part I: Formal information process at TTC.

Part II: Department needs include training courses, ICT equipment, motivation, increase number of staff, and storage space.

Part III: Existing problems related to exchange information between departments; time to process information; use ICT in the class room; index, store and retrieve information, and so on.

Part IV: Suggestions and opinion to improve the problem situation (see Appendix 3).

Thus, five focus groups were carried out. These are:

(1) Academic staff at Department of Arabic Language and Social Science.
(2) Academic staff at Department of Science and Math.
(3) Academic staff at Department of Home Economics and Art.
(4) Operational staff at Student Affairs.
(5) Operational staff at Dean Office.

each focus group comprises six to eight participants and the time taken ranged from two to three hours. The procedures to conduct the focus group are as follows: (1) arrange an appointment and room with the head of the department. (2) Select the participants with similar background. (3) In the meeting, the researcher makes a small presentation about the aim and objectives of the research. (4) The researcher introduces the purpose of the meeting. (5) She asks questions and controls the participants interactions. (6) The researcher listens carefully to the participants oral contributes and takes appropriate notes. (7) She summarises the discussion and confirms the information collected. (8) Finally, the researcher thanks all participants for their cooperation.

2.2.5 Observations

Observation is one of the primary methods of data collection to observe, describe and understand the social world, as subjects would see it. One reason for using observation is to gain information about existing information systems and their environment that is unavailable through any other methods. Observing also helps to confirm or negate and reverse what has been found through interviewing, questionnaires and other methods. Thus, it is of crucial importance that the researcher knows *what* is being observed. Great care and thought must go into what the observation study will cover, as well as when, where, why and how (Kendall & Kendall, 1999). According to Powell (1997) the major advantages of using an observation technique include that it is possible to record behaviour as it occurs; it allows comparisons to be made between what people actually did and what they said they did; it also allows the researcher to study people who are unable to give oral reports. In contrast, Gorman and Clayton (1997) outline that the main disadvantages of this method are that people who are aware of being observed tend to change their behaviour and the method can be very time-consuming.

There are two approaches to observation which are unobtrusive observation (non-participant observation) and obtrusive observation (participant observation). Unobtrusive observation allows the researcher to examine the community without his/her presence influencing the behavior of those being observed; in other words, the aim is to watch what is going on without taking any part in the activities. According to Brewerton and Millward (2001) the main advantages of this type of observation are the researcher not involves in social work and because of the undisruptive nature of this research technique, people do not react to the observer. On the other hand the main disadvantage of this method is that the researcher must be quite watchful and understand the process being completed, as there is no opportunity to ask or clarify content and contest.

In obtrusive observation (participant observation), the researcher becomes as much as possible a participating member in the daily life of the people under study. This method allows the observer to see everything, warts and all (Denscombe, 2003). The major advantages of this technique are that the researcher can describe the setting that was observed, the activities that took place in that setting, and the meaning of what was observed from the perspectives of those observed. As well, the researcher has an opportunity to interact with people in their work that dose not happen with the unobtrusive method. In other words the researcher generates a rich source of high quality data and therefore can gain a deeper understanding of the phenomenon. As well as it gives a chance to learn things that people would be unwilling to talk about in an interview (Patton, 2000). The limitation of obtrusive observation is that it requires a great deal of skill and commitment from the researcher. In addition, it is sometimes unwelcome by the people being observed, as they often feel disturbed and that the researcher is invading their privacy.

Departments	Number of hours daily	Number of days	Total hours
Holy Quran and Islamic Studies	2	3	6
Arabic Language and Social Science	2	3	6
Science and Math	2	3	6
Home Economics and Art	2	3	6
Children Care	2	3	6
Education and Physiology	2	3	6
operation staff office of Deputy DAFA	3	4	12
operation staff office of Deputy DSA	3	4	12
operation staff office at the Dean	3	4	12
Computer Centre	1	1	1
Total		31	73

Table 2.3 Total number of hours spending to observe the TTC departments

Therefore obtrusive observation was adopted in this research to watch, listen, note, describe, analyse and explore current processes and use of information systems. Also, this method gave a holistic overview and understanding of current systems and processes of information management in every department. Several elements can be observed, including physical surrounding (office locations, number of rooms, tables, and cupboards), characteristics of participants, available information technology equipment, information resources (both manual and electronic), and information processing (internal or external) (see Appendix 4). The researcher was carrying out the obtrusive observation in order to observe the process of IS within the TTC. Table 2.3 shows the total number of hours spending to observe the TTC departments.

2.2.6 Pilot Study

Pilot studies can be based on quantitative and qualitative methods before the main survey is conducted. Peat *et al.* (2002) define 'pilot study' as a smaller version of a study carried out before the actual investigation is done. They added, researchers use information gathered in pilot studies to refine or modify the research methods for study to develop the large scale study. Whereas, Pedhazur *et al.* (1991) outline it is vital to test questionnaires in order to ensure the questionnaire's reliability and validity. The reliability scale is usually measured by a statistic known as 'coefficient alpha'. This is a measure of the variance in the test, sometimes referred to as the 'equivalence', or internal consistency, of the test. A test is said to be reliable if there is little variance that is specific to certain items (Giles, 2002). Whereas, validity defined as the degree to which an instrument actually represents what it purports to represent, is a multidimensional one, comprising different forms of validity and, thus, different form of assessment (Brewerton and Millward, 2001).

Furthermore, Bourque *et al.* (1995) point out that a pilot study undertaken before carrying out the main survey provides the researcher with an opportunity to find out the following: (1) are all questions understandable?; (2) are all instructions clear?; (3) is the order of the questions suitable?; (4) are the objectives of the study clearly understood by both surveyors and respondents?; (5) have costs been precisely projected?.

For the purpose of this research, the questionnaires, interviews, and focus groups questions were translated from English to Arabic. The pilot study was carried out by sending 70 questionnaires, 6 interviews, and 6 focus groups questions to the TTC in Saudi Arabia. The questionnaires were distributed to the members of academic staff, operational staff, and students, whereas the interview and focus group questions were distributed to the academic staff and operational staff. Respondents were requested to make suggestions and comments for possible refinements and accuracy of the instruments which could be considered before the full-scale survey was attempted. This process was accomplished while the researcher was in the United Kingdom (UK). In all, 57 questionnaires were returned and all suggestions and comments were considered. The respondents identified that all questions were unambiguous and thus there was no need to modify these questions. Moreover, the reliability measure was conducted on the questionnaire to provide an indication of the level of consistency across the scale items. The result showed that $\alpha = 0.73$. Gill (2002) pointed out that an alpha value between 0.7 and 0.8 was often accepted as indicating a reliable test.

2.3 Secondary Data Sources

There are many secondary data sources available that can be used in this type of study, including journals, books, electronic sources, dissertations and conferences.

2.3.1 Journals

A number of journal were used as secondary data sources for the present research including:

Industrial Management & Data Systems published nine times a year by Emerald Group Publishing Limited.

Information & Management published eight times a year by Elsevier Science.

Information Development published quarterly in March, June, September and December by Bowker-Saur.

Information Processing & Management published six times a year by Elsevier Science.

Information Sciences published monthly by Elsevier Science.

Information Systems Journal (ISJ) published quarterly by Blackwell Synergy.

Information Technology & People published four times a year by Emerald Group Publishing Limited.

International Journal of Information Management published six times a year by Elsevier Science.

Journal of Computer and System Sciences published four times a year by the Academic Press.

Journal of Information Science published six times a year by Bowker-Saur.

Journal of Librarianship and Information Science published four times a year by Bowker-Saur.

Library &Information Science Research published four times a year by Elsevier Science.

Management Science published monthly by INFORMS.

Managing Information published ten times a year by Aslib.

Records Management Journal published three times a year, in April, August and December by Aslib.

The IBM Journal of Research and Development published by IBM Corp.

The Information Management Journal published by ARMA International.

The Information Society (TIS), an international journal published four times a year by Taylor & Francis.

2.3.2 E-sources

There are a huge number of articles and documents that have been written in electronic format and available on the Internet. The researcher looked at these resources to evaluate carefully the information held, the author, publisher and the date of publishing before using the information. The most important electronic sources were the Search engines (such as Google, Northern Light, Alta Vista), Social Sciences Information Gateway (SOSIG), BUBL LINK (is a catalogue of selected Internet resources covering all academic subject areas), Electronic Journals (Science Direct, Ingenta Journals, and Emerald Group Publishing Limited), and Aslib (The Association for Information Management).

There were number of steps were used to search these electronic resources included: (1) setting up the number of terms or keywords related to the subject of the research and producing a concept map include synonyms, broader or narrower terms, acronyms and technical terms; (2) identifying the appropriate electronic sources which produce the best results; (3) searching for terms or keywords or concepts individually; (4) using OR to expand the search or AND to narrow the search; (5) displaying the results to determine relevancy; (6) modifying the search by adding additional or new terms; and (7) printing or saving/downloading the relevant results.

2.3.3 Dissertations

The researcher used a number of previous dissertations related to this research in using or develop methodology or multi-methodology ETHICS, SSM, and VSM. The major sources for dissertations are Loughborough University theses, and Index to Theses. The terms or keywords that were used to search dissertation sources were information system, information communication technology, higher education in Saudi Arabia, multi-methodology, ETHICS, SSM, and VSM.

2.3.4 Books

Loughborough University Catalogue (OPAC) and COPAC were used to search for books relevant to the subject of this research. The terms or keywords that were used to search these source were systems theory, information systems, information communication technologies, management, methodology and multi-methodology, system thinking, system approaches, research methods, socio-technical systems, SSM, ETHICS, VSM, and users of information systems.

2.4 Research Process

Figure 2.1 shows the research process used, to achieve the research aims and objectives.

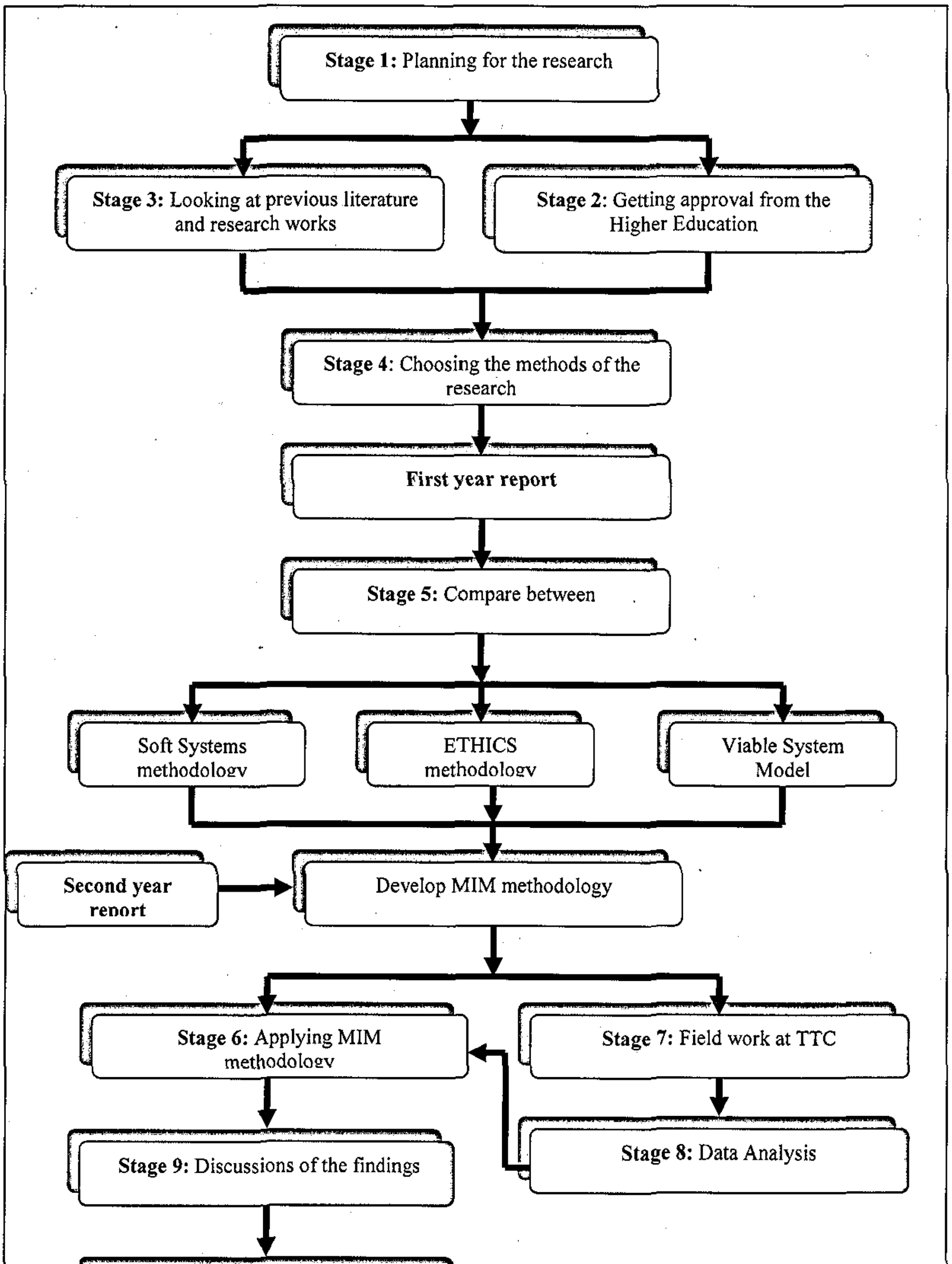


Figure 2.1: The research process .

Stage 1: Planning for the research

- Developing clear aims and objectives of the research with the research supervisor.
- Writing the proposal to include: general background, aims and objectives, and methods.
- Obtaining approval from the supervisor of the research.

Stage 2: Obtaining approval from the Higher Education Department in Saudi Arabia (top management)

The proposal was translated into Arabic and sent to the Higher Education Department in Saudi Arabia to seek acceptance from them. The aim of getting approval from the Department was to:

- Obtain financial and emotional support;
- Gain access to and carry out the survey at the TTC;
- Minimise resistance from academic and operational staff to disclosing the information they possessed.

Stage 3: Looking at previous literature and research works

- Writing a clear timetable (work plan) about the research activities and the time needed to achieve these.
- Reading a variety of literature sources (books, journals, academic papers, theses, and E-sources) which are related to the research area.
- Writing the literature review which includes the key elements of the research.

Stage 4: Choosing the methods of the research

Data collection

- Primary sources (document analysis, interviews, questionnaires, focus groups and observation)
- Secondary sources (journals, E-resources, theses, books)
- Designing interview questions
- Designing the questionnaire
- Designing focus group questions

First year report

- Chapter 1: Introduction and background
- Chapter 2: The research methods
- Chapter 3: Literature review
- Workplan

Stage 5: SSM, ETHICS, and VSM

- Definition, steps, features and weaknesses of SSM, ETHICS methodology, and VSM
- Comparing and contrasting the SSM, ETHICS, and VSM
- Establishing the multi-methodology

Second year report

- Chapter 1: Introduction and Background
- Chapter 2: Research Methods
- Chapter 3: Literature Review
- Chapter 4: SSM, ETHICS, VSM, and MIM Methodologies

Stage 6: Apply MIM methodology

Stage 7: Fieldwork at TTC

Planning for the fieldwork:

- Asking the Dean of the TTC to appoint a coordinator in each department. The purposes of appointing the coordinator were:
    - to allow overall processing of the existing IS;
    - to help the researcher during the distribution and collection of the questionnaires; and
    - to allow the researcher to carry out any observations necessary during her work.
- Carrying out interviews with the Dean, Deputies Dean, Heads of Department, and operational staff by using semi-structured interviews (see Appendix 1).

- Distributing questionnaires to the staff and students at the TTC (see Appendix 2).
- Carrying out focus group interviews with department staff.
- Carrying out obtrusive observation (2-3 hours daily for one week in each department). The observations focused on:
    - Processing and users' problems in using ICT
    - Carrying out a physical examination of the information held in the department
    - Examining the environment and space used for storing the information
    - Observing the security of information.

Stage 8: Data Analysis

- The researcher carried out an analysis of the data collected from the interviews, focus groups, observations and documents.
- The researcher used SPSS software to complete a statistical analysis, and Excel software to draw diagrams showing the results of that analysis.
- The researcher used frequencies for all responses and cross tabulation between the variables in the questionnaire.

Stage 9: Discussion of the findings

Threads used in the logical development of argument in this thesis were identified and discussed in relation to the primary findings obtained.

Stage 10: Conclusions and recommendations

Appropriate conclusions are made that link back to this study's objective. Recommendations are made to senior management.

Chapter 3

Literature Review

3.1 Introduction

This chapter reviews literature that is relevant to the research objectives. It has been divided into four parts: the first part is system theory which includes System Ontology and System Epistemology, Hard and Soft Systems, Simple and Complex Systems, Closed and Open Systems, Socio-technical Systems; and the Systems of Systems Methodologies (SOSM). The second part, Systems Practice, includes Information Systems (IS), Information and Communication Technologies (ICTs), and Information Management (IM). The third part of this chapter considers methodology and multi-methodology. The final part demonstrates the previous studies in this area.

3.2 Systems Theory

Ackoff (1981) defines a system as a set of two or more elements that satisfies the following three conditions: (1) The behaviour of each element has an effect on the behaviour of the whole, (2) The behaviour of the elements and their effects on the whole are interdependent. In other words, no element or subsystem has an independent effect on the system as a whole, and (3) however the subgroups of the elements or subsystems are formed, all have an effect on the behaviour of the whole but none has an independent effect on it. Hitchins (1992), on the other hand, defines a system from both a pragmatic and scientific point of view as a collection of interrelated entities such as, for example, that collection and interrelationships together reduce local entropy. In more detail, Checkland (1993) declares that a system has the following properties: boundaries, input and output, components, structures, the ways of retaining its integrity, and the coherency principle which makes it defensible to describe the system as a system. At the end of his discussion, the systems leads to a new of thinking about the world (i.e. systems thinking) based on which Soft Systems Methodology (SSM) was developed. In line with this Andrew and Petkov (2003) depict a typical system with its necessary components (see Figure 3.1). They represent the system depicted in Figure 3.1 is an open system in that it permits inputs from and output to its environment. The relationships in the systems are characterised by feedback loops where the behaviour of one element may feedback either directly or through (an)other element/s to influence the element that initiated the behaviour.

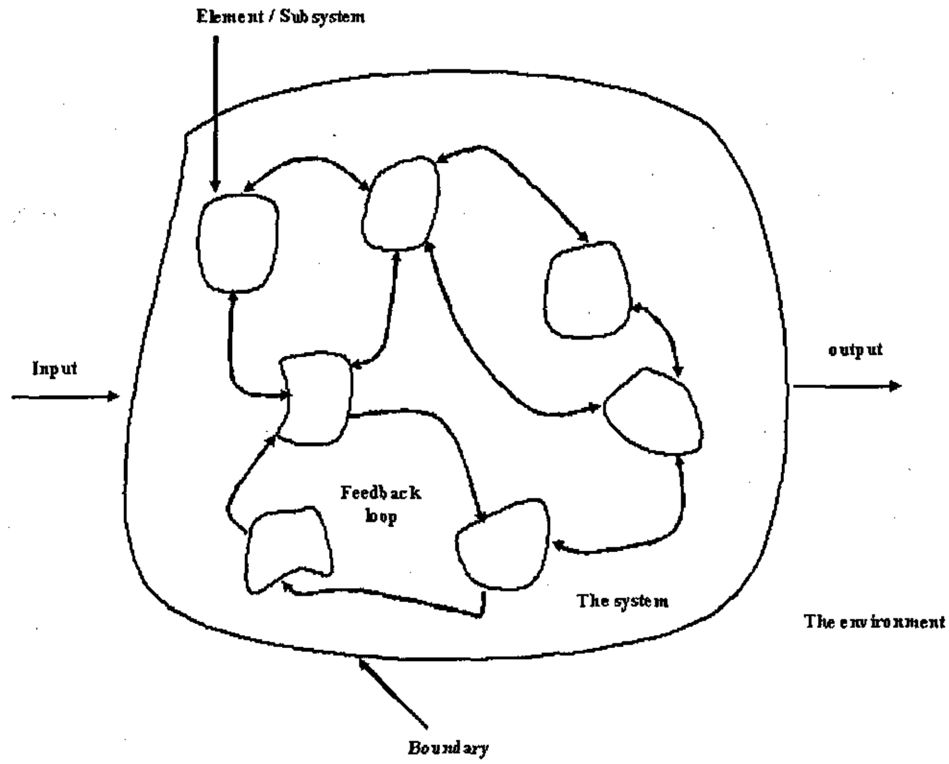


Figure 3.1 General system (adapted from Andrew and Petkov 2003)

Flint (1997) states that systems theory comes from the biology-based General Systems Theory posited by Ludwig von Bertalanffy (1968). (Bertalanffy began formulating Systems Theory in the early 1920s but did not publish his ideas until the 1950s.) Jackson (2000) notes that Bertalanffy derived his own insights from biology but they could also be transferred to other disciplines because the principles at work were not specific to biology. They were instead general system principles that could be applied to complex systems of all types, whether they were of a physical, biological or social nature (Jackson, 2000). The Association for Educational Communications and Technology (AECT) Council on Systemic Change (2003) stated that system theory enabled development of new methods for tackling complex real-world problems that spanned different disciplines. It also provided individuals with a broader view of how complex systems work.

Bertalanffy (1968) and Begley (1999) point out the purposes and aims of general systems theory as a general tendency towards integration in the various sciences, both natural and social. Such integration seems to be centred in a general theory of systems and may be an important means for aiming at exact theory in non-physical fields of science. Developing unifying principles running "vertically" through the universe of the individual sciences, this theory can become nearer to the goal of the unity of science and can lead to much-needed integration in scientific education.

3.2.1 System Ontology and System Epistemology

Solem (2003) states that ontology is etymologically derived from two Greek words: "ontos," meaning being and "logos," meaning word and indicating "logical consideration of or study of." Ontology refers to the philosophical study of being. It is concerned with and focuses on the nature of reality or the nature of knowledge (Guba, 1990). Therefore ontology can be said to refer to our picture of how the real world looks, or our perspective or view of the world. Solem (2003) points out that, when generally approaching a scientific problem, we use our worldview as a starting point for our study. In this way our worldview has implications for the methods chosen to be used in the study. These methods are used to acquire knowledge, so this is a question related to the concept of epistemology. Ontology, as a result, comes before epistemology (Solem, 2003).

Scholten and Beulens (2002) state that the main reasons for the use of ontology are:

- For communication between people, between people and computer systems, or between independent computer systems;
- To enable reuse of domain knowledge;
- To make domain assumptions explicit;
- To separate domain knowledge from operational knowledge;
- To analyze domain knowledge.

Epistemology is a philosophical term etymologically derived from three Greek words: "epi," meaning upon or on; "histemi," meaning to stand; and "logos," meaning word and indicating "logical considerations of or study on." Epistemology therefore deals with the groundwork of knowledge, i.e., with how we understand reality and communicate this to other people. The epistemological issue concerns the foundations of a scientific discipline and refers, as expressed above, to "How do we know?" and not to "What do we know?" Epistemology generally consists, therefore, of reasoning processes, guarantees of truth, proofs, axioms of validity, or any other logic underlying a methodology. Epistemology is also referred to as the theory of knowledge (Solem, 2003).

However, Yndestad (1998) indicates that a system has an ontological view and an epistemological view. These views may be formulated as:

System = System ontology + System epistemology

System ontology is the theory of the existence of the system organization. The ontology perspective represents a deterministic external view of systems as a materialistic organization.

System ontology = System architecture + System dynamics.

System epistemology is the theory of knowledge in system organization. The epistemology view represents a non-deterministic view of system as an abstract organization.

System epistemology = System ethics + System learning.

Mingers (2003) states that different method(ology) including different approach to modelling all makes implicit or explicit philosophical assumptions about: ontology, epistemology, and axiology. He defines these philosophical assumption as a follow:
Ontology: that is what types of entities are taken to have existence. This is exemplified by what kinds of things the method will build models of.

Epistemology: that is the forms of knowledge and knowledge creation the method uses. This is realised in terms of where the model comes from and the form in which it is represented.

Axiology: that is what is valued or considered good. This is manifest in what the purposes or uses of the model are, and who (analyst, facilitator, participant) develops and uses the model.

From the discussion above, a system has an ontology, epistemology, and axiology. Ontology is related to the nature of reality, while epistemology is related to the basis of knowledge, and axiology is related to purpose. Therefore, it is important for the researcher to understand the ontology, epistemology, and axiology for SSM, ETHICS, and VSM to annotative the ontology, epistemology, and axiology for a new multi-methodology.

3.2.2 Hard and Soft Systems

Hard systems have been developed from technology and manufacturing and assume that any process can be broken down into a number of units to be defined and adjusted (Johns *et al.* 1994). In general, a hard system can be used to maximise efficiency by looking for technical solutions to optimize the system. When a new system is designed, the outputs and measures of efficiency are compared with the old system (see Figure 3.2). Jackson (2000) indicates that hard systems are concerned with how we should achieve known goals with prediction and control, and with optimization. Hard systems include Systems Engineering, Systems Analysis, and Operational Research. Jackson (2000) adds that all these systems share the basic orientation identified by Checkland (1978) as "the assumption that the problem task they tackle is to select an efficient means of achieving a known and defined end."

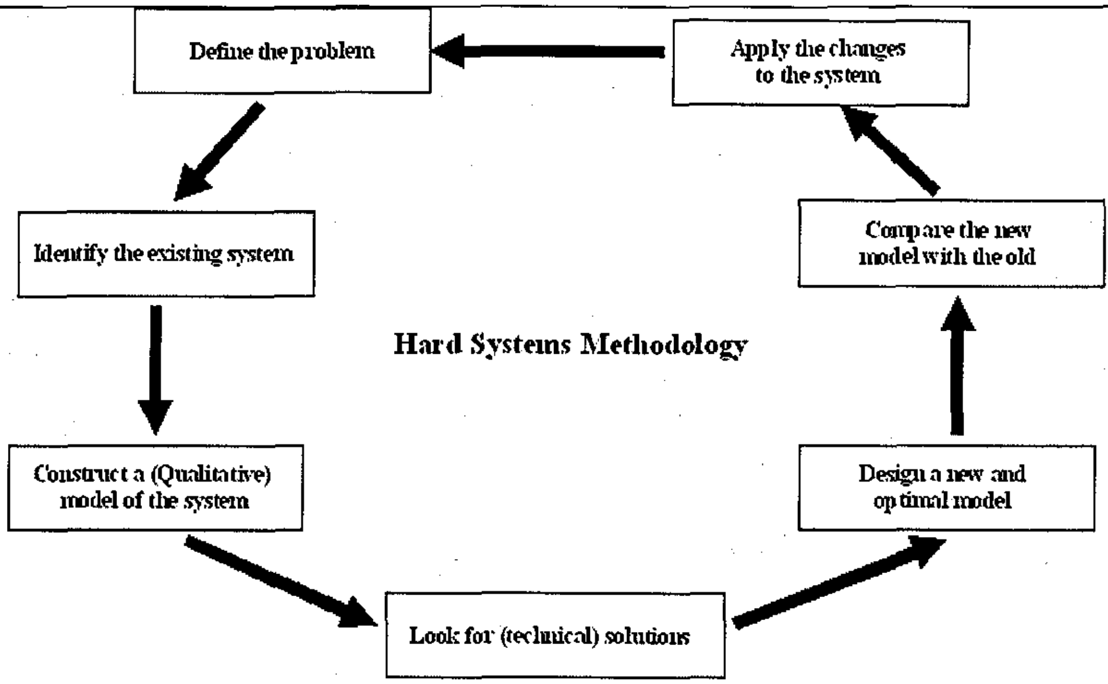


Figure 3.2 Hard systems methodology (adapted from Wilson and Morren, 1990)

Daellenbach (2001) notes that hard systems are based on the following assumptions about the problem situation:

- The problem has been clearly defined, the objectives of the decision maker(s) are known and there exist criteria to ascertain when they have been achieved; the alternative courses of action are specified, either as a list of options or sets of decision variables; the constraints on the decision choices are known; and all input data needed are available;
- The problem is relatively well structured, meaning that the relationships between the variables are tractable; they can be expressed in quantitative form; and the computational effort for determining the optimal solution is economically feasible;
- The problem can be sufficiently well insulated from its wider system of interest;
- The problem is of a technical nature, largely devoid of human aspects; and
- The decision maker can enforce implementation of the solution.

Soft systems or Human activity systems are collections of people undertaking activities to achieve some purpose. Human activity systems are soft because:

- The boundaries or scope of the human activity system may be fluid;
- The purpose of the system may be problematic and certainly open to interpretation; and,
- It may be difficult precisely to define exact measures of performance for the human activity system.

In line with this, Checkland (1981), Checkland and Scholes (1990), and Jackson (2000) indicate that Soft systems focus on problem situations which are complex, messy, ill-structured and ill-defined in terms of their human components and relationships, and which are not independent of the people involved or, in other words, where different stakeholders with different worldviews have different and possibly conflicting perceptions about the problem situation and its major issues; where there may be no agreement about the appropriate objectives, or even the set of possible actions. Figure 3.3 outlines the phases of Soft System methodology. However, Daellenbach (2001) points out that soft systems can be characterised by:

- Structuring the problem situation, rather than by problem solving;
- Facilitating dialogue between the various stakeholders with the aim of achieving a greater degree of shared perceptions of the problem situation, rather than providing a decision aid to the decision maker;
- Asking 'What' questions, rather than 'How' questions, i.e., 'What is the nature of the issue? ; 'What are appropriate objectives? given the various worldviews of the stakeholders; 'What is the appropriate definition of the system for the issue considered? ; 'Which changes are systemically desirable and culturally feasible? and only then 'How are these changes best brought about?;
- Eliciting the resolution of the problem through debate and negotiation between the stakeholders, rather than from the analyst; and,
- Changing the role of the 'problem analyst' to that of facilitator and resource provider who relies on the technical expertise of the stakeholders.

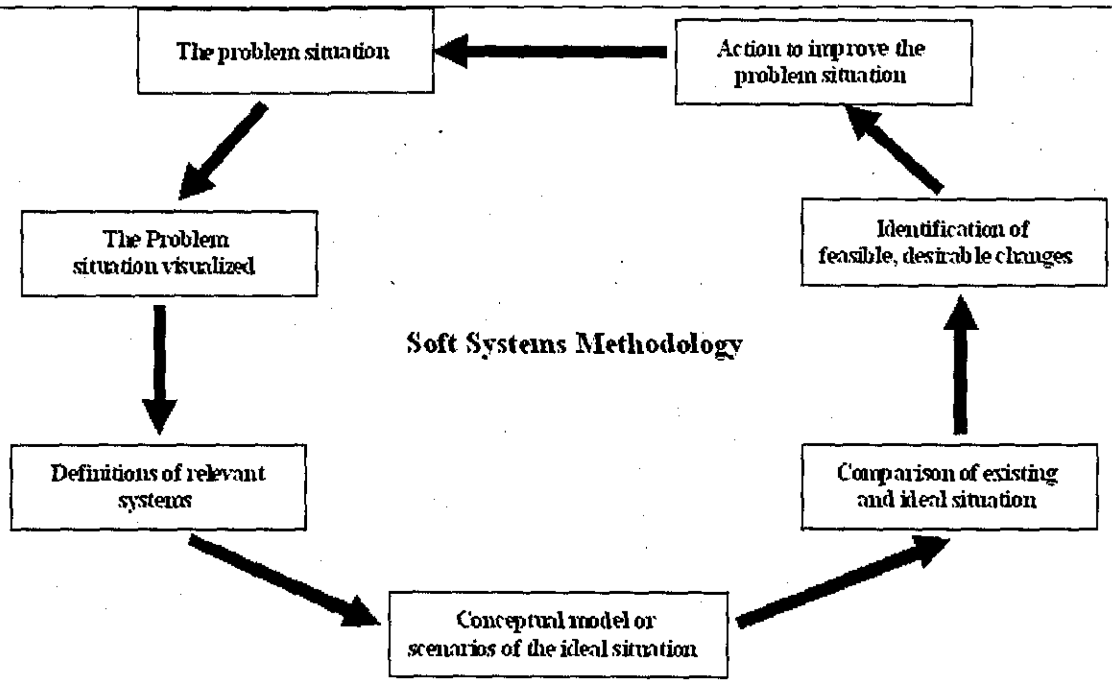


Figure 3.3 Soft systems methodology (adapted from Checkland and Scholes, 1990)

3.2.3 Simple and Complex Systems

Flood and Jackson (1991) elucidate the comparison between simple and complex systems.

Simple systems are characterized by:

- A small number of elements;
- Few interactions between the elements;
- Attributes of the elements are predetermined;
- Interaction between elements is highly organized;
- Well-defined laws govern behaviour;
- The system does not evolve over time;
- Subsystems do not pursue their own goals;
- The system is unaffected by behavioural influences; and,
- The system is largely closed to the environment.

Complex systems are characterized by:

- A large number of elements;
- Many interactions between the elements;

- Attributes of the elements are not predetermined;
- Interaction between elements is loosely organized;
- They are probabilistic in their behaviour;
- The system evolves over time;
- Subsystems are purposeful and generate their own goals; and,
- The system is largely open to the environment.

3.2.4 Closed and Open Systems

Systems can be either closed or open. A closed system has no exchange with its environment, while an open system exchanges matter and energy with its environment. Most physical systems are considered as a closed system whereas most biological and social systems are open. Bertalanffy (1968) defined an open system as a system in exchange of matter with its environment, presenting imports and exports, building-up and breaking-down its material components. Up to comparatively recent times, physical chemistry, in kinetics and thermodynamics, was restricted to closed systems; the theory of open systems is relatively new and leaves many problems unsolved (Bertalanffy, 1968). Skyttner (2001) considered that an open system (all living Systems) is always dependent upon an environment with which it can exchange matter, energy and information. Its main characteristic is its organisation, which is controlled by information and fuelled by some form of energy. Flint (1997) indicates that open systems consist of four things:

- Objects: parts or elements (sub-systems);
- Attributes: qualities or properties;
- Relationships: mutual effect and constraint; and,
- Environment: affected by surroundings.

However, Katz and Kahn (1966), Jackson (2000), and Skyttner (2001) indicate the common characteristics of an open system as follows:

- The importation of energy from the external environment;
- The throughput and transformation of the input in the system;
- The output which is exported to the environment;

- Systems as cycles of events: the output provides new sources of energy for the input so the cycle can start again;
- Negative entropy: open systems "live" off their environments, acquiring more energy than they spend;
- Information input, negative feedback and a coding process: systems selectively gather information about their own activities (so they can take corrective action);
- The steady state and dynamic homeostasis: despite continuous inflow and export of energy, the character of the system remains the same;
- Differentiation : open systems move in the direction of differentiation and structure elaboration (e.g. greater specialization of functions);
- Integration and co-ordination ensure unified functioning; and,
- Equifinality.

3.2.5 Socio-technical Systems

Strategos (2004) indicated that a technical system includes machinery, processes, procedures and a physical arrangement. We usually think of a factory in terms of its technical system. The social system includes people and their habitual attitudes, values, behavioural styles and relationships. It also includes the reward system. It is the formal power structure as depicted on organizational charts and the informal power structure deriving from knowledge and personal influence. Peter (2003) outlined the following features of a socio-technical system:

- The technical system and the social system are in multiple interaction;
- They interact to fulfill the purpose the system is built for, that is, they make the primary process of the system happen;
- They rely on support processes that make sure the primary process can take place;
- They are subject to a management process. This management process steers the system so it achieves its goals;
- They are linked by the formal and informal organisation of the system; and,
- They are directly interrelated through functions and roles (see Figure 3.4).

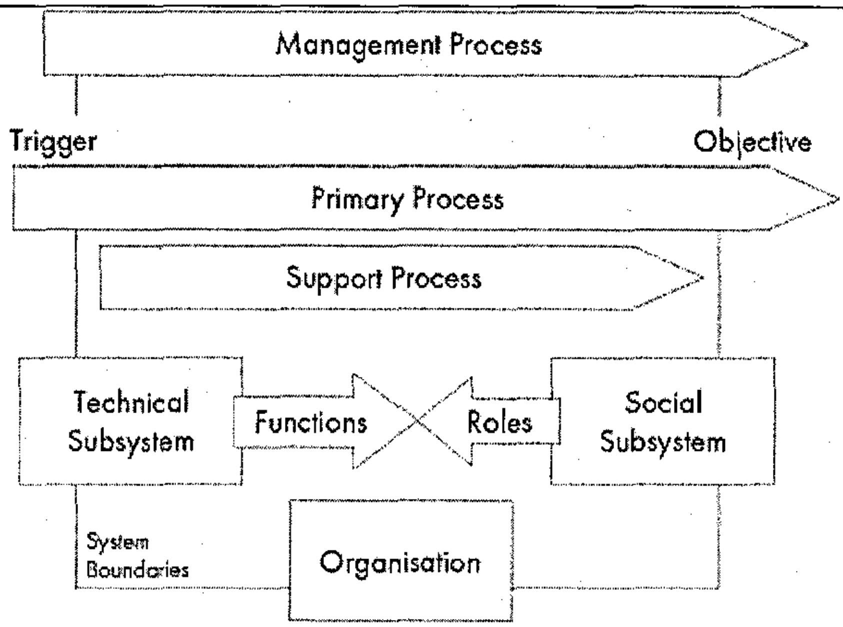


Figure 3.4 Socio-technical system (adapted from Peter, 2003)

Mumford (2003) states that the design of socio-technical systems was the product of a group of social scientists who came together at the end of the Second World War and formed the Tavistock Institute of Human Relations in London. Ropohl (1999) and Emery (2003) define socio-technical systems or (STS) as an approach to complex organisational work design that recognises the interaction between people and technology in the workplace. The aim of participative work design, and hence the socio-technical systems, are to improve job satisfaction, improve throughput, improve quality, and reduce employee problems such as grievance and absenteeism.

Computing Cases.org (2003) indicate that socio-technical systems can include: hardware (mainframes, workstations, peripherals, connecting networks); software (operating systems, utilities, application programs, specialized codes); physical surroundings (buildings also influence and embody social rules, and their design can affect the ways that a technology is used); people (individuals, groups, role support, training, management, line personnel, engineers, etc); procedures (both official and actual, management models, reporting relationships, documentation requirements, data flow, rules and norms); laws and regulations (laws might exist regarding the protection of privacy, or regulations about the testing of chips in military use); and data and data structures (what data are collected, how they are archived, to whom they are made available, and the formats in which they are stored); these are all decisions that go into the design of a socio-technical system.

The use of socio-technical design methods of analysis in many different work situations led the Tavistock group to develop a set of principles for good design. These are described by Albert Cherns (1976) and Clegg (2000). These are as follows:

- Compatibility: the process of design must be compatible with its objectives (so if the aim is to achieve a participative organisation, the design process must participative);
- Minimal critical specification: of the way in which the work is actually carried out and who should carry it out;
- The socio-technical criterion: variances from specifications are to be controlled as near to the point where they arise as is possible;
- The multifunction principle: to provide for flexibility and equifinality, each individual should be able to perform more than one function;
- Boundary location: control of activities in a department should become the responsibility of the members, with the supervisor concentrating on boundary activities;
- Information flow: information systems should be designed to provide information, in the first place, to the work teams who need it for task performance;
- Support congruence: systems of social support should reinforce the organizational structure;
- Design and human value: high-quality jobs based on the six design characteristics; and,
- Incompletion: design as an iterative process (once at the end, one must go back to the beginning again).

Clarke (2000) noted, in discussions on the applicability of socio-technical principles, that it is generally considered that these principles, and the methods of application associated with them, help organisations to explore conflicts and complexity in the human, organisational and technical aspects of change. They relate to how jointly to optimise people and technology within clear ethical principles: that the individual's participation in decision-making and control over his/her immediate work environment is enabled and increased. Socio-technical principles have been applied to organisational change for the following purposes (Clarke, 2000):

- The joint optimisation of technology and people to introduce improvement within the organisation;
- The improvement of the quality of products and services;
- The improvement of communications and the relationships amongst organisational stakeholders;
- Improvement in the organisation's sensitivity and responsiveness to change in complex environments;
- The enhancement of aspects of individual work such as performance levels, involvement, skill levels, job satisfaction and reward structures; and,
- The creation of a culture and structure which encourages continuous improvements in effectiveness.

3.2.6 The Systems of Systems Methodologies (SOSM)

The SOSM builds upon different ideological approaches in the systems community, as characterised by 'hard', 'soft', and 'critical' systems approaches. SOSM was proposed for the first time by Jackson and Keys (1984). The formative idea of the system of systems methodologies is that it is possible to construct an ideal-type grid of problem contexts that can be used to classify systems methodologies according to their assumptions about problem situations (Jackson, 2000).

Mingers and Gill (1997) and Jackson (2000) indicate that there are two dimensions, one defining the nature of the system(s) in which the problems of concern are located and the other the nature of relationship between the participants who have an interest in the problem situation and its improvement. Systems are classified on a continuum from "simple" to "complex" and participants as to whether they could be said to be in a "unitary", "pluralist" or "coercive" relationship to one another. A unitary relationship involves the perception of full agreement between participants on definitions of the problem situation; the pluralist is a perception of disagreement between participant; and the coercive is a perception of disagreement that is masked or is a potential disagreement that is not being allowed to surface due to power relationships between participants. Flood and Jackson (1991) implies the following: the simple-unitary cell contains Operations Research (OR), Systems Analysis (SA), Systems Engineering (SE), and Systems Dynamics (SD). The complex-unitary cell is said to contain Viable Systems Model (VSM), General Systems Theory (GST), Socio-Technical Systems Thinking (STS), and Contingency Theory (CT). Next, the simple-pluralist cell has Social System Design (SSD) and Strategic Assumptions Surfacing and Testing approaches (SAST). The pluralist-complex cell contains Interactive Planning (IP) and Soft Systems Methodology (SSM). Further, the simple-coercive cell has only Critical Systems Heuristics (CSH), while the last cell, the complex-coercive, is said not to have any approach since there are no known methodologies that can support such problem situations. For an overview of this description, see Table 3.1.Thus, System of Systems Methodologies is meant to enable potential users to assess the strengths and weaknesses of different methodologies for their own purposes.

		Participants		
		Unitary	*Pluralist*	*Coercive*
Systems	*Simple*	OR, SA, SE, SD	SSD, SAST	CSH
	Complex	VSM, GST, STS, CT	IP, SSM	---

Table 3.1 The SOSM (adapted from Flood and Jackson 1991)

Jackson (2000) indicates that there are some weaknesses of SOSM. One is that the pluralism embraced by the SOSM is implicitly limited to different interventions. Another weakness is the lack of distinction maintained between "methodology" (relating to the overall theory of method use) and "methods" or "techniques".

3.3 Systems Practices

3.3.1 Information System (IS)

3.3.1.1 Data to Knowledge

Data are defined as raw facts or elementary descriptions of things, events, activities and transactions, that are captured, recorded, stored and classified, but not organized to convey any specific meaning (Hoffer, 1999; Turban, 2001). In contrast, Gupta (2000) defines data as text, numbers, graphics, audio, video, images, or any combination of these, while information is data that have been processed and presented in a form suitable for human interpretation, often with the purpose of revealing trends or patterns (Hoffer, 1999; Gupta, 2000). In addition, Longman (2003) defines knowledge as the information, skills and understanding that has been gained through learning or experience. In line with this, Turban (2000) adds that knowledge consists of information that has been organized and processed to convey understanding, experiences, accumulated learning and expertise as it applies to a current business problem or process. Spiegler (2003) indicates the relationship between data, information and knowledge (Figure 3.5).

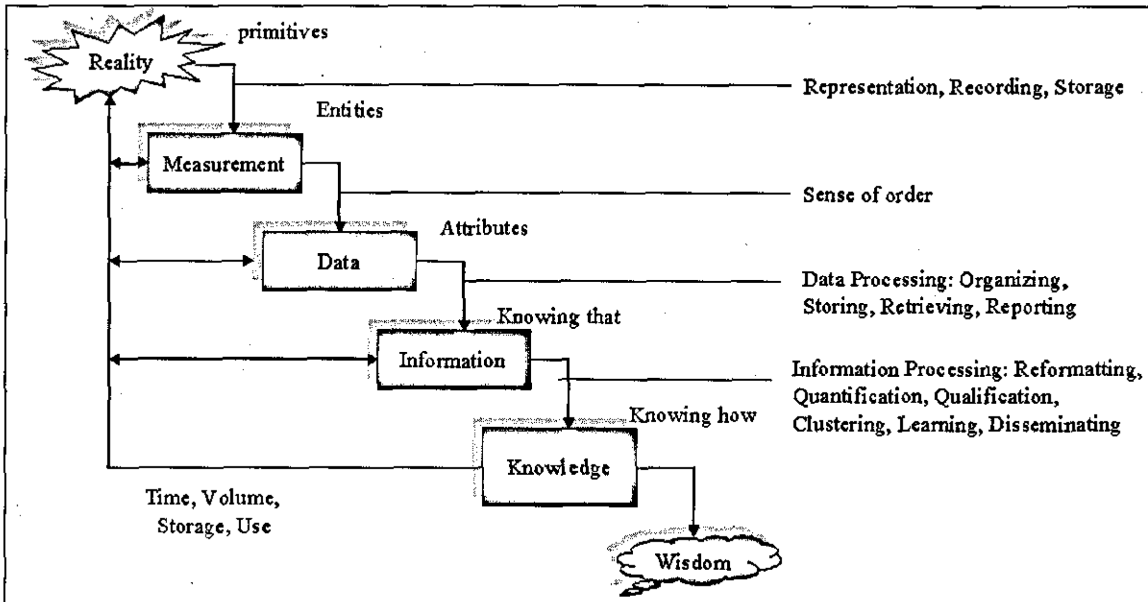


Figure 3.5 Reality, Measurement, Data, Information, Knowledge, and Wisdom (adapted from Spiegler, 2003)

However, Henczel (2000) illustrates the 'data to information to knowledge' process that occurs in every organisation (Figure 3.6). Moving from left to right, data are used to enable and support the tasks and activities of an organisation's business units, sections or departments. The data can originate inside the organisation or be acquired from external sources. As a task or activity is performed the data are transformed into information which is then filtered, further transformed, reused, stored or transferred. The process of creating information, the data to information transfer process, is a knowledge-creating process that creates both *explicit* and *tacit* knowledge.

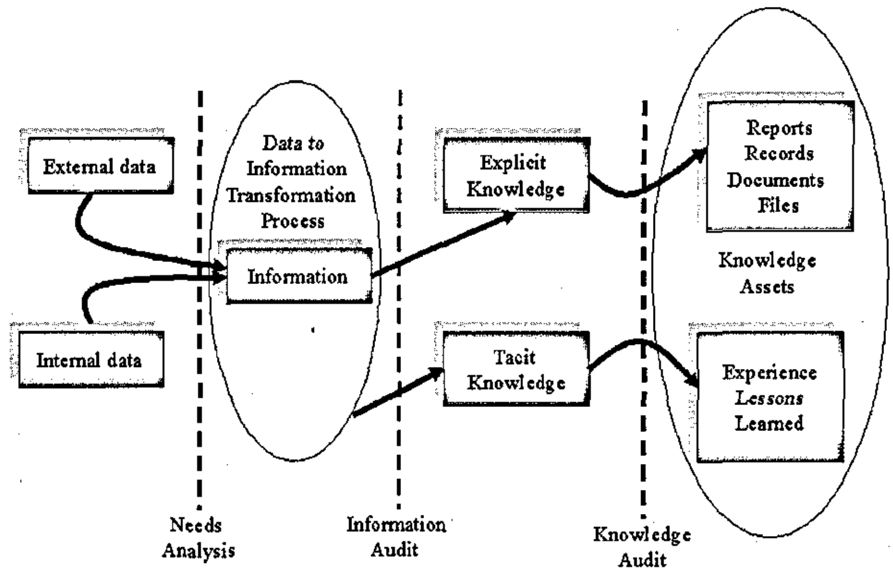


Figure 3.6 From Data to Knowledge (adapted from Henczel, 2000)

Explicit knowledge is the output of tasks and activities that can be documented as reports, databases, procedures and so on. It is easily captured, stored and communicated. *Tacit* knowledge resides in the heads of employees and is more difficult to capture and communicate. It consists of the lessons learned by doing a job and is made up of gathered experience and understanding. Furthermore, Henczel states there are three audits that are used to move an organisation from information management to knowledge management. They are the needs analysis, the information audit, and the knowledge audit.

Needs analysis is a process by which information users are asked precisely what information resources or services they need to perform their jobs. The *information audit* goes one step further in, not only finding out what information resources and services people need to do their jobs, but how those information resources and services are actually used. An *information audit* also enables the mapping of information flows within an organization, and between an organisation and its external environment. A *knowledge audit* is conducted to identify an organisation's knowledge assets, how they are produced and by whom (see Figure 3.5)

3.3.1.2 Components of IS

IS can be defined as a set of interacting components (people, procedures and technologies) that together collect, process, store and distribute information to support control, decision-making and management in organizations (Vidgen, 2002). In line with this, Management Limited (2002) defines IS as an organised combination of people, hardware, software, communication networks and data resources that collects, transforms and disseminates information in an organisation. IS could be electronic or manual, such as a hand written book-keeping system. O'Brien (2001) indicates that people have relied on IS to communicate with each other using a variety of physical devices (hardware), information processing instructions and procedures (software), communications channels (networks), and stored data (data resources) since the dawn of civilization.

O'Brien (2001) illustrates an information system model that expresses a fundamental conceptual framework for the major components and activities of IS (Figure 3.7). An IS depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge bases), and networks (communication media and network support) to perform input, processing, output, storage and control activities that convert data resources into information products.

However, there are two types of IS: formal information systems and informal information systems. A formal IS is a computer-based system that the organisation invests in to implement its information policies, procedures and principles. Informal ISs are systems such as communication systems, created informally to meet information needs. Turban *et al.* (2001) stated that an IS must be able to do the following: provide fast and accurate transaction processing, large capacity, fast access, storage, fast communications (machine to machine, human to human), as well as reducing information overload, spanning boundaries, providing support for decision making, and constituting a competitive weapon.

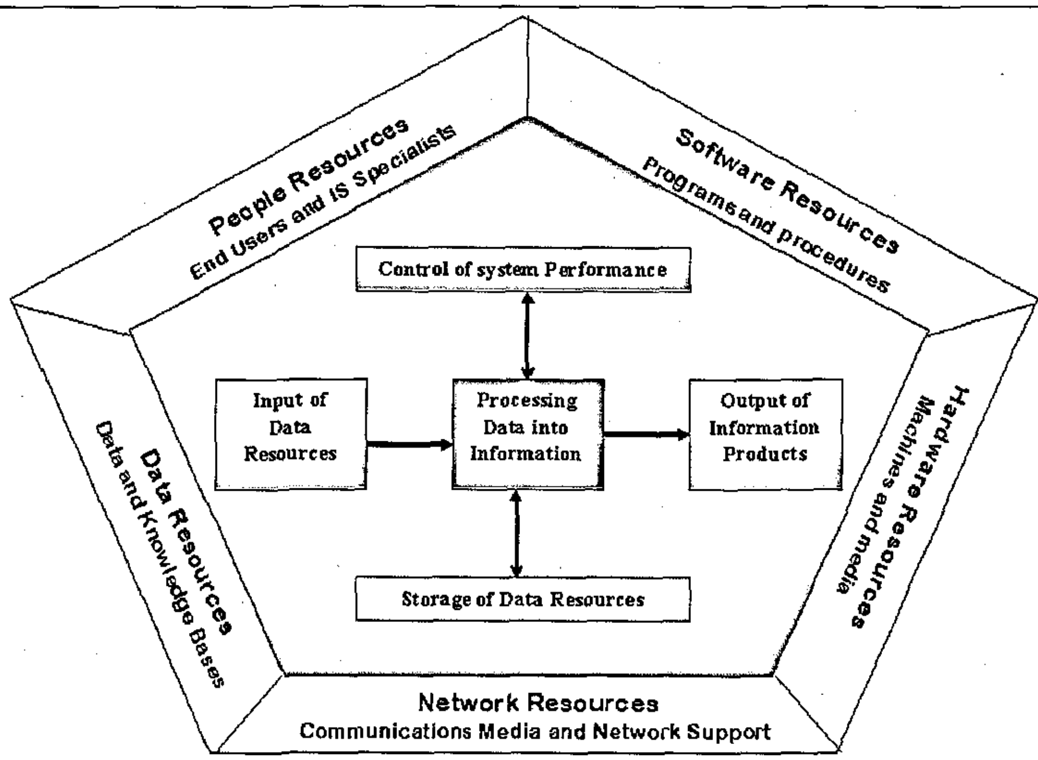


Figure 3.7 Components of an IS (adapted from O'Brien, 2001)

3.3.1.3 Managers' levels

Figure 3.8 indicates three levels of managers and decision-making in an organization. Top managers are responsible for establishing the vision, long-term goals and organisation strategy. The decisions of top managers are mostly unstructured; their decisions rely heavily on judgment, intuition and experience.

Middle managers are responsible for control, and monitor various activities in an organisation. They make many semi-structured decisions that are part routine and part intuitive.

Lower-level managers (operational) are responsible for the day-to-day operations, activities and transactions of an organisation. They are responsible for the short-term performance of the organisation and make many structured decisions that are routine, easily understood, and do not require intuition or judgment (Martin & Powell, 1992; Wilson, 1997; Gupta, 2000).

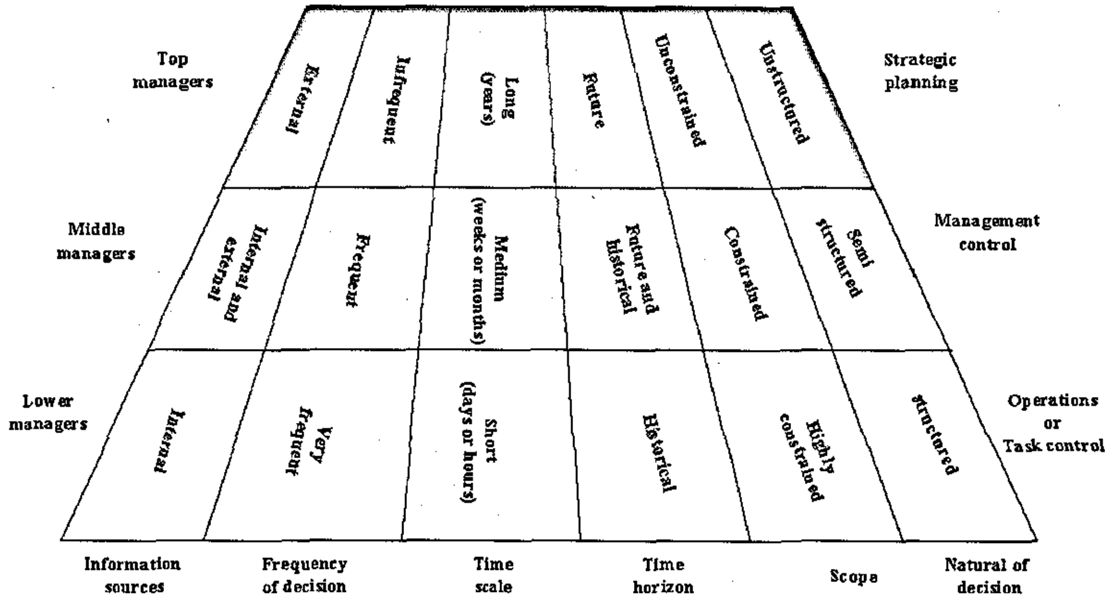


Figure 3.8 Managers' levels (adapted from Wilson, 1997)

3.3.1.4 Systems Development Life-cycles

The systems development life-cycle can be defined as a traditional methodology used to develop, maintain and replace information systems (Hoffer, 1999). The development of a system can be divided into several stages; each stage performs a particular function and requires a specific set of skills. This sequence of stages is called the Life-Cycle.

The classic systems development life-cycle is the 'Waterfall Model'. In this model the output of one stage forms the input to the next. Figure 3.9 shows the sequence of the Waterfall Model (Vidgen *et al.* 2002).

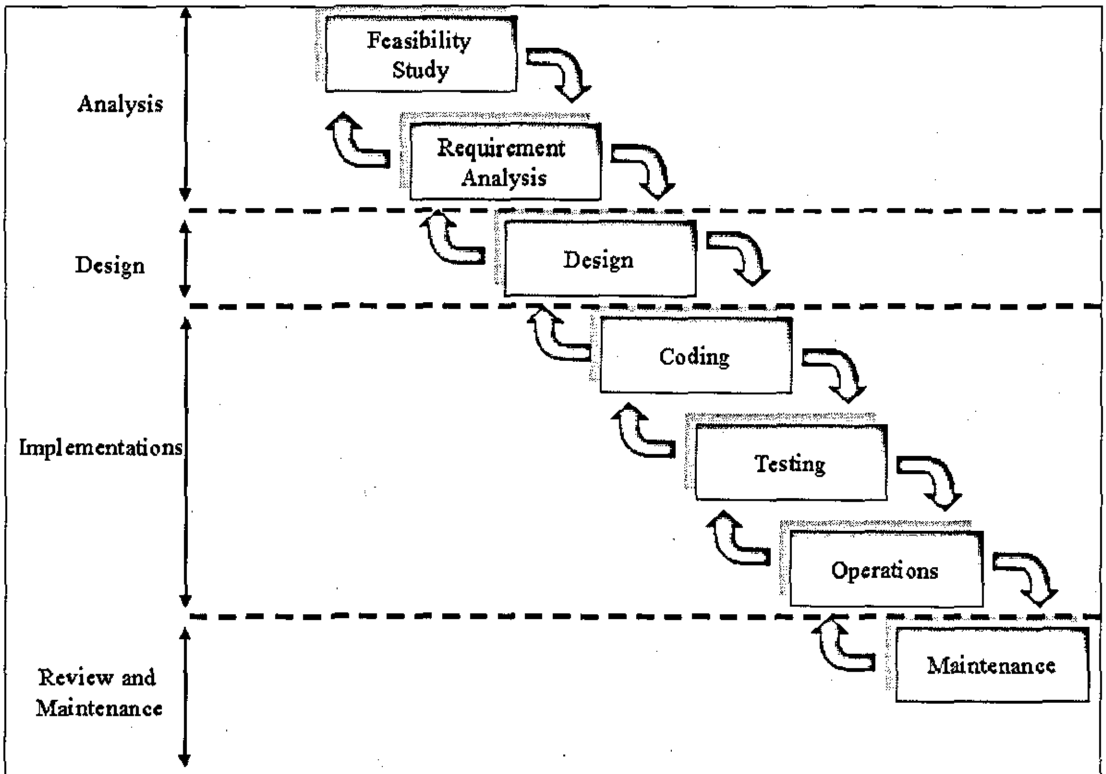


Figure 3.9 The waterfall life-cycle for systems development (adapted from Vidgen *et al.* 2002)

The first stage is a feasibility study, a short study carried out to determine if the proposed system is technically, economically, legally and operationally feasible. In addition, the feasibility study is concerned with defining the aims and objectives of the new system, considering a range of alternative solutions and investigating the impact of the new system on the organisation. The second stage is a requirement analysis, which is a full study undertaken to determine the requirements of the new system. The requirements may be obtained by interviewing staff at different levels, examining current systems documents, using questionnaires, and observing the current procedures. The third stage is design, concerned with translating the requirements into a software system specification that can then be turned into a working system by systems developers (coding). The testing stage is often done at three levels. The first level of testing is for the programmers to unit test the program modules. Once the programmers are satisfied with the individual modules, then the system can be put together for a systems test. The systems development staff develop a comprehensive test plan, devise test data and subject the system to exhaustive testing. This might include pea capacity testing to see how many transactions the system can manage simultaneously before performance degrades to an unacceptable level or the system fails entirely. The third level of testing is the user acceptance test. Once the development team is happy with the systems testing then the system is handed over to the users who then conduct their own (independent) test of the system. Once the system successfully passes user acceptance it can be transferred to live operations where it will then be monitored and maintained as software errors and enhancements are identified (Vidgen *et al.* 2002).

3.3.1.5 Information Quality

The main aims of the IS is to provide relevant information to users in the required fashion: that is, at the right time, at the appropriate level of detail, and accurate enough for the users who are presented with that information. This will help to ensure that the organization will benefit from the information it holds (Avison and Fitzgerald, 1995). In line with this, O'Brien (2001) summarises the attributes of information quality. These include the following dimensions.

1) The time dimension

Timeliness: information should be provided when it is needed,

Currency: information should be up-to-date when it is provided,

Frequency: information should be provided as often as needed,

Time period: information can be provided about past, present, and future time periods.

2) The content dimension

Accuracy: information should be free of errors,

Relevance: information should be related to the information needs of a specific recipient for a specific situation,

Completeness: all the information that is needed should be provided,

Conciseness: only the information that is needed should be provided,

Scope: information can have a broad or narrow scope, or an internal or external focus,

Performance: information can reveal performance by measuring activities accomplished, progress made, or resources accumulated.

3) The form dimension

Clarity: information should be provided in a form that is easy to understand,

Detail: information can be provided in detail or summary form,

Order: information can be arranged in a predetermined sequence,

Presentation: information can be presented in narrative, numeric, graphic, or other form,

Media: information can be provided in the form of printed paper documents, video displays, or other media.

3.3.2 Information and Communication Technologies (ICTs)

The Business Technology Network (2003) defines technology as applying a systematic technique, method or approach to solve a problem while Stevenson (1997) defines IT as the electronic equipment used for applying scientific knowledge, especially in storing and distributing information. Also, IT can be defined as any computer-based tool that people use to work with information and which supports the information and information processing needs of organisations. IT includes keyboards, mice, screens, printers, modems, word processing software, and operating systems software (Haag, Cummings and Dawkins, 1998). Therefore, information and communication technology (ICT) is the term used to describe the items of equipment (hardware) and computer programs (software) that allow us to access, retrieve, store, organise, manipulate and present information by electronic means. Personal computers, scanners and digital cameras fit into the hardware category; database storage programs and multimedia programs all fit into the software category. Norad (2002) added that the term ICT refers to information channels such as the World Wide Web, online databases, management and accounting systems, and the Internet; as well as communication channels such as e-mail, electronic discussion groups, electronic conferences, the use of cell phones, etc; and hardware and software used to generate, prepare, transmit and store data, such as computers, radio, TV, computer programmes/tools, etc.

The terms 'hardware', 'software' and 'firmware' occur frequently in any literature concerned with computers. Therefore, it is important to have an understanding of their meaning. Hardware is the physical components within a computer system, such as keyboards, disks, screens and printers while software is a set of instructions written in a specialised language, the execution of which controls the operation of the computer, for example, programs. Firmware is the permanent storage of program instructions within hardware. It is usually used to refer to a set of instructions that is permanently encoded in a microchip (Curtis, 1998).

The Internet Society (2002) and Beynon-Davies (2002) state that the Internet is a global network of networks enabling computers of all kinds directly and transparently to communicate and share services throughout much of the world. Because the Internet is an enormously valuable, enabling capability for so many people and organizations, it also constitutes a shared global resource of information, knowledge and means of collaboration and cooperation among countless diverse communities. In more technical terms, the University of California (2002) described the Internet as a network of networks, linked by the use of a common communication protocol known as Transmission Control Protocol/Internet Protocol (TCP/IP), Hyper Text Transport Protocol (HTTP), and a language which all local networks understand known as Hyper Text Mark-up Language (HTML).

Darwin (2002) and Beynon-Davies (2002) indicate that an Intranet is a network within an organization that uses Internet technologies to enable users to find, use and share documents and Web pages. Intranets use Internet protocols, TCP/IP, HTTP and HTML to transfer data and information. Intranets usually reside behind firewalls for security and are not limited by physical location; anyone around the world can access the same Intranet. Today, most organisations use an Intranet to communicate with their employees. Intranets are used in organisations as the primary way for employees to obtain and share work-related documents, share knowledge, collaborate on designs, access e-learning and learn about company news. Intranets also can link users to the outside Internet and, with the proper security in place, may use public networks to transfer data and information.

In addition, Darwin (2002) and Beynon-Davies (2002) indicate that Extranets are networks that also use Internet technologies to connect organisations with customers and partners. When it comes to Extranets, an organisation has to work with the other organizations on the network so that information is available to specific people or groups outside an organization. Extranets require more security and technical consideration because they have to send private information securely over public networks. Figure 3.10 illustrates the relationship between the Internet, Intranet and Extranet.

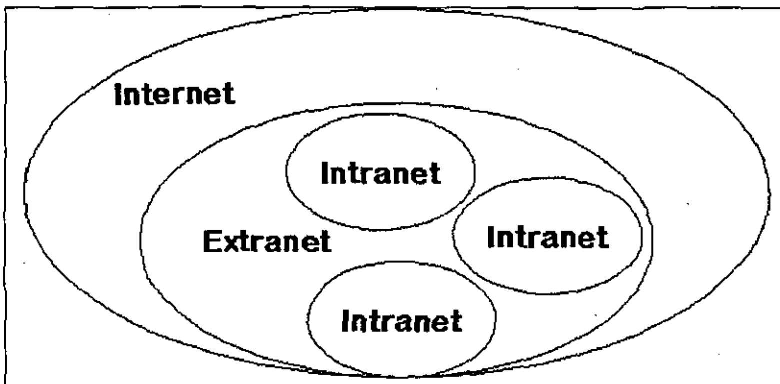


Figure 3.10 Internet, Extranet and Intranet

Beynon-Davies (2002) summarised the main differences between the Internet, Intranet, and Extranet (see Table 3.2).

Network type	Users	Access	Information
Internet	Any external actor with access	Unlimited: no restriction	General
Intranet	Authorised employees only	Private and restricted	Specific/corporate
Extranet	Authorised external actors	Private and authorised partners only	Shared partnership information

Table 3.2: Differences between the Internet, Extranet and Intranet

3.3.3 Information Management (IM)

Middleton (2002) described IM as procedures, which may be technical, analytical or strategic, for optimising the use of information. IM describes the means by which an organisation efficiently plans, collects, creates, organises, uses, controls, disseminates and disposes of its information (both structured records and unstructured information), and through which it ensures that the value of that information is identified and exploited to the fullest extent, both in support of its internal operations and in adding value to its service delivery functions (Office of Government Commerce, 2003). Information Management Associates (2003) added that the goals of IM are getting the right information to the right person, at the right time, from the right source, in the right amount, in the right order, in the right form, in the right medium, with optimal accuracy, as quickly as possible and at the lowest reasonable cost. The Office of Government Commerce (2003) stated that four areas of management are included within the scope of IM, as follows.

- Management of information resources. The governance of information in the organisation must ensure that all these resources are known and that responsibilities have been assigned for their management.
- Management of information technology. The management of the IT which underpins the organisation's information systems is typically the responsibility of the 'supply-side' function, managed within the organisation or delivered through an external service provider. The management of the organisation must be able to operate as an 'Informed Customer' for the IT-based products and services it needs and acquires.
- Management of information processes. All business processes will give rise to operations involving one or other of the information resources of the organisation. The processes of creating, collecting, accessing, modifying, storing, deleting and archiving information must be properly controlled if the organisation is to exercise satisfactory governance of its information resources.
- Management of information standards and policies. The organisation will need to define standards and policies for its information management. These will typically be developed as an element of its IS strategy. Management policies will govern the procedures and responsibilities for IM in the organisation; technical policies and standards will apply to the IT infrastructure which supports the organisation's information systems.

3.3.3.1 Information Strategy

Information strategy is defined as a complex of implicit or explicit visions, goals, guidelines and plans with respect to the supply and demand of formal information in an organisation, sanctioned by management, intended to support the objectives of the organisation in the long run, while being able to adjust to the environment (Galliers and Leidner, 2003). Earl (1989) suggests the use of a three-level model for information strategy (see Figure 3.11). the three interlinked components are information system strategy, information technology strategy, and information management strategy, as indicated below.

Information system strategy

The overall business strategy is the starting point, with continual references back to it as the strategy develops. It defines the information requirements of the organisation at various levels in the organisational, corporate and business units, and in divisional and functional sections.

Information technology strategy

This stage attempts to determine how the available and anticipated technology can be used to meet the information requirements identified in the IS strategy. It embraces hardware, software and the increasingly important area of networks and communications.

Information management strategy

This part of the overall strategy is concerned with planning how the organisation will manage its information system and technology. It covers the areas of the degree of centralization of management, authority and control over IT purchase, and the funding of the whole area.

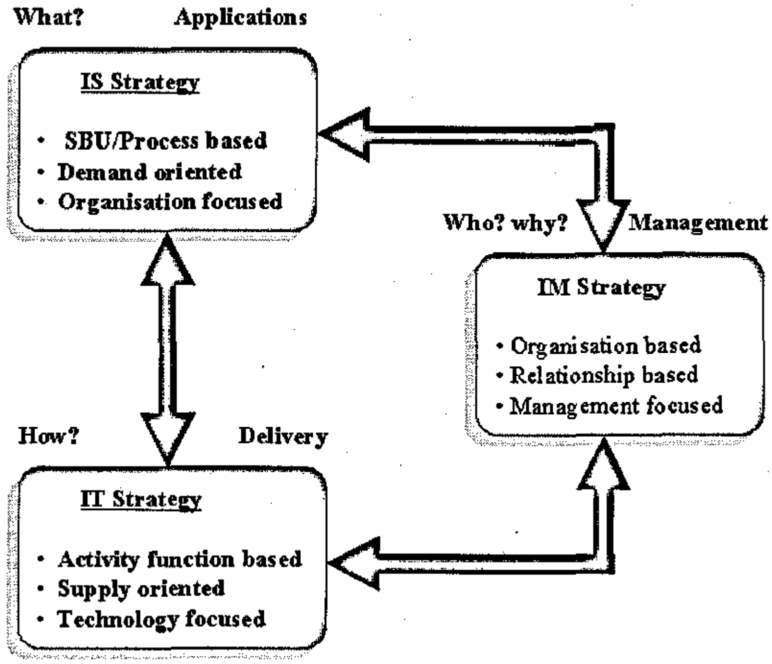


Figure 3.11 Interlink information strategy components (adapted from Earl 1989)

However, Gibb (1997) outlined the relationships between organisation and information strategies. These are shown in Figure 3.12. An organisation's strategy involves four key components: the mission, objectives, policy and constraints, and planning. The mission provides a top-management with a statement (often highly generalised) of what the organisation wishes to be. The mission statement is developed through a series of objectives. These objectives will be perceptions regarding the best way(s) to satisfy the organisation's mission. The objectives will also have to be interpreted within the context of the organisation's policy on, for instance, investment, procurement, recruitment, etc., and constraints such as the availability of capital, the regulatory regime and technological capabilities. The plans will represent the routes which will be followed in order to reach the destinations set out in the objectives. An organisation will have to identify, design, implement and manage the key processes which will be used to achieve its strategy.

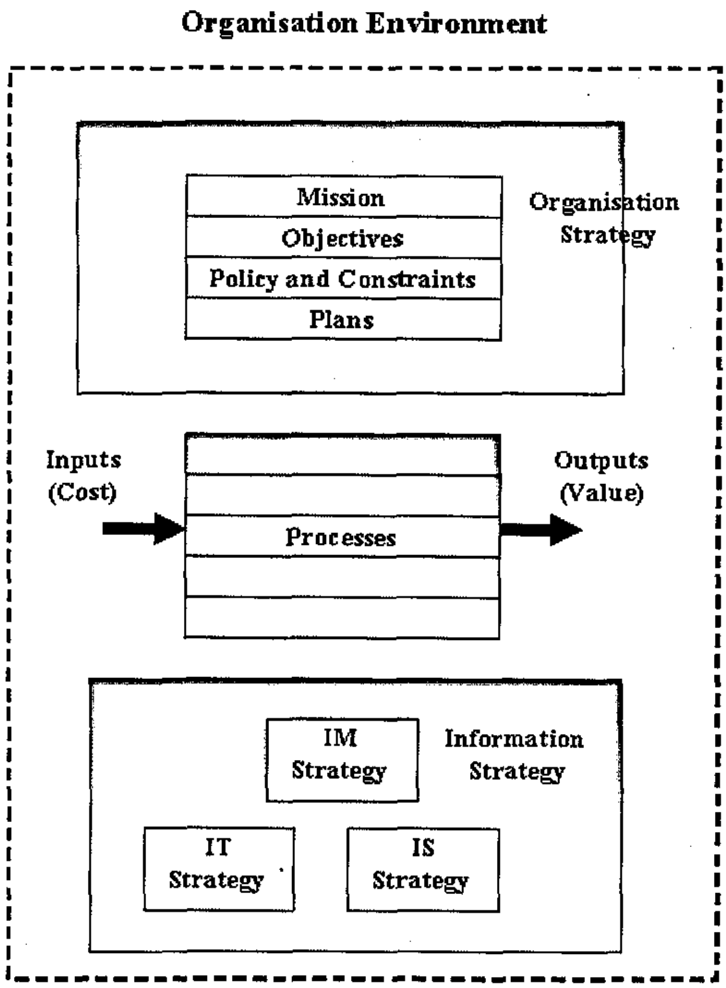


Figure 3.12 Organisation and Information Strategy (adapted from Gibb, 1997)

Figure 3.12 shows three keys for information strategy: IT strategy, IS strategy and IM strategy. IT strategy is concerned primarily with technological issues such as architecture, technical standards, physical security, etc. IS strategy is concerned with aligning IS development with organisation needs and with seeking competitive advantage from IT, while IM strategy is the management framework which is used to guide how the organisation should run its IS and IT functions and activities (Gibb, 1997).

3.3.3.2 Information Policy

Browne (1997) states that information policy cannot restrict itself to studying law and formal written policies. In the other words, the process of policy development must be examined utilizing methods from many disciplines. Hernon (1994) and Drake (2003), however, define information policy as a set of interrelated principles, laws, guidelines, rules, regulations and procedures guiding the oversight and management of the information life cycle: the production, collection, distribution/dissemination, retrieval and use, and retirement, including the preservation, of information.

Chartrand (1986) and Nilson (2001) indicate the topics of information policy: government information and resource management policy and practice; telecommunications and broadcasting policy; international communication policy; information disclosure policy; information confidentiality and privacy; computer regulation and computer crime; intellectual property; library and archives policy; and government information dissemination. Feather and Sturges (2003) illustrated a model of the policy-making process (Figure 3.12).

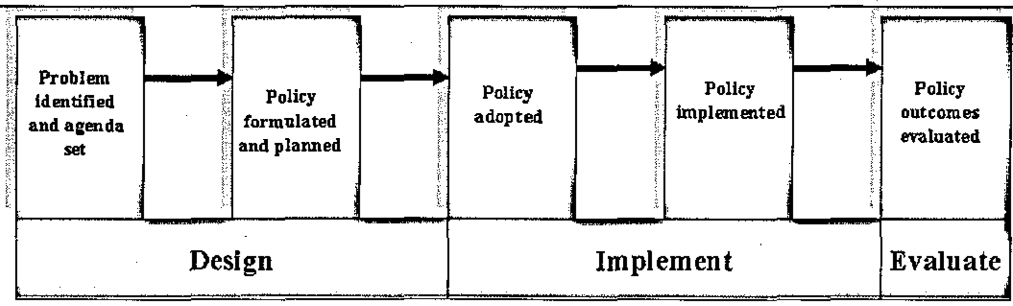


Figure 3.13 Staged of the policy-making process (adapted from Feather and Sturges 2003)

3.3.3.3 Information Security

Security is a very important issue when dealing with information systems. McDaniel (1994) stated that information security can be defined as the concepts, techniques, technical and administrative measures used to protect information assets from deliberate or inadvertent unauthorized acquisition, damage, disclosure, manipulation, modification, loss or use. Tettero (2000) reported that information security has impact on many areas, such as organisational, juridical, psychological or technical disciplines. She added that information security is employed to prevent valuable things, called assets, from being damaged or to minimise the possibility of damage. Examples of assets are buildings, a business strategy, customer data, network components (for example, routers and file servers), personal, products and information about assets.

The Institute of Internal Auditors (2003) outlines the fact that threats to information systems may arise from intentional or unintentional acts and may come from internal or external sources. The threats may emanate from:

- Technical conditions (program bugs, disk crashes);
- Natural disasters (fires, floods);
- Environmental conditions (electrical surges);
- Human factors (lack of training, errors and omissions);
- Unauthorized access (hacking); or,
- Viruses.

In addition to these, other threats, such as business dependencies (reliance on third party communication carriers, outsourced operations, etc.) that can potentially result in a loss of management control and oversight are increasing in significance.

3.3.3.4 Information Resource Management (IRM)

One important feature of IRM consists is that it is a framework that seeks to integrate different information professionals and functions under one umbrella (Bergeron 1996 and Wilson 2002). Schneyman (1985) elaborates on this definition of IRM to cover five types of 'information resources': systems support, including computers and telecommunications; processing data, images, etc.; conversion and transformation, including reprographics; distribution and communication, including network management and telecommunications; and, finally, retention, storage and retrieval, which covers libraries, record centres, filing systems, and internal and external databases. He adds that: 'IRM supports IM by providing the technical capability and overall guidance for IM to do its job', which defines IRM as managing the ownership, content, quality and use of information. Schlögl (2005) and Marchand and Horton (1986) distinguish between information resources and information assets. They stated that:

"Information resources include information specialists; information technology; facilities like the library, the data processing department, and the information centre; and external information brokers. Information assets cover all the formal information holdings of an organization (data, documents, technical literature), know-how (rights on intellectual property, practical experience of staff), as well as knowledge about the environment (competitors; political, economic, and social environment). While the information assets concern information itself, the information resources are a means by which information can be gained."

3.3.3.5 Records Management

It is a vital to consider what is meant by the word " records" before discussing the definition of records management. Emmerson (1989) stated that records include any paper, book, photograph, microfilm, map, drawing, chart, magnetic tape or disk, or optical disk. This definition of records does not include electronic records such as e-mail, database records or digital photos because these only become popular after 1991. In line with this, Chaffey and Wood (2005) declared that records not only include books, documents and microfilm, but should also include digital records such as e-mail, digital images and voice-mail. Records have a 'life' like biological organisms starting from their birth (creation), throughout their life (maintenance and use) and until their death (disposal or archive). In line with this notion, Fisher (1999) states that the complete lifecycle of a record goes through its creation, distribution, use, storage, retrieval, maintenance, distribution (disposal) or retention (archive).

Records management can play an important part in information management because it deals with all types of information organisation, either with hard or soft records. The main objective of records management is to ensure that all records are correctly handled during their creation, reception, indexing, usage, storage, short- and long-term retention, and disposal and so records management should be considered by senior management at a strategic planning level. In line with this, Sprehe (2005) outlined that "many organisations believe that they must adopt good records management as part of their essential infrastructure for the basic reason that keeping good records protects the organisation from harmful damage and ensures regulatory compliance. Risk management by itself is an inadequate rationale for enterprise-wide records management because it is essentially a defensive strategy".

The main advantages of establishing records management are: to protect records from harmful damage; to arrange records in the organisation efficiently and in an accountable manner; to provide high quality and consistent services; and to satisfy an organisation's legislative and regulatory needs. So, a most important issue for many organisations around the world is records management starting from of the capture of information to its organisation, storage, retrieval and destruction, whether it is electronic or paper. Consequently, organisations complain about the rapid increase in paper, duplication and the waste of time, money and effort (Sprehe, 2005).

The records centre plays an important part in an organisation. Ketelaar (1985) defined a records centre as a building normally designed and constructed to provide low cost storage, and for the maintenance and communication of present and related-to-present records, pending their disposal. Later, Fisher (1998) stated that a records centre can play a significant role in the utilisation of a records management programme, thus providing low cost, high density storage and control over the inflow and outflow of records. It can be said in summary that a records centre can help to improve, not only services, but also the integration of information, with low storage costs and control over the growth of records (both inactive and semi-active). It can also avoid duplication, ensure that records are kept securely in a proper environment, are easy to access when they are needed, and can contribute to returning them quickly in case of disasters.

3.3.3.6 Help Desk and Call Centre

A help desk can be defined as a group of technical people who are basically responsible for answering quickly questions related to technical problems or user errors by using any method (e-mail, telephone, fax). In line with this, Brown and Maxwell (2002) asserted that a help desk is a vital part of the interface between an

ICT department and its users and can therefore provide first-line support for problems at a low cost; it can also provide comprehensive and accurate information management about quality services and user support. Moreover, numerous studies have pointed out many advantages of the help desk including better utilisation and increased productivity of skilled ICT staff, identifying problem areas with equipment, providing necessary training, giving better services in a timely manner, providing modern tools that work effectively, and providing a financial benefit from reducing cost (González *et al.* 2005; Brown and Maxwell, 2002; and Foo *et al.* 2000).

On the other hand, Foo *et al.* (2000) outlined a number of disadvantages related to the traditional help desk. These include: technical staff should travel to the user's site even for a small problem and this makes the process time consuming and expensive; the databases of service records contain the past experiences of technical staff concerning how to fix problems with machines which can only be used by technical staff when these databases should be available to users online for fixing their own machine; and no expert advice is automatically available or provided.

Call centres were developed in the USA in the 1980s and were adopted in the UK and in Australia a few years a later. These were defined at that time as a business function, usually comprising a set of agent groups, dedicated to serving telephone transactions (Brown and Maxwell, 2002). There was considerable growth in the number of call centres in the beginning of the ICT revolution as a call centre can provide services to the customer by offering access to information services that are delivered by a human operator (agent) who, in turn, has access to an information resource (database). Usually, a call centre allows a customer to call a toll-free number and to receive information with the assistance of an agent (Adria and Chowdhury, 2004). Nowadays, organisations use ICT to improve their efficiency, intelligibility and accountability as well as to reduce cost and provide better services to users. Therefore, a call centre can be described as a single point of formal interactions and transactions such as information, services, support, maintenance and employee assistance by using ICT such as e-mail, web-sites, fax, telephone, and face to face communication; call centres function with little cost, time and effort. In line with this, Nojoum (2005) described a call centre as a set of functions, or actions that can be carried out in many ways, using multiple delivery channels such as telephone, fax, e-mail, or the Internet, to provide and receive information coming to and from organisations and users in order to provide high-quality services.

Call centres offer a number of benefits to the users and to an organisation but the success of call centres depends on the satisfaction of users with the services provided for them. According to Brown and Maxwell (2002), call centre users evaluate the quality of services by comparing what they request or expect from a call centre with what they received. There are three features of call centre operations that users feel are crucial to quality services. These include: convenience and fast handling of calls, the friendliness of the agent, and consistency in agents providing a reliable and accurate service (Haymarket, 1998). Therefore, the relationship between a call centre's agent and users is not only important, but also sensitive. Positive staff attitudes can increase users' satisfaction, and service gaps between what an agent believes a user wants and what a user actually expects, can lead to a reduction in service quality (Brown and Maxwell, 2002). They state that call centre services should consist of an integrated system among computers, telephones and data while Nojoum (2005) emphasises that human resources should be integrated with computers, telephones and data.

Foo *et al.* (2000) and Nojoum (2005) note that a call centre can provide an organisation with significant benefits which include: providing multiple delivery channels to support multiple lines for processes; enabling the standardisation of products and services across all channels; improving communication between the organisaton and users, particularly in remote locations; saving users' time and cost in getting the information they need; and maximising opportunities to service users. In addition, a call centre can facilitate the exchange of information, not only inside the organisation itself, but also outside, improving the overall control of information from its gathering, organisation and retrieval, to its archiving. It can also help to build strong databases about users and can provide this valuable information to anyone in the organisation who can use it.

3.3.3.7 Database Management System (DBMS)

Connolly and Begg (2002) define the database as a shared collection of logically related data and a description of this data designed to meet the information needs of an organisation. In line with this, Bocij *et al.* (2003) define a database as a collection of related information stored in an organised way so that specific items can be selected and retrieved quickly. Parker and Case (1993) state that most of the data and information needed for managerial decision making is stored in computer-based files and databases. Lower-level managers are the most likely to use computer-based files and database to help them perform day-to-day operational tasks and to develop operational plans. Top-level managers are likely to use information stored in both organizational and external databases to develop strategic plans. Thus, databases can play a crucial role in decision making for managers at all levels to fulfil their responsibilities but, in order for them to do this, it is important for them to understand basic file and database concepts. The hierarchy of the database is illustrated in Figure 3.14.

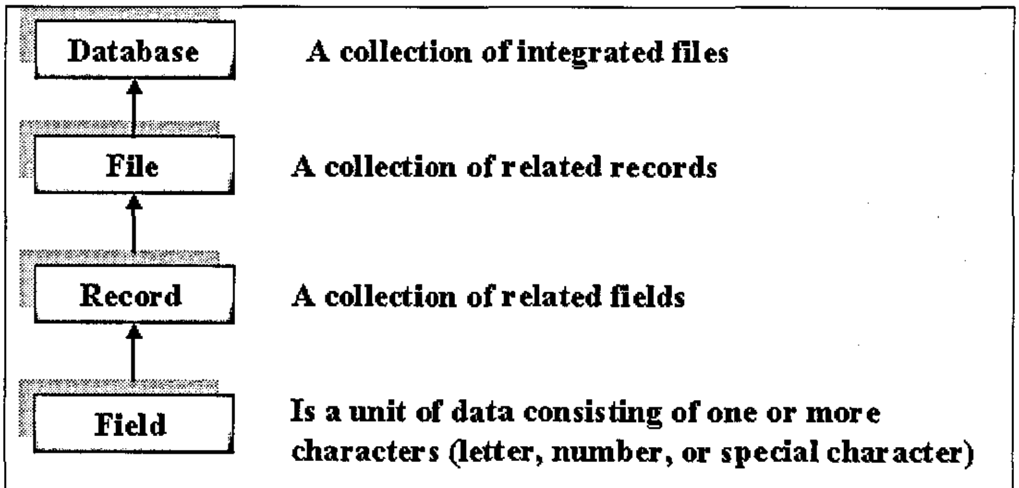


Figure 3.14 Database hierarchy (adapted from Williams and Sawyer, 2002)

DBMS is a software system that enables users to define, create, maintain and control access to a database (Connolly and Begg, 2002). They also identify five major components in the DBMS environment: hardware, software, data, procedures and people, as illustrated in Figure 3.15.

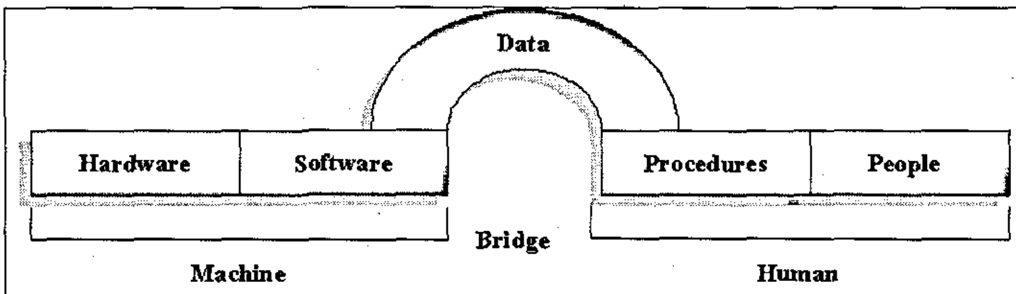


Figure 3.15 DBMS environment (adapted from Connolly & Begg, 2002)

However there are many advantages of using a DBMS in an organization that includes: control of data redundancy, data consistency, more information from the same amount of data, sharing of data, improved data integrity, improved security, enforcement of standards, economy of scale, balance of conflicting requirements, and improved data accessibility and responsiveness (Capron, 1997; Connolly and Begg, 2002).

3.3.3.8 People

People form the most important part of the total system. In line with this, Curtis (1998) emphasized that users are a key element in any successful computer system. Their knowledge and understanding will have been tapped during systems investigation and analysis. Models of users will have influenced the user-machine interface design. But unless staff are adequately prepared for the new system it will have little chance of being used effectively. This requires staff training and education. Curtis added that education is to be distinguished from training in that the former involves providing staff with a general understanding of the way the system functions, and both its scope and limitations. They will be informed of how the system can be used to provide information for their needs or to carry out processing tasks for them. Training, in contrast, involves the familiarization of staff with the skills necessary to operate the computer system to perform tasks.

Curtis (1998) and Daft (2000) stated that there are several training methods. These include the following.

- Lectures and seminars can be used for instructive overviews. Their advantage is that a large number of staff are reached using one instructor;
- Simulation of the work environment is used for training. This is a costly, though effective, training technique;
- On-the-job training involves supervision of personnel as skills that are progressively more complex are gradually mastered. This is a popular way of training new staff on an existing system;
- Software packages are used for training personnel in applications software. For example, there are tutorial programs for most of the major word processing packages; and,
- The information centre should devise training courses for staff involving some, if not all, of these techniques.

3.4 Methodology and Multi-methodology

A methodology can be defined as an approach to the design of information systems which contains methods and rules about procedures in order to ensure consistency, comprehensiveness and completion (Burton, 1997). Jayaratna (1999), on the other hand, defined a methodology as an explicit way of structuring one's thinking and actions. Methodologies contain model(s) and reflect particular perspectives of 'reality' based on a set of philosophical paradigms. She added that a methodology should tell what steps to take and how to perform those steps but most importantly the reasons why those should be taken, and in that particular order. Therefore methodology can be defined as a collection of procedures, techniques, tools and documentation aids which will help the system developers in their efforts to implement a new information system (Avison and Fitzgerald, 2002).

Avison and Fitzgerald (2002) addressed different objectives for a methodology. These objectives could be: (1) to record accurately the requirements for an information system; (2) to provide a systematic method of development so that progress can be effectively monitored; (3) to provide an information system within an appropriate time limit and at an acceptable cost; (4) to produce a system which is well documented and easy to maintain; (5) to provide an indication of any changes which need to be made as early as possible in the development process; and (6) to provide a system which is liked by those people affected by that system.

Mingers and Gill (1997) define multi-methodology as a combining together of more than one methodology (in whole or part) within a particular intervention. Thus, it is not the name of a single methodology, or even of a specific way of combining methodologies together. Rather it refers to the whole area of utilizing a plurality of methodologies or techniques within the practice of taking action in problematic situations. In the other words, multi-methodology can be defined as a process of linking together or combining a number of different management science methodologies (such as SSM, VSM, cognitive mapping etc), possibly from different underlying paradigms, within a single intervention or piece of research (Mingers, 2003).

Rosenhead and Mingers (2001) state that there are three main arguments in favour of multi-methodology (see Figure 3.16): the first is that real-world problem situations are inevitably multidimensional. There will be material aspects, social aspects, and personal ones. The material world refers to aspects of problem situations that concern physical space-time, entities and objects. This world is governed by natural laws that are independent of human beings in that they would exist without us and we cannot change them. The social world can be characterized in terms of shared languages, norms, and practices. This world of concern depends on humans in the broad sense - it would not exist without them but is generally independent of any particular person. Finally, the personal world is the result of our own individual history of choices, interactions, and experiences. It is the world of feelings, beliefs, and values that is peculiar to our own self. Different approaches tend to focus attention on different aspects of the situation and so multi-methodology is necessary to deal effectively with the full richness of the real world (Mingers, 2000).

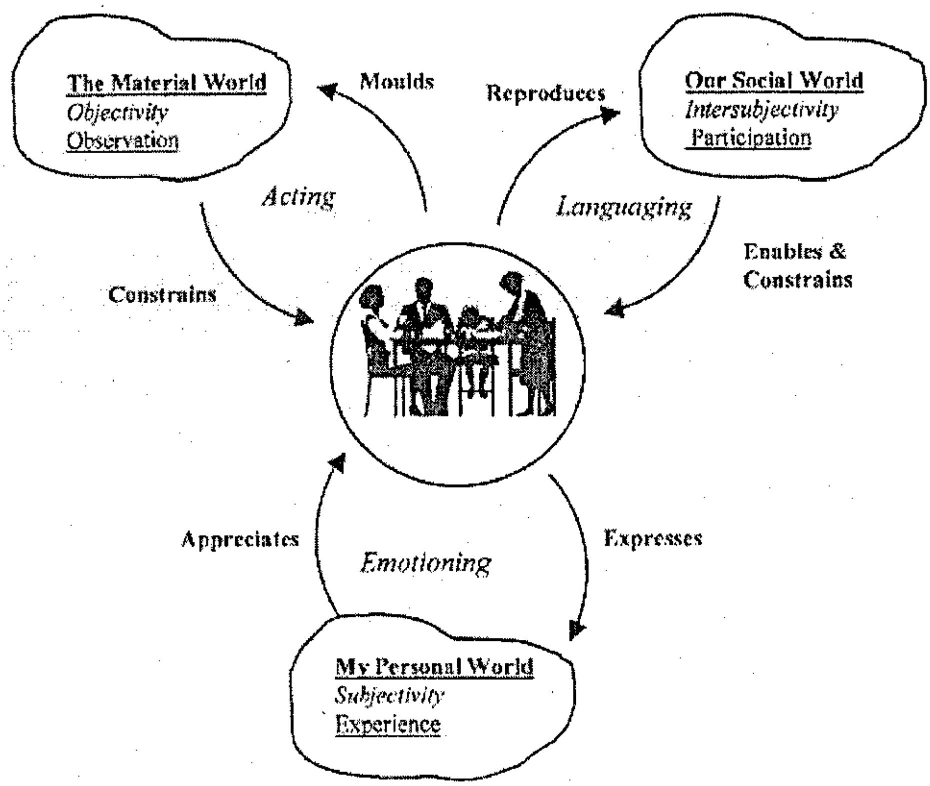


Figure 3.16 Habermas' three words (adapted from Rosenhead and Mingers, 2001)

The second is that an intervention is not usually a single, discrete event but is a process that typically proceeds through a number of phases. Rosenhead and Mingers (2001) identify the four phases (see Figure 3.17).

- Appreciation of the situation as experienced by the practitioners involved and expressed by any actors in the situation;
- Analysis of the information produced so as to be able to understand and explain why the situation is as it is;
- Assessment of the postulated explanation(s) in terms of other predicted effects, alternative possible explanations, and consideration of ways in which the situation could be other than it is. Interpretation of the result, and inference to other situations; and,
- Action to bring about the changes, if necessary or desired.

At the beginning of an intervention, especially for an agent from outside the situation, the primary concern is to gain as rich an appreciation of the situation as possible. The next activity is to begin to analyse why the situation is as it appears, to understand the history that has generated it, and the particular structure of relations and constraints that maintain it. Next, in cases where change to the situation is sought, consideration must be given to ways in which the situation could be changed. This means focusing attention away from how things are, and considering the extent to which the structures and constraints can be changed within the general limitations of the intervention. Finally, action must be undertaken that will effectively bring about the agreed changes.

It is clear that the wide variety of methods and techniques available do not all perform equally well at all these activities. To give some brief examples: collecting data, administering questionnaires and surveys, developing rich pictures and cognitive maps, all contribute to contribute to finding out about the different aspects of a particular situation. Whereas building simulation or mathematical models, constructing root definitions and conceptual models, using role-playing and gaming, or undertaking participant observation helps to understand why the situation is as it is, and to evaluate other possibilities (Mingers, 2000).

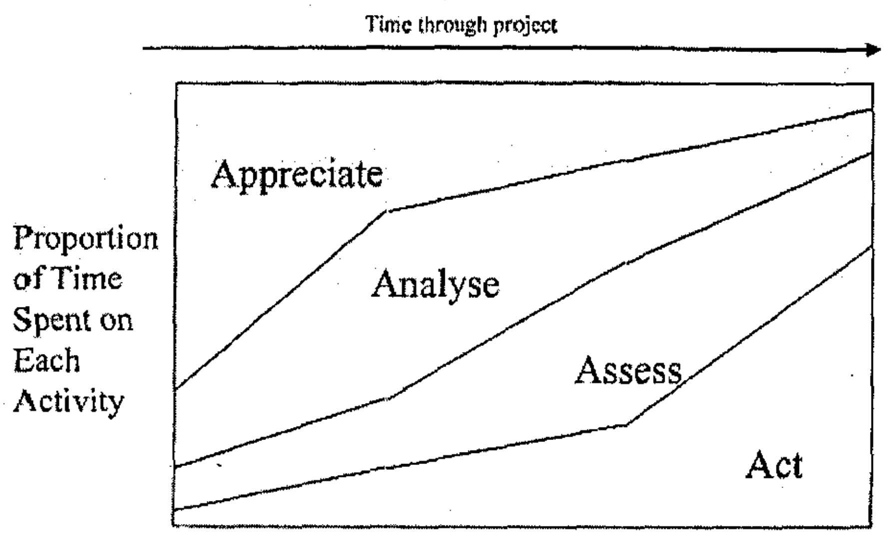


Figure 3.17 Phases of intervention (adapted from Rosenhead and Mingers, 2001)

Third, combining different methods, even where they actually perform similar functions (such as cognitive mapping and rich pictures), can often provide several advantages: i) triangulation – seeking to validate data and results by combining a range of data sources, methods, or analysts; ii) creativity – discovering fresh or paradoxical factors that stimulate ideas and solutions; and iii) expansion – widening the scope of the study to take in other aspect of the situation that may be of importance (Mingers, 2000). The use of multi-methodology clearly lays on the three notional systems and the relations between them (see Figure 3.18): the problem content system, that is the real-world site of concern; the intervention system - the person or people and the resources available to tackle the situation; and the intellectual resources system consisting of theories, methodology and techniques. More important from the point of view of multi-methodology are the relationships between these notional systems - those between agents and methodologies/techniques, those between the agents and the situation, and those between methodologies/techniques and the situation. Some of the important dimensions of these relations can be highlighted in a series of questions, and the relationships between the notional systems are highly interactive. So, for example, when considering the relationship between agents and methodologies/techniques to respond to the question what methodology the agent might use, the relationship between the agent and situation – that is, facilitator or expert – should also be considered. To make matters slightly more complex, the relation between methodologies/techniques and situation may also have a bearing, responding to the associated question of whether or not the test organisation (situation) has any experience of intervention via the methodologies/techniques chosen. However what is clear from the work of Rosenhead and Mingers (2001) is that the entities and the relations between them constitute the context for an intervention.

Figure 3.19 outlines the process of multi-methodology design. Rosenhead and Mingers (2001) state that the two lower cylinders show the ongoing process of the intervention in which the practitioner(s) take action in the problem content system. The fact that the two circles are not contiguous represent the fact that both systems have lives of their own outside, but conditioning, the intervention. The upper cylinder shows the metalevel activities of *reflection* and *design* that appreciate and respond to the intended and unintended consequences of previous actions by specifying the next steps to be taken and the methods to be used. There are four key sub-activities: **Reflection** (1) *Review* the current situation; (2) *Determine* which area of the problem situation currently need addressing; **Design** (3) *Understand* what methods or techniques could possibly be useful; (4) *Choose* the most appropriate to use in relation to the project context as a whole.

Rosenhead and Mingers (2001) demonstrate that the essence of multi-methodology is to utilize more than one methodology or part thereof, possibly from different paradigms, within a single intervention. There are several ways in which such combinations can occur, each having different problems and possibilities. The researchers distinguish between the following (see Table 3.3):

Methodology combination: using two or more methodologies within an intervention.

Methodology enhancement: using one main methodology but enhancing it by importing methods from elsewhere.

Single-paradigm multi-methodology: combining parts of several methodologies all from the same paradigm.

Multi-paradigm multi-methodology: as above, but using methods from different paradigms.

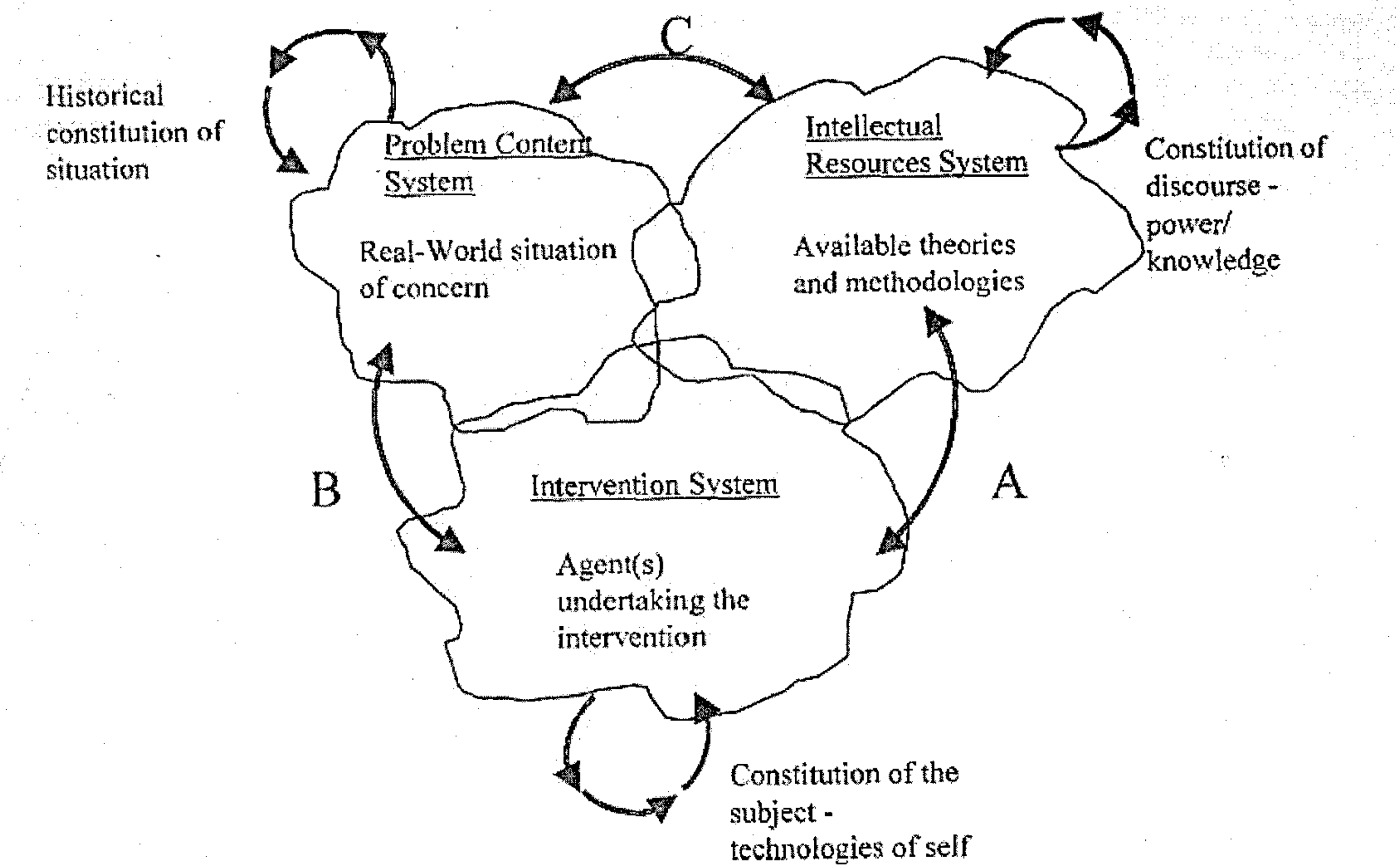


Figure 3.18 Context of an intervention (adapted from Rosenhead and Mingers, 2001)

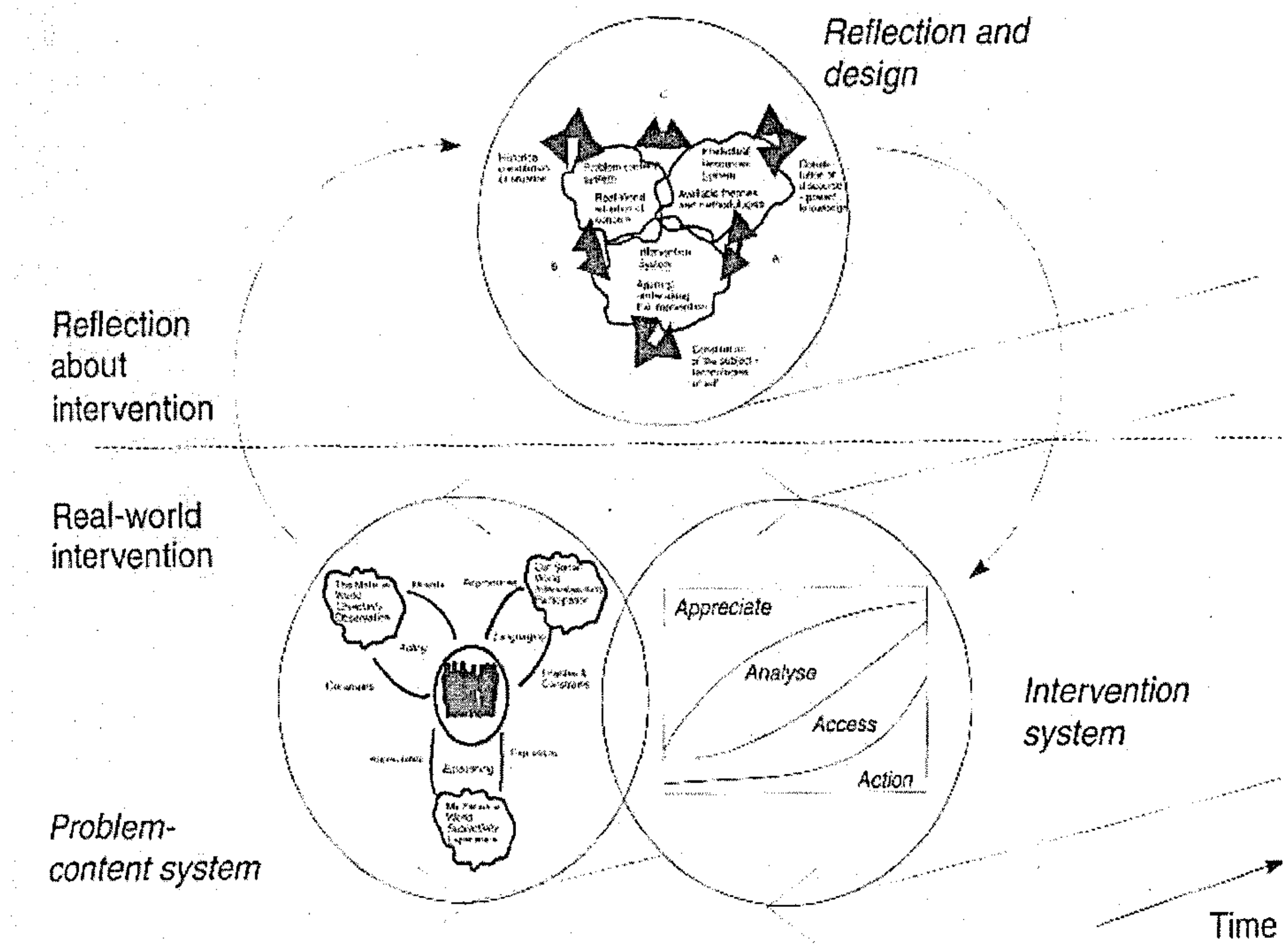


Figure 3.19 Multi-methodology Process (adapted from Rosenhead and Mingers, 2001)

	One/more methodologies	One/more paradigms	Same/different intervention	Whole/part methodology	Imperialist or mixed	Example	Name	Literature (Theoretical Case Study)
A	One	One	-	-	-	SSM only	Methodological isolationism	Checkland and Scholes (1990)
B	More	ditto	Different	Whole	-	SSM | Start. choice	Paradigmatic isolationism	
C	ditto	ditto	Same	Whole	-	Simulation + queuing theory	Methodology combination	Omerod (1995,1996a)
D	ditto	ditto	same	Part	Imperialist	Cognitive mapping in SSM	Methodology enhancement	Mingers and Taylor (1992)
E	ditto	ditto	Same	Part	Mixed	Cog-map. + root definition	Single paradigm multi-methodology	Ormerod (1994,1996b), Holt (1993), Taket (1993), Bennett (1985,1990)
F	ditto	More	Different	Whole	-	Simulation | SSM	Methodology selection	*Jackson and Keys* (1984), *Jackson* (1987, 1989,1990)
G	ditto	ditto	Same	Whole	-	VSM + interactive planning	Whole methodology management	*Flood and Jackson* (1991), *Flood* (1995), *Ulrich* (1991)
H	ditto	ditto	Same	Part	Imperialist	JSD in SSM	Methodology enhancement	Savage and Mingers (1996)
I	ditto	ditto	Same	Part	Mixed	Cognitive map + system dynamics	Multi-paradigm multi-methodology	Eden (1994), Lehaney, Paul et al (1994), Hocking and Lee (1994), Midlegy (1989a, 1989b, 1990, 1992), Flood (1995), Mingers and Brocklesby (1996)

Table 3.3: The different possibilities for combining methodologies (adapted from Mingers and Gill, 1997)

3.5 Previous Studies

There are a number of studies related to the development of information systems which use a different methodological approach. In this part of the literature review, previous studies are represented in terms of their aim, and the methods they used. These are related to the basic methods used in this study including SSM, ETHICS and VSM.

Al-Zahrani's study (2001) aimed to investigate the needs concerning the infrastructure required for computer network systems to enable Saudi University Hospitals to exchange medical data, information and knowledge. The major techniques used for gathering data were questionnaires and interviews. SSM (Mode 1) was applied to identify the current problem situation and to improve the problem situation by developing a strategic management system, a funding system, a technology system, a communication system, a maintenance and monitoring system, and an end-user training system.

Al-Shehri's study (2003) revolved around investigating the feasibility, practicality and desirability of establishing a virtual university based on the Internet and related technologies to deliver higher education courses and programmes. This would constitute an alternative approach to the previously attempted solutions carried out by higher education decision-makers to cope with the proliferation of potential higher education students in the Kingdom of Saudi Arabia. The major techniques used for data collection in this study were questionnaires and interviews. SSM (Mode 1) was used to achieve the study's aim.

Al-Foudary (2005) aimed to investigate and analyses the current state of ICT use in charitable organisations in the State of Kuwait and to provide Guidelines to improve ICT in order to meet the needs of the charities, the donors and beneficiaries, and to enhance the ability of the charities to comply with state legislation. The major techniques used for data collection were questionnaires, interviews, case studies and focus groups. Al-Foudary's study comprised a combination of two research methodology systems to develop a multi-methodological approach. He used all seven stages of SSM (Mode 1) and the last two stages of ETHICS which sought to implement the proposed system in detail; this was followed by an evaluation of the new system.

Mat Taib's study (2005) aimed to investigate the exciting information management system (IMS) at the Ministry of Health in Malaysia (MoHM). This used an information driven perspective (Aim 1) in order to utilise appropriate systems-based approaches for the organisation in Malaysia to demonstrate the inter-relationships between entities identified in the system of interest, in the wider system and in the system environment (Aim 2). The study also aimed to develop a system model to cover strategic management requirements in the MoHM (Aim 3). The major techniques used for data collection were interviews, questionnaires and document analysis. The Viable System Model (VSM) was adopted in this research as a system intervention to diagnose the operational viability of the public health services offered by the MoHM. However, VSM can be used as an easy route to develop a shared understanding of organisational complexity by discussing issues of organisational design and structure, stability and change, control and coordination, centralisation and decentralisation.

Bustard *et al.* (2005) paper aims to examine the potential benefit of using well-established systems concepts and techniques in the development of such systems. They used Checklands Soft Systems Methodology (SSM) and Beers Viable Systems Model (VSM) in system design. This paper outline the relevant aspects of each approach and then assesses both their individual and joint strengths in support of the construction and evaluation of designs.

Paucar-Caceres (1999) paper has discussed the problems of measuring the performance of a system. The Three Es of SSM have been compared with the levels of achievement of Beer's VSM. There seems to be a correspondence between the two first Es of SSM (Efficacy and Efficiency) and the Actuality and Productivity levels proposed by Beer. The third E of SSM, Effectiveness (is 'x' the right thing to be doing?) corresponds to the Beer's level of Potentiality (what we ought to be doing). The case of improving the Foreign Exchange element on a Business Studies course has been used to illustrate the two approaches. A general conclusion is that SSM is more easy to apply in this case mainly because numerical data seems not to be available; VSM levels of achievement will give more insight if factual data is available. Both approaches are useful to shed light into situations whose performance needs to be measured. More conceptual work is needed in this area and perhaps reference to the work of Ackoff would be productive (Ackoff, 1995). Also, further research on the application of these systems concepts are necessary with the view of comparing the use and practicalities of them.

The current research uses previous studies as a basis for an innovative, new multi-methodology for the development of an information system which is related to SSM (Mode 1), ETHICS and VSM. This new multi-methodology was applied at the Teachers' Training College (TTC) in Makkah Al-Mukkaramah, Saudi Arabia, and aimed to evaluate the current information system there in order to improve or develop the existing system. The new information system at TTC would be designed to help academic and operational staff, students and external users to access accurate information efficiently and more effectively, in a limited time, at the lowest cost and effort, when they needed it.

3.6 Summary

Chapter 3 aims to present key elements relevant to the research objectives and to understand the basic elements of the system, its practice, methodology and multi-methodology, and previews studies which help to develop a new multi-methodology. Therefore, this chapter consist of four main parts: the first part is system theory which includes System Ontology and System Epistemology, Hard and Soft Systems, Simple and Complex Systems, Closed and Open Systems, Socio-technical Systems; and the Systems of Systems Methodologies (SOSM). The second part, Systems Practice, includes Information Systems (IS), Information and Communication Technologies (ICTs), and Information Management (IM). The third part of this chapter considers methodology and multi-methodology. The final part demonstrates the previous studies in this area.

Chapter 4 aims to present overall description of SSM, ETHICS and VSM that can assist in building the structure of proposed new multi-methodology by using the strengths of them and avoiding the weaknesses. Therefore, chapter 4 divided into five parts. Part one presents an intervention of Systems Thinking while part two introduces SSM. Part three introduces ETHICS and part four introduces VSM. The final part makes comparisons between SSM, ETHICS and VSM.

Chapter 4
SSM, ETHICS, and VSM

4.1 Introduction

The central theme of this study is to contrast two methodological approaches and one model to design, implement and evaluate a novel information system that is capable of passing to the staff more accurate information in a timelier manner. The methodological approaches adopted are Soft System Methodology (SSM, Mode 1) (Checkland, 1981), Effective Technical and Human Implementation of Computer-based Systems (ETHICS) (Mumford, 1983), and Viable System Model (VSM) (Beer, 1972).

The main reasons for the chosen two methodological approaches are that both methodologies have been used successfully in numbers of studies and projects, particularly issues related to education, government services, information systems, and information management. Both methodologies are considered to involve the human element to be incorporated into the design of information systems. Both of them have a step by step approach that keeps the research moving forward. It also gives the researcher a logic of achievement as each stage is completed. In addition, SSM and ETHICS are flexible methodologies that can be used in many different ways according to the wishes of the participations (users, mangers, operations staff, and stakeholder). SSM and ETHICS have powerful methods: SSM has rich pictures, root definitions and conceptual models while ETHICS has social and technical design aspects. The main reason for choosing the VSM approach is that it consists of a set of five deeply interacting sub-systems which must support any organisation.

The purpose of this chapter is to give an overall description of Systems Thinking, SSM, ETHICS, and VSM. The first part presents an intervention of Systems Thinking, and comprise Hard, Soft and Critical Systems Thinking. The second part introduces a definition and historical overview of SSM. Then, the chapter moves on to describe the SSM Mode 1 and Mode 2, and reasons for choosing SSM (Mode 1). The third part of this chapter offers the definition and history of ETHICS, and then the 11 stages of ETHICS are outlined. The fourth part presents the definition and history of VSM, then its five sub-systems. The final part shows comparisons between SSM, ETHICS, and VSM.

4.2 Systems Thinking

Ellis (1995) provides a brief description of the development of systems thinking. Systems thinking as a discipline, emerged in the 1940s, and until the mid 1970s there was general agreement concerning the notion of 'system' with respect to systems concepts such as 'boundary', 'feedback', 'control', etc. The assumption made by these early systems thinkers was that all systems existed and that they could be identified and analysed by a combination of empirical observation and the methods associated with the natural sciences. This so-called 'traditional' approach become the subject of increasing levels of criticism from the late 1970s onwards. This criticism was founded on the premise that the traditional or 'hard' approach was not capable of dealing with increasingly complex strategic problem situations involving conflicting human perceptions. It was from such criticism that 'soft' systems thinking emerged during the late 1970s and early 1980s.

O'Connor and McDermott (1997) state that systems thinking looks at the whole, and the parts, and the interconnection among the parts, studying the whole in order to understand the parts. It is the opposite of reductionism (the idea that the whole is simply the sum of the parts, that wholes can be broken into their constituent parts and studied in order to gain an understanding of how they work). To take this concept further, Checkland, (1999) indicates that systems thinking implies thinking about the world in terms of the concept of a system which can be defined as a set of elements connected together in an organized and inter-related way to form a whole, this showing emergent properties which are properties of the whole, rather than properties of its component parts. Thus, systems thinking is a framework for investigating problems, looking to the system as a whole (holisim), understanding its parts, and examining the relationships between the parts of the system.

One of the main aspirations of adopting systems thinking is to be comprehensive. According to Flood and Ulrich (1990), systems rationality is an 'ideal' that may orientated applied inquiry toward a critical rational social practice in the face of incomplete knowledge and understanding. Systems thinking should, according to this view, support the notion of 'holon' whose meaning is 'creating and managing diversity and tension, rather than manufacturing harmonious, perfect wholes'(Flood and Romm, 1996).

Checkland and Scholes (1999) suggest that if the word 'holon' were adopted for the abstract idea of a whole having emergent properties, a layered structure and process of communication and control which in principle enable it to survive in a changing environment, then Figure 4.1 would be readily understood. It would make it clear that systems thinkers are people who formulate some holons (*x*) relevant to aspects of perceived reality which they are interested in, and then use the holons in a methodology, *M,* to find out about, or gain insight into, or engineer, some of the world outside themselves.

Therefore, systems thinking aims to address complex issues allowing wiser decisions to be made in a more manageable and understanding way by looking at the problem holistically. It aims to identify the key factors, establish the main drivers, and ascertain how they interact together and influence the outcome by looking at the system as a whole (Sherwood, 2002).

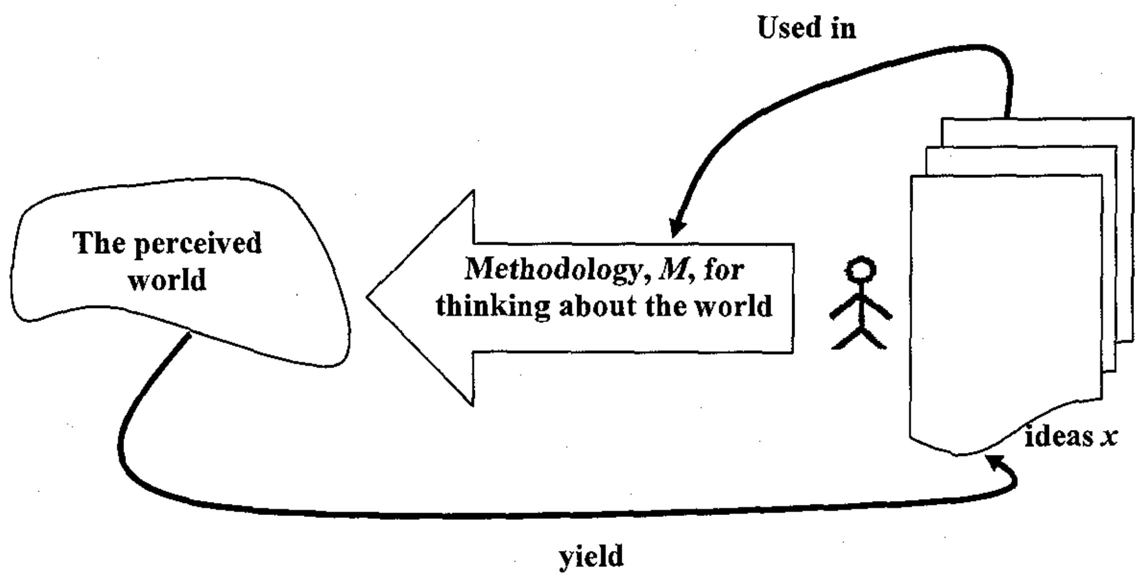


Figure 4.1 Expended to the world interpreted by ideas whose source is the world itself (adapted from Checkland and Scholes 1999)

4.3 'Hard', 'Soft' and 'Critical' Systems Thinking

Systems thinking exhibits three different kinds of system approaches, 'hard systems thinking', 'soft systems thinking' and 'critical systems thinking'. The definition of 'hard' and 'soft' centered around the assumption made about the 'systems' concept and how it is used to represent the real world (Checkland, 1993; Checkland & Holwell, 1998). Therefore, the differences between 'Hard' and 'Soft' systems thinking are the vital step to understanding SSM.

Mirijamdotter (1998) formulates a significant comparison between hard systems thinking and soft systems thinking. He indicates that a hard system thinking assumes the world is mechanistic, that is contains systems which can be modelled and engineered in order to accomplish their objectives. Consequently, the 'system' itself is not perceived as problematic; problems are defined as the difference between the present situation and a desired situation. The methodology provides systematic guidance in the process of finding the solution. This is usually done by searching for alternative means and then choosing the optimal situation for meeting the desired end. Soft systems thinking, in contrast, considers the world as problematical, complex, and mysterious, characterised by multiple angles of approaches and perspectives. The understanding of reality is dependent upon the observer, his interpretations and what he chooses to focus on. Consequently, it considers that the real problem is not to find solution, but to define the problem itself and improve the 'problem situation' (see Figure 4.2).

In real world applications, the hard systems thinking considers organisations to be logically arranged, goal-seeking mechanisms (Lewis, 1994). Organisations are seen as goal-seeking entities made up of parts that perform individually without being interrelated to each other. Soft systems thinking, on the contrary, considers organisations to be complex and changing entities made up of collection of elements that interact with each other to form a complex situation (Checkland & Holwell, 1998).

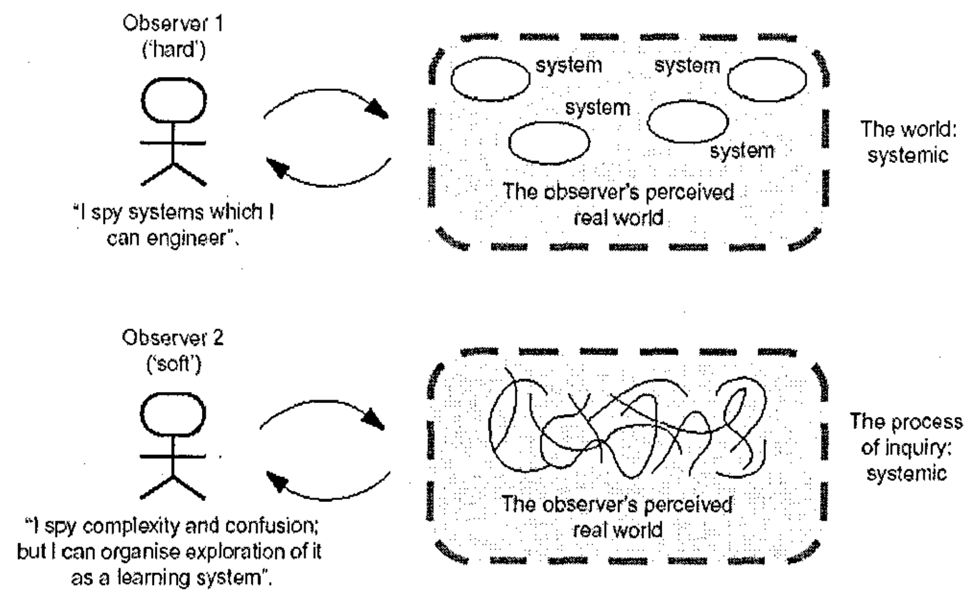


Figure 4.2 The Hard and Soft Systems Stances (adapted from Checkland and Scholes 1999)

Furthermore, hard approach tends to leave the human aspect of systems aside. People are treated as components to be engineered, not as actors whose commitment must be own if solutions are to be implemented and plans realized (Jackson, 2003). While, he notes that, soft approach treats the notion of 'organisation' as extremely problematical. It only arises because of the readiness of people, members and nonmembers alike, to talk and act as though they were engaging with a collective entity capable of purposeful action in its won right. As a result, the soft approach takes a more social view of organisations and sees them as relationship-managing entities, whereas, hard approach takes more technical view of organizations.

Another response to the criticism of hard system thinking was the critical systems approach, developed by Ulrich and Churchman in Europe and the USA respectively, and by the work of Mingers and Jackson in the UK. Critical systems thinking (CST) can be traced back to two separate origins in the early 1980s which were Critical Systems Heuristics (CSH) and a critique of systems interventions by Mingers (1980) and Jackson (1982). CSH originated from work of Churchman and has been further developed by Ulrich. CSH represented the first systematic attempt at providing both a philosophical foundation and practical framework for CST. Jackson's ideas became encapsulation in the notion of Total Systems Intervention (TSI), which originated from Jackson's own work with his collaborator Flood (Flood and Jackson, 1991).

There are two main ideas taken for Churchman which were further developed by Ulrich and used in a more radical direction to develop the CSH methodology (Ulrich 1988, 2003). One of Churchman's contributions to systems thinking was establishing the essential idea that the drawing of boundaries to determine how improvement is to be defined and what action should be taken. Another idea of Churchman's, developed by Ulrich, focuses on the clear need for social systems design to be incorporated into the whole system.

Ulrich (1983) suggests three terms for his methodology: "critical", "system", and "heuristic". Jackson (2003) declares these three terms as: to be "critical" means reflecting on the assumptions that enter into both the search for true knowledge and rational action; the "system" idea in Kant refers to the totality of elements (ethical, political, ideological and metaphysical) on which theoretical or practical judgements depend; the "Heuristic" component means the process of continually revealing those assumptions and keeping them under review. In Ulrich's view, the distinguishing features between CSH and system science (Operational Research, systems analysis, systems engineering, cybernetics) is that in system science the idea limited on mechanistic and organismic analogies which is used only in the context of instrumental reason to help us to decide *how to do things*. It refers to a set of variables to be controlled. On the other hand, Ulrich's purpose is to develop the systems idea as part of practical reason, to help us decide *what we ought to do* (Jackson, 2003).

Ulrich (1993) outlines the 'purposeful systems paradigm' that underpins his methodology. Social systems designers inevitably come up against human intentionality (self-consciousness, self-reflectiveness and self-determination) as well as space and time. Therefore, Ulrich reasons that social reality is understood and improved only if additional dimensions of 'purposefulness' and social systems design are added. 'Purpose' is a key system trait in Ulrich's view of the world. In a purposeful system the ability to determine purpose must be spread throughout the system. The system should produce knowledge relevant to purpose and encourage its debate. To encourage this, all plans or design proposals should be critically assessed in terms of their normative content.

The next step is to construct some principles for the methodology around Kant's three transcendental ideas (the World, Man and God). They are adjusted by Ulrich to yield the 'systems', 'moral' and 'guarantor' concepts (Jackson, 2003). The systems idea is required to reflect on the inevitable lack of comprehensiveness of attempts to map social reality and produce systems designs. The moral concept instructs the systems designer to use his or her design to improve the human condition for all, but at the same time to question constantly the values built into designs and consider their moral imperfections. Moral limitations are best revealed by listening to the views of those affected, but not involved in the planning process. The guarantor idea insists that there can be no absolute guarantee that planning will lead to improvement; but, the systems designer should seek to incorporate as many sources of imperfect guarantees as possible. This means taking into account any scientific data available, evaluation, feedback, etc., as well as the views of experts and other stakeholders. The next stage of the methodology is intended to assist systems designers to make transparent to themselves and others the 'whole system' judgements (limited by knowledge, ethics and guarantee) that inevitably enter into social systems designs. Jackson (2003) indicates that this is where Ulrich's concept of 'boundary judgements' are particularly useful.

When planners design systems they inevitably make assumptions about what is inside the system of concern and what belong to its environment. These boundary judgements reflect the designers' whole system judgements about what is relevant to the design task. If they are not made transparent, they also represent 'justification break-offs', revealing the scope of responsibility accepted by the designers in justifying their designs. Thus boundary judgements provide an access point to the normative presuppositions entering into systems designs. The task is to find a means of interrogating systems design to reveal the boundary judgements currently being made and a means of asking what other boundary judgements might be possible. Ulrich proceeds to look at the nature of the boundary judgements that must inevitably enter into any social systems design (Jackson, 2003). There are 12 criteria to be take into considerate when applying boundary judgements (see Table 4.1). The criteria are arranged around a distinction between those 'involved' in any planning decision (client, decision-taker, designer) and those 'affected but not involved' (witnesses).

Ulrich (2003) states that to reveal the boundary judgements involved, boundary questions must be asked for each of the four groups of clients, decision-takers, designers and witnesses. The questions relating to the client concerns the 'sources of motivation' flowing into the design. They are about its purpose. The questions relating to the decision-taker examine 'sources of control'. They are about the design's 'basis of power'. The questions relating to the designer concerns 'sources of expertise'. They ask for the basis of guarantee. The questions relating to the witnesses reflect on the 'sources of legitimation' considered in the design. So they ask about the values it incorporates. Jackson (2003) declares that there are three questions asked of each of the four groups giving the complete set of 12 boundary questions. The first question is about the 'social roles' of the involved or affected; the second refers to 'role-specific concerns'; and the third to 'key problems' surrounding the determination of boundary judgements with respect to that group. The power of the 12 questions to reveal the normative content of systems designs is best seen if they are asked in an 'is' mode and an 'ought' mode, and the answers contrasted. The 12 questions are set out in the 'ought' mode, in Table 4.1.

Midgley (2000) suggests that the 12 boundary questions include some jargon and that it can be useful to employ other versions of the questions in plain English. There will be other alternative methods that can be used for uncovering normative assumptions. He also indicated that the 12 questions can be used as a tool to support other methodologies. From Midgley's perspective, the Ulrich approach to system boundary identification can be used as a useful concept in any multi-methodological systems approach.

1	Who ought to be the client (beneficiary) of the system S to be designed or improved?
2	What ought to be the purpose of S (i.e., what goal states ought S be able to achieve so as to serve the client)?
3	What ought to be S's measure of success (or improvement)?
4	Who ought to be the decision-taker (i.e., have the power to changeS's measure of improvement)?
5	What components (resources and constraints)of S ought to be controlled by the decision-taker)?
6	What resources and conditions ought to be part of S's environment (i.e., not be controlled by S's decision-taker)?
7	Who ought to be involved as design of S?
8	What kind of *expertise* ought to flow into the design of S(i.e., who ought to be considered an expert and what should be his role)?
9	Who ought to be the guarantor of S(i.e., where ought the designer seek the guarantee that his design will be implemented and will prove successful, judged by S's measure of success (or improvement))?
10	Who ought to belong to the *witness* representing the concerns of the citizen that will or might be affected by the design of S (i.e., who among the affected ought to get involved)?
11	To what degree and in what way ought the affected be given the chance of *emancipation* from the premises and promises of the involved?
12	On what *worldview* of either the involved or the affected ought S's design be based?

Table 4.1 Ulrich's 12 boundary questions in the 'ought' mode (Jackson, 2003)

The second type of critical systems thinking is a UK development which can trace its origins to the critique of soft systems thinking that was initiated by Mingers and Jackson. Mingers (1980), using critical theory, started questioning the theoretical foundation of systems thinking. Jackson (1982) then exposed the limitations of both hard and soft systems thinking in dealing with problem situations characterized by elements of coercion, arising typically from asymmetry of power (Maru and Woodford, 2000).

Jackson (2001) suggests that if all systems approaches have different strengths and weaknesses, it is sensible to use them, in combination to address different problem situations and different purposes. Therefore, Jackson and Keys during 1983 initiated a research programme, within the Department of Management Systems and Science, University of Hull, aimed explaining the theoretical relationships between different systems-based methodologies and practically at discovering the efficacy of particular approaches in various problem contexts (Jackson, 2001). He added that the theoretical tool at its heart was the System of Systems Methodologies (SOSM).

The system of systems methodology rests upon an 'ideal-type' grid of problem contexts, more information about SOSM see section 3.2.6 (Chapter 3). Jackson (2003) states that the ideal-type grid of problem contexts is useful in helping us to understand how applied systems thinking. It enables us to grasp the variety of responses made by systems practitioners in their attempts to overcome the weaknesses of hard systems thinking in order to tackle more complex problem situations.

It is clear from Figure 4.3 hard systems thinking is in the 'simple-unitary' category. In other words, hard systems thinking remain' stuck in that area of the grid of problem contexts where it is assumed that people share values and beliefs and that systems are simple enough to be mathematically modelled. As mentioned earlier, hard systems thinking is unable to deal with more complex problem situations, and in problem contexts that are deemed to be more pluralist and coercive in character.

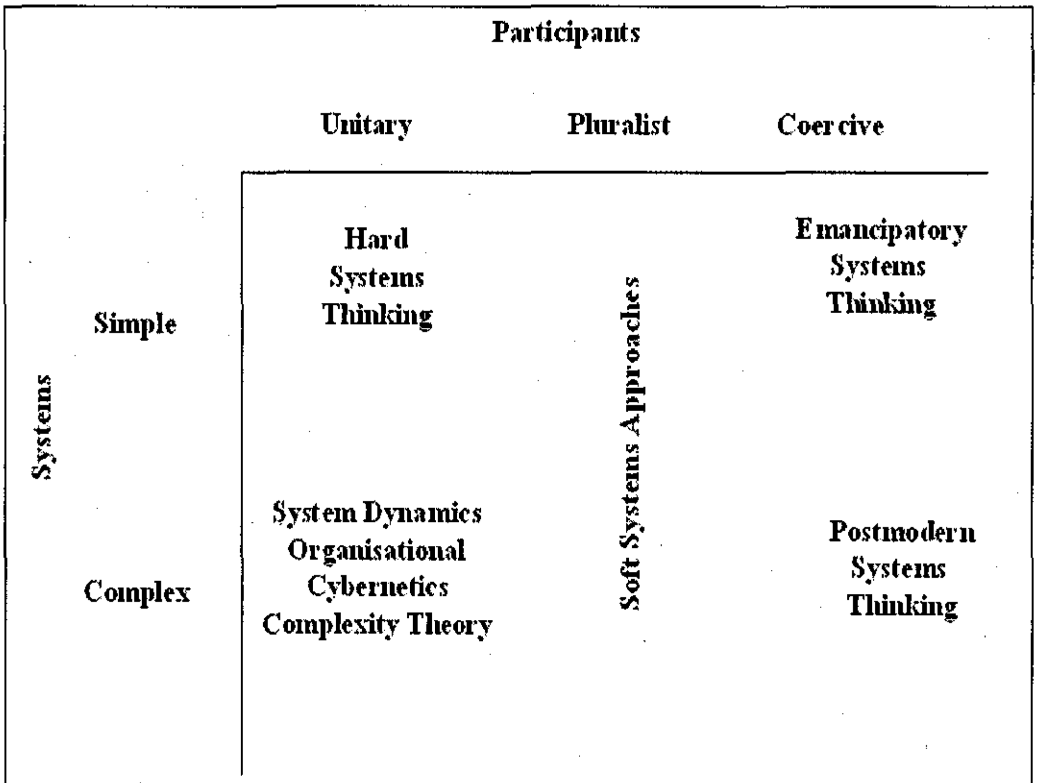


Figure 4.3 Systems approaches related to problem contexts in the System of Systems Methodologies (SOSM) (Jackson, 2003)

Jackson and Keys (1984) begin with the vertical axis of the ideal-type grid of problem contexts, and our concern, therefore, is with those systems practitioners who wanted to move down the axis by assuming that problem contexts were more complex than hard systems thinkers believed. They added that the aim of hard systems thinking was to optimize the system of concern in pursuit of a known goal, and to do this it appeared necessary to model the interactions between all those elements or subsystems that might affect that system of concern. On the other hand, in complex systems, the vast numbers of relevant variables and the myriads of interactions make this an impossible requirement. The solution, suggested by those wishing to progress down the vertical axis, was to identify those key mechanisms or structures that govern the behaviour of the elements or subsystems and, therefore, are fundamental to system behaviour. Examples to complex systems are system dynamics, organizational cybernetics, and complexity theory. Jackson (2003) states that if we move part way along that axis we find that a number of methodologies have been developed that assume that problem contexts are pluralist and provide recommendations for analysis and intervention on that basis. This tradition of work has become known as soft systems thinking. In soft systems thinking attention had to be given to ensuring sufficient accommodation between different and sometimes conflicting world views in order that temporary coalitions could be fashioned in support of particular changes. The solution was to make subjectivity central, working with a varity of world views during the methodological process. In Checkland's 'soft systems methodology'(1981), a highly developed approach of this kind, systems models expressing different viewpoints, and making explicit their various implications, are constructed so that alternative perspectives can be explored systemically, compared and contrasted. Jackson (2003) points out, if we shift further along the horizontal axis of the grid of problem contexts, the issue arises of how to intervene in problem situations that are regarded as coercive. Soft systems thinking fails to respond appropriately because of its pluralist bias that consensus, or at least accommodation, between different stakeholders can be achieved. Therefore, Jackson added, systems practitioners have sought to formulate 'emancipatory' systems approaches based on the assumption that problem situations can be coercive. Ulrich's critical systems heuristics' allows questions to be asked about who benefits from particular system designs and seeks to empower those affected by management decisions, but not involved in them. Finally, there are systems practitioners who worry about the claims of any systems methodology to be able to guarantee generalized improvement. They advocate postmodern systems practice in the face of the massive and impenetrable complexity and coercion that they see as inherent in all problem contexts.

Mingers and Gill (1997) define pluralism as interpreted in the broadest sense of the use of different methodologies, methods and /or techniques in combination. In addition, Jackson (2001) indicates that SOSM established 'pluralism' as a central tenet of critical systems thinking. It recognized that pluralism could be achieved based on methodologies (hard, cybernetic, soft, etc.) that were developed from more than one paradigm. Mingers and Gill (1997) outline that Reed's book (1985) described that there were, four developmental strategies for management science include isolationism, imperialism, pragmatism and pluralism. Jackson (2003) explains that isolationists, who believed in just one systems methodology, divided the discipline and discredited the profession. Imperialists, who sought to incorporate different methodologies within their favoured systems-theoretical orientation, ignored the benefits of other paradigms and 'denatured' many of the approaches they used. Pragmatists, who eschewed theoretical distinctions and concentrated on building up a 'toolkit' of methods and techniques on the basis of what 'worked' in practice, limited the possibilities for learning (e.g., why the method worked) and passing on knowledge to future generations. However, pluralism offered excellent opportunities for future progress. It respected the different strengths of the various strands of systems thinking, encouraged their theoretical development and suggested ways in which they could be appropriately fitted to the diversity of management problems that arise.

The final element in the maturation of critical systems thinking was the implementation of its key ideas in a practical meta-methodology which was called "Total Systems Intervention" (TSI), a product of an intellectual partnership between Bob Flood and Mike Jackson (1991). Flood (1995) describes TSI as the problem solving system developed to provide managers with a practical and useful systems-based approach to problem solving. It offers procedures to integrate all methods for problem-solving in a process which ensures that they are employed to tackle only the issues they are best suited to. Moreover, TSI was successful in providing guideline for the use of critical systems ideas in practice, in that it employed critique of different systems approaches, respected the possibility of 'coercive' contexts and was based upon a sophisticated form of pluralism in which methodologies sticking to different paradigms were to be used in the same intervention on the same problem situation (Jackson, 2001).

TSI was built around three phases: creativity, choice and implementation. Jackson (2003) elucidates that the creativity phase gave recognition to the many different views that were possible of organisations and their problems, and encouraged managers and analysts to explore these through the use of Morgan's 'images' (1986) particularly the machine, organism, brain, culture and coercive system metaphors. He added that the aim was to take the broadest possible critical look at the problem situation but gradually to focus down on those aspects most crucial to the organisation at that point on its history. Worthy of note is the attention paid to 'creativity' in the possibility that the problem situation could be perceived as coercive. Having identified the crucial problems for the organisation, a 'choice' had to be made of a suitable systems methodology or methodologies to address the problem situation. This was done on the basis of a review of the strengths and weaknesses of the different methodologies conducted using the 'system of systems methodologies'. Implementation of change could then proceed by employing appropriate methodologies, either singly or in combination.

Another way to look at the problem situations that managers face is to view them from the perspectives offered by different sociological paradigms. It is Burrell and Morgan's thesis (1979) that theories about the social world can be conceived of in term of four key paradigms. The word paradigm is commonly used to refer to something like world view or way of seeing things. Paradigm can be defined as a set of ideas, assumptions and beliefs that shape and guide their scientific activity (Jackson, 2003). He states that we are of course concerned with sociological paradigms because managers, in trying to improve the operations, services or organizations they manage, have to contend with social systems. Jackson (2003) notes that Burrell and Morgan's four paradigms are constructed around the different assumption social scientists make about the nature of social science and about the nature of society. The four paradigms are: the functionalist paradigm; the interpretive paradigm; the emancipatory paradigm; the postmodern paradigm (see Figure 4.4).

The functionalist paradigm takes its name from the fact that it wants to ensure that every thing in the system is functioning well so as to promote efficiency, adaptation and survival. The expertise it provides should put managers more in control of their operations and organisations, and enable them to eliminate inefficiency and disorder. Associated with this paradigm can usually be found the machine, organism, brain, and flux and transformation metaphors.

The interpretive paradigm takes its name from the fact that it believes social systems, such as organisations, result from the purposes people have and that these, in turn, stem from the interpretations they make of the situation in which they find themselves. Organisations happen, and people act and interact in organisations, as a result of their interpretations. This paradigm wants to understand the different meanings people bring to collaborative activity and to discover where these meaning overlap, and so give birth to shared, purposeful activity. Managers can be guided to seek an appropriate level of shared corporate culture in their organizations. Associated with this paradigm are the culture and political system metaphors.

System of Systems Methodology

	Unitary	Pluralist	Coercive
Simple	**Functionalist** *Hard systems thinking*	**Interpretive** *SAST*	**Emancipatory** *CSH*
Complex	**Functionalist** *VSM*	**Interpretive** *SSM*	**Emancipatory** **Or** **Postmodern**

Figure 4.4 Burrel and Morgan's sociological paradigms (adapted from Jackson, 2003)

The emancipatory paradigm takes its name from the fact that it is concerned to 'emancipate' oppressed individuals and groups in organisations and society. It is suspicious of authority and tries to reveal forms of power and domination that it sees as being illegitimately employed. It wants to encourage a radical reformation of, or revaluation in, the current social order. It pays attention to all forms of discrimination, whether resting on class, status, sex, race, disability, sexual orientation, age, etc. Usually associated with this paradigm are the psychic prison and instruments of domination metaphors.

The postmodern paradigm takes its name from the fact that it opposes the 'modernist' rationality that it sees as present in all the other three paradigms. It challenges and ridicules what it regards as their 'totalizing' attempts to provide comprehensive explanations of how organisations function. From the postmodern perspective organisations are far too complex to understand using any of the other paradigms. It takes a less serious view of organisations and emphasizes having fun. It also insists that we can learn much by bringing conflict to the surface, claiming a space for disregarded opinions and thus encouraging variety and diversity. The carnival metaphor fits well with this paradigm.

This study proposes a pluralist approach captured by the use of a bespoke multi-methodology (see Chapter 5). the creativity required stems from notions described in this section. The so-called 'Mandoora Interative Multimethodology' uses SSM, ETHICS, and VSM as an underpinning core, these two methodologies and model are discussed in depth in the next three sections. However, as will revealed (Chapter 5), the ideas encapsulated in critical systems thinking also has a place in the Mandoora Interative Multi-methodology (MIM).

4.4 Soft Systems Methodology (SSM)

4.4.1 Definition and Historical Overview

The soft systems methodology (SSM) was developed in the 1960s by Peter Checkland and his colleagues at Lancaster University, because traditional methodologies: fail to address the social aspect of system development; put too much stress on technical aspects; ignore the human aspect of the system development; and take account of fuzzy problems in organisational contexts (Checkland 1981, Checkland & Scholes 1990). Mingers (2000) states that the history of SSM has already been documented by Peter Checkland himself in his three books: *Systems Thinking, Systems Practice* (Checkland, 1981), *Soft Systems Methodology in Action* (Checkland & Scholes 1990), and *Information, Systems and Information Systems* (Checkland & Holwell, 1998). The first period, during the 1970s, when the main techniques of SSM were developed and its distinctive and original philosophical stance was first articled this period culminated in publication, in 1981, of *System Thinking, Systems Practice,* which documented what is known as seven "stages method".

The second period during the 1980s, was marked by a maturing of the methodology through its reflective use in practice. The philosophy was articulated more clearly, particular techniques were refined, the distinction between mode 1 and mode 2 was made, and the constitutive rules defined. This included Checkland's declaration of the seven-stage method in favour of a more flexible rendition. These developments are all documented in *SSM in action*, published in 1990, (Checkland & Scholes 1990).

The third period, up to the present, is characterized not so much by internal development but by wider and wider application, and dissemination and diffusion both geographically and across disciplines. Checkland's third book documents the increasing use of SSM within information systems, how it is now an approach that is recognised throughout the management disciplines as well as more widely within the social sciences.

4.4.2 Philosophy and Theory

Lane and Oliva (1998) outline the basic theory of SSM and they stated that SSM holds an interpretive perspective of social settings, organisational life included: social reality is the ever-changing outcome of the social process in which human beings continually negotiate and re-negotiate with others their perceptions and interpretations of the world outside themselves (Checkland, 1981). Reality, under this perspective, is complex and can not in itself be assumed to have systemic properties. Instead, Checkland (1985) suggests that the notion of the adaptive whole, i.e., what we normally call a system, is an epistemological device, a conceptual abstraction that we use to make sense of the real world. As indicated earlier in the Chapter, Checkland (1988) proposed the word 'holon' to distinguish the systemic construct from the real world entities commonly labelled as systems. In other words, a holon is a particular type of model, one which organises thinking using systemic ideas.

Lane and Oliva (1998) identify that this interpretative view of reality has two crucial implications for SSM studies. Firstly, it is difficult for an SSM practitioner to accept a unique definition of a problem. Checkland uses the term '*Weltanschauung*' to capture the interpretive stance, or perspective, that individuals adopt in order to define and interpret a problem. SSM is not concerned with the objective study and optimal solution of problems it is intended as a methodology to explore, question and learn about ill-structured problem situations or messes (Ackoff, 1974). Secondly, the models built in SSM do not attempt to describe the real world nor are they intended to be used as normative models. The modelling process embedded in SSM generates 'holonic ideal types' of organised human behaviour under a particular *Weltanschauung*. Each model can only be faithful to one simple and static *Weltanschauung*. Consequently, several models are used to explore the problem situation under different perspectives. The models, as a source of questions to ask of the problem situation, create a structured debate about possible change. What is sought in this debate are accommodation, not consensus, between different outlooks and people which enable change. Therefore, the expected output of an SSM study is a set of insights and changes that emerge from the comparison of these ideal types with the real world problem situation and are acceptable to the agents involved in it.

4.4.3 SSM (Mode 1)

SSM (mode 1) can be described as a broad approach to examine problem situations in a way which would lead to decisions on action at the level of both 'what' and 'how'. The main steps in SSM are illustrated in Figure 4.5 the diagram is divided into two parts. The stages (1,2,5,6,7) above the dotted line are ' real world' activities involving people in the problem situation, whereas stages (3,4,4a,4b) below the dotted line are activities concerned with system thinking about the problem situation (Checkland & Scholes, 1990).

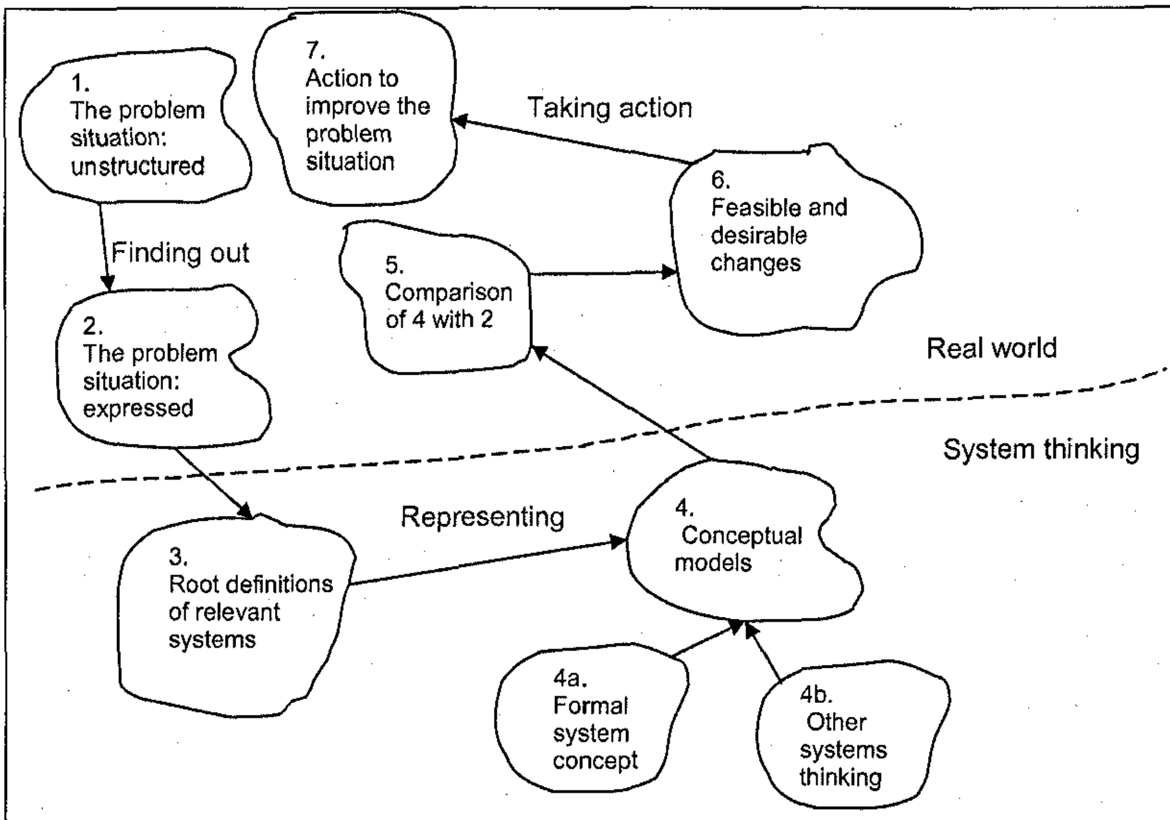


Figure 4.5 Outline of SSM (adapted from Checkland,1981)

Stage 1: The problem situation unstructured

This stage is concerned with finding out about the problem situation from as many individuals in that situation as possible. The problem at this stage is still fuzzy and confusing, and the role of the analyst is to clarify what the problem is. Jackson (2003) indicates that there are three Analyses in developing ways of finding out, and expressing, the problem situation can be recognized in the evolution of SSM (see Table 4.2).

Analysis 1 considers the intervention itself and the roles of client, problem-solver and problem-owners, defined as follows: the client is the person(s) who causes the systems the systems study to take place; the problem-solver is the person(s) who wishes to do something about the problem situation; the problem-owners are stakeholders with an interest in the problem situation. The way the intervention is defined needs to reflect the problem-solver's perceptions, knowledge and ability to make resources available and to take into account the client's reasons or causing it to happen. No one is intrinsically a problem owner, but, in order to be holistic, the problem-solver(s) should consider a wide range of stakeholders as possible problem owners.

Analysis	Dimension	Purpose
1	Intervention	To identifies client(s), possible problem owners, role of problem solver, organisational form through rich pictures within an SSM inquiry.
2	Social	To explore the relationships between social roles, behavioural norms, and cultural values within an organisation.
3	Political	To explore the power relationships, the commodities through which power is represented, and how these commodities are obtained.

Table 4.2 A ways of finding out and expressing the problem situation through three related analysis (adapted from Checkland & Scholes, 1990)

Analysis 2, social system analysis, looks at roles, norms and values, defined as follows: roles are social positions that can be institutionally defined (e.g., head of department, shop steward) or behaviourally defined (e.g., opinion leader, confidante); norms are the expected behaviours that go with a role; cultural values are beliefs about what good and bad performance means in relation to a given role. These three elements are assumed to be in continuous interaction with each other and to be constantly changing. Analysis 3 examines the politics of the problem situation and how power is obtained and used. This can be overt or covert and rests on various 'commodities' that bring influence in an organisation, such as command over resources, professional skills, talent and personality.

Stage 2: Problem situation expressed

In stage 2 the problem solvers gather and sort information and provide some description of the problem situation. The rich picture (RP) is used to describe the real world problem situation. Checkland (1972) states that the RP is "an account of what exists" and results in "as neutral a display as possible" (Checkland, 1981), thus it is 'objective' rather than subjective. Whereas, Avision and Wood-Harper (1997) point out that "drawing a RP is a subjective process" because of in the every essence of the methodology is the idea of interpretation linked to worldview which points at the understanding of the RP as a subjective representation.

Jackson (2003) states that rich pictures are drawings that allow the various features of a problem situation, as it is perceived, to be set down pictorially for all to see. He added that there are no rules for drawing rich pictures and, while some are quite formalized, others are very cartoon-like in nature. A rich picture should represent the structure of the organization, the processes or transformations that are carried out within the system and the relationship between them creating the climate of the situation. Jackson (2003) indicates that Analyses 1, 2 and 3 (see Table 4.1) should be fed into the RP. Otherwise, it is obvious that RP are selective and that it is an art to know which issues, conflicts and other problematic and interesting aspects to accentuate. Jackson also mentioned that if done well, RP can assist creativity, express the interrelationships in a problem situation better than linear prose, allow the easy sharing of ideas between those involved in an intervention, catalyse discussion and act as an excellent memory aid.

Stage 3: Root definitions of relevant systems

The formal expression of systems thinking in SSM starts by writing down the names of relevant systems for carrying out purposeful activity, systems thinking to be relevant to that deeper exploration of the problem situation which will lead to action to improve it (Rosenhead, 1989). Since this RD is the basis for a model of purposeful human activity, it needs to have at its core a transformation (T) process in which some input is changed into output.

The formal rules for a well-formulated RD is that it should contain the elements of the mnemonic word CATWOE: the **C** stands for customer, which means the person(s) who would be beneficiaries or victims of the system; **A** for actor, that is a person(s) who would perform the transformation process; **T** for transformation (the conversion of input to output) The change in a process / task / achieving to improve the problem situation; **W** describes the world view which makes the transformation meaningful; **O** stands for the owner, the person who can stop the transformation; and finally, **E**, environment constraints, the elements outside the system that are taken as given (Checkland and Scholes, 1999).

Jackson (2003) says that RDs are used to explore the possibilities available for change in the problem situation given its history, culture and politics. The relevance of any human activity system is always based on a subjective choice of its importance to the problem situation. To be able to build the activity models, decisions has to be taken as of what the primary tasks and main issues are (Checkland and Scholes, 1999). Primary task root definitions tend to refer to officially declared tasks in the organisation and to give rise models that map existing organizational structures. Issue based models refer to current matters of concern, perhaps the need to be more innovative or to resolve a conflict situation, that cross established boundaries (Jackson, 2003).

Checkland and Scholes (1990) emphasise that a RD should not only include CATWOE elements (Customers, Actors, Transformation process, Weltanschauung, Owners, Environmental constraints), but should also be in the form that help to conceive the core transformation in a RD as "a system to do P by means of Q in order to achieve R". Where P = What? ; Q = How? ; and R = Why?.

Stage 4: Conceptual models

Rosenhead (1989) states that the Conceptual Model (CM) is a diagram describing the activities which would have to be there in the system named in the RD. The diagram shows how the various activities are related to each other, or at least how they ought logically to be arranged and connected and they are not models of anything in the real world. Kareborn *et al.* (2004) see that the four parts (RD, CATWOE, PQR, and CM) are closely linked. PQR and CATWOE holds a central position since both the RDs and the CMs build upon these definitions. However, Pala *et al.* (2003) mention that a conceptual model can be built by thinking through and writing down the minimum number of linked activities which is necessary in order to carry out the transformation process in the way defined in the RD.

Originally, the CM was constructed using the Formal Systems Model (general model of purposeful activity) (Checkland & Scholes, 1999). They defined a formal model of a system which he applied to HAS as a checklist of characteristics that must be present in order for a HAS to satisfy the criteria of being a well-designed system. It can therefore be used as a standard to evaluate a real-world HAS, or as a guide for re-designing a HAS. Checkland (1981) outlines the characteristics of formal system model:

1. **Objectives or purpose.** The system represented by the model must have a clear purpose or goals.
2. **Connectivity.** The activities in the system must be connected to other activities.
3. **Measure of performance.** There must be measures of performance and expected levels of performance to be met, which can be used for assessing the efficiency of the system.
4. **Monitoring and control.** There must be mechanisms to collect data about performance and to compare it with the expected levels of performance. There must also be control activities that have the authority to change other activities when performance expectations are not being met.
5. **Decision-taking procedure.** There must be decision-taking procedures which will be influenced by control actions.
6. **Boundary.** The system must have a clearly defined boundary and communications across the boundary must be explicitly defined. The area within the boundary is that within the control of the regulating mechanism.
7. **Resources.** All systems consume resources and these must be obtained, deployed, replenished and accounted for. Consumption of resources must be monitored and controlled.
8. **System hierarchy.** A system can be decomposed hierarchically – i.e. it has components that are themselves systems.
9. **Continuity.** A system has some expectation of continuity and has mechanisms that allow it to recover from disturbances.

Wilson (1984) suggests that when modeling the activities of a root definition, three criteria have to be fulfilled, the so-called 3 E's to measure the performance of the alternatives for the solution. A first criterion checks whether the selected means work, the criteria called *efficacy*. A second criterion, *efficiency*, checks to see whether the transformation process is being done with a minimum use of resources. The third criterion, *effectiveness*, asks whether the transformation process is meeting the long-term-aims. Is it the right thing to be doing?. Checkland & Scholes (1990) added two more 'e' criteria for monitoring and controlling the system; *ethicality* (is the transformation a morally correct thing to do?) and *elegance* (is the transformation aesthetically pleasing?).

Stage 5: Comparing conceptual models with reality.

This stage compares the conceptual model in stage 4 with the real world situation in the stage 2. The aim is not to improve the models, but to find an adjustment between different interests in the problem situation. The adjustment should involve making improvements into the original problem situation.

The comparison of the problem situation to the conceptual models should be done together with involved participants in the problem situation. The purpose is to produce a discussion of possible and desirable changes that can be introduced into the problem situation in order to bring about improvements. Checkland (1981) describes four different methods of doing the comparison: informal discussion, formal questioning, historical reconstruction, and model overlay. All four methods help to promise that the comparison is purposeful, rational, and reasonable. It may be helpful to use any of these comparison methods or to carry out comparisons using various methods.

The method of informal discussion concerns a general debate about the nature of the models. Strategic issues tend to be raised during this kind of discussion because the questions asked about present activities are more in the nature of why it is performed in the first place. It is therefore proper to view this method of comparison as a general approach, making inquiries as to what features of the conceptual model are particularly different from reality, and why this is (Checkland, 1993; Wilson, 1984).

The second method of comparison, formal questioning, is the most commonly used. The models are used as a basis for inquiring into the real world. Answering those questions encourage discussion in a way that seems appropriate to the exact situation. The discussion may be achieved by a group of people in one place at one time, or by interviewing a single person, with dialogues distributed over a period of time. It is impossible to generalize, but the way of generalization is that filling in a matrix which can be seen as a process of asking questions. Does the activity exist? How is the activity done at present? Who is responsible for doing the activity? Is the activity done well or badly? Do the relationship exist? In what form do they exist? (Guy, 2002).

The method of historical comparison requires reconstruction of a sequence of events in the past according to a conceptual model. The sequence of activities is done either mentally or on paper, and the aim is to write a scenario, which can then be compared with some real-world events (Checkland, 1993; Guy, 2002).

The final method of comparison, model overlay, consists of trying to build a model in such a way that it closely reflects what exists in the real situation. By exactly overlaying the model of what really exists on top of the conceptual model, using transparent paper will directly make any dissimilarity obvious. The method of direct overlay of one model on the other will evidently reveal the differences simply. Any differences would be direct refreshment for discussing possible changes (Checkland, 1993; Guy, 2002).

Stage 6: Feasible and desirable changes

The main idea of the comparison is to use the differences between models and reality to discuss possible changes that might be bring about improvement in the problem situation. This discussion should generate a set of recommendation for change. Checkland suggests that three kinds of change are possible changes to: structure, processes, and attitudes. Change to structure: the factors that are not dynamic such as organizational structures, the make-up of groups. Changes to processes: the activities through which the organization carries out its transformations and realizes its goals (changes in the dynamic elements). Changes in attitudes: changes in the expectations of individuals (as reflected in their Weltanschauung – the viewpoints that are the basis for issue based systems). The changes that are decided have to meet two different criteria simultaneously. Comparison of a fecund reality with a number of models (which are simply logical machines) will generate ideas for changes which are 'systematically desirable'. People will not always be motivated to implement change which is justified merely by logic. Therefore, the changes must also be accepted by the unique culture of the problem situation. If the organization and the people in it are acceptable in this way, the changes are said to be 'culturally feasible'. This why so important to think carefully about worldview that is away of ensuring the cultural aspect can not be ignored.

Changes of both structural and procedural kinds are moderately easy to identify and implement. Once made, such changes can have unanticipated effects within the organization, but at least the implementation itself is a definite undertaking that can be designed. The third kind of change that of attitude, is more difficult to bring about. It is possible in principle to intentionally try to undertake this attitudinal change within the organization, but it is difficult in practice to achieve the exact results intended. The discussion of desirable and feasible changes should be together with people in the problem situation that care about the perceived problem and who wishes to do something about it (Checkland, 1993).

Stage 7: Action to improve the problem situation.

SSM is fundamentally a general improvement method that by encouraging a better understanding of a problem situation helps to identify opportunities for change. The building of human activity systems stimulate discussion and debate about possible improvements which will lead up to recommendations for change. The aim for the discussion around comparing the models of human activity systems to reality is to reach at some changes that may be initiated in the problem situation. The new problem situation will then include the implementation of those changes. The process of implementation can also be tackled using SSM (Checkland, 1985). The implementation does not mean that how the problem solvers are going to perform these actions, but it tells them that what are the necessary actions to be taken in order to improve the problem situation.

4.4.4 SSM (Mode 2)

The two-stream model of SSM (Figure 4.6) was first expounded at a plenary session of the Annual Meeting of the International Society for General Systems Research in 1987, and was published the following year (Checkland, 1988). This version of SSM (Mode 2) combines the usual day to day activities of an organisation. It requires constant attention to the interrelationships between "logic-based stream" and "culture stream". This two-stream model of SSM gives equal space to the cultural stream of analysis and to the logic-based stream (Checkland and Scholes, 1999).

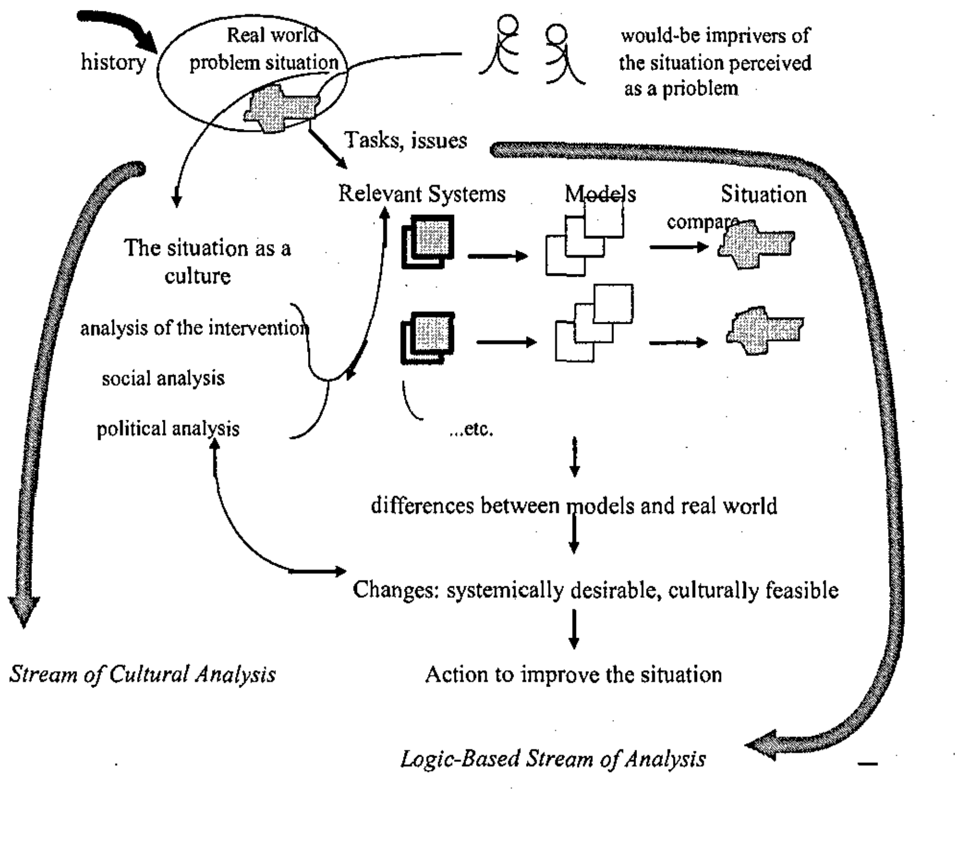


Figure 4.6 The conceptual idea of the dynamic mode of SSM (adapted from Checkland and Scholes, 1990)

The main differences between Model and Mode 2 were summarised by Jackson (2003) as follows: Mode 1 "interventions" are methodology driven and prescribe certain activities that need to be carried out, while Mode 2 "interactions" are situation driven and allow managers to make sense of what is going on. In Mode 1, SSM is external and dominates proceedings, in contrast Mode 2 is internalized and only occasionally breaks the surface of ongoing events. Mode 1 is sometimes sequential, whereas Mode 2 is always iterative (Checkland and Scholes, 1999). They also added that "Mode 2 as a whole excludes the dividing line between the world of the problem situation and the system thinking world. It had served its heuristic purpose".

4.4.5 Reasons for Choosing SSM (Mode 1)

There two reasons stand behind the decision for choosing SSM (Mode 1). It is "intervention" methodology driven and prescribes certain activities that need to be carried out. While, SSM (Mode 2) "interaction" is situation driven and allow manager to make sense of what is going on. The other reason is that this research study was carried out in the UK. Thus, the researcher adopted SSM (Mode 1) because of its external and controls proceeding, whereas SSM (Mode 2) is internalised and only infrequently breaks the surface of ongoing events (Jackson 2000).

4.4.6 Features and weaknesses of SSM

Checkland and Scholes (1990, 1999), Checkland (1981), Chilvers (2000), Finegan (1994), Al-Zahrani (2001), and Vidgen and Avison (2002) outline features and weakness of SSM as follows.

The features of SSM

- SSM is a set of guidelines that help users perform analysis associated with human activity systems while allowing a considerable scope of personal interpretation;
- SSM believes that 'the problem situation' is a more appropriate description since there might be more than one perceived problem identified;
- SSM is used when objectives are hard to define, indeed when the objectives are "problematic";

- SSM concentrates on soft problems such as political, social, and human activities;
- SSM is heavily involved in people interaction, so SSM can deal with complex problem scenarios;
- SSM will be a good method to be used in any project that needs a lot of user involvement;
- SSM can be used by a non-technical people to deal with social problems; and,
- SSM helps to improve problem situation rather than solve problems.

The weaknesses of SSM include:

- SSM is too flexible and too general;
- SSM does not provide any checklists for each stage. Checklists are good ways to keep track what we actually do;
- SSM process could be costly in term of time resources;
- SSM doe not help to develop or implement a system;
- *It is impossible to manage all peoples views; and,*
- SSM does not provide advice about the success or a failure of a problem scenario.

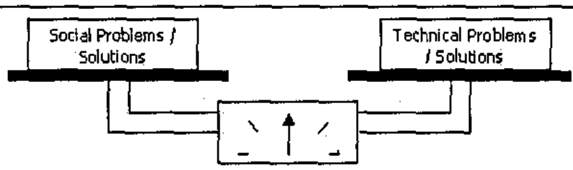
4.5 Effective Technical and Human Implementation of Computer-Based Systems (ETHICS).

4.5.1 Definition and historical overview

The origins of socio-technical systems design can be found in a meeting of social scientists at the end of the Second World War and formed the Tavistock Institute of Human Relations in London in 1946 (Mumford, 1995). This group believed that progress in organisations lay in a new form of work structure that would improve efficiency, but also create a good quality work environment and high job satisfaction. She outlines that these new work structures were based on logically connected groups of tasks that enabled employees to acquire a number of skills, to do a whole job to take decisions and to solve problems they would also offer opportunities for working as members of integrated teams for supportive relationships and personal development. These ideas came from biology and from the notion of 'open systems'. From this point, Mumford (2003) states that ETHICS is a framework based on the socio-technical design principles of the Tavistock Institute, a cybernetic model developed by Professor Stafford Beer.

4.5.2 Philosophy and Theory

The ETHICS methodology was developed by Enid Mumford in the early 1980s (1983a, 1983b), she described it as a participative approach to information system development. Mumford (2003) states that the philosophy of ETHICS is one which has evolved from organisational behaviour and perceives the development of computer systems not only as a technical issue but as an organisational issue fundamentally concerned with the process of change. Jayaratana (1988) classified ETHICS as 'process-oriented'. In other words, ETHICS incorporates the philosophy of both socio-technical design and participation. This means that ETHICS methodology is giving equal importance to social and technical consequences of the solution upon job satisfaction and efficiency (Figure 4.7). Thus, ETHICS is well known for its emphasis on and interest in the 'human' aspects of systems design.



Job satisfaction and efficiency

Figure 4.7 Balance between social and technical consequences of the solution

Job satisfaction has been defined by Mumford (1994) as "the attainment of a good 'fit' between what the employee is seeking from his work - his job needs, expectations and aspirations - and what he is required to do in his job - the organisational job requirements which mould his experience". She identified five areas in order to measure the job satisfaction. These areas include:

1) *The knowledge fit*: a good knowledge fit can be described when the employee thinks their skills are being sufficiently used and that their knowledge is

being developed to make them increasingly knowledgeable. It is recognised that different people have widely different expectations in this area, some want their skills developed while others are content with an 'easy life'.

2) *The psychological fit*: a good psychological fit means a job must fit with employee's status, improvement and work interest. These needs are variable according to age, background, education and class.
3) *The efficiency fit*: a good efficiency fit contain include three areas. First, the effort-reward bargain, which is the amount the employee is prepared to pay as opposed to the view of the member of employee about how much s/he is worth. Second, work controls, which need to fit the staff's expectations. Third, supervisory controls, such as necessary back-up facilities e.g. information, materials, specialist knowledge etc.
4) *The task-structure fit*: is the organisation of work activities in such a way that, from a positive point of view, provides employee with a group of challenging tasks and decisions; and, from a negative point of view employee are not required to under take any thing that they regard as too onerous, too demanding, too dull, or too simple. This element of job satisfaction is strongly related to technology and its method of employment. Technology can affect the task-structure fit substantially and can reduce the fit by simplification and repetitiveness. However, it is also seen as a variable which can be improved dramatically by designing the technical system to meet the requirements of the task-structure fit.
5) *The ethical fit*: this is can be expressed as the social value fit and concerned with needs related to employee value. Some organisations performance is importance thing, whilst others value highly employees who are successful as human beings as well as workers.

The second main strand of ETHICS methodology is participation. This is the involvement of those influenced by a system being part of the decision-making process concerning the design and operation of that system. Users are involved in the decisions concerning the work process and how the use of technology might improve their job satisfaction Mumford (1994).

In ETHICS the development of computer-based systems is seen as a change process and thus it is possible to involve conflicts of interest between all the participants or actors in that process. These conflicts are not simply between management and worker, but often between worker and worker and manager and manager. These conflicts may be related to the various interest group which have different values, needs and objectives. Therefore, the successful implementation of new systems is a process of negotiation between the affected and interested parties.

Systems design can occur at three different organisational levels. Top level concerned with strategic planning, the middle level covers system definition for number of processes, units, functions or departments, and the lower level concerned to implementation of technical and organisational subsystem for single department or functions. There were three type of participation which identified by Mumford (1983). Firstly *Consultative* participation is seen as most appropriate for securing agreement on strategic planning objectives. The major planning decisions are taken by high management, whose senior position enables them to take abroad view of the organisation's future need. However, they will only take these decisions after extensive consultation with interested groups lower down the organisational hierarchy, and a consultative structure must exist or be created so that this opinion can be comprehensive and accurate. Secondly, *Representative* participation is seen as appropriate at the system definition stage when powerful inters groups will which to express an opinion on where system boundaries are to be drawn and the broad from any future system should take. The decisions at this level will be mainly taken by senior staff in most organisations, representative design teams will includes some selected or elected representatives of other grades of staff. Finally, *Consensus* participation attempts to involve all the staff associated with a business process or in an affected function or department to play a part in the design of a new work system.

ETHICS has three principal objectives (Mumford, 1996). These are:

1. To enable the future users of a new system to play a major role in its design and to assume responsibility for designing the work structure that surrounds the

technology. This involves a learning process and a set of simple diagnostic and socio-technical design tools. By socio-technical is meant a design approach which tries to optimise both the use and development of technology and the use and development of human knowledge and skill.

2. To ensure that new systems are acceptable to users because they both increase user efficiency and job satisfaction.
3. To assist users to become increasingly competent in the management of their own organizational change so that this becomes a shared activity with the technical specialists and reduces the demand for scarce technical resources.

4.5.3 ETHICS Stages

There are different views of how many stages should be used when using ETHICS ranging from six stages, twelve stages, fifteen stages, and twenty five stages, depending on which sources are referred to. Avison and Fitzgerald (2002) indicate the major difference is that there is a greater separation of the technical and social issues. This might mean that the technical issues of design could be addressed by a separate, more technically experienced design group. However, the fifteen stages version outlined here corresponds to those described in Mumford (1986).

Stage 1: Why change?

In this first stage the design group should describe the current problems situation. The group should also agree whither there is a need for change or not. The design processes stop in this stage, if the group find difficult to agree and find reasons for changes. In line with this, Mumford (2003) points out that the first stage aims to determine whether there is a need for change or not. She added that the design group should not only concern with the present problem, but also with the future demands and the opportunities for improvement that a new technology and new organisation could bring.

Stage 2: System boundaries.

The aim of this stage is to identify the current system boundaries and all other system interactions with the current system under study. Mumford (1986) stated that the design group should consider four main areas to be identified: organisation activities (for example, sales, finance and personnel); existing technology (hardware and software); organisational parts (e.g. departments, units, sections, teams); and, organisational environment (e.g. culture, suppliers and users). Furthermore, she declares that the design group should know the people that will be affected by the new system directly or indirectly; and conversely, those who will not be affected.

Stage 3: Description of the existing system.

In this stage the design group look at the existing system in detail and how it works. It is also for the design group to identify the benefits of the current system and its problems. The main benefits from this stage are to understand the existing system before focusing on what should be changed. The discussion between design group members give them confidence and enables them to start working together as a team (Mumford, 2003).

Mumford (1986) states that this stage requires the design group to make two kinds of description. A horizontal (input/output) analysis and a vertical analysis. A vertical analysis is presenting different levels of work complexity and importance. It is based on the cybernetic model of a viable system developed by Professor Stafford Beer (1981). A viable system is a practical tool which enables description of work activities to be clear, simple and logical (Mumford, 2003). She describes an organisation, department or work process as a hierarchy of five levels of activity (see Figure 4.8). Each of these levels should be recognised, designed and managed, and interact smoothly with others to provide a good system design if the work process is to proceed at a high level of performance.

Mumford (1996) expresses that the first level consists of operating activities. These are the day-to-day tasks that enable the primary functions of the department to be carried out. These should have been described in the input/output analysis. The second level consists of activities directed at preventing work problems occurring and correcting these when they do occur. These are called problem prevention/solution activities. The third level consists of activities and tasks that add value to the development of the product and establish how they can be carried out most effectively. This must be coordinated within the system and between the system and other systems. These are coordination activities. The fourth level is required new developments will come from an examination of the external environment and the changes that are likely to take place there. For example, what processes, services etc need to be developed and improved. These are development activities. Finally, control level. This is monitoring and measures that can show if progress is being made and goals are being achieved. These are control activities.

Level 5: Control
Meeting targets and standards

Level 4: Development
New thinking

Level 3: Optimisation
Adding value

Level 2: Anti-Oscillation
Preventing and solving problems

Level 1: operational
Day-to-Day tasks

Figure 4.8 A Viable System (adapted from Mumford, 2003)

Stage 4: Definition of key objectives.

In this stage, the design group should find answers to some fundamental questions to guide them through design process. These questions are what is their primary role and purpose?, what are its key tasks?, and will these be the same or different in five years time? (Mumford, 2003). She pointed out that the final discussion should create an initial list of key objectives that must be kept in mind throughout the design process. So, the design group tasks must be created a new system which will achieve these key objectives.

Stage 5: Definition of key tasks.

This stage aims to find out the key tasks which must be carried out to achieve these objectives.

Stage 6: Key information needs.

The aim of this stage is to find out the key information needs for example Operating Information, Problem prevention/solution information, Co-ordination information, Development Information, and Control information. Mumford (1995) outlines a five level model used to describe work in stage 3 that can be used again here (see Figure 4.9).

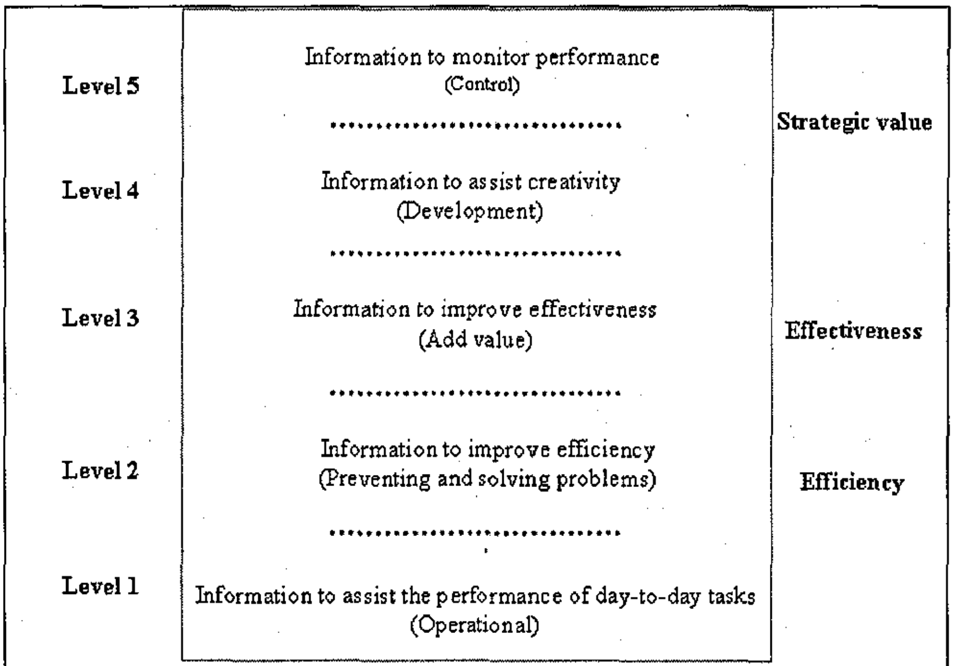


Figure 4.9 A Viable Information System (adapted from Mumford, 1995)

Stage 7: Diagnosis of efficiency needs.

This is a critical part of the socio-technical approach. The aim of this stage is to improve efficiency by looking in more detail at the system problem 'variances'. A variance was developed by the early Tavistock group (1946). It shows how a problem which occurs at an early stage in a work system, if not corrected can cause other later problems in the same system. In the other words, it is a part of a system that deviates from expected or desired standard or norm (Mumford, 2003). She stated also that there are two kinds of variances which are key variances and operating variances. Furthermore, she states that "key variances which are systemic (built into the system) and occur because of the essential goals and function of the user area. Key variances are often arise at the boundary between one set of integrated activities and other". Mumford (2003) added that operational variances which stem from the organizational inadequacies of the old system and the technical and procedural problems which have accidentally been built into it. To identify variances a survey is carried out and all potential users of the new system are asked to describe on paper the key and operational variances that they experience. Each member of the design group now holds meeting with users that they represent to discuss how these problems can be avoided or more easily dealt with.

Stage 8: Diagnosis of job satisfaction needs.

This stage is analytical framework for describing and measuring job satisfaction. Mumford (2003) defines job satisfaction as the achievement of a good fit between job needs and expectations and job experience (see section 4.3.1).

Stage 9: Future analysis.

In this stage the new system deign required to be both a better version of the existing system and able to cope with future changes that may occur in the environment, technology, organisation or people attitudes (Mumford, 1986). Thus an attempt is made to try and identified these changes and to build a certain amount of flexibility into the new system. This may involve the design group in interactions with people outside the organisation in order to identify and assess the potential changes.

Stage 10: Specifying and weighting efficiency and job satisfaction needs and objectives.

Mumford (1995) identifies this as the key step in the whole methodology. The specification of mission and key tasks, diagnosis of efficiency, the identification of effectiveness needs, the job satisfaction needs, and the group discussions associated with this, and the diagnosis of future needs will have identified the problems and requirements of the different units, sections, roles, and grades. These will have been discussed, agreed, documented and prioritised.

The next step is to set specific efficiency, effectiveness, and job satisfaction objectives for the new system. All groups of people concerned in the development of the new system are involved in mapping these objectives out. Often objectives conflict and the priorities of the various constituencies may be very different. The design group should identify the conflict between different interest groups and attempt to resolve these conflicts before alternative design strategies are put forward. In the end, alternative organisational and technical design strategies are tested against the most important objectives and the strategy that the best fits the objectives is the one chosen for implementation. The interest of individual members of the design group and their constituents now have to be reconciled with the interests of the design group as a whole and with those of other groups of users. The design group may have to help the group to resolve these internal and external conflict of interest.

It is necessary, at this stage for the design group to be aware of the wishes and priorities of all group who will be affected either directly or indirectly by the new system. Therefore, any who do not have representatives on the design group must now be asked to attend one or two meetings so that their views can be heard. The views of external groups such as customers and suppliers must not be forgotten in this process. Moreover, it is extremely important for the design group to check its selected objectives with other groups before proceeding further. Therefore, meetings should be held with the steering committee and with staff indirectly affected by the new system. Consequently, all interest groups will then be able to discuss the objectives which the new system is going to attempt to achieve and register their approval or objections (Mumford, 1995).

Stage 11: The Organisational design of the new system.

Organisational design should be considered in parallel with the technical design to achieve the specified and agreed objectives. One of the principles of the socio-technical approach is to make work more satisfying for individual and group doing it while at the same time enabling them to contribute to a high level of technical efficiency. To achieve this it has developed a number of work design principles. Mumford (1995) summarised these as follows.

- The work system comprising a number of logically integrated tasks or unit operations, became the basic design unit not the single tasks or operations which formed it.
- The work group became the primary social unit, not the individual job holder.
- Internal regulation of the system was by the work group itself.
- Because the work group was the primary social unit the job of individuals could be multi-skilled.
- Greater emphasis was placed on the discretionary as opposed to the prescribed part of the work roles.

- People were treated as complementary to machines not as extensions of or subservient to machines.
- Work organisation aimed to increase not decrease work variety.

The ETHICS methodology uses many of the socio-technical principles for the design of jobs, for example, the notion of self-managing groups, but also considers the technical design options that are available and evaluates the efficiency and human advantages and disadvantages of each of these as part of the design task. Alternative technical and social solutions are first considered separately and later merged. In order to specify human alternatives, a design group needs to have a good knowledge of the different ways in which work can be organized. Mumford (1983) recommends three ways of working:

- Improving the employee's 'task variety'. In other words, giving an individual more tasks to carry out, or by allowing movement around a number of tasks, with period of time being spent on each. These will reduce work monotony and will be appropriate if a particular employee group is generally satisfied with work and merely wants more variety in order to have a higher level of job satisfaction.
- Job-enrichment this is where tasks are handled by different groups and by giving staff responsibility for activities, such as problem-solving and the obtaining of information, which has previously been carried out by supervisors. This gives supervisors more time for long-term planning and coordination with other groups and departments. This kind of job enrichment seems to improve both job satisfaction and efficiency in many situations, provided that staff can be trained to the necessary level of competence. This means that an individual has the freedom to change the way the job is performed. This leads to constant review and the implementation of new ideas and methods.
- Self-managing groups, here, groups are formed that have responsibility for a relatively wide range of the tasks to be performed. These groups are preferably multi-skilled, so that each member is competent to carry out all the operational activities for which the group is responsible. self-managing

groups can hand over a great many control activities for example, let the group organise its own work activities, set its own performance targets, and monitor them. This kind of group may require little supervisory intervention in its activities and management's responsibility will become one of long-term planning.

Stage 12: Technical options.

In this stage all technical options for the system are discussed including hardware, software and the design of the human-computer interface. Each option is evaluated against efficiency, job satisfaction, and future change objectives. The results of this stage and stage 11 are merged to ensure compatibility, and are evaluated against the primary objectives and the one that best meets the objectives is selected. This selection is performed by the design group with input from the steering committee and other interested constituencies.

Stage 13: The preparation of a detailed work design.

The selected system is now designed in detail. At this stage data flows, tasks, groups, individuals, responsibilities and relationships are defined. It is important to have a review at this stage to ensure that the detail of the design still meets the specified objectives. Obviously, the design detail includes the organisational aspects as well as the technical.

Stage 14: Implementation.

Implementation is planned by the design group to facilitate a smooth changeover when the old system is succeeded by the new system. This deals with strategy, education and training and co-ordination of parts.

Stage 15: Evaluation.

The implemented system is checked to ensure that it is meeting its objectives, particularly in relation to efficiency and job satisfaction, using the techniques of variance analysis and measures of job satisfaction. If it is not meeting the objectives, then corrective action is taken. Indeed, as time progresses, changes will become necessary and design becomes a cyclical process.

4.5.4 Features and Weaknesses of ETHICS

Burton (1997), Mumford (1996), Avison and Fitzgerald (1995), Jayaratna (1988), and Adman and Warren (2000), outline features and weaknesses of ETHICS.

The features of ETHICS

- It helps to gain user acceptance of the new system and develops commitments;
- It can improve the quality of the final system by employing the knowledge of people who actually work with it, rather the idea that senior management may have;
- It creates realistic demands from users (it is a two-way process);
- It recognises the importance of employee's individual goals and values;
- It is satisfying and ego-enhancing (everyone like to be asked their opinion);
- It is a source of many more alternative, since it canvasses a wider range of opinions; and,
- It provides an element of user control (and thus is less likely to be seen as a system enforced by management).

The weaknesses of ETHICS

- ETHICS takes time to implement, as it requires design group members to learn new analytical and design skills;
- May only suitable for large organizations;
- This methodology is very expensive in terms of man-hours and thus money;
- This is very time consuming due to a lack of objectivity – independent analysts can be more brutal in their assessment of what a job entails than the person who will actually be doing the job. Management may not trust workers to design their own jobs – it is an ideal opportunity for them to ease their workload; and,

- There is no clear definition of when each stage is complete and it is appropriate to move on to the next stage.

4.6 Viable System Model

4.6.1 Definition and Historical Overview

A Viable System is any system which is organised in such way as to meet the demands of surviving in changing environment. Survival means maintaining many of its important features over the short term and some fundamental features over the long term. The Viable System Model (VSM) was developed by Stafford Beer (1972, 1979) to combine his expertise in cybernetics (the science of communication and control in organisms and machines) and his study of biological systems to create a generic systems framework that could be used to explain and analyse organisational viability, viability being the capability to preserve an independent identity in the long term (Snowdon and Kawalek, 2003).

VSM is supported by fundamental cybernetic principles of communication and control in complex organisations. By being supported by those principles the model offers a way of providing true autonomy. Thus, VSM provides a guideline for the design of adaptable and flexible organisation. These organisations are then able to balance both internal and external view, long and short term thanking and more efficient. The model can be used to diagnose organisational problems, and to design new organisational structures and processes (Liber, 2004).

4.6.2 Philosophy and Theory

To understand the VSM, two key concepts related to complexity (variety and recursion) must be understood. Variety can be defined as a measure of the number of possible states of a system. Thus, variety is a measure of the complexity of a system. There is a fundamental law of cybernetics, invented by Ashby (1956). Ashby's Law of Requisite Variety, is interpreted as "only variety can absorb variety." This means that for one system to be able to effectively control or regulate another, it must have a similar degree of variety. Therefore, the solution to a complex problem requires the problem solvers to be able to understand and influence all the variables contained in the problem. The environment has enormous variety than the organisation, which in turn have much more variety than management. The organisation does not respond to all possible events of requirement of the environment, nor can management ever know every detail of all its employees and activities. In practice, variety is engineered either consciously or more likely unconsciously. High variety is reduced or attenuated, while low variety is amplified (see Figure 4.10) (Beer, 1979).

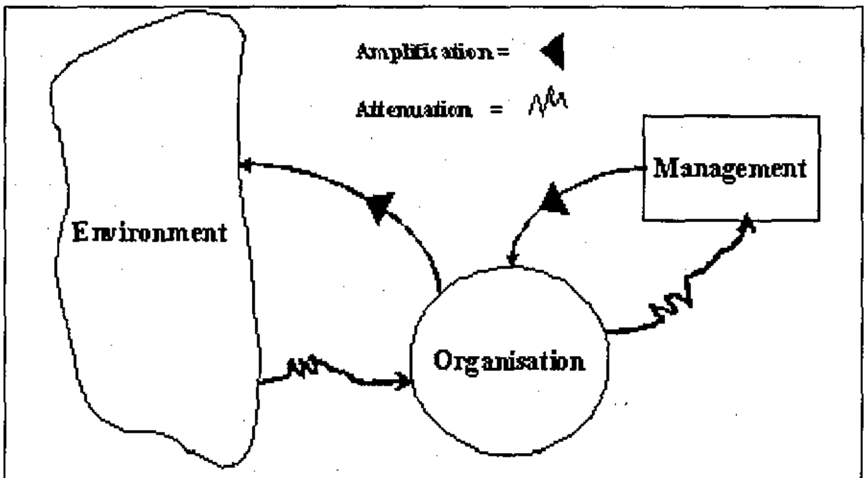


Figure4.10 Variety attenuation and amplification (adapted from Beer, 1979)

A second key concept related to complexity is recursion: this concept is about the construction of complex organizations based on the idea that all living systems are composed of sub-systems, each having self organisation and self regulatory characteristics. The sub-systems each contain further sub-systems, and so on. Moving through levels of recursion, each sub-system should itself be a viable system. This means that there are repetition of the same pattern and relationships at different levels of sub-system. It enables the same functions to be mapped up and down and compared for appropriate matches of attention, consistency and completeness. The concept of recursion implies that attention is given to the level of the analysis that Beer calls the 'system in focus'. At the same time it is important to be aware of other levels, in particular the levels immediately above and below the system in focus. When modelling an organization, heading in one direction one moves from the system-in-focus towards the microcosmic while heading in the other direction leads to the macrocosmic (Beer, 1979).

At whatever level these sub-systems occur, they are autonomous. Within them they contain the capacity to adapt to their environment. They are also able to deal with the complexity that is relevant. Recursive structures are efficient generators of complexity. However, they are also efficient absorbers of complexity and must be highly adaptive to change. These structures function this way because they consist of a developing series of primary activities which are supported by sufficient regulatory and communication functions. The structures are there to enable the activities to operate effectively at every level (Espejo and Gill, 1997).

4.6.3 VSM Sub-systems

VSM distinguishes between five interacting sub-systems whose proper operation will both fulfil the purpose of an organisation and will maintain the organisation within its changing environment. The VSM is thus a process model structured as five sub-systems.

4.6.3.1 Implementation (System 1)

System 1 is concerned with implementation and is the system in focus. It consists of the various parts of the organisation that performs the tasks that the system is intended to achieve, which is directly related to its purpose. In Figure 4.11 the organisation (for example) has been divided into four operational elements labelled A, B, C and D. Each of these elements has its own localised management (the squares box) 1A, 1B, 1C and 1D, and its own relations with the local environment. The operation elements may interact with each other (shown by the wavy lines) in various ways, for example sharing facilities or competing resources. Each parts of system 1 must be designed according to the VSM with own policy, development, operational control, coordination and implementation functions. Then, the system 1 parts are designed to be viable system and they can respond to changes in their environments according to their own main concern.

4.6.3.2 Coordination (System 2)

System 2 is called co-ordination. The different types of structural relations between the system 1 can be recognised within the model, but the potential problem that can occur is in co-ordinating or arranging their interactions so as to avoid oscillations or clashes. Therefore the system 2 purpose is not to control elements of system 1, but to facilitate and smooth its operation.

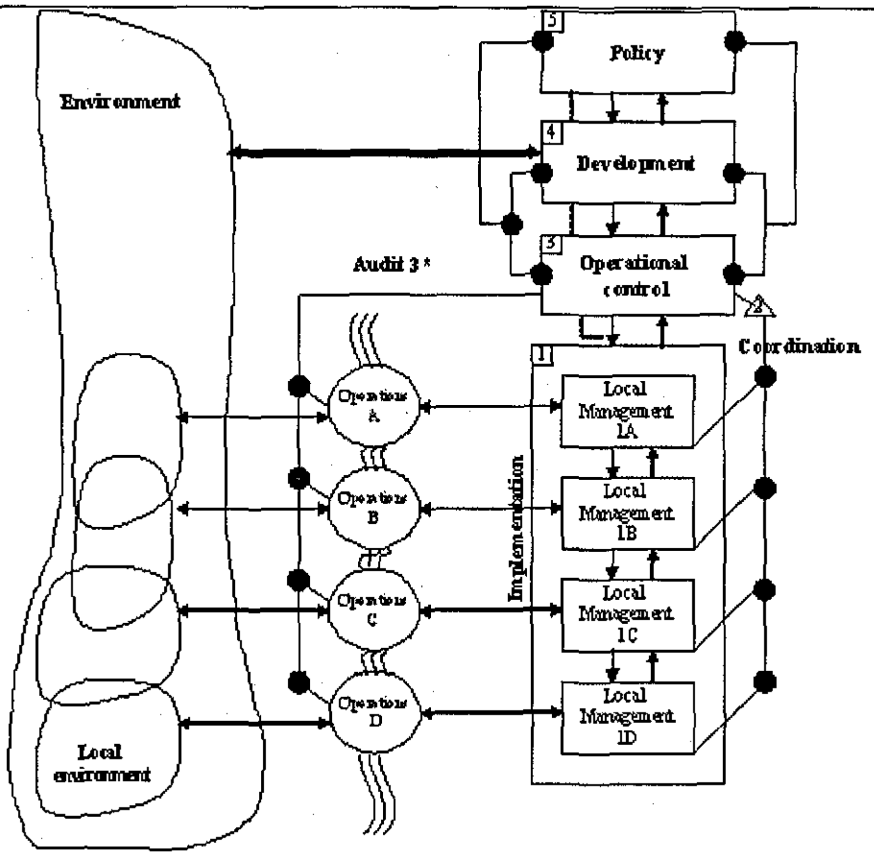


Figure 4.11 The Viable System Model (adapted from Jackson, 2003)

4.6.3.3 Control (System 3)

System 3 is the 'every day' control of the System 1 as well as supervising the coordination activities of System 2. System 3 is a two-way communication channel, between sub-unit and meta-level unit. It depends on information directly from the localised management through the command axis (indicated by vertical lines downwards from system three) and internal data from the audit channel, system three-star, (3*). System 3* (on the left hand triangle) is a servant of System 3, fulfilling an auditing function to monitor various aspects of the responsibility relations between System 3 and System 1 units. This channel gives system 3 direct access to the operation of System 1. System 3 engages in a 'resource bargain' with System 2 which is at the heart of the balance between control and autonomy. Jackson

(2003) indicates that System 1, 2, 3 make up what Beer calls the 'autonomic management' of the organisation. They can maintain internal stability and optimise performance, within an established framework without reference to higher management. Autonomic management does not control an overall view of the organisaton's environment. Therefore, it is incapable of reviewing corporate strategy. This is why Systems 4 and 5 are necessary.

4.6.3.4 Development (System 4)

System 4 deals with the future environment, this makes it different to the other systems in that it needs a model of that environment that enables predictions to be made about its likely future state. System 4 mediates between Systems 3 and 1 and the policy (System 5). Typical System 4 tasks are: corporate planning, marketing, research and development, and quality improvement (Beer, 1985).

4.6.3.5 Policy (System 5)

System 5 considers the organisation's identity, thus, is responsible for the strategic direction of the whole system. Considering information received from System 4 and communicates this downwards to System 3 for implementation by System 1. An essential task is to monitor the balance between the long-term actions suggested by System 4 and the short-term suggested by System 3.

4.6.4 Features and Weaknesses of VSM

Espejo & Gill (1997), Skyme (1997), Espejo (2003), Snowdon and Kawalek (2003), and Liber (2004) summarise the features and weaknesses of VSM as follows.

Features of VSM

- The VSM can be used to both diagnose existing organisational structure and to design new ones;
- The VSM can be used to establish a clear identity for an organisation, which embodies purposes achievable in the environment and is agreed and understood throughout the enterprise;

- The VSM offers an easy route to developing a shared understanding of organisational complexity throughout discussing issues of organisational design and structure, stability and change, control and coordination, centralisation and decentralisation; and,
- The VSM provides true autonomy this means, the part can be given independence and empowered without any threat to managerial control and organisational cohesion.

Weaknesses of VSM:

- VSM does not reflect richness, diversity, and interdependence of most real-life situation;
- VSM dose not addresses all the social and political factors in designing system;
- VSM complex and need professional skill to apply; and,
- VSM classified as a hard system thinking and limited concern with soft issues.

4.7 Comparison Between SSM, ETHICS, and VSM

The aim of this section is to find out the similarity and differences between SSM, ETHICS and VSM that will allow a multimethodological approach. This multimethodology can be used to develop an information system at TTC. Table 4.3 shows the description of SSM, ETHICS and VSM.

Methodology	SSM	ETHICS	VSM
Developed by	Peter Checkland	Enid Mumford	Stafford Beer
Year	1981	1983	1972
Purpose	To examine problem situations in a way which would lead to decisions on action at the level of both 'what' and 'how'	To design a new system with the dual objectives of improving job satisfaction (social system) and work efficiency (technical system)	The model can be used to diagnose organisational problems, and to design new organisational structures and processes
Technique	Rich Picture; Root Definitions; Conceptual Models	Data Flow Diagrams (DFD) Entity Relationship Diagrams (ERD)	Amplification and Attenuation, Resource bargain
Number of Stages	Seven stages	Fifteen stages (original) Seven Stages after Hirschheim (199**)	Five sub-systems
Problem Situation	Covered used in situations in which the problems themselves are hard to defined	Covered Problems are defined	Covered Emphasizes identification of the key operational elements and clarification of the role of the necessary facilitative functions.
Philosophy	Evolved from hard systems methodologies to include human activity systems. The social technical system has ill-defined problem objectives. (Summers, 2004)	"The philosophy is one which has evolved from organisational behaviour and perceives the development of computer system not as a technical issue but as an organisational issue which is fundamentally concerned with the process of change." (Avison and Fitzgerald, 1995, p. 353)	Ashby's Law of requisite variety and recursion
Concern	Social	Social and Technical	Technical and environment
Example case studies	Checkland & Scholes (1990) Checkland & Holwell (1998)		Snowdon and Kawalek (2003), Hoverstadt and Bowling (2002)

Table 4.3 Comparison between SSM, ETHICS and VSM

4.8 Summary

The central theme of this study is to contrast two methodological approaches and one model to design, implement and evaluate a novel information system that is capable of passing to the staff more accurate information in a timelier manner. Therefore, chapter 4 divided into five parts. Part one presents an intervention of Systems Thinking while part two introduces SSM. Part three introduces ETHICS and part four introduces VSM. The final part makes comparisons between SSM, ETHICS and VSM. While, chapter 5 aim to give an overall description of the Mandoora Iterative Multi-methodology (MIM). Thus, this chapter starts with a definition and historical overview. Then, the chapter moves on to describe the MIM philosophy and theory. Part three outlines the components of the MIM and includes two main parts: process and evaluation.

Chapter 5

Mandoora Iterative Multi-methodology

5. Introduction

All the system approaches examined in this study have different strengths and weaknesses so it is reasonable to use them in combination to address different problem situations and to serve different purposes. Therefore this chapter utilises the strengths of SSM, ETHICS, and VSM to develop a new multi-methodology: the Mandoora Iterative Multi-methodology (MIM). This proposed methodology aims to explore different worldviews relevant to a real world situation and contrast them in a process of debate (SSM); to improve job satisfaction (social system), work efficiency (technical system), cultural support and political approval (ETHICS); and to use the cybernetic principle of viability to design new organisational structures and processes (VSM). MIM combines a functionalist paradigm (VSM) with an interpretive paradigm (SSM and ETHICS). The process-oriented and evaluation were the main strands of MIM. The process-oriented strand consist of five stages: planning, analysis, design, implementation, and maintenance. This strand is followed by the evaluation strand which aimes to provide the most suitable and reliable information to middle and lower management about the information system at TTC. Needs evaluation, formative evaluation, and summative evaluation were the main stages of the evaluation strand.

The purpose of this chapter is to give an overall description of the Mandoora Iterative Multi-methodology (MIM). This chapter starts with a definition and historical overview. Then, the chapter moves on to describe the MIM philosophy and theory. Part three outlines the components of the MIM and includes two main parts: process and evaluation.

5.1 Definition and Historical Overview

The main reasons that a multi-methodological approach is desirable are: (1) the real world appears to be multidimensional and, in each intervention, consideration needs to be given to material, social and personal aspects; (2) interventions themselves have distinct phases (appreciation, analysis, assessment, and action) that need different methods; (3) the use of several methods can improve the reliability of results through triangulation; and (4) using several methods improves the richness and variety of possible results (Rosenhead and Mingers, 2001). The Mandoora Iterative Multi-methodology (MIM) has been developed as part of this study to evaluate information systems, whether they are existing or new. All system approaches have different strengths and weaknesses so it is reasonable to use them in combination to address different problem situations and different purposes. The SSM (Checkland, 1981), ETHICS (Mumford, 1983) and VSM (Beer, 1972) are the genesis of MIM (see Figure 5.1).

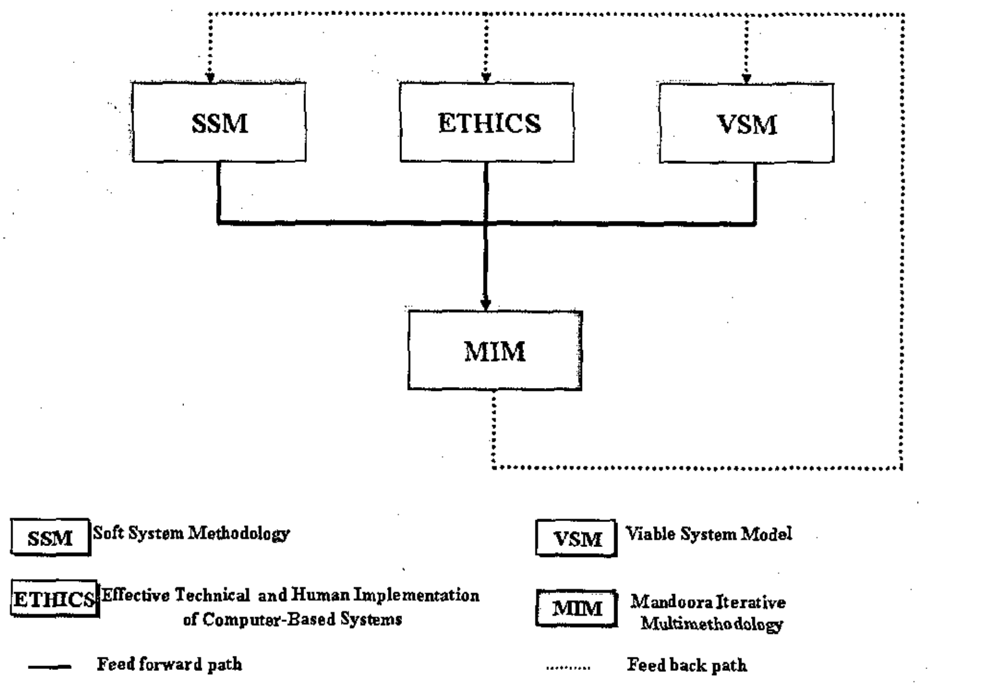


Figure 5.1 The genesis of the Mandoora Iterative Multi-methodology

5.2 Philosophy and Theory

The purposes of MIM are to explore different worldviews relevant to a real world situation and contrast them in a process of debate (SSM); to improve job satisfaction (social system), work efficiency (technical system), cultural support and political approval (ETHICS); and to use the cybernetic principle of viability to design new organisational structures and processes (VSM). MIM combines a functionalist paradigm (VSM) with an interpretive paradigm (SSM and ETHICS). Therefore, MIM can be classified as a pluralism Multi-methodology (see Section 4.3). Table 5.1 below explains the ontology, epistemology and axiology for MIM and its component parts.

Methodology/ model	**What it does** A system to	**Ontology** What it assumes to be	**Epistemology** Representation by modelling	**Axiology**			
				Necessary information	Source of information	Users	Purpose in order to
SSM	Examines problem situations in a way which would lead to decisions on action at the level of both 'what' and 'how'.	Real-world problem situation; conceptual human activity systems; worldviews (Ws).	Problem themes; RD; CM.	Hard and soft info. concerning structure, process, climate and relevant worldviews.	Concepts. Language, logic, and participation by concerned actors.	Analyst, researcher, facilitator, participants.	Learn about and improve problematic situation by gaining agreement on feasible and desirable changes.
ETHICS	Designs a new system with the dual objectives of improving job satisfaction (social system) and work efficiency (technical system).	Diagnosis of needs: day-to-day tasks; efficiency needs; effectiveness needs; and job satisfaction needs.	Viable system; and viable information system.	Consultative, representative and consensus of participants' views about system design at three different organisational levels	Involvement by all the participants in the design of the system by diagnosing their information needs and requirements.	Analyst, researcher, participant.	Improve efficiency and the creation of a work environment that is of high quality and provides job satisfaction.
VSM	The model can be used to *diagnose* organisational problems, and to *design* new organisational structures and processes.	Uses the principle of cybernetic viability.	Organisation in terms of VSM structure of five inter-related subsystems and their interlinkages.	Purposes, structure and environment within an organisation.	Cybernetic principles and research into an organisation.	Analyst.	Diagnose and design to improve organisational structure and functioning.
MIM	Explores multi worldviews relevant to a real world situation.	Real-world problem situation defined by human activity systems; system environment; social systems; technical systems; variety and recursion.	Problem themes; RD; CM; cybernetic models; VSM-diagnostic mode; VSM-design mode.	Hard and soft information related to structure, process, and environment. Technical and job satisfaction needs, and communication of organisation.	Document analysis, interviews, questionnaires, observation and focus groups.	Researcher, analyst, facilitator, participants.	Improve a problematic situation; balance between social and technical sub-systems; and diagnose or design organisation structure and functioning of information system.

Table 5.1: Framework for characterising the philosophical assumption (adapted from Mingers, 2003)

5.3 MIM components

The MIM comprises two main strands: process and evaluation (see Figure 5.2).

5.3.1 Process

The first part is process-oriented; this consists of five stages: planning, analysis, design, implementation and maintenance.

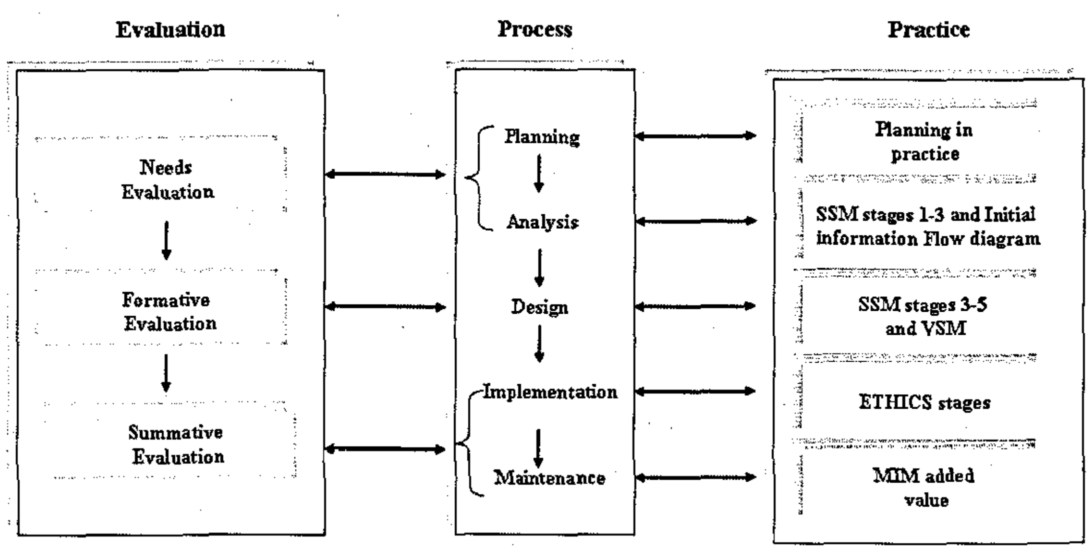


Figure 5.2 Phases of the Mandoora Iterative Multi-methodology

5.3.1.1 Stage 1: Planning

The aim of this stage is to develop aims and objectives for the project. Planning could be developed by a project team which may include stakeholders, planners, researchers, analysts and consultants. There are six steps to develop the planning phase (see Figure 5.3) which are: develop a strategic plan; forecast information needs; establish the aims and objectives of the project; produce the project plan; secure financial resources; and finally, seek agreement from the upper managers of the organisation. The dotted lines in Figure 5.3 represent the important feedback mechanisms that make the planning process a dynamic cycle. Iteration of the aims and objectives may increase or decrease their focus, depending on the wishes of funders and the upper management imperatives of the organisation. Corrective action is necessary when the aims and objectives are established but the upper managers of the organisation who may wish to change the project plan to meet moving performance targets that address their policy or strategic needs. Aims and objectives are constantly checked for appropriateness and may change during the lifetime of the project.

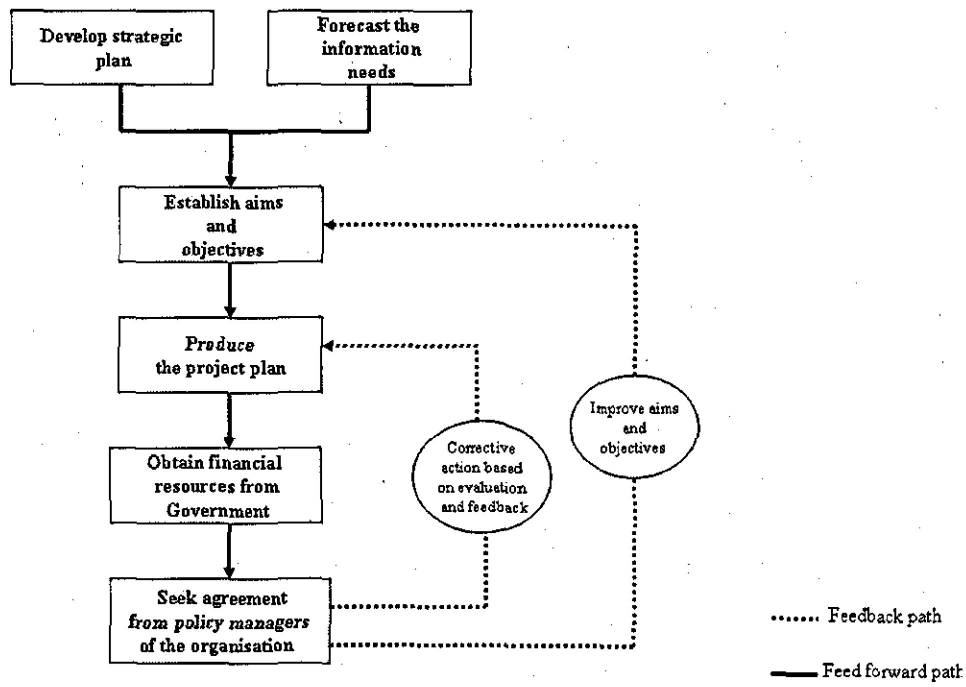


Figure 5.3 Planning in practice

Step 1: Develop a strategic plan for the organisation

In order to develop a strategic plan, it is important to identify and evaluate the current situation, which includes understanding the internal and external operation of the organisation in terms of its processes, procedures, technologies and human resource inventory. The next activity is to describe the future situation that focuses on where the organisation should be at some point in the future and identify what should happen to move the organisation closer to achieving its aims and objectives. The strategic plan should be broad and imaginative: for example, to have (or become) ... (the results) ... by ... (year). The strategic plan should be closely related to the information strategy of the organisation (that is, the IS, IT, and IM strategy). This relation helps to facilitate the acquisition and use of IT that fits with the organisation's competitive needs. The strategic plan should be updated each year and evaluated at least every five years.

Step 2: Forecast the information needs

To design an information system it is important to identify information needs in general, and to provide effective information services in particular. There are several steps that should be used to forecast the information needs. Firstly, different methods should be used to gather the underpinning information, including interviews, focus groups and observation. Secondly, the organisation and its environment should be investigated; this will assist in the identification of the different types and styles of management, and decision-making processes used. Thirdly, specific user environments are studied. These include: organisational structure; background of the departments, their objectives, functions and activities; their information flow (vertical and horizontal); current sources of information (internal and external) and the ICT used; types of information services being used; and any other items of interest such as training programmes and their take-up. Finally, users' needs (internal and external) are investigated to establish issues with interfaces in the system.

Step3: Establish aims and objectives of the project

This step is to develop a set of clear aims and objectives for the project as it is important to identify the reasons for conducting the project and consider carefully what it is hoped to achieve. The aims and objectives of the project should be closely related to the strategic plan as well as to the mission of the organisation. An aim can be defined as a general statement which tries to summarise the activities that are about to take place. After establishing the aim(s), it is important to break these aims down into smaller achievable parts which are the objectives. There are several characteristics of objectives. These include: 'specific' which means to understand exactly what has to be done; 'measurable': to know when this has been achieved; 'achievable' which indicates that it is possible to achieve the aims in the time and with the resources available; 'realistic' which means that it is possible to achieve them; and 'timely' which means that the objectives can be achieved within a time-frame that is useful for decision-making.

One of the most important characteristics of the aims and objectives of the project should be that they correspond to the reasons for conducting the project. These reasons should be related to the strategic plans of the organisation, such as the development of information systems, the development of formal information policies, and to ensure that information resources and services support organisational goals. Moreover, it is crucial to understand the structure of the organisation and the processes within both the organisation and the external environment. In addition, it is important to identify the users (internal and external) who rely on the provision of efficient and effective organisational services.

Step4: Produce the project plan

The project plan adds value by providing a structured framework about how and when a project's objectives are to be achieved, by showing the activities and resources required for the project. The project plan should inform the policy makers of the organisation what the project needs to accomplish, by whom, and for how much. The project plan should address requirements, implementation, training needs, and plans for future work and expandability. The project plan should align with the strategic plan.

The project plan should include the following information: a unique name to avoid confusion with the related project; a clear outline of the aims of the project, reasons for carrying out the project, and an approximate time and cost estimate; an allocation of the financial resources or the people who actual benefit from the project; a chart of the project planning activities; the name of the project manager and team members; the output of the project; a list of references related to the project, such as those found in previous studies, books, journals papers and E-sources; and a list of acronyms and terminology relating to the project.

The project plan should be presented to the policy makers of the organisation to obtain approval for conducting the project. The advantages for getting this approval are: to ensure that high level management understands the benefit of the project; to ensure that the project is taken seriously; to get support from high level management when the project needs it; and to minimise the resistance from employees in disclosing essential information.

Step5: Obtain financial resources

The aim of this step is to obtain financial assistance to cover the costs of the project. Funding sources could include regional and/or national government bodies, industrial sponsorship, and other sources in the private sector such as from individuals of high net worth.

Step 6: Seek agreement from upper managers of the organisation

The aims of this step is: to seek agreement from management in order to inform them of the benefits to be gained from the project; to understand their perspectives; know the right time, methods, place, and types of response to collect information; to reduce the number of objectors to the project; and to obtain support when the project team needs it.

It is important to present the project plan to management by commencing with a formal presentation in order to get formal evaluation and feedback and, in addition, to discuss with them their views and find the best way to implement the plan.

The output from this stage (Planning) is to establish the aims and objectives of the project and to obtain the approval (financial and moral) to conduct the project. The next stage is to form a rich picture of the problem situation to enable a wide selection of viewpoints to be explored. The process starts by analysing the structure, processes and climate of the problem situation, investigating the tasks and issues (perceptions causing disagreements) of the agent of that problem situation.

5.3.1.2 Stage 2: Analysis

This stage is based on the work of Professor Peter Checkland (the originator of SSM), who has carried out wide-ranging studies on systems analysis using the concept of 'human activity systems'. The term 'human activity systems' involves the real world where problems are perceived differently depending on individual values, beliefs, personality and culture. SSM gives a world-view, drawing together people's different appreciations of situations based on their experiences. Moreover, problems do not appear in isolation as they interact with each other. The key concept of this methodology is that it is 'holistic', in that it provides an appreciation of the whole system at one time.

The central focus of this stage of the analysis is to search for a particular view(s). This **Weltanschauung** (World view) will form the basis for describing the current system requirements and will be carried forward to further stages in the methodology. This worldview is extracted from the problem situation through debate regarding the main purpose of the organisation concerned. Therefore, the MIM at this stage adopts the SSM (see Figure 5.4).

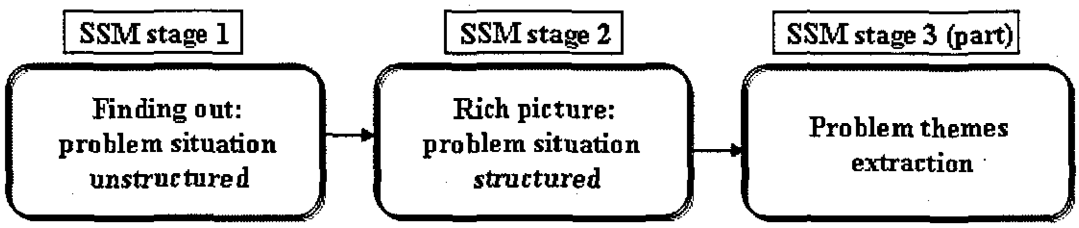


Figure 5.4 Analysis in practice

Step 1: Finding out: the problem situation unstructured

The aim of this step is to define the problem in fuzzy, ill-structured situations where there is no clear view of what constitutes the problem. In this step, the analyst should conduct three different analyses, including an analysis of the intervention which should find out who is the client, problem owner and problem solver in this situation. Each of these analyses gives their own version, expectation and views of the problem situation. The next phase is an analysis of the social system which investigates what roles, norms and values the system holds and also how these change between the actors in the system. The final analysis is that of political systems which identifies where power is found and how it shows itself.

The broader the methods employed by the analyst to collect data, the broader will be the understanding of the problem situation. Therefore, the analyst should use the most appropriate quantitative and qualitative methods (for example, document analysis, questionnaires, interviews, focus groups, observation) to understand the specific issues of the stakeholders, in order to define various worldviews of the problem situation and to capture a holistic summary of the application. When all these methods are complete, the analyst moves ahead towards creating a rich picture (Step 2).

Step 2: Rich Picture: the problem situation structured.

The best way to understand the problem situation structured is via a rich picture, which has been found to be an invaluable tool for this purpose. Before constructing the rich picture, the analyst should understand the problem situation by understanding the organisation's aims, its structure, boundaries, sub-systems, and the needs and concerns of employees.

Checkland and Holwell (1998) suggested that the rich picture technique is particularly useful in expressing the problem situation, as using two-dimensional diagrams is a better way to represent relationships than using linear prose. Rich pictures can reflect the breadth of views felt across all participants. Moreover, the use of icons and symbols, including connecting lines and arrows, is very appropriate in illustrating the high level abstract mental images of the problem. A rich picture should represent the following aspects of the problem situation:

- Boundaries: who is included and who is excluded; what work is done inside and outside of the boundary and how these activities interrelate; who is in charge of the work inside the boundary; what people are trying to achieve what inside this boundary.
- Resources: involved personnel and their roles.
- Hard and soft aspects (facts, opinions, concerns, reactions and responses).
- Organisation structure.
- Processes (tasks and activities).
- How structure and process interact.
- Conflicts.
- Needs and constraints.
- Climate and context (environment).

Step 3: Extracting problem themes

The aim of this step is to extract problem themes from the rich picture and to describe them in greater detail. This involves defining the primary tasks of the system process and those issues that may be hampering the completion of these tasks; an example might be conflicts between two departments and/or shortages of supplies. The analyst team lists as many problems as possible to establish the common themes, then the identified problem themes are named to form relevant systems (ways of looking at the problem which provide a useful insight).

The output from Stage 2 (Analysis) is the identification of the problem situation, the establishment of problem themes from the rich picture, and the formation of the relevant system(s) to be explored further.

5.3.1.3 Stage 3: Design

System design can be conducted through five steps, starting with the root definition, the conceptual model, the comparison of the model to the rich picture, the use of VSM to define System 1 to System 5, and the use of VSM to define a whole system (see Figure 5.5).

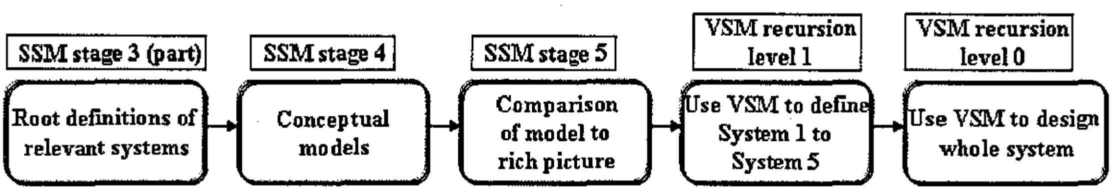


Figure 5.5 Design in practice

Step 1: Root definition of relevant systems

After the relevant system is extracted, the root definition (RD) is then produced. This is not a definition of what the system does in reality, but an indication of what the ideal system should be. This is achieved by using the CATWOE criteria and including these in the RD (see Section 4.4.3 Stage 3).

Step 2: Conceptual models

The aim of this step is to produce a conceptual model or activity model of the ideal system which is defined in the RD. Therefore, this step will describe in words what the system will be (RD) and provide an inference diagram of the activities of what the system will do (the conceptual model).

Step 3: Comparison of model to the rich picture

The aim of this step is to set up a debate with participants in which any differences between the ideal system, as represented in the conceptual models, and the real system, as illustrated in the rich picture, can be identified. These differences form problematic areas that may benefit from a change intervention.

Step 4: Use VSM to define System 1 to System 5

When an organisation has more complex issues, such as where economical, political, ecological and cultural phenomena appear, its structure may become chaotic, leading to conflict as an emergent property. An example might be conflict concerning who reports to whom, who needs to talk with whom, and how all the pieces of a complex interrelated jigsaw fit together to form a whole. As a result, the information and knowledge then often becomes trapped in local networks, reducing the chances of people working in cooperation with others across organisational boundaries. This means that people may be unaware of related issues and activities which should concern them. Consequently, the MIM at this step adopts the VSM in the design mode; this offers a way of gaining both functional decentralisation and cohesion of the whole. This philosophy provides a particularly useful framework for organisational design. The purpose of this step is to identify the five sub-systems (Implementation, Coordination, Control, Development, Policy) for each of the conceptual models of the relevant system and then to draw them on a large VSM diagram which represents the parts of the organisation in its entirety.

Each of these sub-systems is autonomous and allows the individual sub-system substantial freedom, independence and discretion to make decisions about administrative matters, to plan the work, and to determine the procedures for carrying it out (Beer,1985).

Step5: Use of VSM to define the whole system

The aim of this step is to make all sub-systems work together for the benefit of the universal system. The role of this system is twofold: first to monitor the environmental factors. (The external environmental factors include the broad set of dimensions within which the organisation operates, including political-legal, social, cultural, technological and economic dimensions, while the internal environmental factors include organisational departments, people and individuals that influence the organisation's operations). The second role is to integrate the sub-systems to create a whole from the parts; this is achieved by sharing communication, managing duplication, keeping sub-systems from interfering with each other, managing them together, and focusing on the future to produce global cohesion and local autonomy simultaneously.

In the initial diagnosis (Stage 2) the organisation is considered and the units of which it is composed are examined. Then, a Large Viable System Model (LVSM) is drawn up which identifies the following. The Operational System or System 1 (S1): this is made up of all the operational parts or primary activities which carry out all the basic work such as production, distribution and administration (Beer, 1979). Beer added that each S1 primary activity is itself a viable system due to the recursive nature of the system; that is, the same principles of organisation recur at all organisational levels, regardless of scale. In this step, the LVSM is composed of Smaller Viable Systems (SVSs), for example, the VSM of the Human Resource System, the VSM of the Database System, and the VSM of ICT. Operational parts may include the management of these operations, the team of people, departments, and separate companies (see Figure 5.6). The Coordination System or System 2 (S2): this constitutes a way of dealing with conflicting interests which are inevitable in the interactions which arise as the parts of S1 interact. Conflict resolution is the job of S2; this may include creating a production plan and organisational schedule. This system consists of a regulatory centre (denoted by the triangle) for each element of S1. This will be organised by managing the S1 operations (see Figure 5.7).

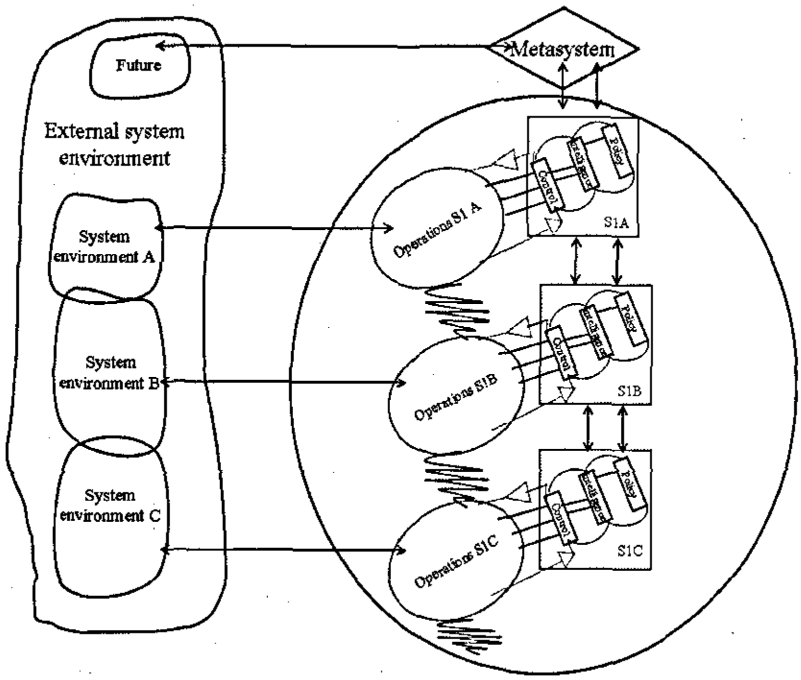


Figure 5.6 S1 and their environment with their communications connections

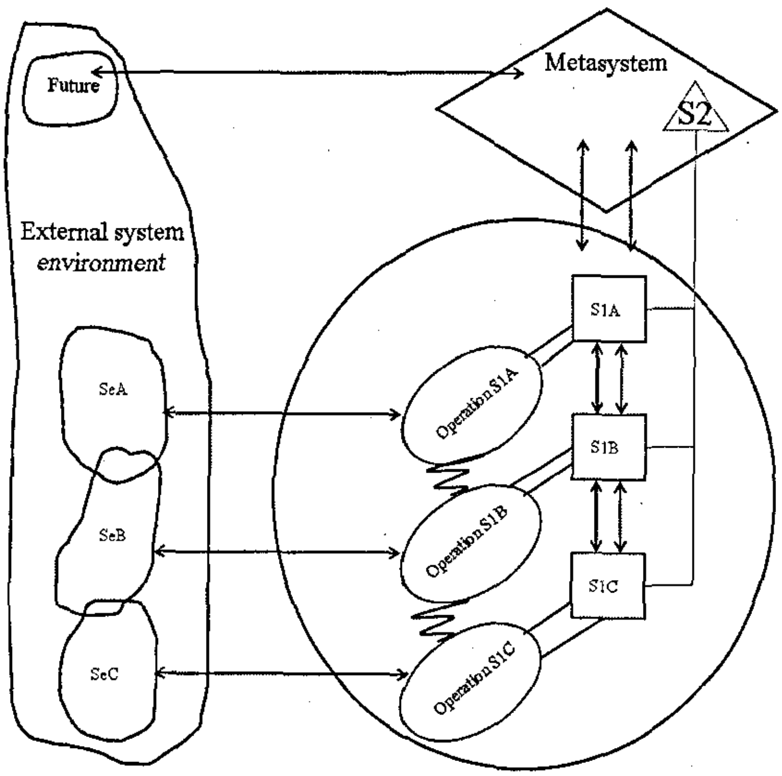


Figure 5.7 S2 looks after the coordination of the operation's activities

The Metasystem is composed of System 3 (S3), System 4 (S4), and System 5 (S5). These are responsible for stability, optimisation and future planning to ensure the organisation can adapt to a changing environment. This is also a way of rounding off the whole system to ensure all the various parts are working within the same basic ground rules.

The Control System or System 3 (S3): this is concerned with everyday control by looking at the whole of S1 and improving its overall performance. Thus, its main area of manipulation is optimisation. In other words, S3 is concerned with the resource bargain: the process by which S3 (the senior management of LVSM) makes an agreement with S1 (the management of each operation of SVSs) on what they need to provide for each other.

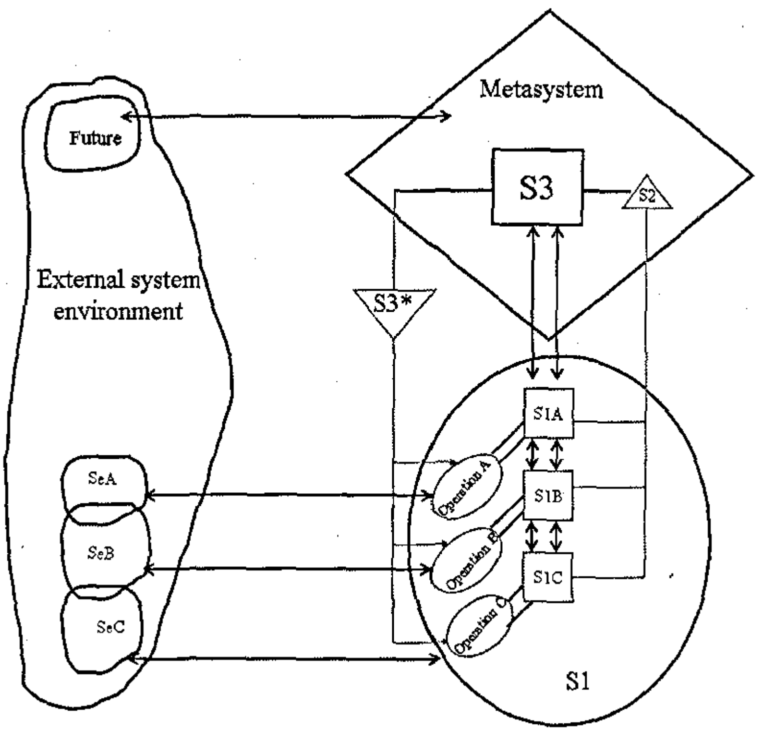


Figure 5.8 S3 and S3*

In order to achieve this, the senior management of LVSM is responsible for establishing the rules (security rules, employment rules and conditions); allocating resources in terms of both people and money (this may involve cutting back in one area and re-allocating those resources to another to improve overall performance); and establishing mutual responsibilities (what the parts of S1 need from S3 to do the job properly, and what S3 needs from the parts of S1 for the requirements of the LVSM to be met). S3 also needs the SVSs to be accountable; this means it should be able to demonstrate that it can justify the allocation of resources from S3. Moreover, S3 should have the ability to intervene within the SVSs if the cohesion of the LVSM begins to deteriorate as this will mean a loss of autonomy that could put the whole system at risk. Legal and corporate requirements are also among the functions of S3 as it needs the SVSs to obey higher authority (S4 and S5 of the LVSM) and must ensure these systems adhere to the policies of the organisation (see Figure 5.8). the feedback 'audit' channel, S3*, is discussed below.

The Development system or System 4 (S4): S4 of the LVSM deals with long-term plans and has channels to the system environment. It has an intelligence function by providing the primary activity of S1 with continuous feedback, via S3, about all external factors that are likely to be relevant to it in the future; it also massages of the organisation into its environment. The intelligence function is concerned with the future planning system to develop strategies to ensure the organisation can adapt to a changing environment. These loops should operate in balance. For example, the future planning system should have the ability to examine and find the relevant information; it should be aware of the capabilities of the operational parts and develop strategies within this context; it should be able to agree and implement its plans through its connection to the operational parts; and it should function within policy guidelines (see Figure 5.9).

The Policy system or System 5 (S5): S5 balances the interaction between S4 and S3, and also balances the data coming in from the external environment (into S4) with the information coming from the internal environment (into S3). S5 should have ultimate control of the whole process which is responsible for setting context, building and maintaining identity or the organisation's purpose, promoting coherence, and providing closure to the system as a whole. The tasks of the Metasystem (S3, S4 and S5 of LVS) are to service the needs of the operational parts of the SVSs (see Figure 5.9).

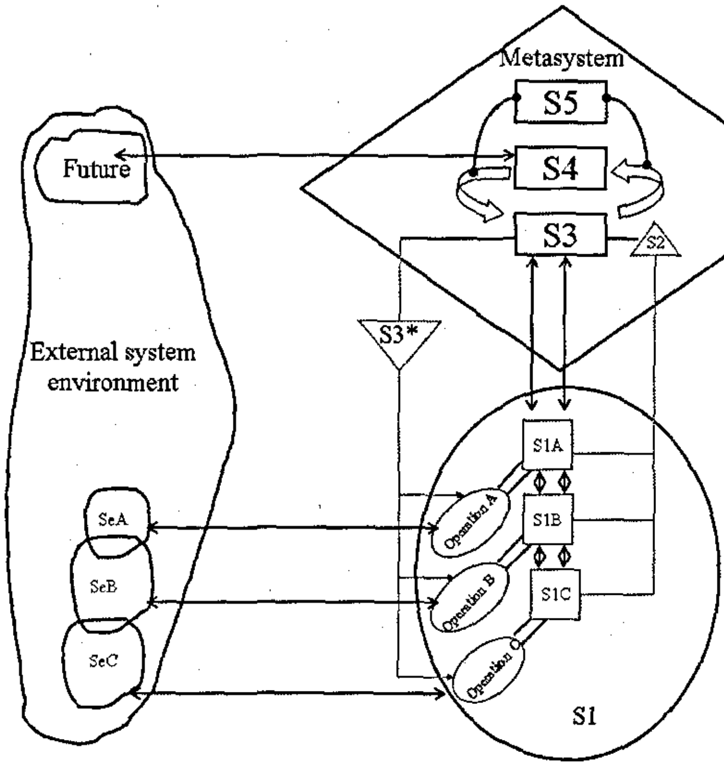


Figure 5.9 S4 and S5

There are four communications channels that connect S3 with S1 (SVSs). Firstly, there is a resource bargaining channel which is responsible for communicating information, requests and responses which travel continuously in a two-way active channel. Secondly, there is a command channel which communicates requirements and decisions directly between S1 and S3, and also via S2; this exists to damp oscillations. The third link between S3 and S1 is S3* which is responsible for investigating and validating whatever information is needed by S3 via auditing and monitoring activities. For example, it provides assurances that financial issues, internal control, quality, security standards and other particulars are in order. S3* should be able to carry out this function without overhead resources, or indeed without the authority of the formal organisation, since it depends on corporation and consensus. In addition, there are channels between S3 and S4, called the Three-Four homeostat, because the requirements of the present are balanced with those of the future. The final internal channel, from the bottom to the top of the organisation, is called the algedonic signal system; this is proposed to alert automatically higher-level management to a serious problem, such as the immediate response necessary to obtain a competitive advantage, or responding to the competitive advantage that a third party has that threatens the existence of the viable system itself.

The output from Stage 3 (Design) is to identify the five sub-systems: (Implementation, Coordination, Control, Development and Policy) for each conceptual model of the relevant system. Then, the Large Viable System Model (LVSM) is depicted. This represents all the sub-systems (SVSs) which work together for the benefit of the universal system.

5.3.1.4 Stage 4: Implementation

Implementation can be defined as an attempt to change the organisation from its present state to a new state. The implementation process can convert a plan of action into practice and it is a guide to who does what, when, where and with whom. Implementation should be constructed in such a way as to reconcile and manage both social and technical issues. Therefore, the ETHICS methodology can provide useful starting points for the implementation process as this requires careful planning and monitoring to ensure that the implementation stays in line with job satisfaction and efficiency objectives.

To ensure a smooth and successful implementation, the implementation process cycle should involve four steps: planning, testing, training and changeover (see Figure 5.10).

Step1: Planning

Implementation planning should consist of the following tasks:

- The vision and the goals: this vision should include the identification of the means (who does what, when, where and with whom) that will allow the goals to be achieved.
- The detailed schedule for implementation should be described: this includes objectives, the project end date, and the resources needed for funding staff and external support, for example.
- High management support: management would be expected to acknowledge the plan and provide the necessary support and resources. Management then plays a useful role in settling disputes and providing clear direction.
- Resource allocation (human and financial) should be identified: this may mean cutting back in one area and re-allocating those resources to another to improve overall performance.

- The implementation team should be identified: the team's tasks are to find out the problems that are likely to be encountered on implementation and how these can be avoided; to coordinate the activities of both the user area and between this and other areas; to determine the time required for implementation; and to monitor improvements. These tasks provide the implementation team with an understanding of the best implementation strategy.

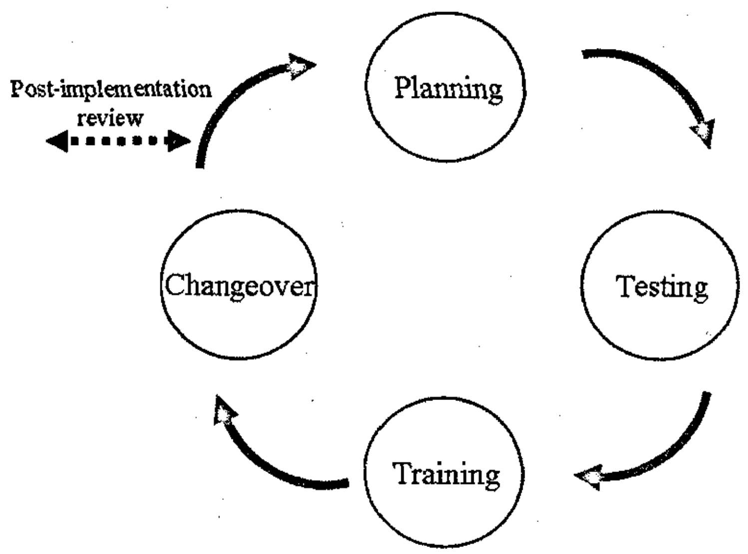


Figure 5.10 Implementation process cycle

In line with this, Zhang *et al.* (2005) outlined several elements that have a significant influence on the success of the implementation. These include: user satisfaction; intended business performance improvements; being on time; staying within budget; achieving acceptance and usage of the system; and matching predetermined corporate goals.

Step2: Testing

Testing the system is performed to determine how well the system will achieve the set goals and meet specific requirements and ensures that each function works as expected. In addition, testing the system helps meet the multiperspective needs of the users. Testing the system can be applied in seven phases:

1. **Component testing**: is concerned with the parts of the system because it is easier to identify problems at this level than it is to isolate problems when testing interrelated components.
2. **Functional testing**: is concerned with the performance of related components in a functional subsystem.
3. **Unit testing**: is concerned with the testing of individual subsystems.
4. **Integration testing**: is concerned with testing the system as a whole to ensure that all subsystems work and communicate with each other.
5. **Security testing**: is concerned with checking that the system and its data are protected from accidental or serious damage; the system must be secure against unanticipated and anticipated attacks.
6. **Recovery testing**: determines the ability of users to recover or restart the system after failure.
7. **Acceptance testing:** is designed to provide assurance that all system changes and performance issues meet with job satisfaction (that is, that it satisfies users) and efficiency objectives.

Step3: Training

Training is the process of ensuring that system users understand what they need to know about both the organisational system and its operation. It not only involves activities that develop the competence, skills and knowledge of users, but also includes factors such as how to use the technical equipment, how to keep the equipment running, and providing the necessary support services to both internal users (managers, staff and operators) and to external users (customers and other related organisations). Therefore, it is vitally important to establish a training plan that will help to fulfil the requirements of each type of user, explain how the users will be trained, determine the time-scale for accomplishing the training, and state how much it will cost.

Step4: Changeover

When the testing and training have been carefully planned, the actual implementation can proceed by using one or more of the four changeover methods (see Figure 5.11). These are: direct changeover, parallel running changeover, deferred parallel running changeover and phased changeover. Each will be discussed below in more detail.

1. **Direct changeover:** In this method, the old system is completely replaced with the new one. This method immediately stops the use of the old system and simultaneously puts the new system into operation. The major strength of this method is that it minimises the duplication of work but it demands careful planning, testing and attention to operational detail to be completely successful. The major weakness of this method is the possibility that the new system is not totally correct or complete. Also, there may be a lack of current results from the old system with which the new system can be compared once direct changeover has occurred.

2. **Parallel running changeover:** In this method, the old system and new system are run simultaneously for a period of time until the new system has proven its reliability. The advantage of this method is that the results of the new system can be directly compared with those using the old system. The disadvantages include the duplication of the same work and that users have to run both systems during the short period of parallel running.

3. **Deferred parallel running changeover:** This method is known as 'pilot running'. It involves re-running on the new system the data from the previous period of the old system, while the old system continues processing current data. The advantage of this method is that it allows more time for arranging the source data and checking the results. When the new system is proved to be fully correct, only then is the old system discontinued. The disadvantage of this method is that it requires a double cycle of work to be performed.

4. **Phased changeover:** This method is similar to the parallel running changeover except that, at the start, not all functions of the system are run in parallel. For example, only personnel records from the administration system may be selected. The chosen function is taken into the new system and the functionality of the new system increases each period. After the final part has been run in parallel, the old system is stopped. In other words, the old system is replaced by the new system

gradually over time. This method allows an organisation to begin taking advantage of some aspects of the new system's functionality while retaining a measure of flexibility to deal with any issues. The disadvantage of this method is the prolonged delay before full implementation of the new system is achieved.

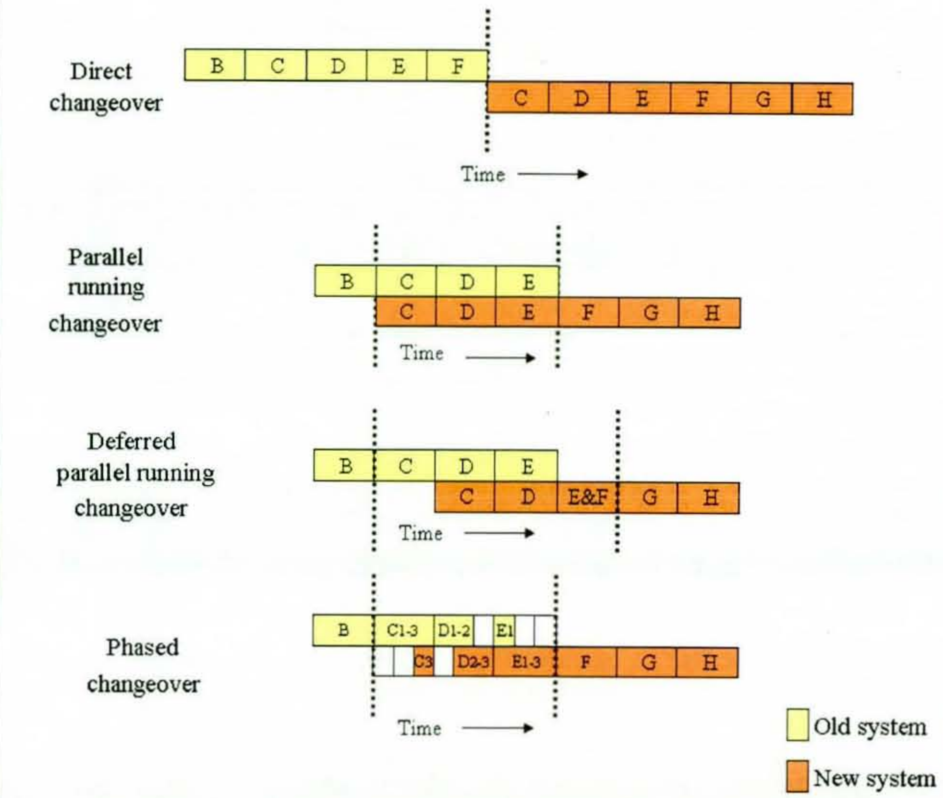


Figure 5.11 Changeover methods (adapted from Clifton *et al.*, 2000)

A post-implementation review takes place three months after the new system has been implemented. This aims to assess the success of the new system and allows decisions to be made on any necessary corrective actions. The features of a post-implementation review are: to determine errors, and make suggestions and recommendations which need to be implemented for future release; to determine the system's success by its ability to achieve organisational goals; and to record the experiences for use in further studies.

The output from this stage is to complete the implementation process; this determines the extent to which the system is successful by its ability to accomplish the organisation's goals. The next stage is to perform a maintenance and reliability operation to ensure that the system is running, is managed and to eliminate failures that might lead to losses in the system's functions.

5.3.1.5 Stage 5: Maintenance

Maintenance is a principal phase in the lifecycle of the system. After the system has been tested and implemented, it should continue to be maintained while it is in use. The aims of this stage are to ensure that the infrastructure functions are at a sufficient level of reliability and control to enable operational objectives to be achieved and to document the modification of the systems over time. Maintenance could be short-term, such as day-to-day or weekly, or long term, such as quarterly or annually, according to the stability of the system.

Maintenance is designed to maximise improvement activities throughout the service. The main tasks of maintenance are: to reduce failures in the system and increase efficiency; to reduce costs and increase performance; to control user access to the system; to integrate information between the various sub-systems; and to upgrade hardware and software as appropriate. Furthermore, maintenance provides a measurement of performance, serviceability, usability, reliability and security in a system over time, within a minimum number of activities, at low cost, and with good productivity.

Abudayyeh *et al.* (2005) outlined that planning, organising, directing and controlling are the main steps for a maintenance management system. Planning is the first step of system maintenance and involves setting objectives, guidelines, service levels and a maintenance budget. The second step is organising the resources required, and distributing work tasks and work schedules. The third step is directing, which includes authorising. The final step is controlling; this includes reporting and evaluating performance (see Figure 5.12).

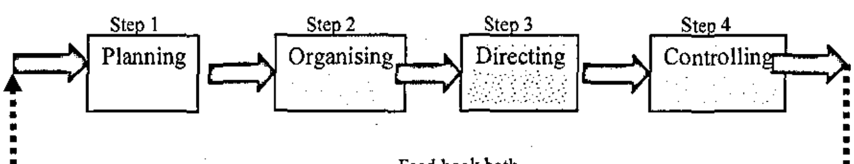


Figure 5.12 Maintenance Process (adapted from Abudayyeh *et al.* 2005)

However, maintenance can be divided into two broad types: the maintenance of information communication technology and the maintenance of human activities (see Figure 5.13). The first type, information and communication technology maintenance, consists of hardware, software, and information maintenance. Hardware maintenance is usually carried out under a maintenance contract with the suppliers of the equipment while software maintenance can be carried out when errors are discovered in programs. Information maintenance is performed when errors are discovered in the information that is provided to the users. Therefore, it is vital to have a regular maintenance schedule carried out by qualified technicians to avoid hardware breakdowns or poor performance.

The second type, human activities maintenance, concerns understanding users' needs, dealing with the new system, and organisational culture. Responding to user needs can be carried out when the users realise that the new system is quite good as then they begin to show more optimism and tentatively request more facilities or services as their interest increases.

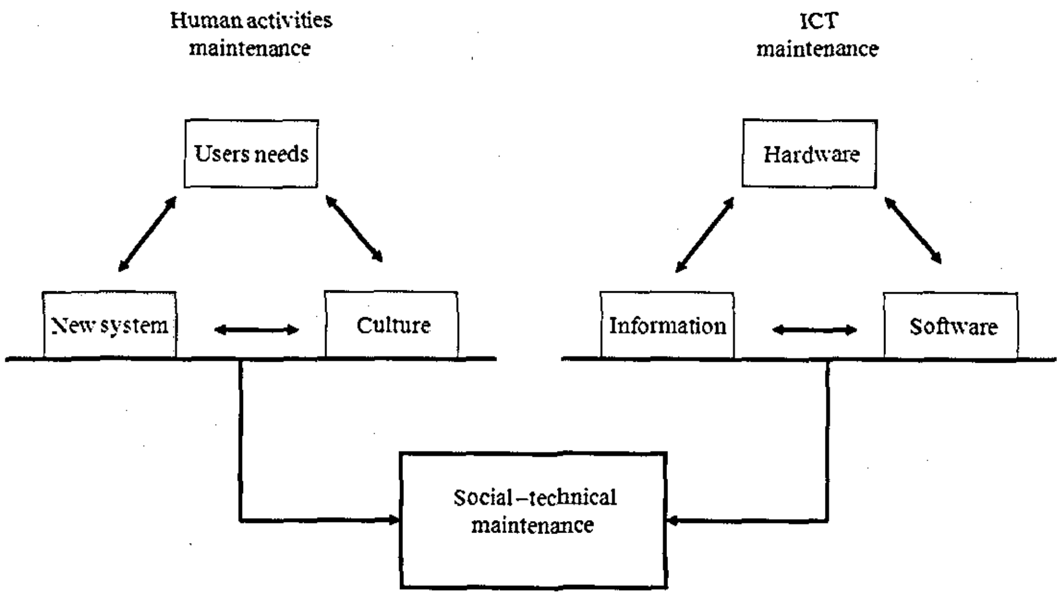


Figure 5.13 Social-technical maintenance

The new system and its usage may meet with resistance to change because of the way that work is performed and because people's job functions will be changed. If the justification behind the change is not explained, then all the classic signs of resistance to change will be apparent. This resistance to change will increase if the new system fails to satisfy the users.

Organisational culture refers to the attitudes, values and beliefs of members of the organisation; it also appears in the relationships between the organisation and its competitors, its external users and other external factors. Organisational culture has a significant effect on organisational processes such as decision-making, the design of structure, group behaviour, motivation and job satisfaction, and management control. In contrast, organisational culture is a major conventional force within the organisation and as such may prevent improvement in work practices or the acceptance of a new system.

So, the maintenance of organisational culture could involve: policies and management, organisational structure, staffing and motivation, training and educating, social events, supervisory behaviour, communication, and the physical environment.

One of the main factors that can assist maintenance is the use of a Help Desk (HD) facility. The objectives of the HD are to provide a single point of contact for users (internal and external), to resolve problems related to ICT systems and human activity systems in the organisation, and to offer assistance as needed. The HD should offer access to many different information and knowledge sources which include files (hard or soft), databases, ICT, and HD employee knowledge.

The HD can support maintenance in two ways, using hard and soft success criteria. Hard criteria involve the quality of problem solutions (solving problems correctly and consistently at a low cost); the quality of processes (solving problems in a limited time frame and by actively prioritising tasks to achieve quick response times); and organisational quality (the availability of ICT equipment in a suitable environment with trained staff). On the other hand, soft criteria involve end-user satisfaction (the availability of an HD, resolving queries, and giving advice quickly and in a friendly way).

There are four main advantages of the HD. These are:

1. Incident control: the process of identifying, recording, classifying and progressing incidents until affected services return to normal. So, an HD maximises achievable ICT service availability, decreases the number of incidents, ensures accurate information management, and eliminates the number of incidents that are lost or dealt with incorrectly.
2. Support of an organisation's operations: the HD provides a first-line support service to users when they are unsure of how to handle a particular organisational situation using an ICT service and need assistance. It also provides an opportunity to increase significantly the overall cost effectiveness of ICT-based services. Therefore, the HD reduces the requirement for ICT knowledge throughout the user community, offers a timely resolution of operational problems in the organisation's systems, and gives early warning of potential operational failures.
3. Satisfying users' needs: the HD can improve the relationship between the ICT division and the user community as a result of improving communications and resolving users' difficulties at an early stage. Also, all users will know immediately who to contact if an incident occurs.
4. The centralisation of information management resources: the HD provides effective use of the available data to produce meaningful information management; to maximise the benefits to management of stored information or system events and incidents; to reduce administrative overheads; and to provide the data required for centralised information management by reporting issues regarding users' interests and concerns about all aspects of ICT service quality.

Knowledge management is a discipline that provides the strategies, processes and technology to facilitate the sharing and leverage of information and expertise that will increase the level of understanding; thus, problems can be solved and decisions made more effectively (González *et al.* 2005). A knowledge management-centric Help Desk system is a means to avoid the disadvantages of the traditional HD by recognising repeat problems and other such examples. In the traditional HD, the staff do not capture the knowledge of other staff about resolving problems of a particular situation in a way that can be searched, reviewed, disseminated and updated by others (González *et al.* 2005).

They added that as a result, the benefits of learning are not fully realised because the structure of the HD does not facilitate knowledge-sharing. Moreover, a knowledge management-centric Help Desk system can also avoid another problem related to HD staff who leave with their considerable knowledge, skills and abilities to quickly resolve problems. It does this by capturing this significant knowledge concerning the system, organisational processes and technologies which then increases both the efficiency and effectiveness of the HD.

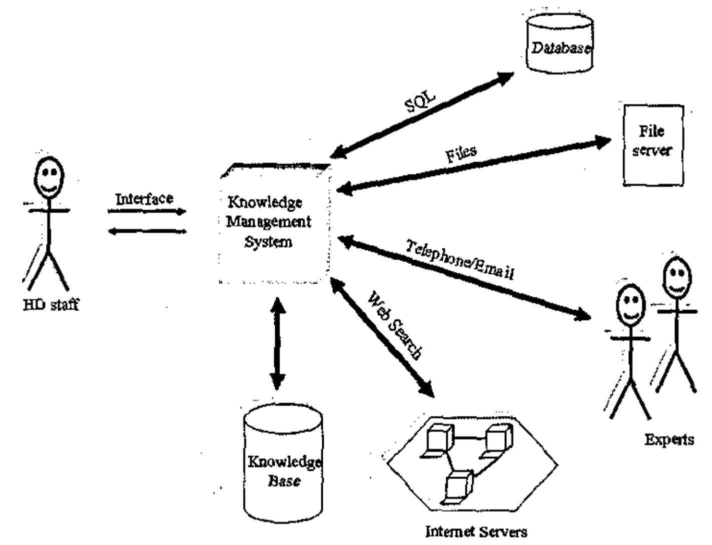


Figure 5.14 Knowledge Management-centric Help Desk Process (adapted from González *et al.* 2005)

González *et al.* (2005) indicated that the Knowledge Management System acts as a mediator between the HD staff and information management sources (see Figure 5.14). The advantages of this approach are to capture staff knowledge acquisition into the system for use by other HD staff; to standardise the interface between HD staff and knowledge sources in different files and formats at remote locations; and to integrate several ICT and records management systems including information storage, information retrieval, and document management.

The output of this stage is to increase performance and efficiency by developing a knowledge management-centric Help Desk system that will help in the maintenance operations, that will maximise improvement activities throughout the service, and that will create a balance between the maintenance of information communication technology and the maintenance of human activities.

5.3.2 Evaluation

The second component of MIM is evaluation. This consists of three stages: needs evaluation, formative evaluation, and summative evaluation (Summers, 1992). Each will be discussed in more detail.

Evaluation is a systematic inquiry designed to provide information to decision makers (senior management) and other parties interested in a particular programme, policy or intervention. Such evaluation takes place throughout a series of measures carried out to determine the extent to which goals and objectives have been met, to determine if the organisation is effectively carrying out planned activities, to provide feedback about progress and encourage reflection about outcomes, and to produce recommendations to improve the quality of the services provided.

Evaluation is not only something that happens once a system has been in place for a while, but is also an important part of planning, designing and implementing systems; it should therefore run in parallel with all stages of MIM. The main reasons for undertaking evaluation studies are: to judge the value of the progress made and estimate the utility of attempts to improve it; to identify any problems which occur in the design and implementation with the aim of providing improvements; to carry out a needs analysis related to the educational, psychological and social needs that people have in order for them to be in a satisfactory or desirable state; to control system costs; and to provide information for guiding future plans.

5.3.2.1 Needs Evaluation

This is conducted in the early stages of MIM (planning and analysis) and aims to establish planning for short and long-term evaluation to improve organisational performance and efficiency. It also allows an analysis of the organisation's current situation; this includes determining how well the organisation is currently meeting its users' needs by producing a list of needs (such as training, education, organisation development etc.) in view of their importance to organisational goals, reality and constraints. Moreover, it also identifies the causes of problem situations by carrying out a detailed investigation and analysis of users, jobs and the organisation. Furthermore, a needs evaluation includes an analysis of external inputs, such as national and local government policy, the level of government support, national demand, and other environmental pressures, into the system under investigation.

There are several methods of carrying out needs evaluation. These aim to obtain a rich picture from many sources and viewpoints and it is fundamental to use a combination of some of these methods, as appropriate. The methods include: questionnaires, interviews, document analysis (including relevant literature and studies), observations, and focus groups.

5.3.2.2 Formative Evaluation

This is conducted in the design stage and early steps of implementation stage. It is a process of ongoing feedback on performance which aims to identify problems that arise during the design, thus allowing for modification. Formative evaluation provides information for internal improvement without external consequences in order to improve practice while the system is in development, rather than waiting until the system is completed and finding out too late that the system was not implemented as planned and that an unwanted result has been obtained. Formative evaluation often involves both written and informal discussions about results and can be a useful tool for identifying sub-systems which need assistance on a timely basis.

5.3.2.3 Summative Evaluation

This is conducted at the end of the implementation and maintenance stages. This can be done by outside evaluation organisations or independent evaluators. Summative evaluation focuses on the value or worth of the outcome of the system and is designed for the purposes of accountability and/or continuation. A summative evaluation is usually made through formal written reports on the system's impact with the added benefit of keeping top management informed and satisfied.

Evaluation criteria are practical standards that can be used as the basis for making judgments about the quality of an information system. The indicator of evaluation criteria should be based on validity (the extent to which the indicator is a true and accurate measure of the event under study); reliability (the extent to which the indicator is reliable and dependable over time); sensitivity (the possibility of change within a reasonable time period); utility (the ability to produce data that can be easily interpreted); and usefulness (the production of guidelines for change).

To ensure a successful evaluation of an information system, the evaluation should involve five steps (see Figure 5.15).

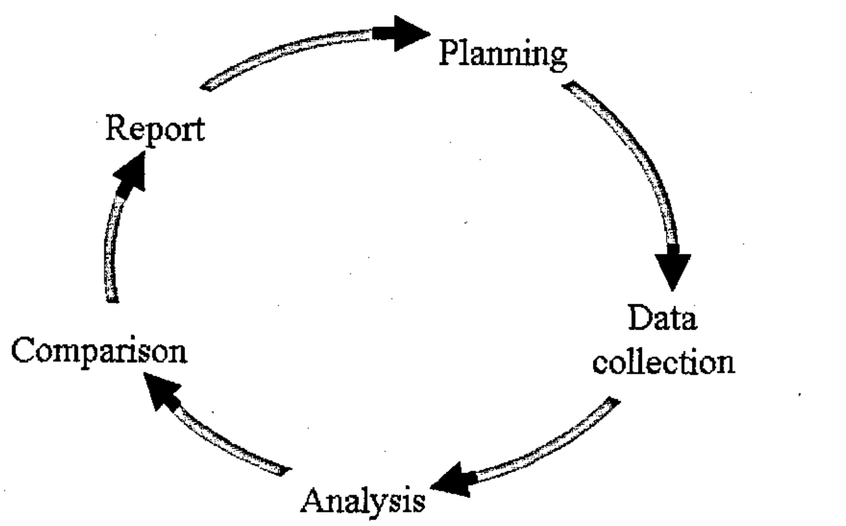


Figure 5.15 Evaluation process

Step 1: Planning

An evaluation plan is a written document that specifies the evaluation design and details the practices and procedures for conducting the evaluation. This can be done by determining the goals and objectives of the evaluation study, establishing evaluation measurement criteria, and designing appropriate approaches to achieve the goals and objectives in terms of the budget, time, available resources and expertise.

Step 2: Data Collection

The aim of this step is to identify the most appropriate methods to collect relevant data. Data collection should involve collecting both *quantitative* and *qualitative* data. Quantitative data refer to numeric information and usually come from asking closed-ended questions while qualitative data provide a record of thoughts, observations, opinions or words. These typically come from asking open-ended questions.

Step 3: Analysis

In this step the relevant data collection should be summarised and analysed by using appropriate system analysis tools.

Step 4: Comparison

The aim of this step is to compare the analysis of relevant data (Step 3) and the evaluation measurement criteria (Step 1).

Step 5: Report

The aim of this step is to produce a report and draw conclusions based on all the data sources and types and to provide feedback to top management to improve the quality of the information system.

Figure (5.16) illustrates the feedback of evaluation. Feedback evaluation can help at the planning stage to evaluate the current strategy and develop a new one; it also provides a set of new needs or requirements at the analysis stage. Feedback evaluation can help during the design stage to improve performance and efficiency of the system and, at the implementation stage, can provide elements which satisfy user needs, leading to job satisfaction and fulfilling efficiency objectives. Finally, feedback evaluation can help to increase production and services at a low cost at the maintenance stage.

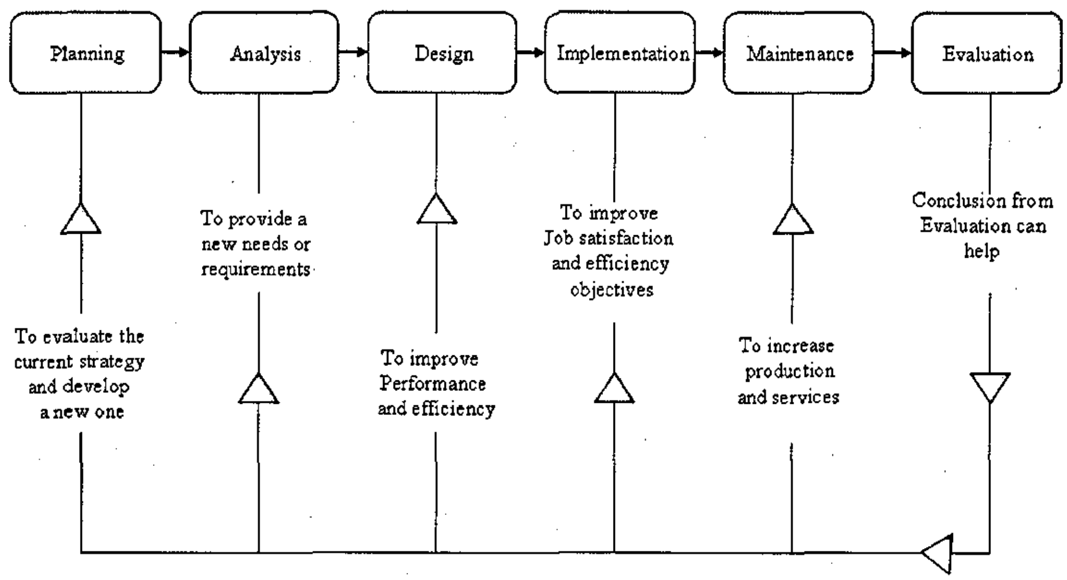


Figure 5.16: Relationship between evaluation and MIM process (feedback)

5.4 Summary

The objective of this chapter was to present a generic framework to enable the Mandoora Iterative Multi-methodology (MIM) to work as a multi-methodological approach and achieve reasonable consensus, as well as addressing different problem situations and different purposes. The contribution of this chapter lies in the MIM (Mandoora, 2005) integrating SSM (Checkland, 1981), ETHICS (Mumford, 1983), and VSM (Beer, 1972) in order to perform in-depth quantitative and qualitative analyses, and to help in designing integrated systems which can be implemented and evaluated in a real organisation to achieve the system's objectives. Therefore, the purposes of MIM are to explore different worldviews relevant to a real world situation and to contrast them in a process of debate (SSM); to improve job satisfaction (the social system), work efficiency (the technical system), cultural support, and political approval (ETHICS); and to use the cybernetic principle of viability to design new organisational structures and processes (VSM) (see Figure 5.1).

Chapter 6
Findings

6.1 Introduction

This chapter aim to present the results of the five methods used in this research. These methods are: document analysis, interviews analysis, focus groups analysis, observation analysis, and questionnaire analysis.

6.2 Document Analysis

Document or paper sources provide the researcher with a wealth of information. An organisational document can help to disclose the formal system which lies behind many of an organisation's activities. Document analysis, therefore, can play a significant role in helping the researcher to gather information about current systems. Policies, general statistics, official and historical documents, charts, report files and system documents can provide the researcher with general background information.

The document analysis of TTC has been divided into six elements: general objectives, hierarchy management, managerial structure, student affairs, library resources, and information infrastructure.

6.2.1 General Objectives

The general objectives of the TTC, according to Syam and Ashary (2000), include:

1. Developing belief in God, strengthening the Islamic faith and improving the attitude of pupils.
2. Developing an interest in scientific research, reading and conducting meaningful conversations so that pupils are trained to be good housewives, experienced researchers and professional educators in order to use their abilities to develop the Saudi community scientifically, socially, mentally and physically, all aspects of which suit them naturally.
3. Leading the pupils in the tradition and culture of Islam and educating them about the leaders and great figures in order for them to understand more about humanities subjects.

6.2.2 Hierarchy Management

There are four levels of management committee at TTC. These are High-level Management, Middle Management, Lower Management and Operational Control (see Figure 6.1).

High-level Management Committee

The High-level Management Committee is concerned with the development of the overall goals of the education system and the methods used to achieve these goals. This level comprises members of the Consultative Council (*Majlis Al-Shura*); the General President of the Affairs of the Grand Mosque and Prophet's Mosque; the Secretary-General of the Muslim World League (MWL); the Minister of Water and Electricity; the Minister of Higher Education; and the Minister of Education. It is chaired by the second Deputy Prime Minister (Office of the Royal Embassy of Saudi Arabia in Washington DC, 2003).

Middle Management Committee

This Committee is responsible for the process of ensuring that College goals are accomplished effectively and efficiently. It comprises the Minister of Education, the Under-secretary for Girls' Education at the Education Ministry, and the General Management for College Affairs in the regions.

Lower Management Committee

The Lower Management Committee makes sure that all specific tasks are achieved. Members have a meeting every month and this College Committee consists of the Dean, the Deputy Dean for Higher Education and Scientific Research, the Deputy Dean for Administrative and Financial Affairs, the Deputy Dean for Student Affairs, and Heads of Department.

Operational Control Committee

The Operational Control Committee makes sure that all day-to-day tasks are carried out successfully and professionally. Members have meetings twice a month and the Committee consists of heads, academic and operational staff of the departments.

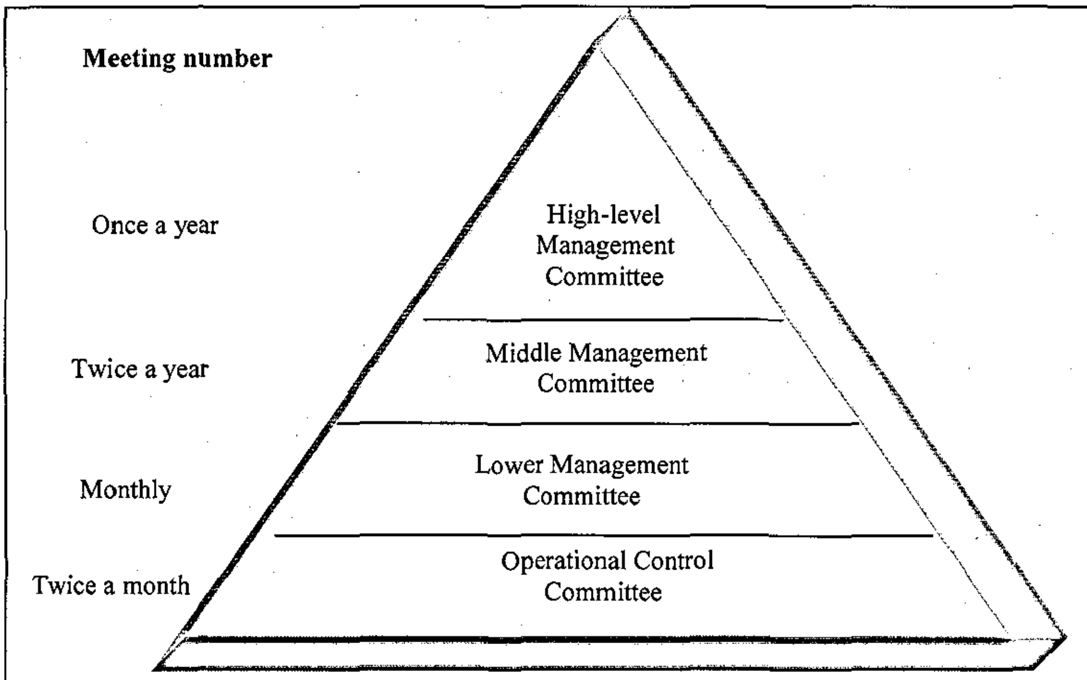
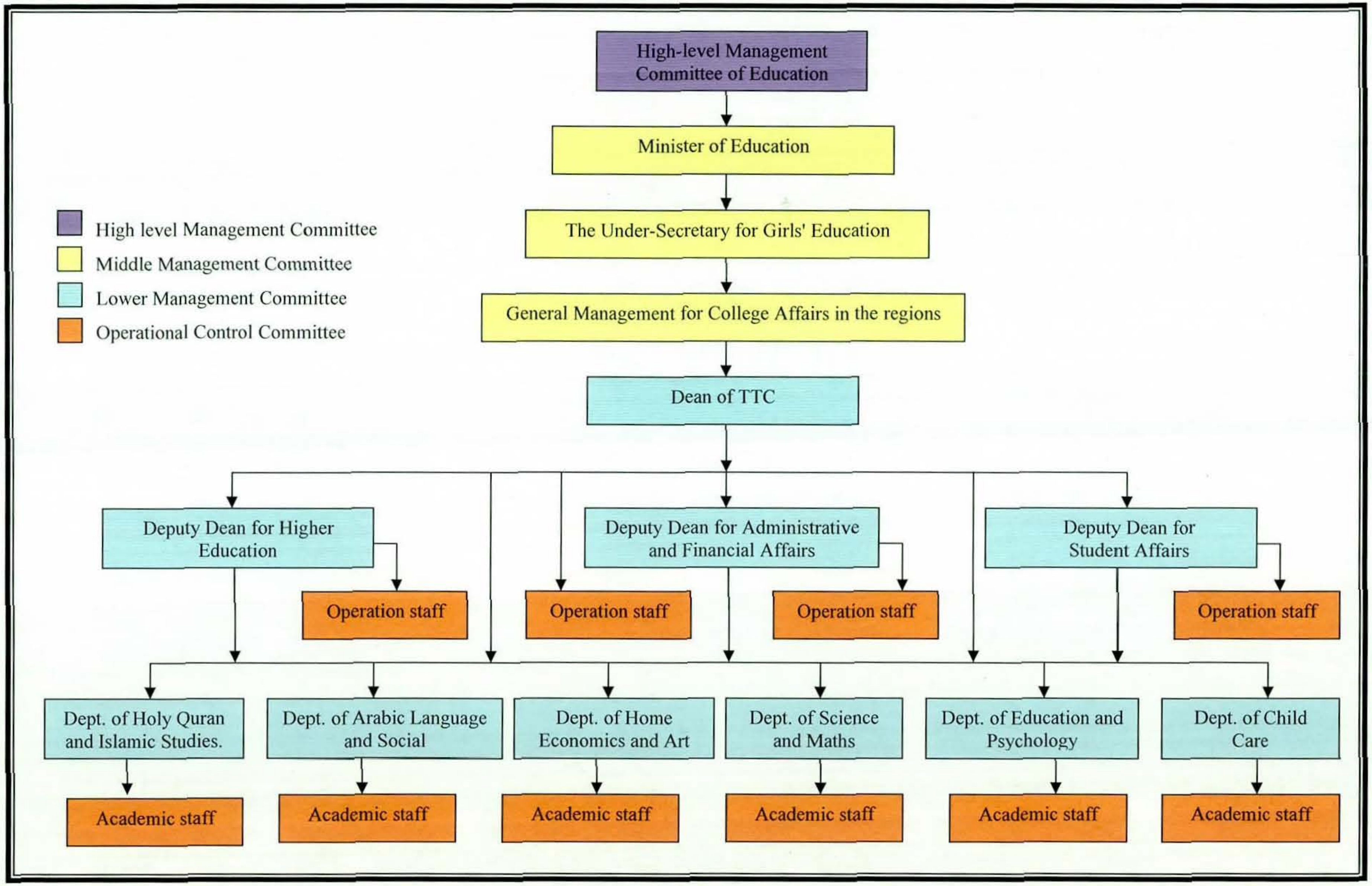


Figure 6.1 Hierarchy of TTC management

6.2.3 Managerial Structure

The managerial hierarchy of TTC starts with the High-level Management Committee of Education, followed by the Minister of Education, followed by the Under-Secretary for Girls' Education at the Education Ministry, followed by the General Management for College Affairs in the regions, followed by the Dean of TTC, followed by Deputies Dean and Heads of Department (see Figure 6.2).



Figurer 6.2 Managerial structure of TTC

6.2.4 Students Affairs

The Student Affairs section at the Department of Administrative and Financial Affairs aims to manage all operations related to students. For example:

- To register all accepted new students and store their files, receive the exchange request from and to TTC, or internal exchange between departments at TTC, and follow up exchanged students' files;
- To receive requests related to student absece and present these to the College Committee, to follow up absence and the attendance of students, give statistical information about students whose absences extend beyond accepted limits, and receive medical reports and send these to the departments at TTC to take action;
- To create and produce an ID card for every student;
- To produce lists of students' names and their attendance according to their departments and distribute these lists to TTC departments and to the General Management for College Affairs at Makkah every academic year; and,
- To create files as paper documents related to the departments.

Table 6.1 shows the number of students at TTC in each level of the Departments for the year 2004 and 2005. The total number of students at the college was 2264 in 2004 and 2248 in 2005. The highest number of students was in the Department of Arabic Language and Society (2004= 772 and 2005=789), followed by the Department of the Holy Quran and Islamic Studies (2004=652 and 2005=606), while the lowest number of students was in the Department of Science and Maths (2004=242 and 2005=261); the second lowest number of students was in the Department of Home Economics and Art (2004=268 and 2005=304).

According to Syam and Ashary (2000), the courses in the Department of Education and Psychology are compulsory and basic to all departments at TTC from Level Two to Level Four.

Departments	Level	2004	2005
Holy Quran and Islamic Studies	1	186	145
	2	206	174
	3	133	150
	4	127	137
	Total	**652**	**606**
Arabic Language and Society	1	207	157
	2	197	214
	3	183	229
	4	185	189
	Total	**772**	**789**
Science and Maths	1	66	71
	2	73	61
	3	66	69
	4	37	60
	Total	**242**	**261**
Children Care	1	71	78
	2	82	56
	3	114	83
	4	63	107
	Total	**330**	**324**
Home Economics and Art	1	87	101
	2	66	70
	3	67	62
	4	48	71
	Total	**268**	**304**
Total Students at TTC	1	617	552
	2	624	575
	3	563	593
	4	460	564
	Total	**2264**	**2284**

Table 6.1 Number of students at TTC

6.2.5 Library Resources

The library is a central place for finding information and for studying. Considering the importance of the library and its role in the college, the General Management for College Affairs in Makkah provides the college library with reference materials and books in various disciplines, such as Islamic books, books on the Arabic language and literacy, books on education, and Arabic encyclopaedias. The library also accepts gifts (books) from academic staff and some local authorities. The College has created a committee to discuss the requirements of the library in terms of, for example, micro-fiches, photocopies and IT. The aims of the college library are to provide library services to the students and academic staff, and to help students to find books relevant to their research.

The library uses a card indexing system for information retrieval. There are three types of indexing: author indexing, title indexing and subject indexing. Each type is stored in a drawer for ease of searching and each card is computer-processed.

6.2.6 Information Infrastructure

The TTC is constantly seeking to improve the quality of education for students so the inclusion of computers in their services was one of the major steps in this direction. Consequently, the computer centre began by installing 33 desk-top computers connected by a Local Area Network (LAN). The computer centre also has closed-circuit television so that classes can take place between a male instructor and female student body. The aims of this centre are: to teach computer courses to students in different departments in the second term only (with the exception of the departments of Home Economics and Art, and the Holy Quran and Islamic Studies; to provide training courses for academic and operational staff (using Windows, Word and Excel); and to provide maintenance services for all computers in the TTC.

Starting in 1998, the College provided the library with computers for all the library's operations. The College also provided the student affairs unit with a number of computers to make its administrative processes more accessible and to manage the issue of students' absence. The College also provided the Dean's office with computers to manage all official letters. Furthermore, TTC provided all departments with computers to record students' marks and to produce final results. Therefore, the total number of computers at TTC was 62; which are used for a variety of additional services.

The International System Institute for Computer and Languages (ISCL) is under the supervision of the TTC in order to carry forward the transition from a traditional educational system to a new world of knowledge, integrating quality education with modern technology. To this end, ISCL aims to provide students with certificated training courses lasting three months that lead to a diploma which takes two years to complete. The training course certificate includes study of website design, the Oracle database, Visual Basic, Internet applications such as Internet search and Outlook, the Marief application (a Ministry of Education program), and other short courses related to the use of computer applications such as Windows, Word, Excel, Power Point and Access. The diploma certificate includes study of computer programming, network technology (hardware), computer maintenance and operation networks (software). ISCL has provided experienced staff and has selected teachers with high-level qualifications in their specialisms, together with computer centre provide high-quality equipment and educational tools.

However, some researchers and executive managers believe that investing in ICT guarantees success for the organisation's systems and provides users with better services. Unfortunately, this is not so. A survey by the Standish Group (2003) found that 66% of 13,522 IT projects were abandoned before completion. The main reasons for these failures might be related to: ICT being used merely as a replacement for manual and administrative functions; a lack of user involvement in all aspects of the IS life-cycle; executive managers considering short-term rather than long-term strategic planning; and a lack of integration between systems which leads to data duplication, and unnecessary data entry and data processing.

6.3 Interview Analysis

In order to obtain as much qualitative data as possible in relation to the current problem situation, semi-structured interviews were used to understand the experiences of the interviewees and to access the context of their behaviour. In addition, interviews were conducted to build up a clear view that helps to develop a rich picture of the problem situation. The style of interview questions was explained in Chapter 2. This part of the interview analysis has been divided into three main sections. The first section covers the interviews with the Dean and Deputy Deans (3 interviews, 6 hours, see Appendix 5 for summary information), the second section examines interviews with Heads of Department (4 interviews, 8 hours, see Appendix 6 for summary information), and the final section involves interviews with supervisors (3 interviews, 6 hours) at TTC.

6.3.1 Dean and Deputy Deans

6.3.1.1 General Background

The Dean indicated that the aims of TTC were to promote teachers scientifically, educationally and in terms of religion. She added that these teachers should be teaching only in primary and nursery schools, while both Deputies indicated that the aim of their offices was to help the Dean achieve the objectives of the TTC. The Deputy DAFA stated that her job was to facilitate all issues such as administrative management, financial matters, staff affairs and issues in academic departments. Deputy DSA, on the other hand, stated that her major job was to assist in all matters related to students, including admission and registration, student appeals and student problems. The interviewees indicated that all the aims and objectives of TTC are documented by high-level management at the Ministry of Education.

The Dean and Deputies were asked about their current functions in TTC. The Dean indicated that the major functions of her job were to supervise all activities related to TTC in achieving its goals, to provide information requested by the Middle Management Committee and to apply Ministry of Education policy. Deputy DAFA stated that the functions of her job included following administrative and financial affairs, managing issues related to the curriculum, supporting cooperation among departments, and providing various reports. Deputy DSA stated that the functions of her position included assisting students in improving their skills, knowledge and education, and linking students with TTC management and educational and operational practices.

The Dean stated that her activities were supervising the activities of departments and providing them with services and what they needed to help them achieve the objectives of these activities. Deputy DAFA stated that these activities included receiving all documents and letters from the Dean that related to administrative and financial matters and sending these to the departments for them to take appropriate action; managing issues associated with the curriculum such as improving educational planning or organising examination timetables; cooperating with departments in tackling the lack of academic staff; providing an annual report concerning employees; and providing an annual report about the TTC. She added that these activities related to the activities of other departments, such as providing the Department with necessary information. Deputy DSA outlined a number of activities involved in her role such as conducting lectures, acquiring knowledge about competition, organising courses and workshops, and practising field work.

6.3.1.2 The Current Information System

The Dean indicated that the current system of TTC was a conventional one which depended on manual indexing to distribute and collect official letters between departments by using signatures in special record books designed for the purpose. She added that a number of operational staff, carrying out different tasks, were formally responsible for the management of records in the office. Each of these operational staff had responsibility for creating, indexing, storing, retrieving and destroying files. She also stated that the current system had been in use since the creation of the TTC in 1982. She mentioned that since 2001 the TTC's management has tried to improve the system by using personal computers to store official letters going out from the Dean's office.

Deputy DAFA stated that she had two secretaries who were formally responsible for records' management from creation to storing and retrieving, although under her direct supervision. She added that all files were created according to a job request. Such requests included: department files, employees' files, non-Saudi employees' files, general official letter files, student files, complaints files, statistics files, examination files, and financial files.

Deputy DSA indicated that the secretary and staff department are responsible for records management and that the current system had been in use since 1982. She indicated that there are number of files related to admissions, registrations, student appeals, student problems, general official letters, examinations, and part-time students. The Dean and the Deputy Deans stated that the indexing of these files depends on what is written at the beginning of each file. This contains the serial number of each document, the date, the document's subject and a document number. The documents in each file are sorted by date.

Interestingly, Deputy DAFA stated that the current system has been used for only two years while the Dean and Deputy DSA stated that the current system had been used since the creation of the TTC in 1982 until the present day. It can be said that there is no standard system for record management between the offices of the Dean and her deputies.

6.3.1.3 Current Problem

The Dean and Deputies mentioned that there are a number of problems related to the current IS. These problems can be grouped into the following issues, as noted below.

One of the major problems facing the Dean and Deputies was the increased amount of paper caused by duplication of the same information, such as general official letters, student files, complaints files, and examination files. Another problem related to creating, indexing, storing, retrieving and destroying records because the records do not have a proper indexing system which takes time when searching for and/or retrieving information, particularly old records. Moreover, the Dean said that the old files and unwanted documents have been stored in the traditional way, such as in cupboards and drawers, which might then be affected by insects and mice. Moreover, the exchange of information between the Dean and her deputies depended on traditional processing by using a signature to receive and send documents; this took time and effort. Furthermore, Deputy DAFA confirmed that there was a strategic plan for destroying some files such as exam papers.

The Dean and Deputy DSA stated that there is no telephone network between academic staff offices and departments so they use a personal mobile phone for communicating inside TTC. They also added that there is a limited number of computers (3 PCs in the Dean's and Deputy DSA's offices) and no Local Area Network at TTC; there is also limited use of computer services which are only used for word-processing. A further major problem is the lack of funds which affects all operation in TTC. Deputy DAFA stated that there are two PCs, a telephone and a fax in her office used for communication; there is also e-mail facility in the Dean's office. She also stated that TTC has recently developed a local information network to connect all academic departments with the department dealing with student and staff affairs, the Dean's office, Deputies' offices and the library in order to facilitate an exchange of information between them. She added that the local network is under the supervision of a private professional computer engineering company to establish Internet services and to develop a TTC website to achieve TTC objectives.

When the Dean and Deputy DSA were asked about information security they answered that there was no information security planning and that all documents had been stored in an unsuitable environment that would, in time, lead to their decay and ultimate destruction. They added that there were no back-up files in the case of disasters such as fire, flood and electricity overload. In addition, every department was responsible for its own files. Deputy DAFA stated that there was a special archive for TTC and some information was stored there on CD and floppy disks. Also, she indicated that there were copies of files in the Dean's office and departments. Moreover, TTC had a copy of most official documents which were sent to top management.

The Dean and Deputy DSA stated that there was a limited number of operational staff with ICT skills and the current staff (academic and operational) had been offered insufficient training courses related to ICT and record management. Also, because of the limited number of staff available, they were overloaded with work.

Deputy DAFA stated that academic and operational staff trained by undertaking a training program at TTC and most of the staff who use a PC trained on their own or by taking private courses. Moreover, she stated that the College had created its own ICT training courses with other academic organisations for many years. Furthermore, Deputy DAFA stated that institute for computer was recently establish at the TTC to provides training courses for academic staff and fee-paying students. However, Deputy DAFA complained about the limited number of operational staff when compared with the work they have to do.

6.3.1.4 Suggestions to Improve the Current IS

The Dean and Deputies pointed out a number of suggestions to improve the current IS. These include: increasing the number of staff who have ICT skills; reducing the system for exchanging information between departments; developing a Local Area Network (LAN) to improve communication; developing an information centre to help staff and students access information easily and effectively; and creating a records centre to store records and decrease the risk of their destruction. Deputy DAFA added that expanding the use of Internet services (E-mail) between departments and between TTC and high-level management, as well as colleges; and using fax instead of postal services and documents, would be more efficient. When the Dean was asked about her opinion of the centralised information and the Help Desk (HD) at TTC, she stated that the Information Centre and HD can play an important role at TTC in helping staff and students to satisfy their needs, particularly if the Information Centre and HD were provided with new Information Communication Technology and professional staff to deal with the users' requirements.

6.3.2 Heads of Departments and Supervisors

6.3.2.1 General Background

Heads of Department stated that the aims of their departments were documented clearly by Syam and Ashary (2000) when they described TTC. The Supervisor of the Department of Staff and Financial Affairs indicated that the aim of this branch is to gather staff information (for both male and female academic and operational staff) such as personal information, qualifications and work experience, and other information related to staff. In addition, the Supervisor manages financial processes concerning staff and makes an annual statistical report, as well as providing departments with the information they need.

The Supervisor of Student Affairs stated that the aim of this branch is to manage all information related to students, including admission, registration, ID cards, examination results, problems, awards and medical reports. Also, she added that this branch provides students and departments with information and services when they need them and creates statistical reports. The ICT supervisor indicated that the main aim of ICT is to facilitate the operational management of TTC and helps to store and retrieve information in a timely and specific way. All of the above aims and services were also documented by Syam and Ashary (2000) when they described the TTC in Makkah, which triangulates the findings of this study.

Heads of Department stated that every department has particular functions related to their own aims and objectives. The Supervisor of Staff and Financial Affairs indicated that its aims include creating and managing staff files by organising, editing, storing and retrieving them.

Furthermore, the Supervisor of Student Affairs stated that the Department's functions are to create and manage student files while the ICT supervisor indicated that its aim is teaching computer literacy to different Departments, providing training courses for academic and operational staff, and maintaining all the computers at TTC.

Heads of Department stated that the activities they used to achieve these aims were: academic lectures, workshops, field practice, research, seminars, exhibitions and discussion groups. In addition, Heads of Department pointed out that the activities provided by their Departments were well received by other Departments in the TTC. On the other hand, the Head of Home Economics and Art and the Head of Department of the Holy Quran and Islamic Studies stated that the relationships between departments were very limited. The Supervisor of Staff and Financial Affairs stated that the branch provided a number of activities related to staff issues such as issuing an annual statistical report, implementing processes related to management and financial issues, and managing staff records.

The Supervisor of Student Affairs made clear that the activities carried out to achieve the functions of this Department were to develop and manage student records related to admission, registration, monthly attendance, absence, transcripts, field work reports, certificates, financial issues, complaints and other problems. Furthermore, the branch makes relevant statistical reports and provides these for upper management while the ICT supervisor indicated that the activities carried out by his branch were lectures provided to students, training courses for operational and academic staff at the computer centre and maintenance services.

6.3.2.2 Current Information System

The formal responsibility for the management of records in the Departments lies with the Head of the Department and one or two academic staff who help her to create, index, store and retrieve information from manual files. The Heads of Department stated that wooden cupboards have been used to store different files related to different subjects; each file has an index page at the beginning of the file. This index page has recorded on it a serial number, a date and the subject of the document. These documents are kept in date order. They added that this system has been used since 2002.

The Supervisor of Staff and Financial Affairs stated that the files have been grouped related to staff occupations, such as operational staff and academic staff. Academic staff have been grouped in relation to their department and each file consist of a number of parts (1-10); each part contains staff records, while the number and name of the staff member is written on the outside of this file. There are others files relating to the different subjects and to different areas. This system has been in use since 2004.

The Supervisor of Student Affairs explained that the files are grouped according to student departments while every department has been grouped according to the level of the student with each level being bound together with a list of student names and serial numbers. There are others files relating to different areas. This system has been used since 1998. Both the Supervisor of Staff and Financial Affairs and the Supervisor of Student Affairs stated that the documents in their files have been organised in order of the date they were received. Each file has an index page which contains a serial number, a date and the subject of the document. The ICT supervisor explained that he had a limited number of files relating to ICT and its maintenance. This system has been in use since 1997.

6.3.2.3 Current Problems

The Heads of Department and Supervisors mentioned that there is a number of problems related to the current IS. These problems can be grouped into the following issues as noted below.

Heads of Department indicated that there are large amounts of general official letters because every official letter has to be copied up to eight times and distributed to all lower management officials just to inform them. In fact, this leads to the duplication of the same records which, in turn, takes more time, effort, money and office space. They added that there is also duplication of some files such as staff and student files in the departments and Deputies' offices. Although the staff and student information was already kept in the Deputies' offices, they requested this information from the departments at least twice a year. Consequently, the departments need to create files of staff and student information to fulfil requests form the Deputies' offices.

Although the indexing processes are quite simple, Heads of Department stated that academic staff complained about the lack of time for indexing because they are already overloaded and so there is a delay in getting information requested from other departments. Heads of Department also complained about the rapidly increasing of number of files in their departments which lead to limited space in their offices. Because of this, they destroyed the old files or stored them in an unsuitable environment.

The Supervisor of Staff and Financial Affairs and the Supervisor of Student Affairs complained that there was no standardisation in information management and not enough space for all the files in the offices. Furthermore, there were other problems related to the duplication of students' information kept both on computer and paper files; traditional ways of exchanging information to and from departments were also used.

Heads of Department stated that the telephone network between departments and their academic staff was not set up so they usually used a personal mobile phone for communication. Heads of Department indicated that academic staff did not use ICT in the classroom. This might relate to the lack of a computer infrastructure in TCC and a lack of understanding of computer technology and its terminology.

The Supervisor of Staff and Financial Affairs and the Supervisor of Student Affairs complained about the limited number of computers, and the fact that there were no back-up files and no updating of information on the computers, due to lack of time and staff. In addition, they complained about the limited number of copy machines and that there was no direct telephone line while the ICT Supervisor complained that there is no usage of original application software, training material, and lack of fund.

Heads of Department and Supervisors unanimously said that there is no information security planning to keep records safe even from burglars or disasters. Some Heads of Department mentioned that, for security reasons, they have a copy of important documents in their home. The main reason for this is that the TTC repository is not kept in a suitable environment and is not organised properly so to access and retrieve information is very difficult.

Some Heads of Department stated that most academic staff attend the training courses related to ICT in TTC but they give up after the first lesson. The reasons for this are that the communication between the instructor and trainees is lacking because they use closed-circuit television and so it is difficult to follow instructions. Also, there is a lack in basic knowledge of using computer equipment or of computer terminology. Heads of Department indicated that some academic staff do not attend training courses because of the high numbers in the class and because they perceive no benefit from the training courses if they can not practise what they learn.

The Supervisor of Staff and Financial Affairs and the Supervisor of Student Affairs complained about the limited number of operational staff when compared with the amount of paperwork they had to complete. Also, operational staff have limited training in records' management such as the creation, storage and retrieval of information. In addition, there is a lack of ICT staff and the current operational staff are not used to using computer applications such as Excel, Word, Access and Internet services. The ICT supervisor also complained about the limited number of ICT staff and trainers, lack of training materials and funds. He added that, most application software which is used at TTC is not original and lacks a back up. Further issues surfaced such as information security, and the lack of up date technology and software in the computer centre.

6.3.2.4 Suggestions to Improve the Current IS

Heads of Department indicated that a number of steps should be taken to improve the problem situation including developing strategic plans for information security, using updated technology to manage information effectively, establishing a local telephone network between academic staff offices and Departments, creating a Local Area Network, using Internet services, and providing TTC with qualified staff, particularly ones with ICT skills.

The Heads of Department were asked to express their opinions about centralising information and HD at TTC. They stated that they approved of creating an

Information Centre that could help to exchange information between departments, Deputies' offices and the Dean's office. Moreover, an Information Centre could help to facilitate records management from the creation of information to its storage, retrieval and destruction. In addition, an Information Centre could help to integrate and update information if provided with qualified staff and proper ICT. Furthermore, an Information Centre could link TTC with other colleges around Saudi Arabia. The Heads of Department added that HD could provide a number of advantages for TTC. These include reducing human error, resolving problems related to ICT, improving services, and offering assistance as needed.

The Supervisors outlined a number of suggestions to improve the current situation. These suggestions included developing a Local Area Network with up-to-date ICT and proper Internet services, increasing the number of operational staff with ICT skills, and providing training courses in areas such as records management and computer applications.

6.4 Focus Groups Interview Analysis

Three academic staff and two operational staff focus groups were carried out. The academic staff members included: academic staff from the Department of the Arabic Language and Social Science, the Department of Science and Maths, and the Department of Home Economics and Art. Operational staff members were: operational staff from the Student Affairs office and the Dean's Office. A summary of the focus groups activities is discussed below; a table of the issues raised can be found in Appendix 5.

6.4.1 Formal Information Process Management at TTC

The focus groups were asked about the formal process of information management (see Figure 6.3). The general process of information management depends on a traditional system:

1- Usually, upper levels of management and external users (students, companies, local authorities) use formal methods of communication with TTC to request information, to apply, or to clarify issues.

2- Operational staff in the Dean's office receive documents (official letters, reports, offers, brochures, books) and sign for their receipt in a special record book relevant to upper management or local authorities.

3- In the Dean's office, the operational staff collect all documents and show these to the Dean who directs them to the appropriate place (file) or person (deputies, heads of department, operational staff) to take action. Operational staff take a copy of any document received and send it to the relevant person, saving the original in the relevant file in the Dean's office. Approved documents are sent back to external users or upper management after a copy has been made; this copy is then saved in a relevant file in the Dean's office.

4- In Deputies' offices, the operational staff receive the documents after they have signed a special record book relating to the Dean's office or Heads of Department offices. They show the documents to Deputies who direct them to the appropriate files or Heads of Department. Some documents need to be actioned by operational staff and sent to the Deputies for approval. The operational staff take copy of the approved documents and send the original to the Dean's office while the copy is saved in a relevant file.

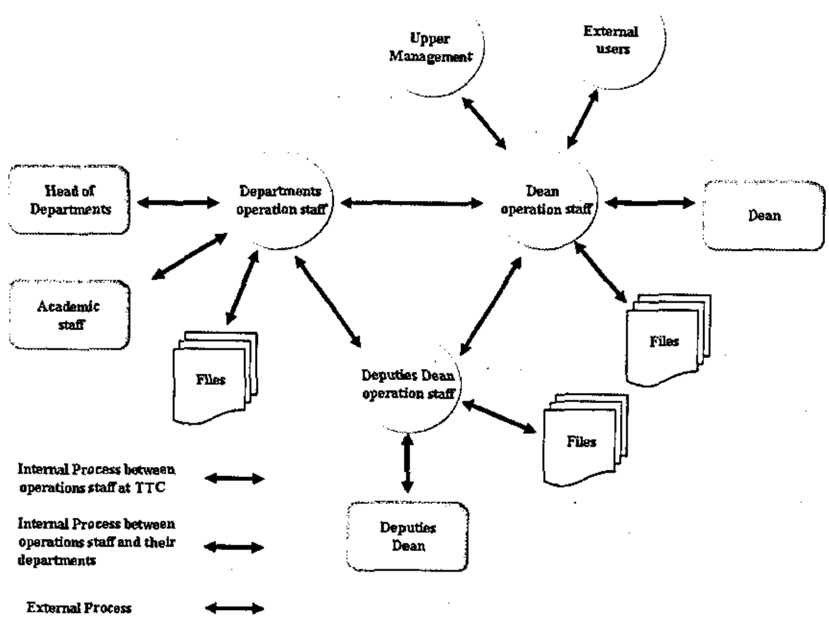


Figure 6.3: Formal information process management at TTC

5- In offices of Heads of Department, the operational staff show the documents to Department Heads who direct them to the appropriate files or academic staff for them to take action. Some of the documents need to be actioned by operational or academic staff to fulfil the request for information; these are then sent to the Heads of Department for approval. The operational staff take a copy of the approved documents and send the original to the Dean's or Deputies' offices while the copy is saved in the departments in relevant files.

6.4.2 Department Needs

When the members of the five focus groups were asked about their needs, academic staff from the departments answered that they needed to use appropriate teaching methods, supported by ICT, in classes to make educational operations more active and understandable. They needed suitable training courses to be provided and an education multimedia centre to be established; they wanted a PC for every academic staff member and a copy machine in each department; a local telephone network between academic staff offices and Departments to be established; the number of academic staff to be increased in line with student numbers; paper work to be reduced in order to decrease the storage of files; and unwanted files to be removed or destroyed. Moreover, academic staff required greater incentives such as increased salaries, the provision of medical services and accommodation, discounted public services, and academic staff awards. Overall, the Departments required new buildings with new services related to educational operations.

Operational staff, however, explained that they needed an increase in the number of operational staff with ICT skills, more PCs with a Local Area Network and an increase in the number of training courses. They also wanted greater use of Internet services; to use a database management system, particularly for the management of students' records; to decrease the number of files; to have a suitable environment to store information; to take out inactive files and destroy unwanted files; and to reduce the duplication of files.

6.4.3 Existing Problems

The focus groups were asked about existing problems relating to information processes. Academic staff explained that some information processes take a long time, particularly those to do with financial issues. Most information processes that take place between Departments, Deputies and the Dean are formal; this takes time and effort and costs money. Furthermore, they complained about the duplication of the same information in different departments with different formats; the use of manual index files that take up time and effort; difficulties in retrieving information from files which have no proper indexing; the lack of training courses related to records' management and ICT; the lack of ICT equipment and services; the lack of any multimedia services in classrooms; the fact that no Internet services are available in the computer centre; and the limited number of ICT staff.

Operational staff, on the other hand, complained about traditional processes of information management which wasted time; the duplication of the same information in PCs and files; the lack of back up files; the rapid increase in paper work and files; lack of time for indexing; the limited number of operational staff; the fact that there was no time for training; the limited number of PCs; and the current information communication system which consists of official letters which take time and effort.

6.4.4 Suggestions and Opinions to Improve the Problem Situation

As part of the focus groups activities, the academic staff made suggestions to improve the current system. These included: using Internet services to communicate between TTC and its students; TTC management evaluating its information processes at least every two years; directing TTC into centralising its information management with a proper information policy; providing TTC with a up-to-date Local Area Network with appropriate ICT (hardware and software), providing TTC with professional information; and suitable training courses with incentives.

Operational staff suggested establishing an integrated information system to help staff to gain the quality information they needed in a timely, flexible and effective manner. Moreover, they suggested reducing the amount of paper work between different levels of management; using suitable files to store documents; removing unwanted files and placing them in proper archives with a proper environment; and moving inactive files from staff rooms to a proper place at TTC to make access easy when staff needed it.

6.5 Observation Analysis

The main aims for adopting obtrusive observation were to understand and explore the current processes and uses of the information system by watching, describing and analysing. The obtrusive observations were carried out in six departments, three offices, and computer centre. The departments included in the study were: the Holy Quran and Islamic Studies, the Arabic Language and Social Science, Science and Maths, Home Economics and Art, Child Care, Education and Physiology. The offices included: the operational staff office of Deputy DAFA, operational staff office of Deputy DSA, and the operational staff office of the Dean. The obtrusive observations were carried out covering the elements below. The data collection form for the obtrusive observation study can be found in Appendix 4.

6.5.1 Characteristics of Participants

The number of lower management participants was 10, the number of academic staff 143 and the number of operational staff was 44 at TTC. For operational staff, the major observations included: lack of performance-related rewards (e.g. money, certificates, higher positions); limited sharing of knowledge and experiences; limited encouragement from lower management; lack of training courses; lack of guidance to improve performance; lack of integrated information which allowed them to do their job well; and a deficiency in lower management in listening to their ideas, concerns and in giving them regular feedback about their performance.

The main observations made concerning academic staff were: the number of academic staff was low in comparison with the number of students; lack of feedback from students to improve the performance of academic staff; limited social gatherings between academic staff and lower management; lack of exchange of experiences and knowledge among academic staff; and a lack of guidance on how to improve performance from lower management, who also failed to listen to the ideas and concerns of academic staff on how to improve education.

Staff at TTC feel disinclined to learn or to improve their situation because of old fashioned ICT equipment and the lack of regular training courses which would keep staff at TTC up-to-date with the technological advances in the area of ICT. There is also a limited amount of ICT equipment which leads to a lack of its usage in TTC classrooms although ICT offers the education process one of the most potentially powerful learning tools available.

The major observations concerning lower management included: lack of planning strategy; lack of financial resources to reward TTC staff; lack of clear a policy to set up guidance to improve performance and reward TTC staff; lack of time for social gatherings during the working day; failure to recognise the basis points on which performance might be judged and lack of time to judge TTC staff; limited financial resources and time to set up proper training courses; and lack of experience in managing information or in integrating information in order to do their job well.

6.5.2 Information Communication Technology

6.5.2.1 Hardware

All PCs were IBM compatible with printers; there were between two and four PCs distributed in each department, in Deputies' offices and in the Dean's office. Only operational staff in the Dean's office had fax facilities while both Deputies' offices had fax but without connection to a telephone line. There was no Local Telephone Network to connect academic staff offices with lower management, and no Local Area Network for computers to connect all PCs together. There were ten copy machines scattered throughout departments and operational offices. There were no multimedia facilities in classrooms but a limited number of overhead and slide projectors were available. All academic staff and Heads of Department use their personal mobile phones to contact each other if a telephone line is not available.

Furthermore, it was found that the computer centre has very limited use because it is only used in the second term of the year by four departments; there was no data show screen as local closed-circuit television was used; it was used as a storage area for around 200 chairs; there were some computers and printers under tables in need of maintenance; students' disks were scattered between computer tables; a collection of computer cables and scanner on a table were disregarded; and there was one cupboard containing four drawers full of computer course handouts and a collection of computer peripherals, as well as office tools.

6.5.2.2 Software

All PCs were loaded with Windows 2000 and Windows XP. Word and Excel applications were used on these PCs to produce items such as formal letters, students' transcripts, statistics and reports. There was no virus protection software and no back up procedures; all software applications at TTC are not original. Internet services, such as E-mail, searching and Websites, were only available in the Dean's operational staff office.

6.5.3 Information Resources (Manual or Electronic)

As other resources, such as humans, finances and equipment, can be managed, so can the organisation of information. The information resources of TTC located at the Dean's office, Deputies' offices, and Department offices.

Information resources \ Office of operational staff at	Dean	Deputy DAFA	Deputy DSA	Departments
General files	√	√	√	√
Paper forms	√	√	√	√
Lecture timetables	√	√	√	√
Meeting files	√	√	√	√
Staff files	√	√		√
Staff health files	√	√		
Staff absence book	√			√
Student files	√	√	√	√
Students' result files	√	√	√	√
Students' health files	√	√	√	√
Students' absence files	√	√	√	√
Statistics files	√	√	√	√
Students' field work files	√	√	√	√
Reports	√	√	√	√
Books	√	√	√	√
Copy machine papers	√	√	√	√
Envelopes	√	√	√	√
Blank exam papers	√	√	√	√

Table 6.2: Types of paper-based information in operational staff offices to show duplication

6.5.3.1 Observation of Paper Files

Table 6.2 shows the duplication of paper-based information at TTC. The files were stored on shelves in a wooden cupboard, with some of the files having labels on the outside bearing by the name of the file and the year. Some of these labels were written by hand in different colours and with different directions. Some of the files opened from right to left while the rest opened from left to right.

The Dean, the Deputy Deans and Heads of Department are responsible for creating files according to their roles and experiences. For example, Heads of Department create files related to staff affairs while Deputy DAFA's office create a number of staff files relating to issues such as: TTC academic staff, external TTC academic staff, files on non-Saudi staff, and staff health care files. The operational staff offices are responsible for indexing, storing, editing and retrieving information. The indexing system consists of an index page at the beginning of each file. This page contains a serial number, a date and the subject of the document, but around quarter of these files lack any indexing; this might be related to lack of staff and time.

The observer noted that when the Deputies' offices received documents relating to different issues, the operational staff faced difficulties in knowing in which file they should store the document. Normally, these staff make a number of copies of this document according to the number of files it should be stored in. Therefore, there is significant duplication of the same information in the same office in different files. This duplication also required indexing to be carried out which takes time, effort and money. Moreover, there was no integration between files such as student files, students' absence files, students' health files, and information regarding student affairs. This lead to difficulties in finding completed records for specific students. The same problem occurred with TTC staff files.

There were other problems relating to the retrieval and access of information which was the result of the lack of indexing. The observer examined the process to retrieve and access documents related to specific issues (an approval letter applying to carry out this research at TTC); it took around forty five minutes to obtain this document. The observer noted that there was a clear relationship between the date of a document and the time it took to retrieve it. In other words, if documents were old (before 2002) the retrieval was more difficult and therefore took longer.

Operational staff in the Dean's office keep originals of official letters coming from outside TTC. They make a copy (or more) of the original official letters and send it to the related office to take action. Therefore, most of the paper in files in the Departments and in the Deputies' operational offices were copies. In addition, there are ten copy machines distributed around TTC which leads to an increasing number of papers and duplication of the same information in different places.

Some files have a specific subject and there is a limited number of documents with limited use. In addition, there are some files have been used for documented and confirm purpose and limited use; other files, such as meeting files, students' result files and general files, are created every year and yet past files are still stored in the offices. This leads to a rapid increase in the number of files because their creation is without proper control. Furthermore, there is a large amount of blank paper, such as copy machine paper, envelopes and exam papers, in every operational staff office which takes up a large storage space.

Although each office is responsible for taking care of its own information, operational staff face difficulties with the file and record management system, especially when documents refer to the number of a subject. Consequently, it is important to establish a master plan for information management which will address standards, policies, guidelines, practices and procedures.

TTC does not tend to back up paper files. Moreover, all paper files were kept in a wooden cupboard which was easy to access and which meant the documents might be easily destroyed. This means that there is no information security planning in place to minimise and/or provide for recovering information from potential natural threats such as fire, floods and water leaks, mice or bugs, and from man-made threats including bombs and vandalism.

In fact, there is no scheduled maintenance and services for copy machines; some cupboards were not suitably situated and were not properly air-conditioned; there was a limited number of PCs and these were not up to date; and education media and materials were limited. This offers clear evidence that TTC faces a problem in managing financial resources.

6.5.3.2 Observation of Electronic Resources

TTC started to use PCs in operational staff offices and the library in 1998. There are different file formats including Word and Excel files. Some operational staff offices create their own files with numbers of folders, each folder relating to a specific subject such as the Dean's folder, official letters' folder, general folder etc. The rest of the operational staff offices situate all their files in one folder which means that there are huge numbers of Word files for different subjects. This makes searching for a specific file very difficult. Some files, such as students' absence files, exam timetables, students' names and students' evaluations, have been deleted after being printed onto paper. Some files are related to each other yet no one, except the member of staff who created it, is aware of this (these files are kept in one folder) and there is no standard way of organising files. Files that are two years old or over have been deleted by certain operational staff because there is limited hard disk capacity; this means there is no back-up plan.

Operational staff also bring in their own personal application software which is usually a copy. Some files have been created for one reason and are never used again but are still kept in a folder. After some time has passed, operational staff do not know which files are important and which are unnecessary. No usernames and passwords have been used in PCs which leads to easy access for unauthorised persons. There are also no anti-virus applications used on PCs which means that a virus could attack PCs and destroy data or interfere with the processing and storage of information without anyone being aware of it.

6.5.4 Information Processes (Internal or External)

There are two types of information process at TTC: external and internal. The external process normally functions between TTC and external users such as upper management, companies, students and other authorities. The major method of communication is by official (formal) letters which come to TTC by post or which are handed directly to the Dean's operational staff office. There are also informal ways for communication to take place such as by fax, E-mail, telephone and by direct talk. It can be seen that these formal processes require effort, cost and take a long time to move from the external users to be safely received by the TTC as this is usually more than two weeks, particularly if the official letter is sent by post. When external users follow up their information request, the Dean's operational staff often reply that they have not received the request. The external user believes that the request has been lost and this results in a lengthy information management process.

A similar problem may occur when an official letter leaves the Dean's office to go to external users.

Internal processes normally take place between the Dean's office and Deputies' offices, Department offices, and staff. The formal method of communicating internally could be by official letters, meetings and by direct talk when asking for or giving commands. Official letters need to be signed into a special book as proof of their receipt. This internal process requires effort, cost and time as it can take around two working days. The most usual informal methods of communication, used to follow up and push forward the information process, are by personal mobile phone or by direct conversation. There are four types of internal information process: the downward, upward, horizontal and diagonal process (see Figure 6.4).

An example of a downward process is the communication of information from the Dean's office to the Deputies' offices, Department offices, or to staff. This type of process can be affected by formal and informal communication. A large amount of communication can be dealt with by a downward process such as writing official letters, giving an order to do a job, and to command someone to apply rules.

The process of sending information from staff, Department offices and Deputies' offices to the Dean's office is an upward one. This type of process can be replied to according to the way the communication process began (formal or informal). Information in the upward process can come in the form of reports, official letters, results and statistics.

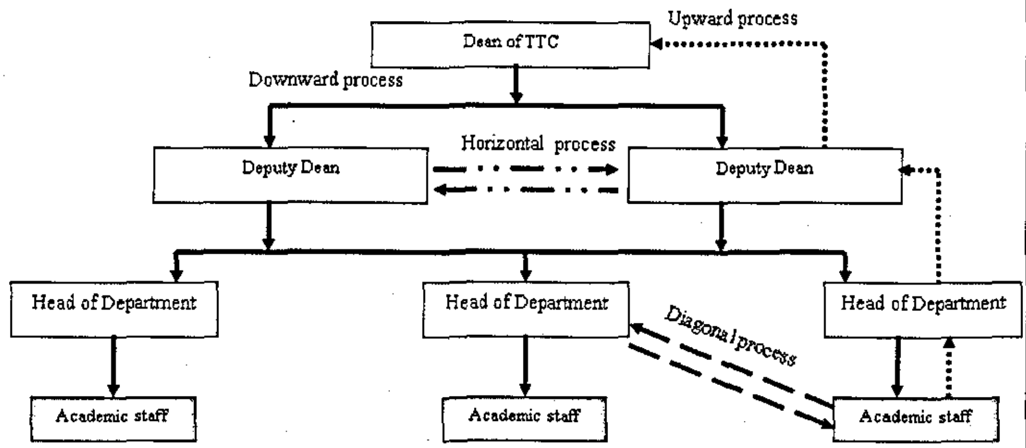


Figure 6.4: Internal information processes in TTC

An example of an horizontal process is the movement of information between Heads of Department or Deputies' offices as usually this happens across one level of management. This horizontal process is used for cooperation and coordination between activities such as students' fieldwork, lectures, using the computer centre, and students' result. Communication in the horizontal process can be by direct talk, mobile phone and through department meetings.

A diagonal process exists between Heads of Department and other academic staff departments. For example, the Head of Science and Maths might request the results of students from academic staff at the Education and Psychology Department. This process can increase the speed of the information process among departments and, moreover, can help to improve cooperation and coordination to fulfil students' studies requirements. On the other hand, this process may affect Heads of Department if they do not know about the work of their staff.

6.6 Questionnaire Analysis

This part of the analysis presents the survey questionnaire. The purpose of the questionnaire was to collect quantitative data about the users of the information system, including staff, academic staff and students. The questionnaires were designed to allow the respondents to read the question carefully and answer by simply ticking or choose appropriate boxes. The questionnaires also allow the respondents to add comments at the end of each part.

SPSS (Statistical Package for the Social Science) software was used to present statistical analysis. The main reasons for using this software are: it is available and commonly used in social science and provides many examples for tabulating, analysing and visualising data and information. At the initial stage of analysis, the researcher used descriptive statistics for all responses which include the Mean and frequency. The second stage of analysis, cross-tabulation, was used to study the influence of one variable on another. The third stage of analysis, the Chi-Squared test (χ^2-test), was used to test the level of significance between nominated variables. The Excel software was used to visualise the result of these analyses.

6.6.1 Questionnaires Respondents

The purpose of the questionnaire survey was to uncover the skill mix of the operational and academic staff, and students within the TTC. This was achieved in a number of ways by asking respondents to indicate their level of experience in using various aspects of information and communication technology. Table 6.3 shows the population, sample size and response rate for each of the departments that comprise the TTC. As can be seen, an excellent response rate of 78% was achieved. The culture within this system was such that a letter of support from the Dean of TTC that accompanied the questionnaires, and approval from middle management (General Management for College Affairs in Makkah-Al Mukkurmah) resulted in a large number of respondents.

Departments	Elements of Population	Population	Questionnaire Distribution	Response
Holy Quran and Islamic Studies	*Academic*	25	10	3
	Student	606	100	66
Arabic Language and Social Science	*Academic*	31	20	20
	Student	789	100	80
Science and Maths	*Academic*	28	15	12
	Student	261	100	79
Home Economics and Art	*Academic*	35	20	18
	Student	304	100	78
Child Care	*Academic*	18	10	9
	Student	324	100	85
Education and Physiology	*Academic*	12	12	9
	Student	--	--	--
Administrative Affairs	*Academic*	4	3	3
	Operational	44	30	19
	Student	--	--	--
Total	*Academic*	153	90	74
	Operational	44	30	19
	Student	2284	500	388
		Total	*620*	*481*

Table 6.3: Elements of population in each department, questionnaires distributed, and the number of responses

6.6.2 Respondents' Characteristics

The first series of questions refers to computer use and experience. Table 6.4 shows the distribution of those who had a computer at home: 64% of the total number of respondents (N=308/481). The breakdown is as expected, with the academic staff having the highest proportion of computers at home, at 80% (N=59/74). On other hand, the operational staff had an unexpectedly high percentage (58%) of computers at home (N=11/19). This might be related to operational staff not having extra or spare financial resources and/or not being interested in having a computer at home. 61% (N=238/388) of students had computers at home. This is perhaps because the new generation of students feels interested in understanding and using computer services; also the price of computers is falling each year.

	Yes		NO		Total
Respondents	**Freq.**	**%**	**Freq.**	**%**	**N**
Academic staff	59	79.7	15	20.3	74
Operational staff	11	57.9	8	42.1	19
Students	238	61.3	150	38.7	388
Total	308	64.0	173	36.0	481

Table 6.4: Respondents who have a computer at home

Respondents' experience of using computer technology is shown in Table 6.5. Here, the greatest percentage of respondents who had used a computer for more than one year were academic staff 73% (N=43/59) while this was 63% (N=7/11) for operational staff. This can be contrasted with the distribution of experience of students as a majority (70% ; N=166/238) had experience in using computers for more than one year, reflecting that they might have been introduced to computers at the TTC.

	< 1 year		1 year ≤ x < 3 years		≥ 3 years		
Respondents	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**N**
Academic staff	16	27.1	13	22.0	30	50.8	59
Operational staff	4	36.4	2	18.2	5	45.5	11
Students	72	30.3	91	38.2	75	31.5	238
Total	92	29.9	106	34.4	110	35.7	308

Table 6.5: Respondents and years of using a computer

Table 6.6 and Figure 6.5 show the departments (in terms of academic staff, operational staff and students) whose members had a computer at home. More than 72% in the Departments of Science and Maths, Home Economics and Art, and Child Care had a computer at home. This might be related to the fact that academic staff and students have more experience in using computers and also have a direct influence on each other. Moreover, there is a great deal of information on websites relating to those departments. On other hand, although there is a large amount of information on websites related to Islamic Studies and the Arabic Language, the percentage of respondents who had a computer at home in these two departments was still small. In fact, academic staff have a limited knowledge of using computers and this has a direct influence on their students.

	Yes		NO		Total
Departments	**Freq.**	**%**	**Freq.**	**%**	**N**
Holy Quran and Islamic Studies	29	**42.0**	40	**58.0**	69
Arabic Language	55	**53.9**	47	**46.1**	102
Science and Maths	66	**71.7**	26	**28.3**	92
Home Economics and Art	70	**72.2**	27	**27.8**	97
Child Care	71	**75.5**	23	**24.5**	94
Administrative Affairs and Education and Physiology	17	**62.96**	10	**37.04**	27
Total	308	**64.0**	173	**36.0**	481

Table 6.6: Departments whose members have a computer at home

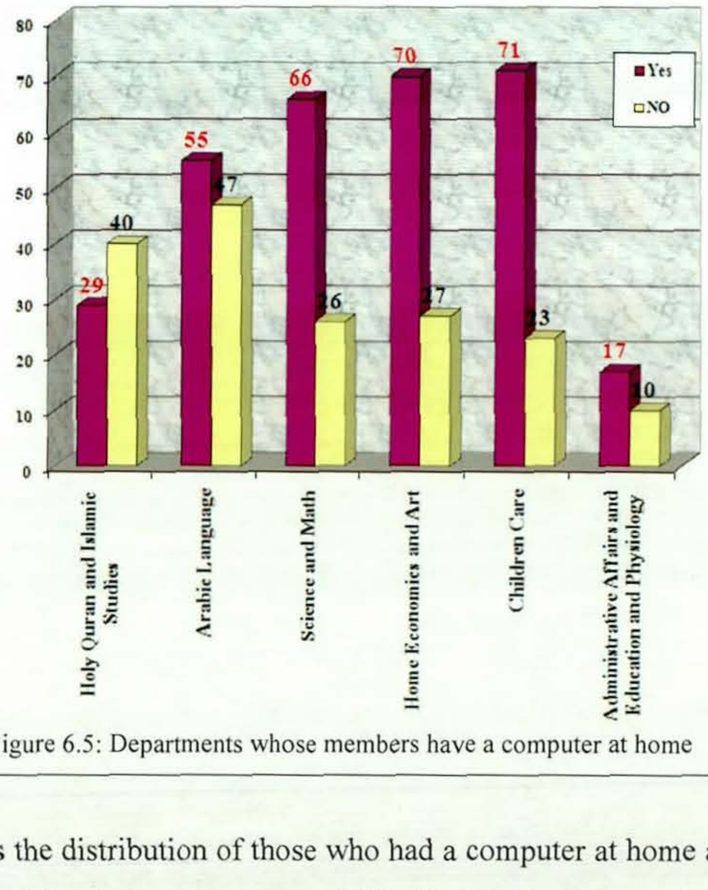


Figure 6.5: Departments whose members have a computer at home

Table 6.7 shows the distribution of those who had a computer at home and how they learned to use it. The highest proportion (46%; N=27/59) of academic staff learned to use a computer on their own while the highest proportion (36%; N=4/11) for operational staff learned to use a computer through friends. On other hand, only a small proportion of academic staff (7%; N=4/59) and operational staff (5%; N= 1/11) learned to use computers by attending TTC training courses and, least importantly, as part of their studies. In fact, there were very few respondents from among the academic and operational staff who studied computers as a part of their curriculum during their education. This funding indicates the limitations of training courses offered at TTC. This is related to the limited amount of time available during the working day; also, limited ICT services exist for users to practice what they have learned on training courses. Around 36% (N=86/238) of students learned to use computers on their own while 22% (N=52/238) learned as part of their study. This might be related to the interest felt by students who wished to understand and use computer services. However, in high school, only the science section has a computer component on the curriculum; this makes students in other sections learn on their own.

	Academic staff N=59		Operational staff N=11		Students N=238		Total N=308	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
On my own	27	45.9	2	21.1	86	36.3	115	37.2
As part of my study	4	6.8	1	5.3	52	21.9	57	18.5
Friends	10	16.9	4	36.4	35	14.9	49	15.8
Private courses	12	20.3	3	26.3	11	4.6	26	8.3
TTC training	4	6.8	1	5.3	1	0.5	6	1.9
Others	6	10.8	1	5.3	20	8.5	27	8.7

Table 6.7: How respondents learned to use a computer (percent)

6.6.3 Respondents' Impressions

Operation Staff and Academic Staff (OS & AS) have been combined together because they are approximately in the same age range, they work together for long time and they have roughly the same experiences. Therefore, it is important to test the level of significance statistical association between OS & AS and students (ST).

Respondents were asked to indicate their impression of how OS & AS dealt with their requirements and with students' requirements in order to satisfy their needs. Table 6.8

shows that about 96% of OS & AS and 83% of ST respondents indicated that they felt this was excellent and acceptable, while only 4% of OS & AS and around 17% of ST respondents indicated that they could not find help. It is interesting to test the statistical association between OS & AS and ST (Table 6.8). This association can be tested using the Chi-Squared test (χ^2-test) and the following hypotheses, the null hypothesis (H_0) and the alternate hypothesise (H_1).

H_0: "There is no difference between the support that OS & AS and ST receive."

H_1: "There is a difference between the support that OS & AS and ST receive."

The result of the χ^2 test shows that there is a significant difference between OS & AS and ST as the calculated test value (χ^2=87.453, df=3, P<0.05) is more than table value. Therefore, the study ACCEPTS H_1 and REJECTS H_0.

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	60	64.5	29	31.2	1	1.1	3	3.2	93
ST	68	17.5	251	64.7	53	13.7	16	4.1	388
Total	128	26.6	280	58.2	54	11.2	19	4.0	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.8: Respondents' impressions about staff dealing with their needs

The main reason for this is that the OS & AS have worked together continuously for a long time (approximately ten years or more) and thus, they deal with each other in a more friendly and flexible way, without having recourse to any official routes. When staff deal with students' requirements, however, they must be official to avoid further issues, such as cultural ones. Moreover, new students, who come from a high school, do not have any training and expertise to deal with TTC official procedures, particularly those related to paper work. Furthermore, the number of staff was limited when compared with the number of students (one operational staff member should deal with around 52 students to satisfy legal requirements, Table 6.3).

Respondents were asked to indicate their impressions of the information process. As shown in Table 6.9, 86% of OS & AS and 62% of ST indicated that their impression of this was that the information process, in terms of finding, collecting and using information, was either excellent or acceptable. However, 14% of OS & AS and 38% of ST pointed out that there are difficulties in identifying and locating relevant information.

It is interesting to test the statistical association between OS & AS and ST (Table 6.9) and this was done using the Chi-Squared test (χ^2-test) for the following hypotheses:

H_0: "There is no difference between the impressions of OS & AS and ST concerning the information process at TTC."

H_1: "There is a difference between the impressions of OS & AS and ST concerning the information process at TTC."

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	22	23.7	58	62.4	13	14.0	0	0	93
ST	44	11.3	195	50.3	98	25.3	51	13.1	388
Total	66	13.7	253	52.6	111	23.1	51	10.6	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.9: Respondents' impressions of information processes

The calculated test value (χ^2=26.743, df=3, P<0.05) is more than table value and therefore the study ACCEPTS H_1 and REJECTS H_0. This may be related to the fact that OS & AS report good experiences when finding, collecting and using information because they have their own methods of storing, indexing, using and retrieving information. In addition, the effective relationship which exists between OS & AS offered them both the opportunity to speed up the flow of information. ST, however, have limited experience and furthermore, the formal relationship between OS & AS, and ST slow dawn the flow of information.

Table 6.10 illustrates that around 77% of OS & AS and 52% of ST respondents indicated that their impression concerning the time taken to process information was either excellent or acceptable. On the other hand, around 23% of OS & AS and 48% of ST respondents stated that their impression was not good or unable to find the information they wanted. It is important to examine the differences in the impressions concerning the time it took to process information between OS & AS and ST by using statistical association (χ^2-test) for the following hypotheses:

H_0: "There is no difference between the impressions of the OS & AS and ST concerning the time taken to process the information they obtained."

H_1: "There is a difference between the impressions of the OS & AS and ST concerning the time taken to process the information they obtained."

The result of the χ^2-test shows that there is a significant difference between OS & AS and ST as the calculated test value (χ^2=28.409, df=3, P<0.05) is more than table value. Therefore, the study ACCEPTS H_1 and REJECTS H_0.

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	14	15.1	58	62.4	21	22.6	0	0	93
ST	22	5.7	179	46.1	138	35.6	49	12.6	388
Total	36	7.5	237	49.3	159	33.1	49	10.2	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.10: Respondents' impressions about the time taken to process information

This result was expected as it relates to the good working knowledge that OS & AS have concerning the requirements of information processes. It is clear that processing information takes an acceptable length of time for the OS & AS but, on the other hand, information processing takes a longer time for ST, because students do not have any knowledge about the steps or requirements that are needed to process information.

The respondents were asked to indicate their impression about information exchange between departments. Table 6.11 shows that around 63% of OS & AS and 45% of ST respondents stated that their impression was that it was excellent or acceptable. However, around 37% of OS & AS and 55% of ST respondents declared that the exchange of information between departments was not good or they had no knowledge of this. A χ^2-test was used to examine the significance of the association between OS & AS and ST and their impression about information exchange between departments. The following hypotheses were tested:

H_0: "There is no difference between the impression of OS & AS and ST about the exchange of information between departments."

H_1: "There is a difference between the impression of OS & AS and ST about the exchange of information between departments."

The result of the χ^2-test shows that there is a significant difference between OS & AS and ST. The calculated test value (χ^2=28.720, df=3, P<0.05) is more than table value and therefore, the study ACCEPTS H_1 and REJECTS H_0. The main reason for this result is that operational and academic staff at TTC know and understand the importance of information exchange between departments to get the right information to the right person at the right time and with the right format in order to produce annual reports, statistics and student transcripts. ST, on the other hand, have limited interaction with other departments and they may face difficulties in exchanging information between departments, particularly when students change or pass information from one department to another at TTC.

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	10	10.8	49	52.7	28	30.1	6	6.5	93
ST	31	8.0	143	36.9	80	20.6	134	34.5	388
Total	41	8.5	192	39.9	108	22.5	140	29.1	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.11: Respondents' impressions about the exchange of information between departments

Table 6.12 shows that approximately 54% of OS & AS and 22% of ST respondents stated that the computer centre were excellent or acceptable. In contrast, approximately 46% of OS & AS and 78% of ST respondents stated that the computer centre were not good or they had no experience of them. A χ^2-test was used to examine the significance of the association between OS & AS and ST and their impressions concerning the computer centre. The following hypotheses were formulated to test this:

H_0: "There is no difference between the impression of OS & AS and ST regarding computer centre at TTC."

H_1: "There is a difference between the impression of OS & AS and ST regarding computer centre at TTC."

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	5	5.4	45	48.4	26	28.0	17	18.3	93
ST	9	2.3	76	19.6	137	35.3	166	42.8	388
Total	14	2.9	121	25.2	163	33.9	183	38.0	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.12: Respondents' impressions regarding the computer centre at TTC

The result of the χ^2-test shows that there is a significant difference between OS & AS and ST as the calculated test value (χ^2=40.179, *df*=3, $P<0.05$) is more than table value. Therefore, the study ACCEPTS H_1 and REJECTS H_0.

The main reasons for these different impressions were because OS & AS attend a few training courses, they face difficulties in understanding computer terminology and they do not have time to enrol on courses. However, although some ST use a computer centre when they study computers as a subject for one term every year, they find computer centre equipment (hardware and software) is not up to date. Moreover, the new student generation has good background knowledge and understanding of the use of ICT that makes them good judges of the quality of the computer centre.

The respondents were asked to indicate their impression of the IT skills of operational staff. Table 6.13 shows that around 66% of OS & AS and 35% of ST respondents indicated that their impression was these skills were excellent or acceptable. On the other hand, around 34% of OS & AS and 65% of ST respondents indicated that their impression of the IT skills of operational staff was that these were not good or they had no knowledge of this. A χ^2-test was used to examine the significance of the association between OS & AS and ST and their impression concerning the IT skills of operational staff. The following hypotheses were considered:

H_0: "There is no difference between the impressions of OS & AS and ST about the IT skills of operational staff."

H_1: "There is a difference between the impressions of OS & AS and ST about the IT skills of operational staff."

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	18	19.4	43	46.2	15	16.1	17	18.3	93
ST	25	6.4	110	28.4	71	18.3	182	46.9	388
Total	43	8.9	153	31.8	86	17.9	199	41.4	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.13: Respondents' impressions about the IT skills of operational staff

The result of the χ^2-test shows that there is a significant difference between OS & AS and ST because the calculated test value (χ^2=36.592, df=3, P<0.05) is more than table value. Therefore, the study ACCEPTS H_1 and REJECTS H_0. This result was expected because OS & AS deal with each other in their daily work and they know the level of IT skills of each other while students do not have knowledge about the IT skills of the operational staff because they have limited interaction with them.

According to Table 6.14, both the OS & AS and ST (33%) respondents indicated that their impressions of the training courses were that they were excellent or acceptable whereas, both OS & AS and ST (67%) respondents pointed out that their impressions were that they were not good or they had no knowledge of this. A χ^2-test was used to examine the significance of the association between OS & AS and ST and their impressions concerning the training courses at TTC. The following hypotheses tested this:

H_0: "There is no difference between the impressions of OS & AS and ST about training courses."

H_1: "There is a difference between the impressions of OS & AS and ST about training courses."

Respondents	Excellent		Acceptable		Not good		Not found		N
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
OS & AS	5	5.4	26	28.0	28	30.1	34	36.6	93
ST	22	5.7	105	27.1	67	17.3	194	50.0	388
Total	27	5.6	131	27.2	25	19.8	228	47.4	481

OS & AS=Operational Staff and Academic Staff **ST=Students**

Table 6.14: Respondents' impressions about training courses at TTC

The result of the χ^2-test shows that there is a significant difference between OS & AS and ST since the calculated test value (χ^2=9.154, df=3, P<0.05) is more than table value. Therefore, the study ACCEPTS H_1 and REJECTS H_0. The result above was expected because OS & AS have limited access to training courses and these do not satisfy their requirements. ST, however, apart from those studying computers as a subject, do not have any training courses which educate them about basic computer programs and the use of Microsoft Word; this does not satisfy their needs.

6.6.4 Respondents' IT Skills

The respondents were asked how well they understood Word Processing. Table 6.15 indicates that around half (52%) of the total number of respondents used Word Processing while only 2.5% of them had difficulty in using it. 45.1% of the total number of respondents, however, stated that they did not know how to use this. The table also shows that the highest percentage of those who did not know how use Word Processing was operational staff (57.9%). This may be related to the fact that they had started as employees more than fifteen years before and have had no training courses on the use of Word Processing. They were followed by students (48.5%); this may be because they do not have any practice in Word Processing in high school. Finally, academic staff showed the lowest percentage (24.3%) of those who were unable to use Word Processing. This group of academic staff may be from an older generation that does not find it useful to use such a facility. However, the table indicates that all these groups (AS, OS and ST) need more training courses and practice in Word Processing.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	25	33.8	29	39.2	2	2.7	18	24.3	74
OS	5	26.3	3	15.8	0	0	11	57.9	19
ST	115	29.6	75	19.3	10	2.6	188	48.5	388
Total	145	30.2	107	22.2	12	2.5	217	45.1	481

Table 6.15: Respondents' use of Word Processing

The information contained in Table 6.16 summarises how well the respondents understood Spreadsheets. The majority of the respondents (72%) had difficulty with this and did not know how to use them although a minority (29%) did know how to use Spreadsheets. Although Spreadsheets are a very useful way to present and calculate students' marks, there were high percentages of operational (84%) and academic (64%) staff who did not use them or found it difficult to use them.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	8	10.7	19	25.7	7	9.5	40	54.1	74
OS	2	10.5	1	5.3	1	5.3	15	78.9	19
ST	51	13.2	56	14.4	33	8.5	248	63.9	388
Total	61	12.7	76	15.8	41	8.5	303	63.0	481

Table 6.16: Respondents' use of Spreadsheets

The respondents were then asked how well they understood Presentation Software. Table 6.17 shows that 35% of the total number of respondents knew how to use this while the majority (65%) had difficulty or did not know how to use it. Presentation Software (PowerPoint) plays an important part in the education process but the academic staff (70% of them) failed to make use of this facility because they had no idea how to use it or found it difficult to use.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	5	6.7	18	24.3	5	6.8	46	62.2	74
OS	3	15.8	0	0	3	15.8	13	68.4	19
ST	78	20.0	65	16.8	24	6.2	221	57.0	388
Total	86	17.8	83	17.3	32	6.7	280	58.2	481

Table 6.17: Respondents' use of Presentation Software

Table 6.18 illustrates how well the respondents used Databases (Microsoft Access). It can be seen from the table that around 79% of total number of respondents experienced difficulty and did not know how to use Databases (Microsoft Access) while the rest (21%) knew how to deal with this. Interestingly, all of the operation staff either did not know about or had difficulty in using Databases although Databases are very important in managing information in order to obtain and integrate accurate information at the right time with less cost and effort.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	2	2.7	9	12.2	9	12.2	54	73.0	74
OS	0	0	0	0	1	5.3	18	94.7	19
ST	36	9.3	53	13.7	31	8.0	268	69.1	388
Total	38	7.9	62	12.9	41	8.5	340	70.7	481

Table 6.18: Respondents' use of Databases (Microsoft Access)

According to the data shown in Table 6.19 on Internet services (E-mail), around 49% of academic staff did not know how or had difficulty using such services, compared with around 51% of the academic staff who had mastered E-mail. In addition, the table shows that approximately 79% of operational staff were unaware of how to use or found it difficult to use E-mail, compared with around 21% of the operational staff who had succeeded in mastering it. The table also indicates that about 63% of students did not know how to use or had difficulty in using E-mail, compared with around 37% of them who were able to use it with ease. It can be seen from the table that a high percentage (61%) of the respondents do not know how or find it difficult to use E-mail. This is because the E-mail facility is only available in the Dean's office and this has never been used by the majority of respondents.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	15	20.2	23	31.1	1	1.4	35	47.3	74
OS	0	0	4	21.1	0	0	15	78.9	19
ST	77	19.8	67	17.3	29	7.5	215	55.4	388
Total	92	19.1	94	19.5	30	6.2	265	55.1	481

Table 6.19: Respondents' use of E-mail

The respondents were asked how well they used Search Engines. Table 6.20 shows that more than half (56%) of the total number of respondents found it difficult or did not know how to use Search Engines but that 44% of them knew how to use such a facility. The table also illustrates that the majority of operational staff (68%) did not know how Search Engines could be used, followed by students (57%) and academic staff (47%). The main reason for this high percentage is that Internet services are not provided to all TTC members; they are available only in the Dean's office and have limited use.

Respondents	Reasonably well		Have used		Difficult to use		Not at all		N
	Freq.	%	Freq	%	Freq.	%	Freq.	%	
AS	15	20.3	24	32.4	3	4.1	32	43.2	74
OS	3	15.8	3	15.8	0	0	13	68.4	19
ST	96	24.7	70	18.1	23	5.9	199	51.3	388
Total	114	23.7	97	20.2	26	5.4	244	50.7	481

Table 6.20: Respondents' use of Search Engines

6.6.5 Respondents' Opinions

The respondents were asked to indicate the extent to which they agreed that staff's knowledge of the English language would affect the efficiency of TTC. Table 6.21 shows that a majority of academic staff (92%), operational staff (84%) and students (60%) strongly agreed or agreed that knowledge of the English language is important for staff. Conversely, only 8% of academic staff, 16% of operational staff and 40% of student respondents disagreed or did not give any significant sign to indicate an opinion. The English language is considered to be the only language used to communicate within the global context and most information resources are written in this language, so is vitally important for academic staff and operational staff, as well as students, at TTC to have at least a basic knowledge of the English language.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	38	51.4	30	40.5	5	6.7	1	1.4	0	0	74
OS	6	31.6	10	52.6	3	15.8	0	0	0	0	19
ST	110	28.4	122	31.4	112	28.9	28	7.2	16	4.1	388
Total	154	32.1	162	33.7	120	24.9	29	6.0	16	3.3	481

Table 6.21: Respondents' opinion about staff knowledge of the English language

The information contained in Table 6.22 points out the degree to which respondents agreed that access to Internet services influences the ability of TTC. This table shows that the majority of academic staff (91%), 79% of operational staff, and 68% of student respondents strongly agreed or agreed, while a few (9% of academic staff, 21% of operation staff, and 32% of student respondents) disagreed or did not indicate an opinion about access to Internet services and the effects of this on the ability of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	32	43.2	35	47.3	6	8.1	1	1.4	0	0	74
OS	4	21.1	11	57.9	4	21.1	0	0	0	0	19
ST	167	43.1	103	26.5	96	24.7	15	3.9	7	1.8	388
Total	203	42.2	149	31.0	106	22.0	16	3.3	7	1.5	481

Table 6.22: Respondents' opinion about access to Internet services

The respondents were asked to indicate the extent to which they agreed that developing an information strategy would affect the ability of TTC. From Table 6.23 it can be seen that the majority of academic staff (89%), operational staff (90%), and students (70%) strongly agreed or agreed while a few academic staff (11%), operational staff (10%), and students (27%) did not offer an opinion. In addition, 3% of student respondents disagreed with the idea that developing an information strategy would affect the ability of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	41	55.4	25	33.8	8	10.8	0	0	0	0	74
OS	12	63.3	5	26.3	2	10.4	0	0	0	0	19
ST	150	38.6	123	31.5	102	26.5	13	3.4	0	0	388
Total	203	42.2	153	31.8	112	23.3	13	2.7	0	0	481

Table 6.23: Respondents' opinion about developing an information strategy

According to Table 6.24, most academic staff (98%), operational staff (95%), and students (84%) agreed that improving training would affect the efficiency of TTC. On the other hand, a small percentage of academic staff (2%), 5% of operational staff and 14% of student respondents did not express any opinion. Only 2% of students disagreed that improving training would affect the efficiency of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	56	75.5	17	23.0	1	1.5	0	0	0	0	74
OS	16	84.2	2	10.5	1	5.3	0	0	0	0	19
ST	198	51.0	129	33.2	54	13.9	3	0.9	4	1.0	388
Total	270	56.2	148	30.8	56	11.6	3	0.6	4	0.8	481

Table 6.24: Respondents' opinion about improving training

The respondents were asked to specify the extent to which they agreed that centralising information would affect the efficiency of TTC. As shown in Table 6.25, the majority of academic staff (78%), operational staff (89%), and student respondents (58%) agreed with this idea. However, 22% of academic staff, 11% of operational staff, and 42% of students disagreed or gave no opinion about whether centralising information would affect the efficiency of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	32	43.2	26	35.1	14	18.9	1	1.4	1	1.4	74
OS	6	31.6	11	57.9	2	10.5	0	0	0	0	19
ST	107	27.6	117	30.2	149	38.4	11	2.8	4	1.0	388
Total	145	30.1	154	32.1	165	34.3	12	2.5	5	1.0	481

Table 6.25: Respondents' opinion about centralising information

The respondents were asked to specify the extent to which they agreed that developing a computer network would affect the efficiency of TTC. Table 6.26 shows that the majority of academic staff (94%), students (85%), and all the operational staff (100%) agreed with this while a minority (6% of academic staff and 15% of student respondents) disagreed or did not express an opinion about whether developing a computer network would affect the efficiency of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	59	79.7	11	14.8	4	5.5	0	0	0	0	74
OS	14	73.7	5	26.3	0	0	0	0	0	0	19
ST	223	57.5	107	27.6	52	13.4	6	1.5	0	0	388
Total	296	61.5	123	25.6	56	11.6	6	1.2	0	0	481

Table 6.26: Respondents' opinion about developing a computer network

According to Table 6.27, the majority of academic staff (93%), students (82%) and all the operational staff (100%) respondents agreed while a small percentage of academic staff (7%) and 18% of students disagreed or gave no opinion about whether developing a help desk would affect the efficiency of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	52	70.2	17	23.0	5	6.8	0	0	0	0	74
OS	9	47.4	10	52.6	0	0	0	0	0	0	19
ST	180	46.4	139	35.8	64	16.5	5	1.3	0	0	388
Total	241	50.2	166	34.5	69	14.3	5	1.0	0	0	481

Table 6.27: Respondents' opinion about developing a help desk

The respondents were asked to indicate the extent to which they agreed that improving communication between departments would affect the efficiency of TTC. Table 6.28 shows that the majority of respondents from among academic staff (97%), students (85%), and all the operational staff (100%) agreed. A minority of academic staff (3%) and 15% of student respondents, however, disagreed or did not make any significant sign to provide an opinion about whether improving communication between departments would affect the efficiency of TTC.

Respondents	Strongly agree		Agree		No opinion		Disagree		Strongly disagree		N
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
AS	64	86.5	8	10.8	2	2.7	0	0	0	0	74
OS	16	84.2	3	15.8	0	0	0	0	0	0	19
ST	207	53.4	121	31.2	53	13.7	5	1.3	2	0.5	388
Total	287	59.7	132	27.4	55	11.4	5	1.0	2	0.4	481

Table 6.28: Respondents' opinion about improving communication between departments

6.7 Summary

The finding of the document analysis showed that general objectives are developed by the High Management Committee but the analysis also revealed an absence of strategic policy. Also, the document analysis demonstrated that TTC, like other government organisations, obtains its budget from the Saudi government while, the interviews analysis showed that there is a clear shortage of funds to support all TTC's operations.

the interview analysis and the focus groups analysis showed a lack of policy related to creating files, information processes take a long time, and it is difficult to access and retrieve information from files. In other words, the general process of information management at TTC depends on a traditional system. Information is delivered to the departments in many forms (e.g. general official letters, students' papers, complaints, reports and examination results) and from both internal and external resources. It is often left to the operational staff in the departments to cope with information as they see fit. They always do not manage this information and put it into appropriate files, with the result that the information is often difficult to find, access and retrieve. In addition the results of the interview analysis and the focus groups analysis showed that there was an increased amount of paper caused by duplication of the same information, a lack of training and ICT staff, a lack of funding and equipment to support TTC operations, no standardisation in information management and processes, and that the exchange of information among departments took a long time. This leads to the Dean and their Deputies seeking short-term rather than long-term plans to achieve TTC's objectives.

The observation analysis, as seen in Table 6.2, illustrates the duplication of paper-based information which is stored on shelves in a wooden cupboard. Some of the files have labels on the outside bearing the name of the file and the year, some of these labels were written by hand in different colours and in different directions, and some of the files opened from right to left while the rest opened from left to right. Moreover, the observation analysis showed that there were ten copy machines scattered throughout departments and operational offices. This means it is easy to duplicate records but leads to difficulties in managing them.

481 responses were received from the total 620 questionnaires distributed to academic staff (N=74), operational staff (N=19) and students (N=388) at TTC. This excellent response rate (87%) was related to the formal letter from the Dean and the approval of the middle management that accompanied the questionnaire; also the questionnaires were thoroughly tested through a pilot study.

The highest proportion of academic staff (46%) and students (36%) learned to use computers on their own, while the highest proportion of operational staff (36%) learned to use computers through friends. Significantly, only 7% of academic staff, 5% of operational staff, and less than 1% of students learned to use computers by attending TTC training courses. This indicates that the TTC computer centre has not achieved its goal to provide proper training courses for academic staff, operational staff and students.

The majority of student respondents indicated that, in their opinion, the services provided by TTC are not acceptable. This included dissatisfaction with the information process (38%), the time taken to process information (48%), the exchange of information between departments (55%), computer centre at TTC (78%), the IT skills of operational staff (65%), and training courses (67%).

The majority of respondents indicated that they need more training courses to improve their IT skills, particularly in Software Packages (Word Processing, Spreadsheets, Presentation Software and Databases), and Internet Services (E-mail and Search Engines).

Finally, according to the opinion of the respondents, in order to improve the information services at TTC, the most important points were to improve the quality of the training courses, to develop a computer network, to develop a help desk, and to improve communication between departments.

Chapter 7

MIM Application for Design IS at TTC

7.1 Introduction

This chapter aims to design an IS at TTC by applying the MIM. It is divided into two main parts: part one covers the process-oriented strand while the second part is the evaluation strand (see Chapter 5, Figure 5.2).

7.2 Process-oriented

As mentioned above, there are five stages in the process-oriented strand which include planning, analysis, design, implementation, and maintenance. These stages are explained in more detail in the following sections.

7.2.1 Stage 1: Planning

The aims and objectives of the project should be established at this stage. Six steps are used to establish the aims and objectives of this project. These include: develop a strategic plan; forecast information needs; establish the aims and objectives of the project; produce the project plan; secure financial resources; and finally, seek agreement from the upper-level managers of the organisation.

7.2.1.1 Step 1: Develop a strategic plan for the organisation

The Seventh Development Plan (2000-2004) of the Kingdom of Saudi Arabia includes, as its 14^{th} strategic objective, the establishment of a national science and technology base capable of innovating and inventing, as well as adapting existing technologies through a number of activities (see Chapter 1, Section 1.4.6).

The Ministry for Planning and Administrative Development (2005) established the Ministry of Education's Ten-Year plan in Saudi Arabia (see Chapter 1, Section 1.4.7). The goals of this plan include: organising girls' technical education; improving the quality of both male and female teachers; increasing the number of citizens in the education sector to achieve maximum use of Saudi human resources; developing the infrastructure of information and communication technology and its employment in education and learning; and establishing integrated systems for accountability. The strategic plan at TTC responds to these high level goals, and operationalises them for the benefit of all.

7.2.1.2 Step 2: Forecast the information needs

Two types of methods were used to forecast the information needs at TTC. The first method was document analysis using documents which included: System Structures and Management for Girls' Colleges, Description of the Teachers' Training College, Official Statistics for the Teachers' Training College, and Official Statistics for Girls' Education at Makkah Al-Mukkaramah. These documents were a very good starting point in analysing the current situation; they also provided an overview of the system at TTC. Consequently, the initial document analysis helped to build a basic forecast for information needs by considering information such as TTC's structure, the number of departments, and the number of students and academic staff. The second method used was to carry out informal and unstructured interviews with the Dean and academic staff at TTC. As a result of these interviews, a number of needs were identified including: increasing the number of staff (operational and academic) in line with student numbers; decreasing the amount of paper work; improving services for students and staff, using ICT to handle and exchange information between TTC members (internal) and between TTC and upper management or other colleges (external); providing TTC with a properly integrated information system which would achieve the aims and objectives of TTC and fulfil the users' demands.

7.2.1.3 Step3: Establish aims and objectives of the project

The initial aim of the project was to evaluate the current information system at TTC and improve or develop a new information system. After a number of discussion meetings with the upper management of TTC (Dean and Deputies) concerning aims and objectives, the final aim was set to apply an appropriate methodology for the development of an information system for use in the Teachers' Training College in Makkah Al-Mukkaramah. To achieve this aim, the following objectives were developed:

1. To investigate the current problem situation and causes of it.
2. To complete an information audit in the TTC.
3. To apply MIM to develop an information system at TTC.
4. To establish a recommendation to achieve the aim.

7.2.1.4 Step4: Produce the project plan

The complete proposal was written to include a clear title, introduction, a description of the current problem and importance of the project, aim and objectives, research methods, references ,and a time table of planning activities.

A professional presentation was displayed to the Dean, Deputies, Heads of Departments, and supervisors at TTC in order to obtain approval for conducting the project. The planning that was carried out for this presentation included: the creation of a proposal handout, making an appointment, using a PowerPoint application, organising the slides, preparing to present the slides on time, allowing time for questions at the end of the presentation, and using appropriate language that would be understood by the audience, avoiding unclear words.

7.2.1.5 Step5: Obtain financial resources for designing IS

The upper management committee at TTC agreed that the research could be conducted on the basis that this research will help: to improve the TTC information system, to improve services, to assist in the handling and exchange of information easily and effectively, and to connect TTC with other colleges and universities. Furthermore, the Ministry of Higher Education agreed to support this research in order to achieve the 14th strategic objective of The Seventh Develop Plan (2000-2004) of the Kingdom of Saudi Arabia and meet the goals of the Ministry of Education's Ten-Year Plan.

The proposal was sent to the Ministry of Higher Education by the Dean of TTC to request cover for all of the costs of conducting the fieldwork at TTC.

7.2.1.6 Step 6: Seek agreement from upper level managers of the TTC

The agreement from the Ministry of Higher Education was received by the TTC. Consequently the Dean sent a formal letter to start the project. The main reasons for requesting this letter were to minimise resistance from respondents, and to obtain support from upper management.

7.2.2 Stage 2: Analysis

This stage focuses on analysing the current problem situation from different viewpoints. There are three steps in the analysis of the current problem situation at TTC: finding out (the problem situation unstructured), creating the Rich Picture (the problem situation structured), and extracting problem themes.

7.2.2.1 Step 1: Finding out: the problem situation unstructured

Five techniques was used to understand the specific issues related to the current problem situation. These are: document analysis, semi-structured interviews, questionnaires, a focus group, and obtrusive observation.

The Dean complained about the rapid increase in the number of papers, the traditional processes used to exchange information, lack of funds, lack of a Local Area Network, the lack of information security planning, the limited number of ICT staff, and the lack of training courses related to ICT and records management.

Deputy DAFA stated that there are PCs, a telephone and fax and e-mail facilities in the Dean's office; a Local Area Network and Internet services have recently been established. Moreover, she stated that information at TTC has been stored in archives, as well as on CD and floppy disks; also there are back-up files in the Dean's office and in other departments; academic and operational staff are trained in the use of PCs. She added that there is institute for computers inside TTC. On the other hand, she complained about the duplication of records, that records take time to retrieve, and the limited number of operational staff compared with the job they have to do.

Deputy DSA complained that the storage space used is inappropriate, there is no telephone network between staff academic offices and upper management, the number of computers is limited, there is limited use of computer services, there are no back-up files, the number of information professionals is limited, and they suffer from job overload.

Heads of Department complained about the large amount of general official letters, the duplication of records in different departments, delay in exchanging information, the rapid increase in the number of files in the departments, the lack of a telephone network between departments and their academic staff, the lack of use of ICT in classes, and the lack of information security planning. Moreover, they added that there are difficulties in attending training courses. These difficulties include: lack of basic knowledge in using computer equipment and its terminology, and lack of time.

The Supervisor of Staff and Financial Affairs complained about the large amount of paperwork, the lack of information management, the lack of time available to update information, that there were no back-up files, not enough space for storing files, a lack of use of computer applications, a limited number of computers, a limited number of copy machines and no direct telephone line. Moreover, she added that there were no plans to increase information security, a limited number of staff, and limited training courses.

The Supervisor of Student Affairs complained about the duplication of students' information in computer and paper files, the use of traditional methods of exchanging information between the departments, the lack of sufficient space for all the files in the offices, the lack of information security planning, the limited number of staff, and limited training courses.

The Supervisor of ICT complained about the lack of using original application software and training materials, the lack of funds and information security planning, and the limited number of ICT staff and trainers.

Academic staff complained about using formal communication methods inside TTC and using manual index files which takes time, effort and money. There is a duplication of same information in different departments with different formats (electronic and paper), difficulties in retrieving information, a lack of training courses, a lack of ICT equipment and services, there are no multimedia services in classrooms, no Internet services in computer centre, and a limited number of ICT staff.

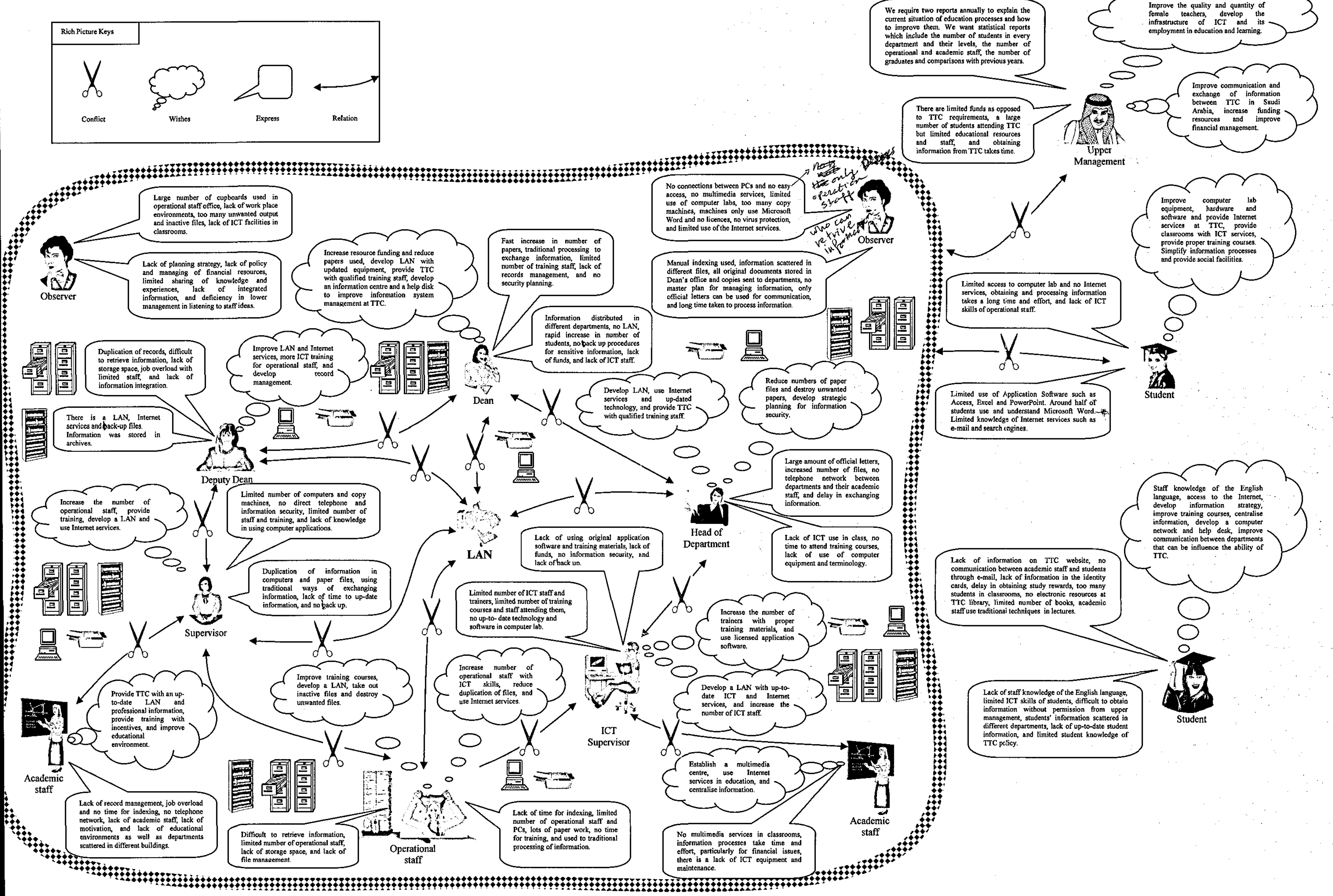
Operational staff complained about the traditional processing of information which wastes time, the duplication of the same information in PCs and in files, the lack of back-up files, the rapid increase in paperwork and files, the lack of time for indexing, the limited number of operational staff, the lack of time for training, the limited number of PCs, and the use of official letters for formal communication which take time and effort to produce.

The observer noted a number of problems related to the current information system at TTC. These included a lack of strategic planning at TTC related to policies, finance, managing information, record systems, ICT, staffing and training, security, and use of databases. Moreover, from this scenario, it was evident that the TTC needs clear policies relating to using software applications, Internet services, exchanging information between departments, creating and destroying files, staff training, and security.

7.2.2.2 Step 2: The Rich Picture: the problem situation structured

The Rich Picture (RP) was used to describe *Step 1* by analysing the data collected by way of the document analysis, interviews, questionnaires, focus groups, and observation. The current rich picture represents the boundaries of the TTC system, information resources and storage, information processes, personal opinions, needs, conflict, and the environment (see Figure 7.1). However, the researcher aimed to express the current problem situation at TTC by using the RP to help obtain problem themes.

Figure 7.0 Problem Situation at TTC - Rich Picture



7.2.2.3 Step 3: Extracting problem themes

The current problem situation was split into a number of problem themes as can be seen in the RP. These problem themes have been converted into a formal relevant system. The current problem situation was grouped into four problem themes, as shown below:

1- Strategic policy
2- Organisational resources
3- Human resources
4- ICT resources

1- Strategic policy

Strategic aims to put into place guidelines and plans to support the organisation's objectives in the long run. In addition, policy is a set of organised principles, laws, guidelines, rules and procedures guiding an organisation's management to protect operations from mistreatment. Therefore, TTC needs to establish a number of strategic policy issues related to:

- Providing and managing financial resources regarding all TTC operations including the purchasing and maintenance of ICT, and improving information services and facilities.
- Creating, managing, indexing, storing, retrieving, destroying, and operating TTC record systems.
- Providing ICT (hardware and software) services and maintenance to all TTC operations.
- Providing TTC with qualified academic and operational staff and providing training courses to current staff.
- Improving administrative affairs and simplifying information processes.
- Providing security systems for all TTC information resources whether this is storage (in paper or electronic formats) to prevent them from being damaged or affected by other disasters.
- Providing TTC with proper database systems to manage electronic information relating to students and staff.

2- Organisational resources

Organisational resources include financial and administrative affairs, and records management. Financial and administrative affairs constitute the most important department in the TTC so it is vitally important to provide such a department with highly skilled financial and management professionals to operate, manage and deal with financial resources and information processes. Also, a financial and administrative affairs department should look for financial resources and manage these in the longer rather than the shorter term; the department should also simplify information processes. In addition, records management aims to manage any information captured in paper or electronic files from their creation to retention until their disposal, in order to meet the TTC's needs. Therefore, TTC needs to address the following issues:

- Increase financial resources, particularly from the private sector (i.e. companies, personal donations etc.);
- Look for the management of funding in the longer, rather than the shorter term;
- Make more flexible and simplify information processes to avoid wasting time and effort;
- Provide TTC with highly qualified and skilled staff in financial and administrative affairs;
- Minimise the number of paper files via decrease the amount of paperwork;
- Avoid duplication and control file creation;
- Develop clear and easy methods of indexing; and
- Use a proper system for back-up files.

3- Human resources

Human resources are the most important factor to the success of any organisation. Therefore, TTC should be concerned about their staff by providing them with proper training and education to achieve job satisfaction and work efficiency. Therefore, TTC needs to:

- Increase the number of academic, operational and ICT staff;
- Provide training courses related to ICT and records management;

- Utilise training in the right place with a suitable instructor at the right time and using appropriate teaching methods;
- Provide motivation and rewards for attending training courses; and
- Exchange knowledge and experience among staff.

On the other hand, many ICT projects fail to achieve their objectives because the systems' analysis does not take into account the needs and views of users. So, TTC needs to:

- Facilitate the exchange of information between departments;
- Understand departments' needs and increase staff motivation;
- Offer new buildings with new services related to educational operations;
- Establish an educational multimedia centre and provide TTC classrooms with ICT;
- Expand the use of Internet services; and
- Develop an information centre and a help desk.

4- ICT resources

ICT at TTC can be described as the equipment (hardware) and computer programs (software) that allow staff to create, edit, retrieve, store and organise information in electronic forms. PCs and printers fit into the hardware category, while Windows XP, Word, Excel and Internet services fit into the software category. There is a number of needs at TTC:

- Establishing a Local Area Network (LAN) and developing a telephone network;
- Developing the ICT infrastructure;
- Providing TTC with up-to-date hardware and software;
- Using licensed software applications;
- Providing TTC with ICT professionals; and
- Improving the use of Internet services.

A database can be defined as a shared collection of related information stored in an organised way which aims to meet the TTC needs. However, TTC needs to:

- Establish integrated database systems;
- Centralise databases by using a LAN;
- Increase electronic information resources; and
- Provide TTC with qualified staff to manage its database systems.

Information security aims to protect information resources from unauthorised or harmful disclosure; and from modification, loss or mistreatment. Therefore, TTC needs to:

- Develop a back-up system and destroy unwanted files;
- Develop a security system and provide an anti-virus application;
- Use username and password access to PCs;
- Establish plans in case of disasters; and
- Provide a secure environment for information.

7.2.3 Stage 3: Design

There are five steps in this stage of MIM, starting with the root definition, the conceptual model, the comparison of the model to the rich picture, the use of VSM to define System 1 to System 5, and the use of VSM to define a whole system (see Chapter 5, Figure 5.5).

7.2.3.1 Step 1: Root definition of relevant systems

In this step the RD constructed from each problem theme is formulated and can be tested via CATWOE analysis. Each of the four RDs are considered in turn below.

1- Strategic policy system

"A strategic policy system owned by Middle Management Committee for TTC to develop and operate strategic policy system, by means of the agreement of High Management Committee in order to plan for the achievement of TTC objectives."

C	Academic staff, operation staff, students, Heads of Departments, Deputies, and Dean
A	Middle, Lower, and Operational Management
T	lack strategic policy → develop and operate strategic policy system
W	Middle and Lower Management should have knowledge and experiences in develop strategic policy system
O	High and Middle Management
E	Saudi culture, Saudi regulation, Saudi Arabia's Plans, and The Ministry of Education Ten - Year plan in Saudi Arabia

2- Organisational resources system

"An organisational resources system owned by Lower Management Committee for TTC to develop and manage organisational resources system, by means of the agreement of Middle Management Committee in order to achieve sufficient support for all TTC plans and operations."

C	Academic staff, operation staff, students, Heads of Departments, Deputies, and Dean
A	Middle, Lower, and Operational Management
T	Lack of organisational resources and management → develop and manage organisational resources system
W	Lower Management should have knowledge and experiences to develop and manage organisational resources system
O	Middle and Lower Management
E	Saudi culture, Saudi regulation, Saudi Arabia's Plans, and The Ministry of Education Ten - Year plan in Saudi Arabia

3- Human resources system

"A human resources system owned by Lower Management Committee for TTC to develop and manage staffing, training, and users need by means of the agreement of Middle Management Committee in order to achieve better qualified staff with different skills, and to satisfy users and provide them with high standards of service."

C	Academic staff, operation staff, students, Heads of Departments, Deputies, and Dean
A	Middle, Lower, and Operational Management
T	Lack of human resource management ⟶ develop and manage human resources system
W	Lower Management should have knowledge and experiences in develop human resources system
O	Middle and Lower Management
E	Saudi culture, Saudi regulation, Saudi Arabia's Plans, and The Ministry of Education Ten - Year plan in Saudi Arabia

4- ICT resources system

"An ICT resources system owned by Lower Management Committee for TTC to develop and operate ICT, databases, and security, by means of the agreement of Middle Management Committee in order to achieve and operate ICT resources system to provide better exchange information and communication between TTC users, to integrate databases, and to prevent information from harm."

C	Academic staff, operation staff, students, Heads of Departments, Deputies, and Dean
A	Middle, Lower, and Operational Management
T	Lack of ICT resources ⟶ develop and operate ICT resources system
W	Lower Management should have knowledge and experiences in develop ICT resources system
O	Middle and Lower Management
E	Saudi culture, Saudi regulation, Saudi Arabia's Plans, and The Ministry of Education Ten - Year plan in Saudi Arabia

7.2.3.2 Step 2: Conceptual models

To develop a conceptual model from the RD is the aim of this stage. So this step can be described in words what the system will be (RD) and provide an inference diagram of the activities of what the system will do (the conceptual model). It is then possible to check the model against the 'formal system' model to ensure that it meets the general criteria for a viable system.

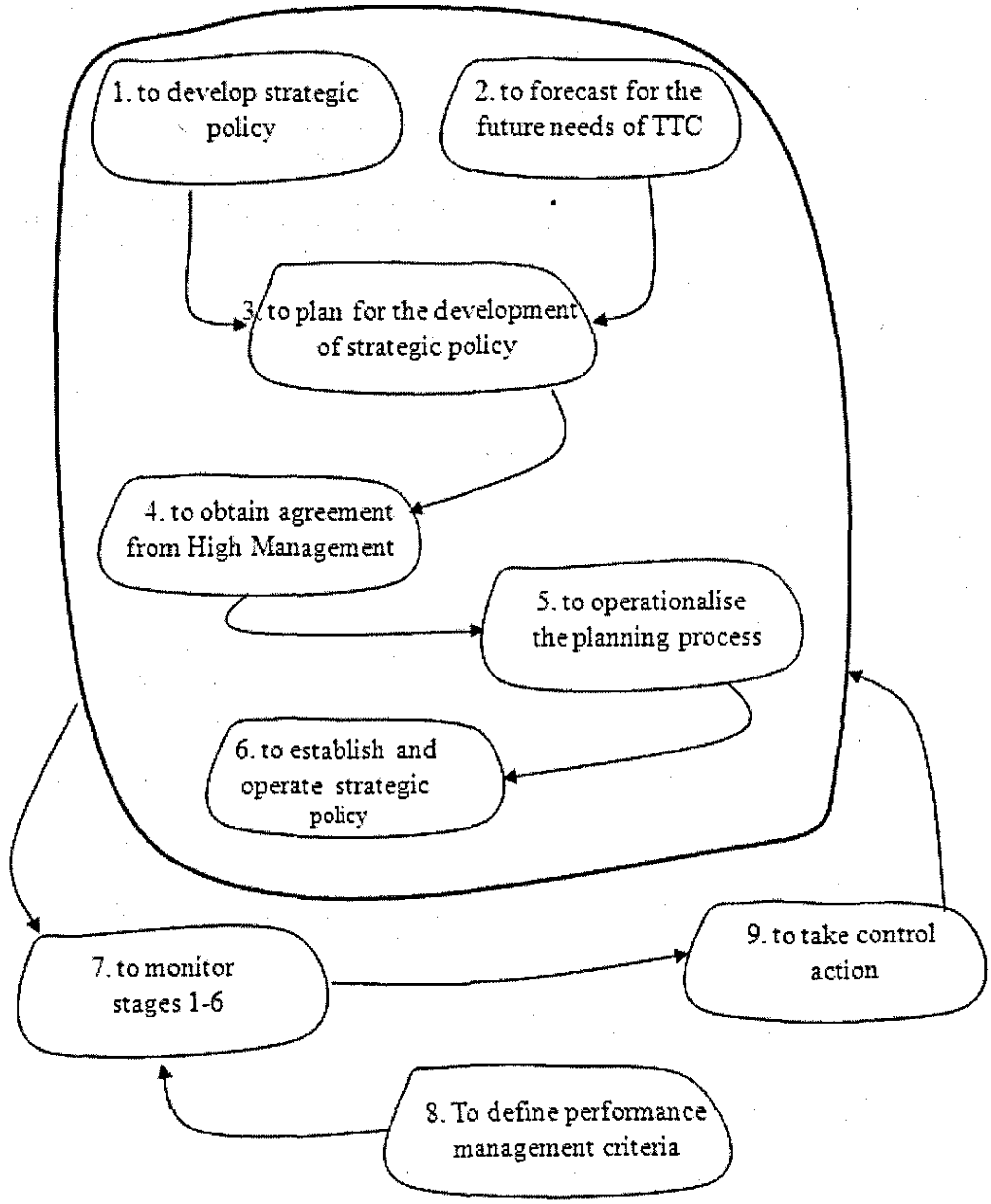


Figure 7.2 Conceptual model – Strategic policy system

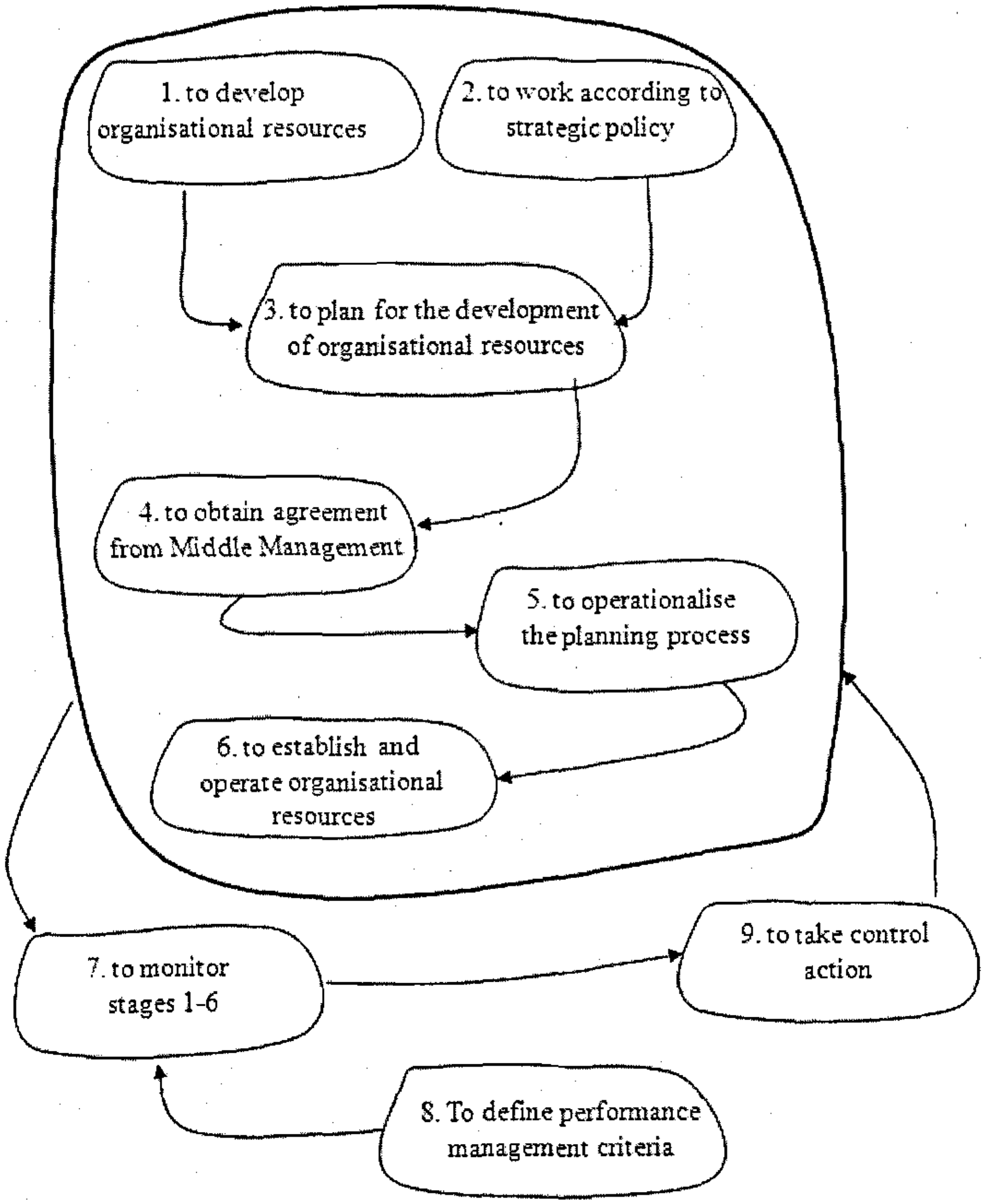


Figure 7.3 Conceptual model – Organisational resources system

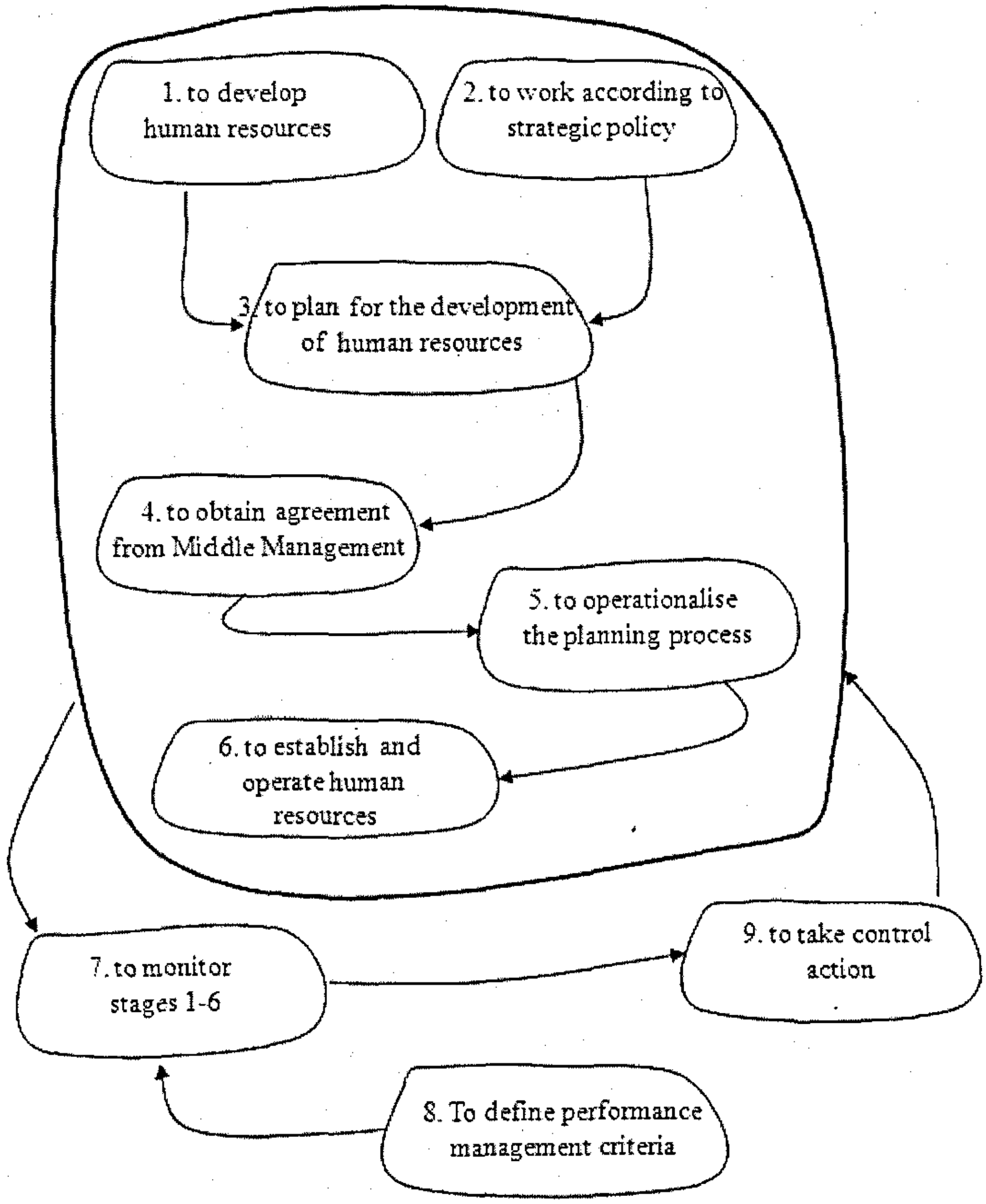


Figure 7.4 Conceptual model – Human resources system

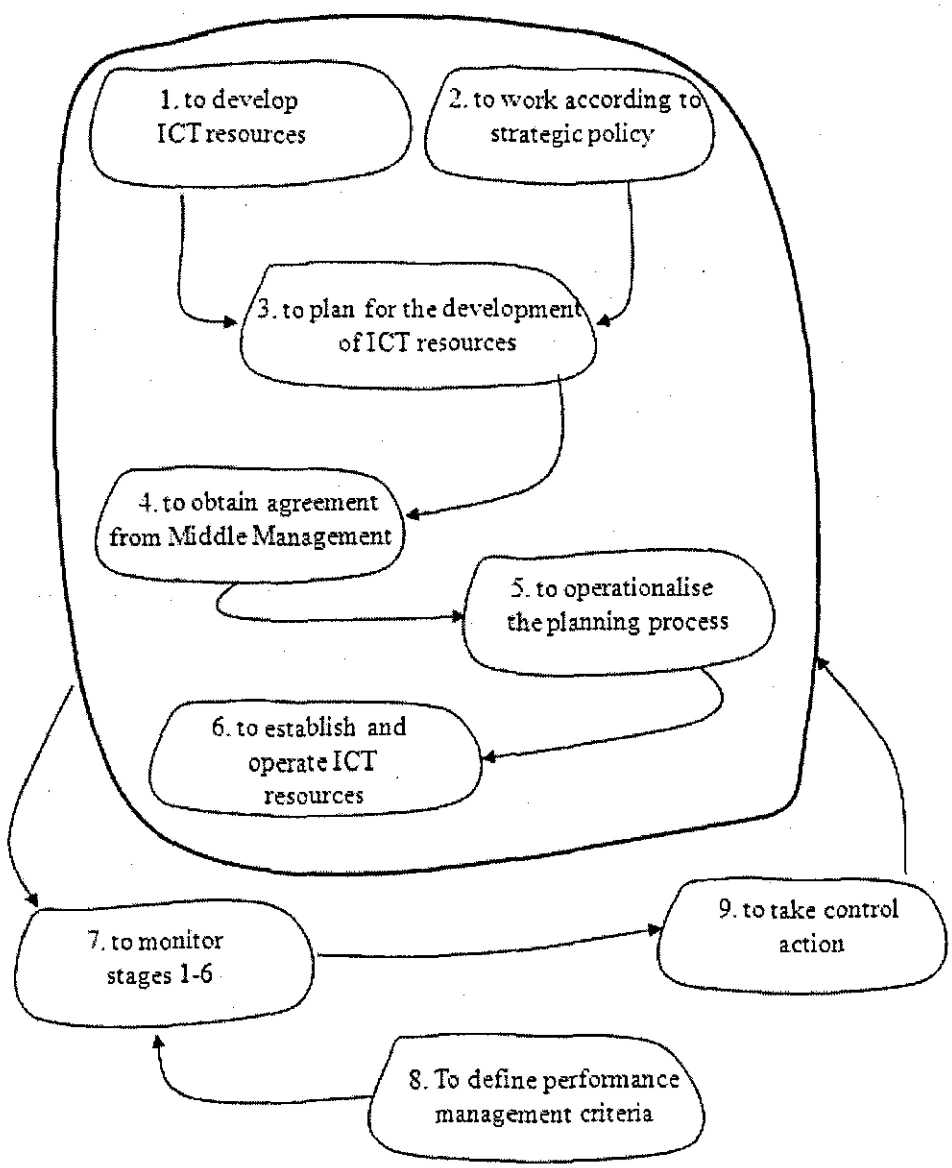


Figure 7.5 Conceptual model – ICT resources system

7.2.3.3 Step 3: Comparison of model to rich picture

The aim of this step is to take the result of the conceptual model and compare them with the real word activity as seen in RP. The problems identified will be in mind instead of problems solution. Therefore, Table 7.1 outline the comparison between the conceptual model activity and the real world. There are five columns for each conceptual model. These columns are:

1. ***Activities in the conceptual model*** (Step 2 in Stage 3)
2. Is this activity ***present in the real world*** (Step 2 in Stage 2)
3. If the activity is not present in the real world, ***how*** will it be integrated within the system?
4. ***Who*** will be responsible for adding the activity to the system?
5. A list of contextual ***comments,*** if appropriate.

Activities in the conceptual model	*Present in the real world*	*How?*	*Who?*	*Comments*
1- to develop strategic policy.	RP indicates lack of strategic policy.	Identify and evaluate current strategy and policy.	Middle, Lower, and Operational Management.	Strategic policy should be re-evaluated every five years according to TTC needs.
2- to forecast for the future needs of TTC.	RP indicates a concern in the short term needs only.	Using proper information gathering techniques such as interviews and focus group.	Middle, Lower, and Operational Management.	Concerned with long term needs as well as short term needs.
3- to plan for the development of strategic policy.	No	Use a proper methodology to establish plan for develop the strategic policy system.	Middle and Lower Management.	The methodology should take in accounts people, technical, political, organisational, and cultural issues.
4- to obtain agreement from High Management.	Real world indicates usually get approval from High Management.	Present the proposal of planning and using formal presentation to provide evidence the TTC will benefits from this system.	High and Middle Management.	This will help developers team to get support from High Management when need it.
5- to operationalise the planning process.	No	Changeover the planning for develop strategic policy to practice.	Middle, Lower, and Operational Management.	Convert the planning stages from action into practice.
6- to establish and operate strategic policy.	No	Establish and operate strategic policy include organisational resources, human resources, and ICT resources Which aim to achieve objectives of the strategic policy system.	Middle, Lower and Operational Management.	Strategic policy should be clear, integrated, updated each year and evaluated at least every five years to indicate the extent to which strategic policy has achieved its objectives.

Table 7.1 Comparison of conceptual model with the real world – Strategic policy system

Activities in the conceptual model	*Present in the real world*	*How?*	*Who?*	*Comments*
1- to develop organisational resources.	RP indicates lack of financial resources, administrative affairs, and records management.	Identify organisational resources.	Lower and Operational Management.	TTC should be allocated for financial resources, evaluate current administrative affairs, and records management.
2- to work according to strategic policy.	No	Develop a clear strategic policy related to organisational resources.	Lower and Operational Management.	Concerns with long term needs as well as short term needs.
3- to plan for the development of organisational resources.	No	Use a proper methodology to establish plan for develop the organisational resources system.	Lower and Operational Management.	The methodology should take in accounts people, technical, political, organisational, and cultural issues.
4- to obtain agreement from Middle Management.	Real world indicates usually get approval from Middle Management.	Use professional presentation to provide evidence the TTC will benefits from the organisational resources.	Middle and Lower Management.	Get support from Middle Management when need it.
5- to operationalise the planning process.	No	Changeover the planning for develop organisational resources to practice.	Lower, and Operational Management.	Convert the planning stages from action into practice.
6- to establish and operate organisational resources.	No	Manage financial resources, administrative affairs, and records management to provide support to all TTC operation.	Lower and Operational Management.	Financial and administrative affairs, and records management should be evaluated to achieve their objectives.

Table 7.2 Comparison of conceptual model with the real world – Organisational resources system

Activities in the conceptual model	*Present in the real world*	*How?*	*Who?*	*Comments*
1- to develop human resources.	RP indicates lack of staffing, training and users need.	Investigate departments needs and users requirements not only for the current needs but also for the future.	Lower and Operational Management.	Use proper data collection methods to determine Departments and users need.
2- to work according to strategic policy.	No	Develop a clear strategic policy related to staffing, training, and users need.	Lower and Operational Management.	Concerns with long term needs as well as short term needs.
3- to plan for the development of human resources.	No	Use a proper methodology to establish plan for develop the human resources system.	Lower and Operational Management.	The methodology should take in accounts people, technical, political, organisational, and cultural issues.
4- to obtain agreement from Middle Management.	Seek approval from Middle Management	Present the proposal of planning and using formal presentation.	Middle and Lower Management.	Get support from Middle Management when need it.
5- to perationalise the planning process.	No	Implement and operate the human resources planning.	Lower, and Operational Management.	Convert the planning stages from action into practice.
6- to establish and Operate human resources.	No	Provide Departments with qualified staff, provide training courses to the current staff, and satisfy users requirements.	Lower and Operational Management.	Human resources system should be integrated to satisfy Departments and users needs.

Table 7.3 Comparison of conceptual model with the real world – Human resources system

Activities in the conceptual model	*Present in the real world*	*How?*	*Who?*	*Comments*
1- to develop ICT resources.	RP indicates lack of ICT resources.	Identify Departments needs for ICT, databases, and security.	Lower and Operational Management.	Use appropriate data collection methods for identification.
2- to work according to strategic policy.	No	Develop a clear strategic policy related to ICT resources.	Lower and Operational Management.	Concerned with long term needs as well as short term needs.
3- to plan for the development of ICT resources.	No	Use a proper methodology to establish plan for develop the ICT resources system.	Lower and Operational Management.	The methodology should take into account people, technical, political, organisational, and cultural issues.
4- to obtain agreement from Middle Management.	Real world indicates usually get approval from Middle Management.	Present the proposal of planning and using formal presentation.	Middle and Lower Management.	Get support from Middle Management when need it.
5- to operationalise the planning process.	No	Implement and operate the ICT resources planning.	Lower, and Operational Management.	Convert the planning stages from action into practice.
6- to establish and operate ICT resources.	No	Develop TTC infrastructure. Establish and operate security and databases systems for all TTC operation.	Lower and Operational Management.	Infrastructure and databases should be integrated, easy to use, and satisfy Departments and staff needs. Establish a help desk facility at TTC that can solve problems correctly with low cost in limited time. Security system should include master plan for recovery in case of disasters and prevent TTC from harms.

Table 7.4 Comparison of conceptual model with the real world – ICT resources system

7.2.3.4 Step 4: Use VSM to define System 1 to System 5

This step aims to identify the five sub-systems (Implementation, Coordination, Control, Development, Policy) for each of the conceptual models of the relevant system after levels of recursions have been done for each sub-system.

For example, Figure 7.6 outlines three recursion levels of strategic policy: at recursion level 1 resides the system with which we are most concerned, called the 'system in focus' this is strategic policy. At recursion level 0 is the 'wider system' of which the strategic policy is a part, which information system at TTC in Makkah Al-Mukkaramah. At recursion level 1 lie the primary activities of strategic policy that can be regarded as a viable system in their own right which are: (1) to develop strategic policy, (2) to forecast for the future needs of TTC, (3) to plan for develop strategic policy, (4) to obtain agreement from High management, (5) to operate the planning, and (6) to establish and operate strategic policy. Diagnoses began at recursion level 2, such as to establish and operate strategic policy has some activities which include financial and administrative, staffing and training, records management, ICT, databases, security, and user needs.

Figure 7.7 describes strategic policy as a Viable System Model where S1 is Operational Management, S2 is Lower and Operational Management, S3 is Lower Management, S4 is Middle Management, and S5 is High Management. Therefore, S2 is concerned with all primary activities such as identifying and evaluating current strategy and policy. S3 & S4 are concerned with using proper methodology and techniques to gather information to forecast TTC future needs. S4 presents the proposal of planning and using formal presentation to provide evidence the TTC will benefits from this system and seek agreement from High Management. S5 concern with establishing approval for operating the planning of strategic policy. S4, S3 & S2 establish and operate the strategic policy planning to achieve TTC objectives. The same description of recursion levels and VSM can be applied to organisational resources (Figures. 7.8 and 7.9); to human resources (Figures. 7.10 and 7.11); and to ICT resources (Figures. 7.12 and 7.13).

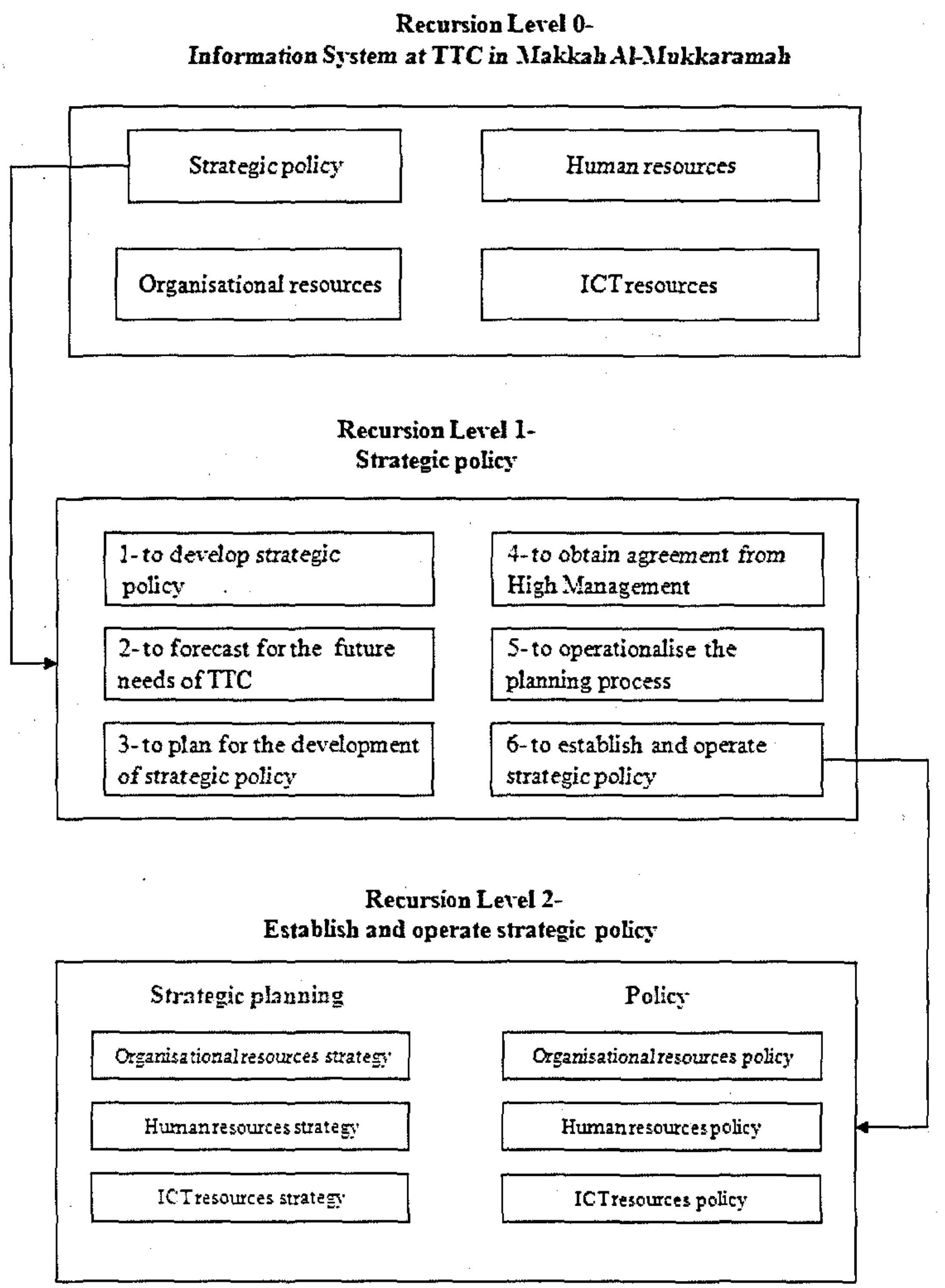


Figure 7.6 Three recursion levels: Strategic policy

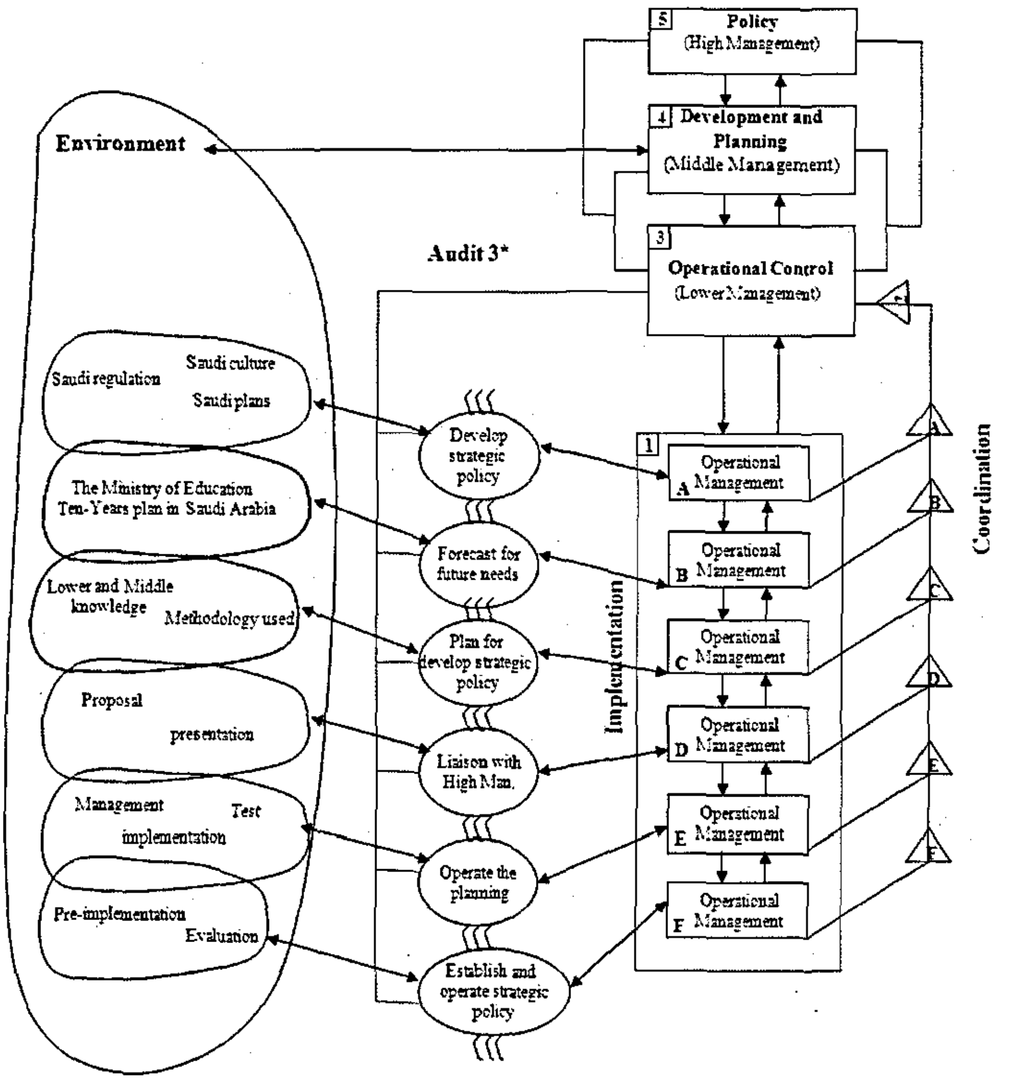


Figure 7.7 Strategic policy as Viable System

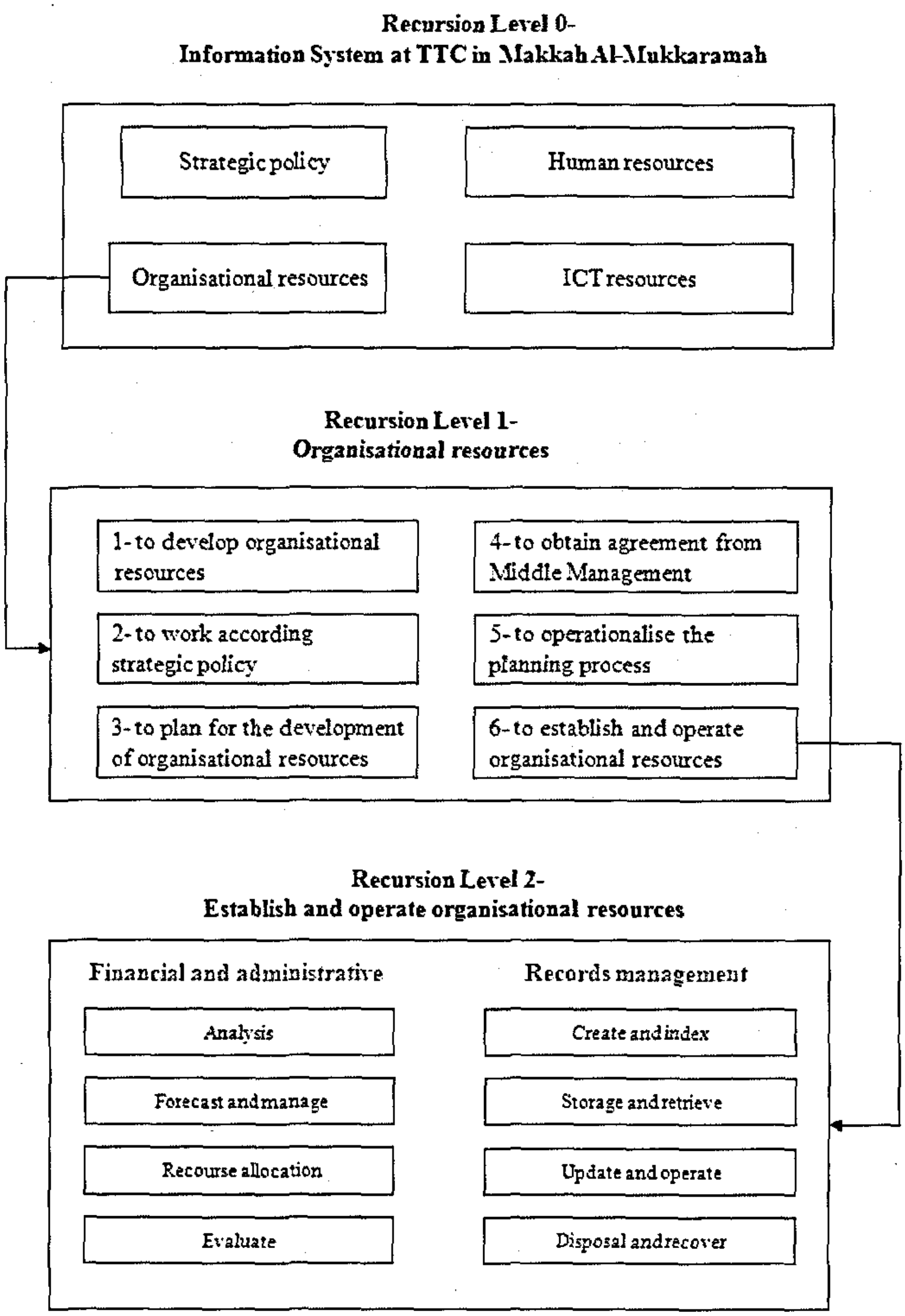


Figure 7.8 Three recursion levels: Organisational resources

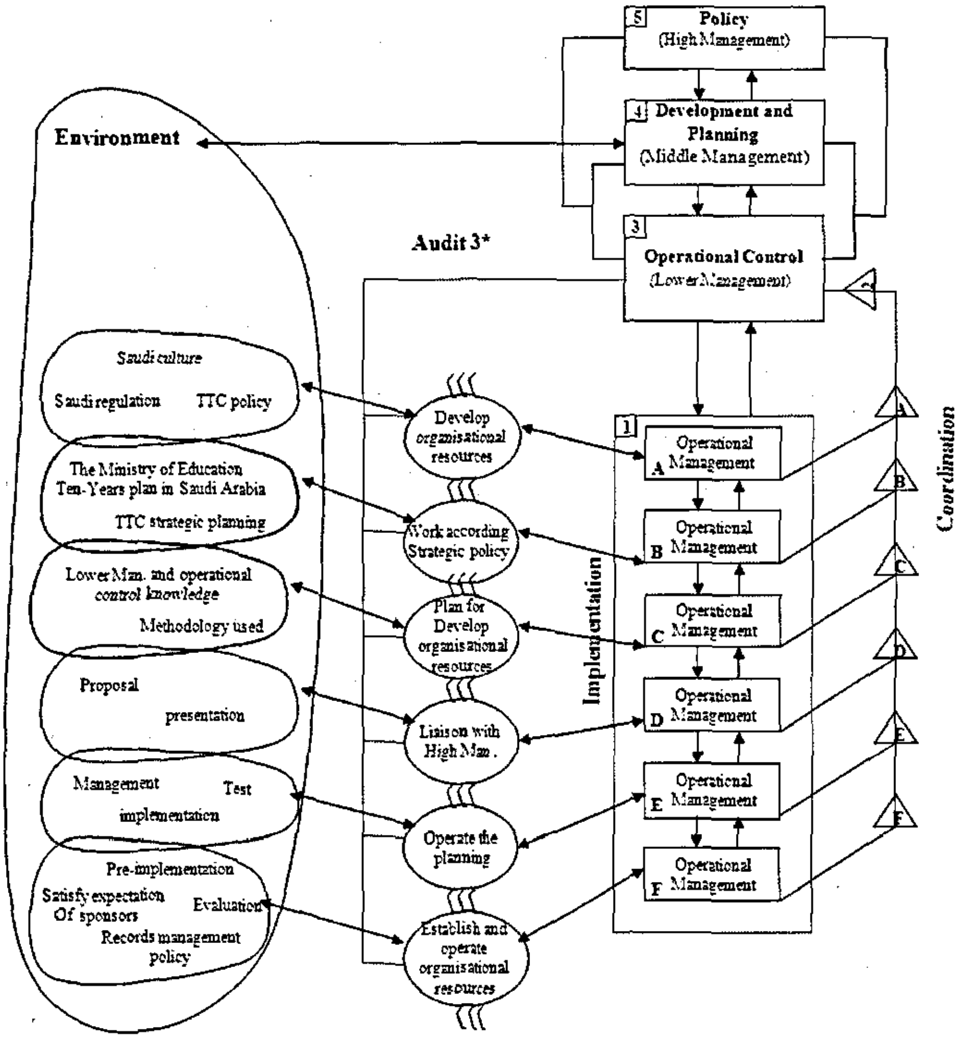


Figure 7.9 Organisational resources as Viable System

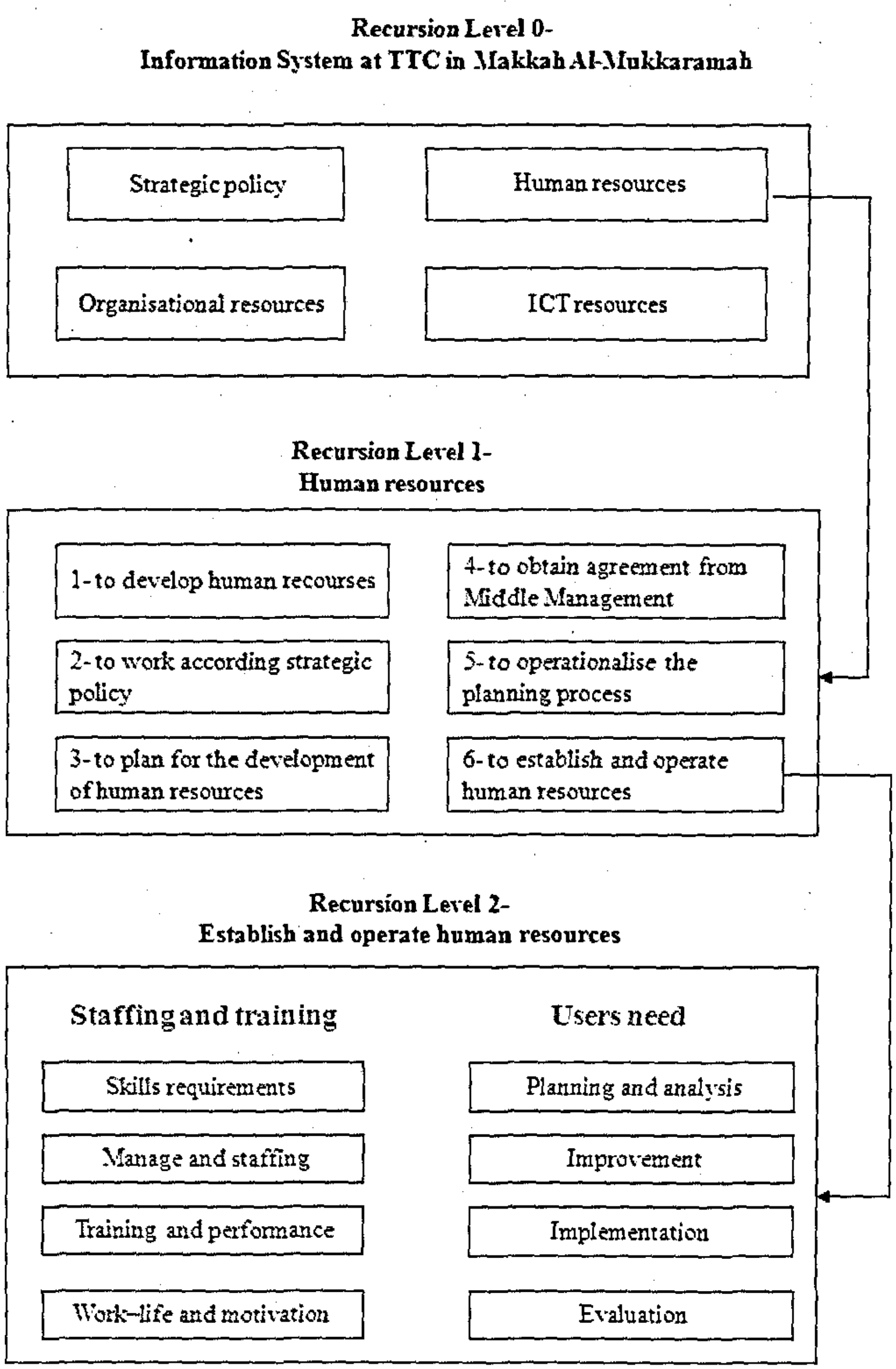


Figure 7.10 Three recursion levels: Human resources

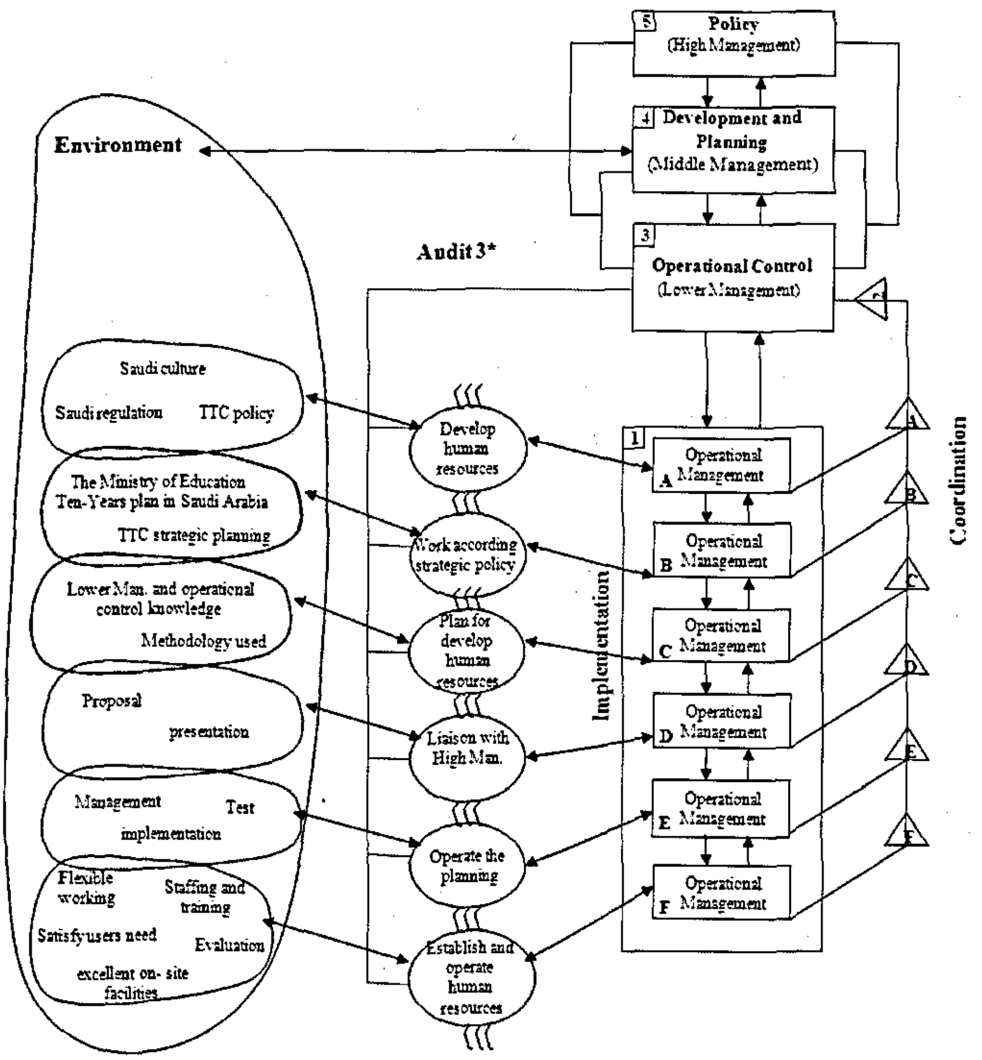


Figure 7.11 Human resources as Viable System

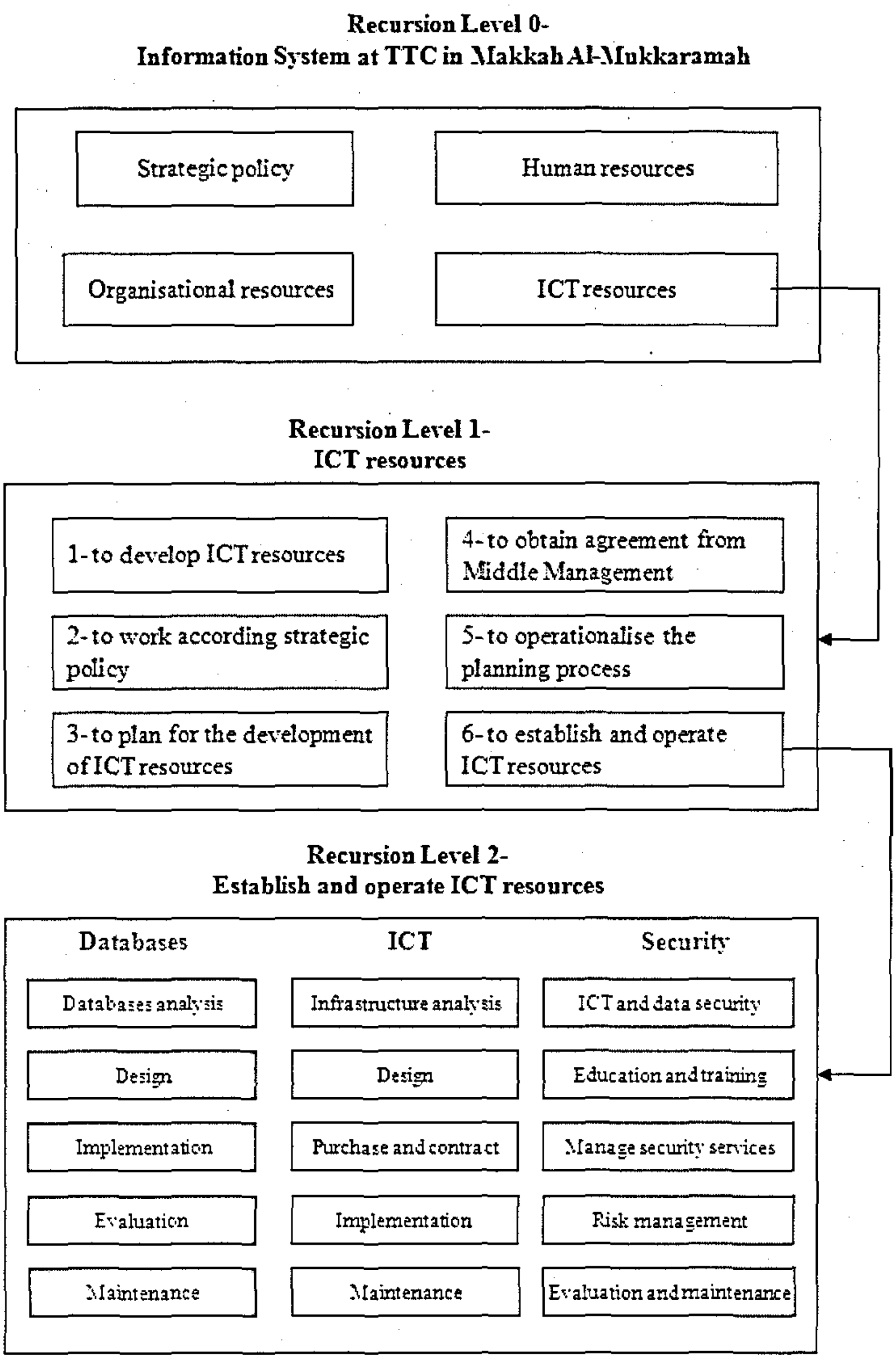


Figure 7.12 Three recursion levels: ICT resources

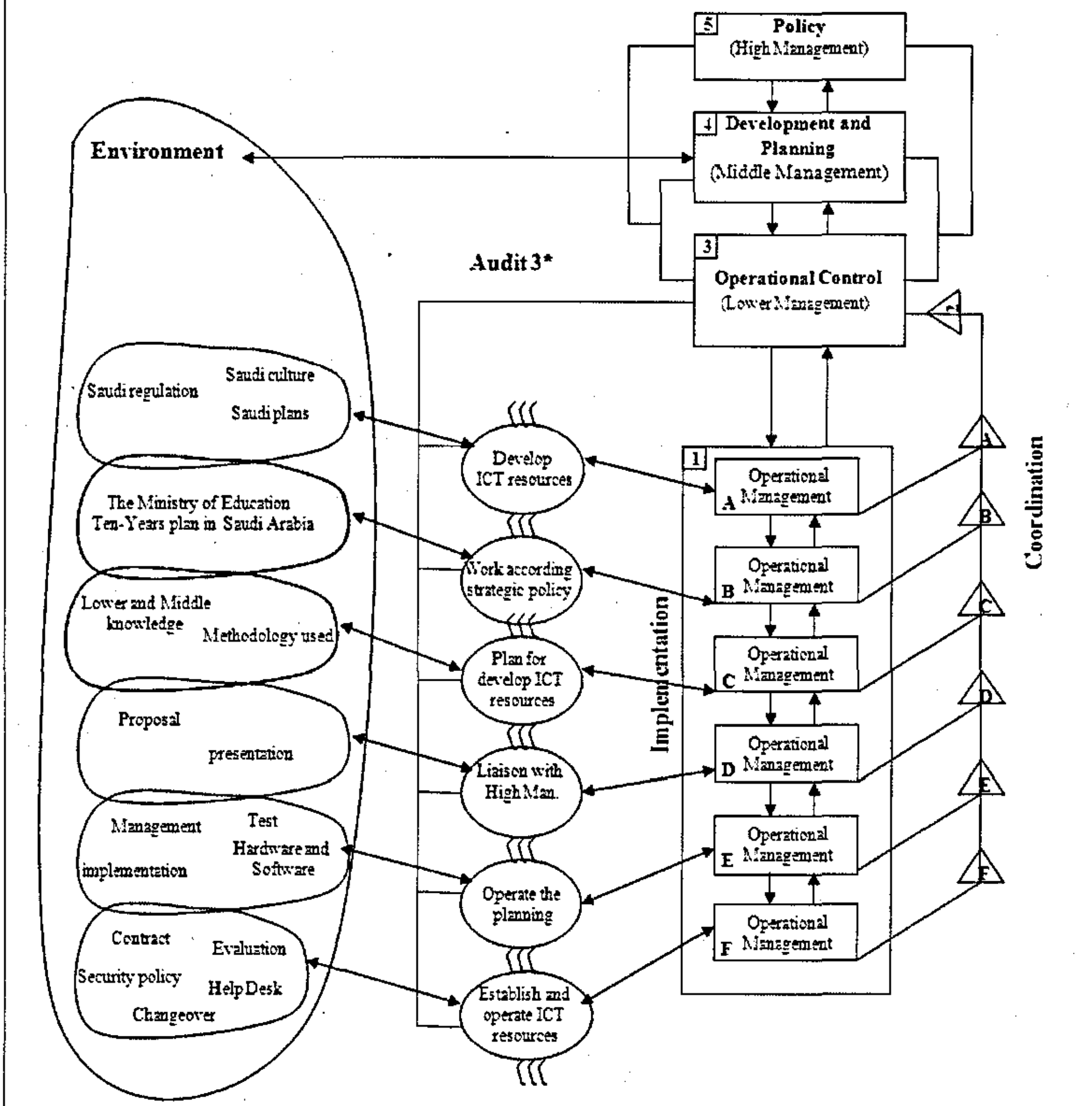


Figure 7.13 ICT resources as Viable System

7.2.3.5 Step5: Use VSM to define the whole system

The aim of this step is to make all sub-systems described in step 4 work together for the benefit of the large system (see Chapter 5, Stage 3). Three recursion levels of IS at the Girls Colleges in Makkah Al-Mukkaramah can be described. At recursion level 0, the IS at TTC and IS at College of Education are the components. If we take the IS at TTC to investigate recursion level 1, called the 'system in focus', the components are strategic policy, organisational resources, human resources, and ICT resources. An example of a further recursion is that the components of organisational resources are: to develop organisational resources; to work according strategic policy; to plan for the development organisational resources; to obtain agreement from Middle Management; to operationalise the planning process; and to establish and operate organisational resources. These six components from recursion level 2, as see in Figure. 7.14.

Figure 7.15 describes the Large Viable System Model (LVSM) at TTC which contains five systems. Operational Management is responsible for the Operation System (S1) which carry out all activities of Smaller Viable Systems (SVSs): strategic policy, organisational resources, human resources, and ICT resources. Lower and Operational Management are responsible for the Coordination System (S2) which resolve the conflict arising at any part of S1 interaction. Lower Management are responsible for the Control System (S3), this is concerned with everyday control by looking at the whole of S1 and improving its overall performance. Middle Management are responsible for the Development system (S4) which deals with long term plans. High Management is responsible for the Policy system (S5) which makes a balancing interaction between S4 and S3.

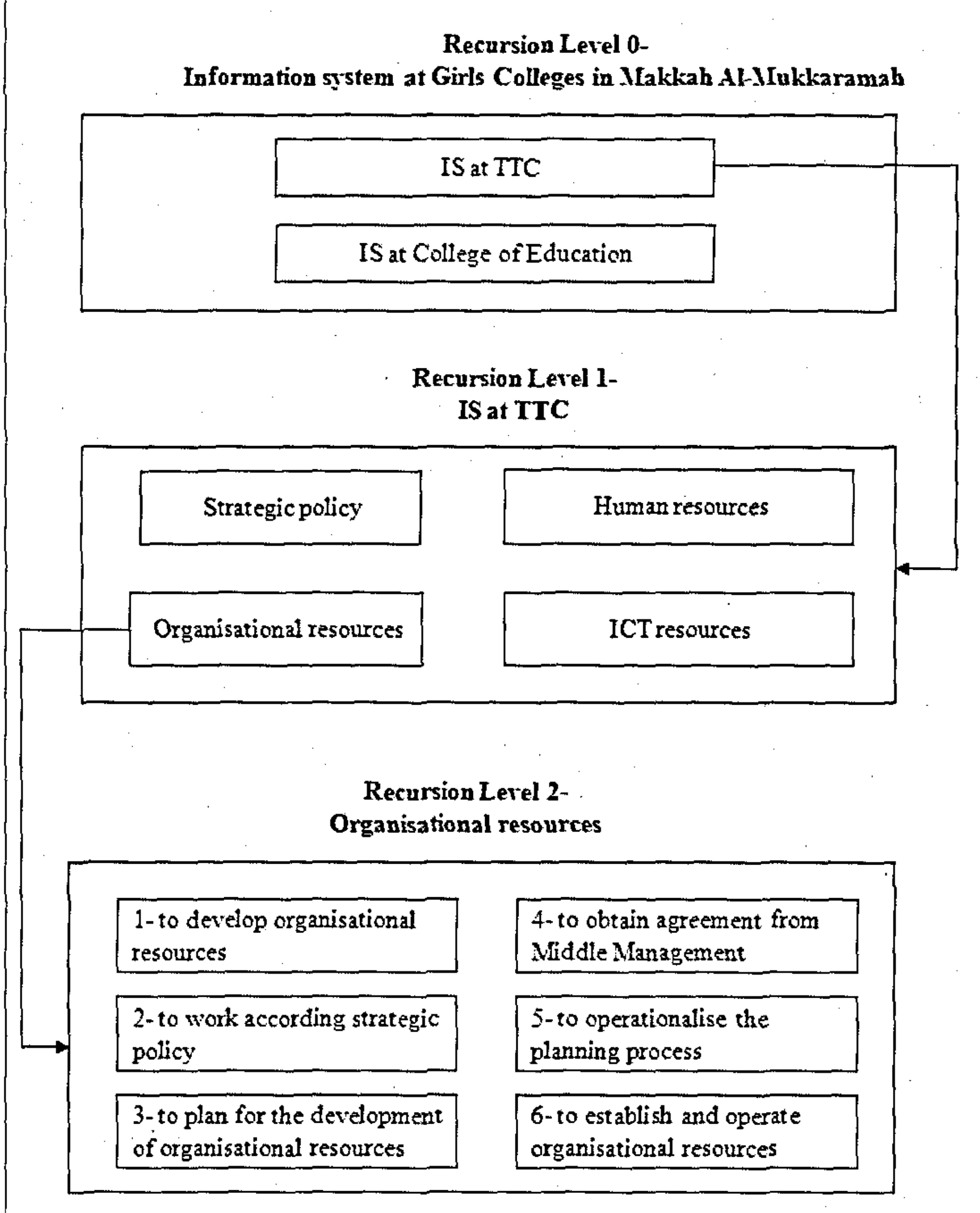


Figure 7.14 Three recursion levels: IS at TTC in Makkah Al-Mukkaramah

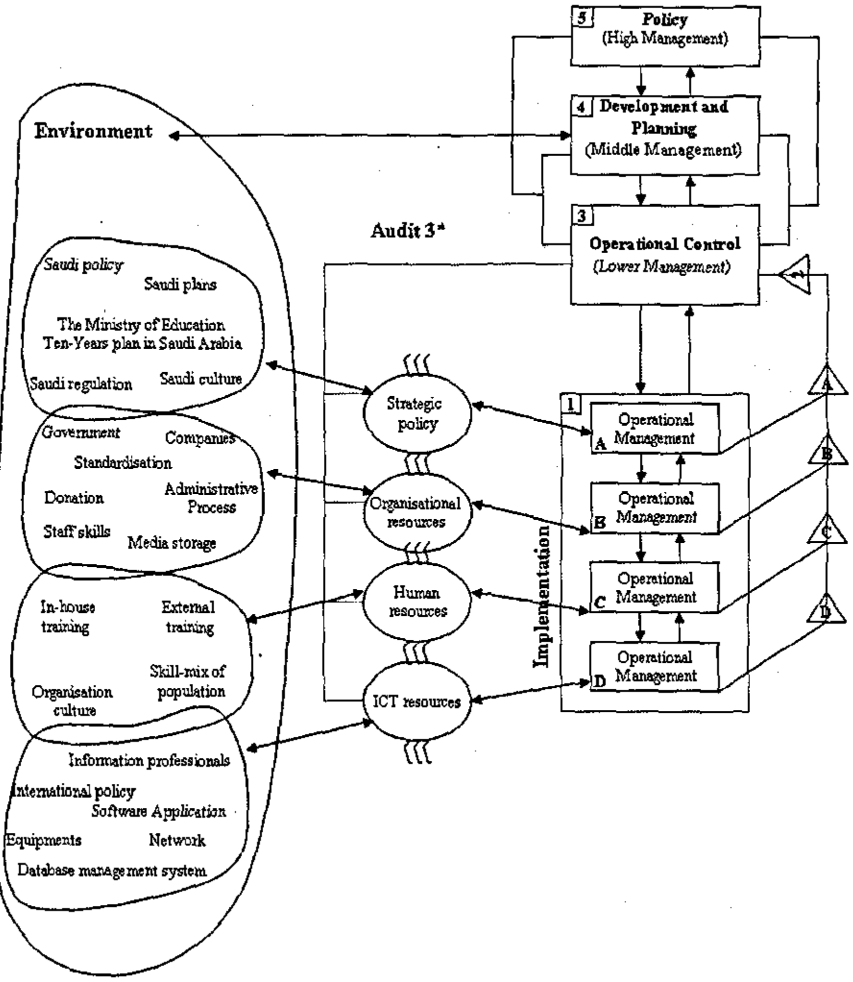


Figure 7.15 TTC Information System as Large Viable System Model

7.2.4 Stage 4: Implementation

There are four steps in the implementation process at MIM: planning, testing, training and changeover. (See Chapter 5, Stage 4.)

7.2.4.1 Step 1: Planning

The aim of the implementation is to convert the design of LVSM into practice, and to reconcile and manage both social and technical issues in order to achieve job satisfaction and efficiency objectives. It is vitally important to provide all resources needed in terms of funds, staff, training, education and external support. In addition, middle management should be informed of the plan in order to provide the necessary support and resources to fund the process of implementation and to provide staff. The implementation team consists of a researcher, three operational staff, and three lower management staff. Their tasks are to explore problems that may be encountered on implementation and the possible ways of avoiding or limiting these; to organise SVSs and their activities; to outline the implementation process and the time needed; and to examine subsequent improvements. The process of implementation covered the following areas:

1. LVSM contains four sub-systems from the design stage; these include the human resources system, the ICT resources system, the strategic policy system, and the organisational resources system. The conceptual diagram (Figure 7.16) shows the four unorganised sub-systems as an individual within a wider system boundary of TTC.

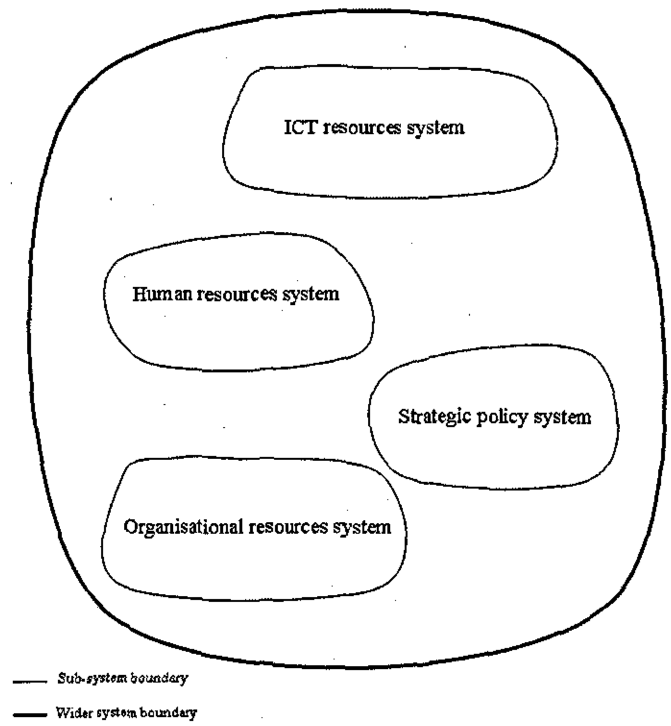


Figure 7.16 Unorganised four sub-systems within wider system boundary of TTC

2. The implementation system team has met twice for two hours to organise these four sub-systems. Before the first meeting, handouts were provided to every member of the implementation team, which cover the aims and objectives of sub-systems, so they could understand the general background

and agenda of the meeting. In addition, every sub-system was written down and recorded on four separate cards.

3. During the first meeting, the aims of the meeting and the methods that would be used to organise the sub-systems were explained. Two cards were selected randomly by the researcher (the human resources system and the strategic policy system). Both cards were displayed on the board and the team were asked if the human resources system would help to achieve the aims of the strategic policy system, or whether the strategic policy system would help to achieve the goals of the human resources system? The majority of the team voted that the strategic policy system would help to achieve the goals of the human resources system.
4. Another card was selected (the organisational resources system) and team members were asked if the organisational resources system would help in achieving the aims of the human resources system or vice versa. After discussion, the majority of the team voted that the organisational resources system would help to achieve the goals of the human resources system. Following this, the team was asked if the organisational resources system would help in achieving the aims of the strategic policy system or vice versa. The majority of the team voted that the strategic policy system would help to achieve the aims of the organisational resources system.
5. The final card was the ICT resources system. Here, the team was asked if the ICT resources system was likely to help achieve the goals of the organisational resources system or whether, conversely, the organisational resources system would help to achieve the aims of the ICT resources system? After discussion, the team voted that the organisational resources system would help to achieve the aims of the ICT resources system. After this, the team was asked, if the ICT resources system would help in achieving the aims of the human resources system or vice versa. After discussion, most of them agreed that the human resources system was most likely to achieve the aims of the ICT resources system. In the end, all the systems had been compared and were then put in order (see Figure 7. 17).

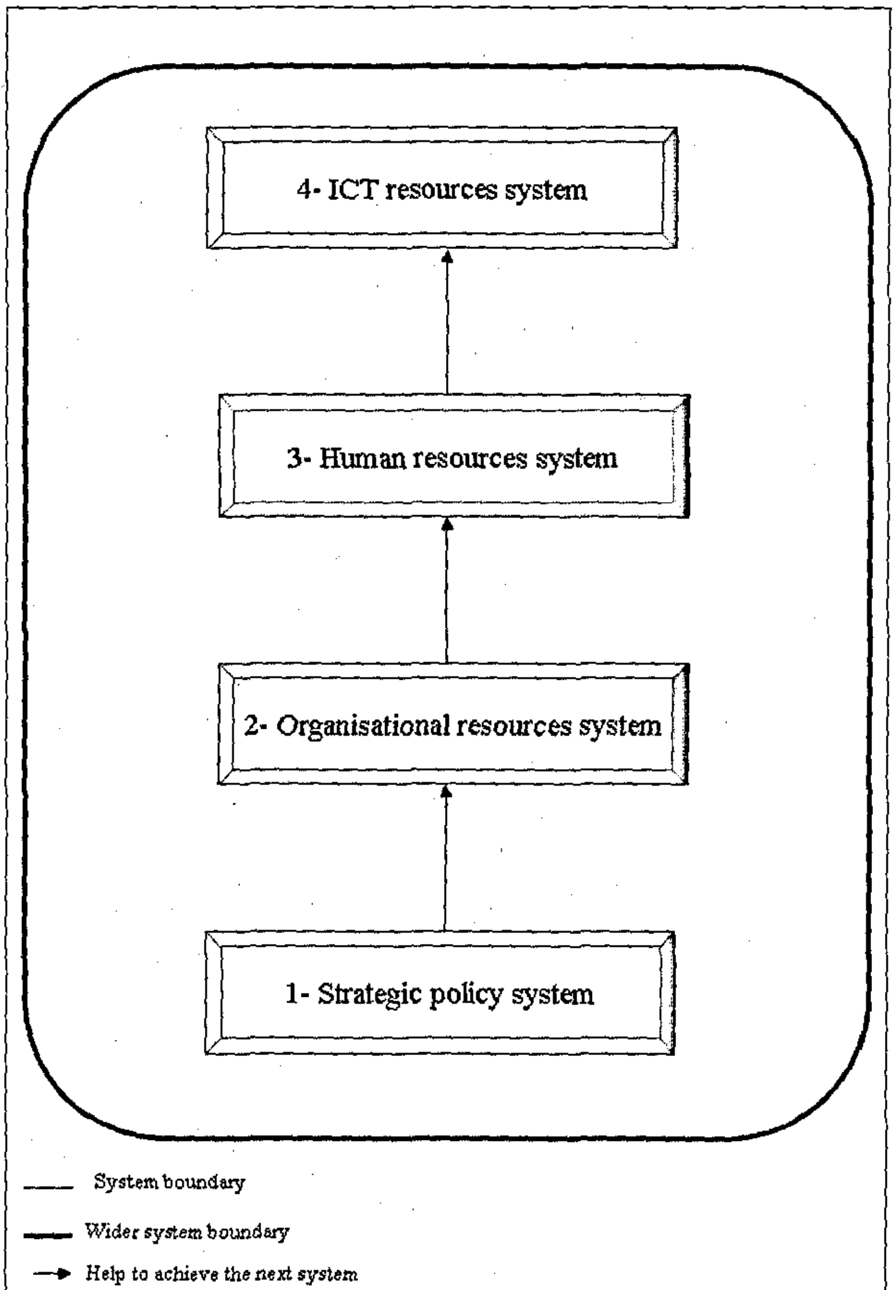


Figure 7.17 Organised four sub-systems within wider system boundary of TTC

6. At the second meeting, Figure 7.17 was displayed on the board, showing how the teams voted at the first meeting, so the team could see a general view of the Information System Implementation Model (ISIM). Deep discussions about the model ensued and this discussion process was time-consuming because it is a critical stage in reaching the final implementation model (see Figure 7. 18).

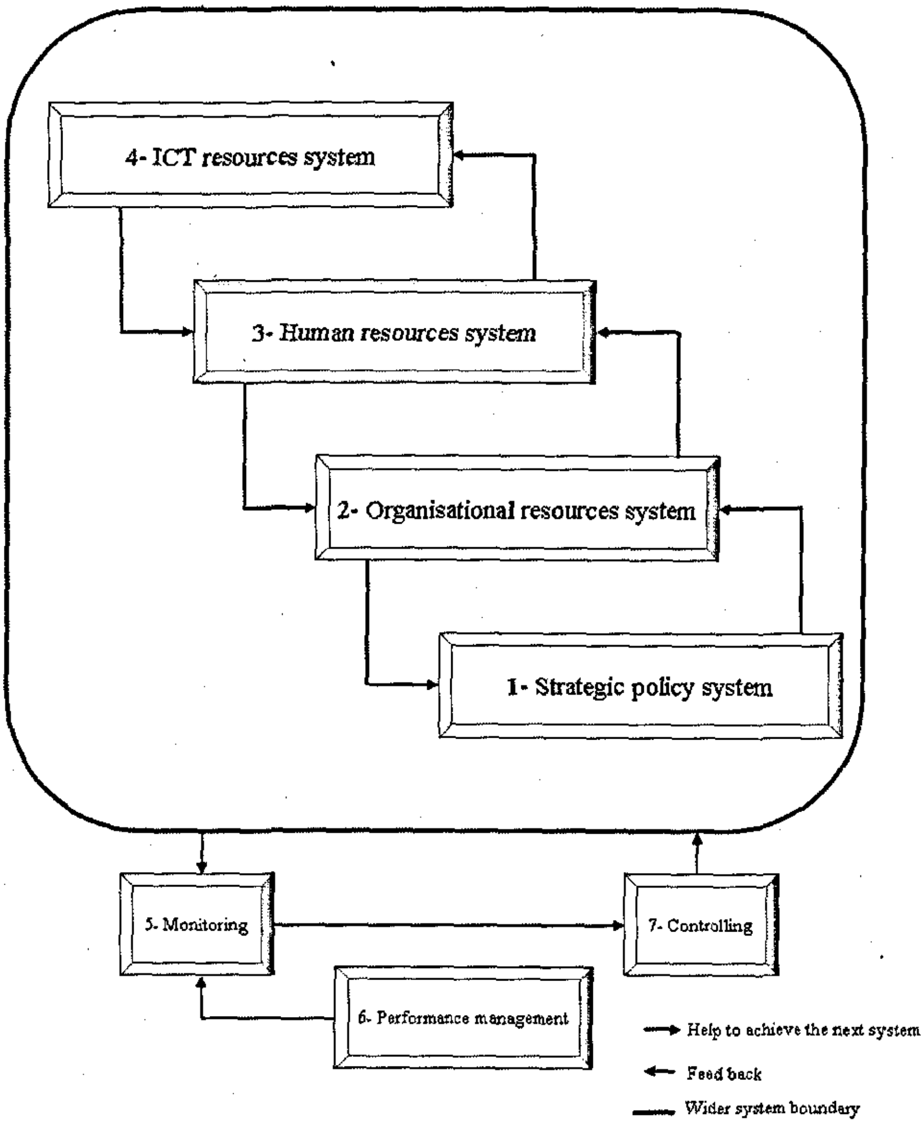


Figure 7.18 Information System Implementation Model (ISIM)

7. Figure 7.18 describes the ISIM process at TTC; this can be recognised as structured order of actions that need to be taken in order to achieve the aims of the implementation. Therefore, the strategic policy system is the initial stage that will help to achieve all other systems in the model. Following the implementation of the strategic policy system, organisational resources can be implemented and when these two systems have been implemented, the human resources system can be put into practice. Subsequently, ICT resource systems can be organised. Feedback can help to improve and maintain each system while monitoring, controlling and conducting performance management can help to improve and measure performance in the overall model.

8. At the end of this meeting, a considerable amount of time was given to the implementation team to express their views of the model.

7.2.4.2 Step 2: Testing

The aim of the testing of the ISIM is to ensure that every system in the model works as expected. This testing of the systems was applied in seven phases: component testing, functional testing, unit testing, integration testing, security testing, recovery testing, and acceptance testing. The first three testing phases (component, functional, and unit) were carried out according to the characteristics of the formal system model (see Chapter 4, SSM Stage 4) by using the RD, the Conceptual Model, and the Viable System Model for each of the four systems (see Tables 7.5 - 7.8).

Characteristics of the Formal System Model	Availability
1- Objectives or purpose	To develop and operate the strategic policy system (see RD).
2- Connectivity	To ensure there is a connection between the activities of the strategic policy system (see Figure 7.2, activities 1-6).
3- Measure of performance	There must be a measurement of performance (see Figure 7.2, activity 8).
4- Monitoring and control	This is part of lower and operational management (see Figure 7.7).
5- Decision-making procedures	This is part of high and middle management (see Figure 7.7).
6- Boundaries	These are: Saudi culture, Saudi regulations, Saudi Arabia's plans and the Ministry of Education's ten -year plan for Saudi Arabia. In addition, objectives, policies, ICT, records, users' needs, databases, security and financial and administrative issues at TTC.
7- Resources	The finance, people, information and equipment at TTC.
8- System hierarchy	The primary activities of strategic policy systems that can be regarded as viable systems in their own right: for example, to develop strategic policies and to forecast future needs of TTC (see Figure 7.7).
9- Continuity	There is a need for continuity in strategic policy systems (see Figure 7.2, activities 7,8 and 9)

Table 7.5: Strategic policy system

Characteristics of the Formal System Model	Availability
1- Objectives or purpose	To develop and manage the organisational resources system (see RD).
2- Connectivity	To ensure there is a connection between the organisational resources system activities (see Figure 7.3).
3- Measure of performance	There must be a measurement of performance (see Figure 7.3, activity 8).
4- Monitoring and control	This is part of lower management and operational management (see Figure 7.9).
5- Decision-taking procedures	This is part of high management and middle management (see Figure 7.9).
6- Boundaries	People, policies, ICT, records, users' needs, databases, security and financial and administrative issues at TTC.
7- Resources	The finance, people, information and equipment at TTC.
8- System hierarchy	The primary activities of organisational resources systems that can be regarded as viable systems in their own right: for example, to develop organisational resources, and to work according to strategic policy (see Figure 7.9).
9- Continuity	There is a need for continuity in organisational resource systems (see Figure 7.3, activities 7,8 and 9)

Table 7.6: Organisational resources system

Characteristics Formal System Model	Availability
1- Objectives or purpose	To develop and manage staffing, training, and users need (see RD).
2- Connectivity	To ensure there is a connection between human resources system activities (see Figure 7.4).
3- Measure of performance	There must be a measurement of performance (see Figure 7.4, activity 8).
4- Monitoring and control	This is part of lower management and operational management (see Figure 7.11).
5- Decision-taking procedures	This is part of high management and middle management (see Figure 7.11).
6- Boundaries	People, policies, ICT, records, users' needs, databases, security and financial and administrative issues at TTC.
7- Resources	Finance, people, information and equipment at TTC.
8- System hierarchy	The primary activities of human resources system that can be regarded as viable systems in their own right: for example, the development of human resources and to work according to strategic policy (see Figure 7.11).
9- Continuity	There is a need for continuity in human resources systems (see Figure 7.4, activities 7,8 and 9).

Table 7.7: Human resources system

Characteristics Formal System Model	Availability
1- Objectives or purpose	To develop and operate ICT, databases and security (see RD).
2- Connectivity	To ensure there is a connection between ICT resources system activities (see Figure 7.5).
3- Measure of performance	There must be measurements of performance (see Figure 7.5, activity 8).
4- Monitoring and control	This is part of lower management and operational management (see Figure 7.13).
5- Decision-taking procedures	This is part of high management and middle management (see Figure 7.13).
6- Boundaries	People, policies, ICT, records, users' needs, databases, security and financial and administrative issues at TTC.
7- Resources	Finance, people, information and equipment at TTC.
8- System hierarchy	The primary activities of ICT resources system that can be regarded as viable systems in their own right: for example, to develop ICT resources and to work according to strategic policy (see Figure 7.13).
9- Continuity	There is a need for continuity in ICT resources system (see Figure 7.5, activities 7,8 and 9).

Table 7.8: ICT resources system

Phase Four, the integration testing, is concerned with testing the system as whole to ensure that all sub-systems work, communicate and integrate with each other. Therefore, the ISIM was tested according to characteristics of the formal system model (see Table 7.9).

Characteristics of the Formal System Model	Availability
1- Objectives or purpose	To implement an information system at TTC.
2- Connectivity	To ensure there is a connection between sub-systems: for example, the strategic policy system and the organisational resources system (see Figure 7.18).
3- Measure of performance	There must be a measurement of performance (see Figure 7.18, activity 6).
4- Monitoring and control	This is part of lower management and operational management (see Figure 7.15).
5- Decision-taking procedures	This is part of high management and middle management (see Figure 7.15).
6- Boundaries	Saudi culture, Saudi regulations, Saudi Arabia's plans and the Ministry of Education's ten -year plan for Saudi Arabia. In addition, objectives, strategies, policies, ICT, records, users' needs, databases, security and financial and administrative issues at TTC.
7- Resources	Finance, people, information and equipment at TTC.
8- System hierarchy	The sub-systems that can be regarded as viable system in their own right: for example, the strategic policy system and the ICT resources system (see Figure 7.18).
9- Continuity	There is a need for continuity in ISIM (see Figure 7.18).

Table 7.9: Implementing the information system

Phase Five, the security testing, concerned the policies, and the technical and administrative measures used to protect systems from planned or unplanned unauthorised acquisition, damage, disclosure, manipulation, modification, loss or use. Figure 7.12 outlines the ICT resources system. This includes the security system that aims to provide physical security, soft security and data security. Physical security, for example, includes locked doors, alarm systems, video cameras, and fire alarm systems. Soft security, on the other hand, includes anti-virus software, original software, and firewall software while data security covers copyright, loss or abuse of information, and data protection. Therefore, each system in ISIM has its own security test to prevent it from intentional or unintentional acts which may come from internal or external sources. In addition, ISIM includes a security test as a whole to make sure the whole system works in an integrated and co-operative way.

Phase Six, the recovery test, is concerned with the process which determines the ability of the implementation team to recover or restart the systems quickly in the case of natural disaster, building fire, power failure, terrorist attack, system failure, human error, and computer viruses which, consequently, can lead to data loss, communication problems, and facility damage. Thus, having a disaster recovery plan in place is an important step in protecting TTC against contingencies before problems strike; it also minimises the impact of disasters. Every system in ISIM should have an appropriate disaster recovery plan which will include the setting up in safe place of regular back-ups for essential documents or electronic files.

Phase Seven is the acceptance test. This aims to examine the relationship between the system and its users: for example, what the users seek from the system (achieving users' needs, expectations and objectives) and what the system requires from the users in order that they can do their jobs. Therefore, questionnaires, interviews and discussion groups can be used to measure job satisfaction. Mumford (1994) identified five areas in order to measure job satisfaction. These include: the knowledge fit, the psychological fit, the efficiency fit, the task-structure fit, and the ethical fit (see Chapter 4, Section 4.5.2).

7.2.4.3 Step 3: Training

One of the most important elements in the success of information systems is the need to educate and train users. So, users should be educated in order to give them a general understanding of the functions, objectives and limitations of the system, as well as how the system can be used to carry out their tasks. This can be done by providing a number of formal presentations to users to address their specifications of an information system and how they might benefit from such a system. In addition, handouts concerning information systems and including their aims, objectives, functions, activities and benefits, could be distributed to users. Moreover, users should be trained to ensure that they understand both information systems and their operation. Thus, users need to develop, not only the competence, skills and knowledge, but also factors such as how to use technical equipment, how to keep the equipment running, and how to provide the necessary support services to both internal (the Dean, deputies, Heads of Departments, academic and operational staff) and external users (students and other academic organisations).

There is a number of methods that can be used after determining the type of trainee, the kind of course they need, the time-scale for accomplishing the training, and the cost. The methods include: lectures and seminars during break times (or lunch times), and on-the-job training, Software packages, such as Word, Excel, Access tutorial programs, and ISCL, can provide training courses to both internal and external users.

7.2.4.4 Step 4: Changeover

Changeover means moving from the old information system at TTC to the new one. Five factors need to be considered when changeover is carried out. These are: cost, time, the quality of the new system, impact on users, and technical issues. There are four changeover methods (see Chapter 5, Section 5.3.1.4): these include direct changeover, parallel running changeover, deferred parallel running changeover, and phased changeover. Phased changeover has been used to convert to the new information system for the following reasons: parallel running change over offers less risk with a high cost, while direct changeover costs less but carries a higher risk. Phased changeover, on the other hand, is less costly and less risky because this method is similar to parallel running changeover, except that, at the start, not all functions of the system are run in parallel. In addition, phased changeover allows TTC to take advantage of some aspects of the sub-systems in the new information system, while allowing a measure of flexibility to be kept in order to deal with any issues. The disadvantage of this method is the lengthy delay before full implementation of the new information system is achieved.

Therefore, a phased changeover of new information system at TTC can be applied as follows:

1. The strategic planning sub-system from the strategic policy system can be introduced first.

2. Financial and administrative sub-systems from the organisational resources system can be introduced second followed by the strategic planning sub-system.

3. The staffing and training sub-systems, from the human resources system, can be introduced thirdly, together with the financial and administrative sub-systems and the policy sub-system from the strategic policy system.

4. The database sub-systems, from the ICT resources system, can be introduced fourth, together with the staffing and training sub-systems, the records management sub-system from the organisational resources system, and the policy sub-system.

5. The ICT sub-system, from the ICT resources system, can be introduced fifth, together with the databases sub-system, the users' needs sub-system from the human resources system, and the records' management sub-system.

6. The security sub-system, from the ICT resources system, can be introduced sixth alongside the ICT sub-system and the users' needs sub-system.

7. After the final sub-system (the security sub-system) has been installed, the old information system is stopped. In other words, the old information system is replaced by the new system gradually over time (see Figure 7.19).

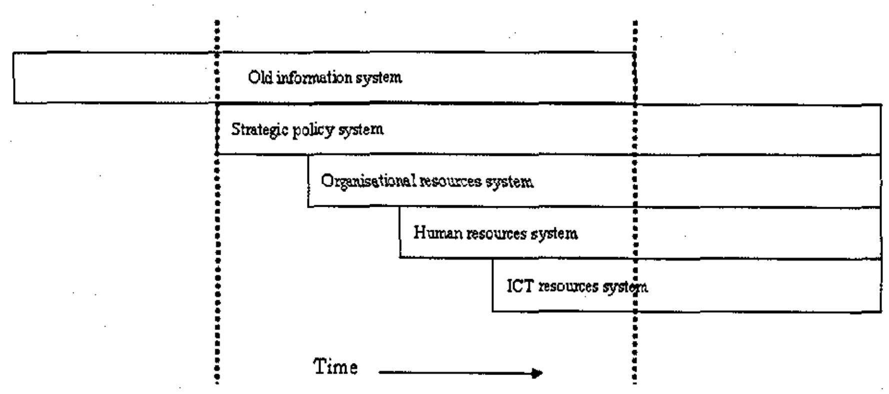


Figure 7.19 Phased Changeover used for convert to the new information system at TTC

It is important to carry out a post-implementation review that aims to measure the success of the new information system and which will allow lower management to make any necessary corrections. The main reasons for carrying out a post-implementation review are: to determine errors; to make suggestions and recommendations which need to be implemented for future release; to determine the information system's success by its ability to achieve TTC goals; and to record the experiences for use in further studies.

7.2.5 Stage 5: Maintenance

The aims of this stage are to ensure that the infrastructure functions of the information system are at a satisfactory level of reliability and control to enable operational objectives to be achieved and to document the modification of the information systems over time. However, the maintenance of the information system at TTC is designed to maximise improvement activities throughout the service. Therefore, the main reasons for applying the maintenance are: to reduce failures in the system and to increase efficiency; to reduce costs and increase performance; to control users' (internal and external) access to the system; to integrate information between the four systems; and to upgrade hardware and software as appropriate. In addition, maintenance provides a measurement of performance, serviceability, usability, reliability and security in a system over time, within a minimum number of activities, and with good productivity.

There are two types of maintenance of the TTC information system according to time: long-term, such as quarterly or annually; and short-term, such as day-to-day or weekly, according to the stability of the system. Suppliers can carry out long-term maintenance according to the long-term contract, while a help desk can carry out short-term maintenance at TTC in cooperation with suppliers.

On the other hand, maintenance can be divided into two broad social-technical types: information and communication technology maintenance, and human activities maintenance. Information and communication technology maintenance is concerned with hardware, software and information maintenance which is carried out by professional technicians under long-term contracts with suppliers. Human activities maintenance is concerned with understanding users' needs, and dealing with the new system and organisational culture. This is carried out through the use of a help desk, which is operational in resolving day-to-day problems discovered during the operations activities (see Figure 7.20).

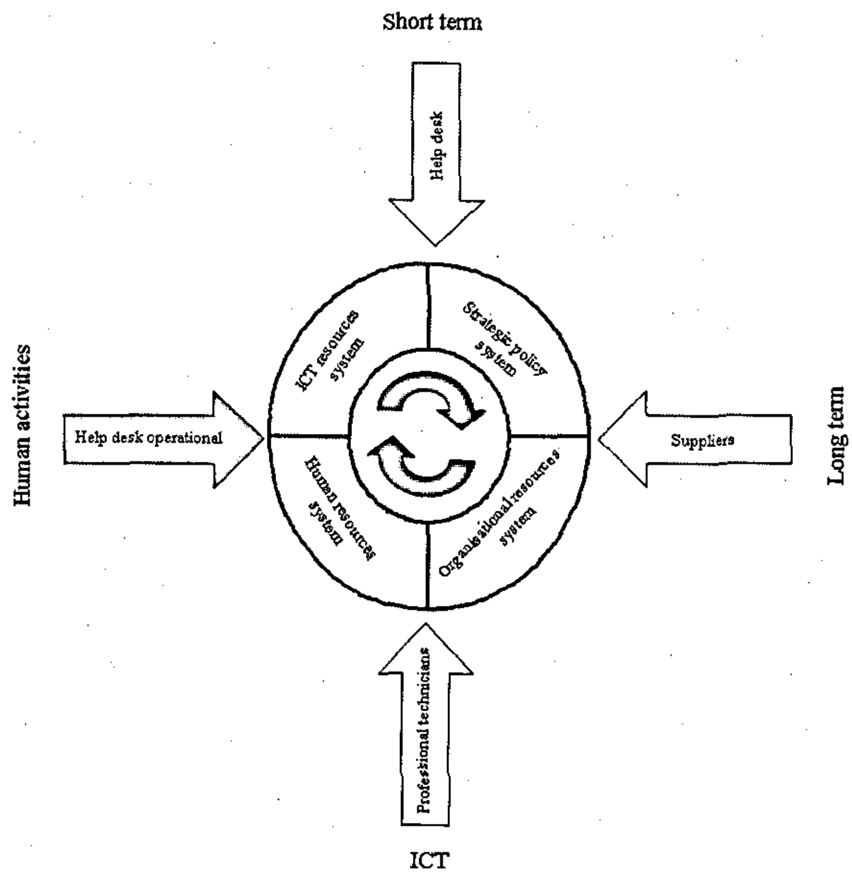


Figure 7.20 Information system maintenance elements at TTC

7.3 Evaluation

The aim of this strand is to provide the most suitable and reliable information to middle and lower management about the information system at TTC. It is vital to apply evaluation in parallel with all stages of MIM, starting from planning to maintenance. Evaluation consists of three stages: needs evaluation, formative evaluation, and summative evaluation (see Chapter 5, Section 5.3.2).

7.3.1 Needs Evaluation

The aim of needs evaluation is to establish planning for short and long-term evaluation and to obtain a rich picture for current problem situations from many sources and perspectives by using appropriate methods of data collection. Thus, needs evaluation should be conducted during the early stages of MIM (planning and analysis).

However, a needs evaluation at TTC can be done by using two broad categories of methods: quantitative and qualitative. Questionnaires can be used as part of a quantitative method by distributing surveys among academic and operational staff, students, and other organisations which benefit from the TTC information system. So, a questionnaire should include users' needs in terms of training, impressions concerning information systems, ICT skills, and their opinions. Interviews, focus groups and observations can be used as part of the qualitative study carried out among lower and operational management. Thus, these qualitative methods should include an analysis of TTC departments, together with information systems, problems and suggestions. Lower management should set up criteria for measuring the extent to which users' needs have been met, by providing feedback about progress and thus leading to improvements in the quality of the services.

7.3.2 Formative Evaluation

This is conducted in the design stage and during the early steps of the implementation stage. Formative evaluation is a process of ongoing feedback on the performance of the strategic policy system, the organisational resources system, the human resources system, and the ICT resources system. It aims to identify problems that arise during the design and allows for modifications. Formative evaluation is carried out for each system by applying seven phases of testing, according to the characteristics of the formal system model (see Section 6.3.3.2). The outcome of systems testing could be evaluated through written or informal discussion. The result of this discussion is a useful tool in improving practice while the system is in development, rather than waiting until the system is completed and finding out too late that the system is not implemented as planned and that the result is unwanted.

7.3.3 Summative Evaluation

Due to nature of summative evaluation, its timing and period in which direct impact of the new information system can be attained, means that it was not attempted as part of this study. Summative evaluation is conducted at the end of the implementation and maintenance stages, usually by external organisations or independent evaluators. Summative evaluation can be carried out through formal written reports on the impact of the information system with the added benefit of keeping high management informed and satisfied. Summative evaluation should consist of five criteria: validity, reliability, sensitivity, utility and usefulness. To ensure a successful evaluation of an information system, the summative evaluation should involve five steps: planning, data collection, analysis, comparison and report (see Chapter 5, Section 5.3.2.3).

7.4 Summary

The process-oriented and evaluation were the main strands of MIM. The process-oriented strand consist of five stages: planning, analysis, design, implementation, and maintenance. Firstly, planning aim to establish aims and objective of the project that can be done by six steps include: develop a strategic plan; forecast information needs; establish the aims and objectives of the project; produce the project plan; secure financial resources; and finally, seek agreement from the upper-level managers of the organisation. Secondly, analysis focuses on analysis the current problem situation that can be done by finding out (the problem situation unstructured), creating the Rich Picture (the problem situation structured), and extracting problem themes. Thirdly, design which consist of five steps root definition, the conceptual model, the comparison of the model to the rich picture, the use of VSM to define System 1 to System 5, and the use of VSM to define a whole system. Fourthly, implementation which consist of four steps include: planning, testing, training and changeover. Finally, maintenance which aim to ensure that the infrastructure functions of the information system are at a satisfactory level of reliability and control to enable operational objectives to be achieved and to document the modification of the information systems over time.

The evaluation strand aimed to provide the most suitable and reliable information to middle and lower management about the information system at TTC. Needs evaluation, formative evaluation, and summative evaluation were the main stages of the evaluation strand. Firstly, needs evaluation conducted in the early stages of MIM (planning and analysis) and aims to establish planning for short and long-term evaluation to improve organisational performance and efficiency. Secondly, formative evaluation conducted in the design stage and early steps of implementation stage. It is a process of ongoing feedback on performance which aims to identify problems that arise during the design, thus allowing for modification. The, summative evaluation was outside the scope of this thesis.

The Wider information system at TTC consist of four systems: strategic policy system, organisational resources system, human resources system, and ICT resources system. Strategic policy system is the initial stage that will help to achieve all other systems in the model. Following the implementation of the strategic policy system, organisational resources can be implemented and when these two systems have been implemented, the human resources system can be put into practice. Subsequently, ICT resource systems can be organised. Feedback can help to improve and maintain each system while monitoring, controlling and conducting performance management can help to improve and measure performance in the overall model.

Chapter 8
Discussion

8.1 Introduction

This study has outlined a number of problems related to information systems at TTC. These problems include the rapid increase in the number of papers, a lack of information integration, missing information, duplication of information, a lack of information security and back-up, limited use of computer services, staff not attending training courses, the rapid increase in the numbers of students enrolled, the fact that information processes take a long time, limited funds, insufficient numbers of ICT staff, lack of records' management, the lack of a disaster plan for information, the lack of space for files in offices, and the huge amount of paperwork. Therefore, this chapter is divided into three parts: a discussion of the various threads that have run through this thesis thus far; suggested actions to improve the information system at TTC; and an identification of the contribution that the methodology and findings have brought to the wider knowledge base.

8.2 Discussion Threads

Strategic policy, and organisational, human and ICT resources constitute the various threads that run through this thesis. Firstly, strategic policy initially needs to be in place in order to achieve the successful implementation of the information system; this includes both information strategy and information policy. Secondly, organisational resources need to be considered; these include financial and administrative affairs, and records' management. A Student Office should be established to maximise opportunities to serve students and staff by providing them with accurate information as quickly as possible, with the minimum of effort and at a low cost. A Records Centre should be established to manage inactive and semi-active records that can be stored, organised, accessed and retrieved at any time. Thirdly, human resources, which include staffing and training affairs, and considering user needs, should be examined; this will lead to greater job satisfaction and achieve technical and operational objectives. Finally, ICT resources, which include ICT, databases and security, must also be considered. A Help Desk should be established to provide technical support for students and staff and to resolve problems related to ICT and human activities.

8.2.1 Strategic Policy

The mission and objectives of the organisation should be established before the strategic policy is decided upon as this will aim to direct the organisation's future, actions and its allocation of resources in the long term (e.g. from 3 to 10 years). This will help in achieving the organisation's objectives in the light of organised principles, laws, guidelines, rules and procedures while guiding the its management to protect operations from malpractice. At the same time, strategic policy planning is the formal process which sets out an organisation's resources and actions in relation to an external environment in order to achieve specific objectives for each strategic policy.

The results of the document analysis (see Section 6.2) showed that general objectives are developed by the High Management Committee but the analysis also revealed an absence of strategic policy. Developing strategic policy is vital to satisfy management's objectives and to ensure that there is strong and flexible information infrastructure that can support all TTC processes. Consequently, strategic policy at TTC should be concerned with a mission and objectives, resources (financial, human, ICT and information), and the external environment (the Saudi culture, Saudi regulations, Saudi Arabia's Development Plans, and The Ministry of Education's Ten-year plan for Saudi Arabia). In addition, strategic policy should be developed by the High Management Committee to deal with issues which relate to TTC in the long, rather than the short term. This study agrees with McGee *et al.*, (2005) when they stated that the three basic dynamic and key factors of strategy to be taken into consideration include goals, resources and the external environment.

The results of the interview analysis (see Section 6.3) and the focus groups analysis (see Section 6.4) showed that there was an increased amount of paper caused by duplication of the same information, a lack of training and ICT staff, a lack of funding and equipment to support TTC operations, no standardisation in information management and processes, and that the exchange of information among departments took a long time.

In addition, when the respondents were asked to indicate their impressions of the information processes (see Table 6.9), nearly 34% of the total number of respondents indicated that these processes, in terms of finding, collecting and using information, were either not good or they were unable to find the information they required. Table 6.10 illustrates that around 43% of total respondents indicated that their impression of the time taken to process information was not good or said that they were unable to find the information they needed (see Section 6.6). These problems might be a result of the lack of strategic policy related to information management, training and funding. In addition, Heads of Department focus on the short rather than the long term. Therefore, TTC should develop a strategic policy, not only related to administrative and financial matters, but also related to staffing and training. The main reason for developing such a strategic policy is to provide legal guidelines for heads of department and supervisors to help them succeed in managing their information. So, this study agrees with Orna (1999) when she stated that information policy objectives in relation to human resources should include establishing formal communication links with appropriate organisational structures among the people concerned. Furthermore, an audit of staff information skills and knowledge should be maintained to ensure that these skills are fully used and also developed by suitable training, with staff participating in identifying their own training requirements and in planning appropriate training programmes.

Table 6.23 indicated that the majority of academic staff (89%) and operational staff (90%) strongly agreed or agreed that developing an information strategy would affect the performance of TTC. There are number of factors that may have contributed to this impression, including information strategy and information policy that could offer legal guidelines and plans for all information processes to achieve TTC's objectives in both the long and the short term. Therefore, strategic policy is required from the start in order to establish successfully all other systems which will form the infrastructure of an integrated information system at TTC. This study thus agrees with Gibb *et al.*, (2006) when they stated that an information strategy is the result of the demands of the organisation, such as an organisation's strategy and its associated goals and objectives; it also provides an opportunity to assess how successful information management is in terms of meeting those demands.

The research study demonstrates that TTC has a combination of strategic policy and objectives. This leads to the Dean and their Deputies seeking short-term rather than long-term plans to achieve TTC's objectives. Therefore, strategic policy at TTC should include an information strategy, a policy strategy, an administrative and financial strategy, a records management strategy, a staffing and training strategy, a user needs strategy, an ICT strategy, a database strategy, and a security strategy. The Middle Management Committee should develop strategic policy and gain approval from the High Management Committee to obtain support when needed, in order to operate and achieve TTC's objectives. Therefore, a strategic policy, authorised by the Middle Management Committee, would provide plans, laws, regulations and guidelines to fulfil the demands and to support the objectives of TTC in both the short and the long term. So, this study agrees with Galliers and Leidner (2003) when they defined information strategy as a complex set of implicit and/or explicit visions, goals, guidelines and plans with respect to the supply and demand of formal information in an organisation, sanctioned by management, and intended to support the objectives of the organisation in the long run, while being able to adjust to the environment. It also agrees with Drake (2003) who defined information policy as a set of interrelated principles, laws, guidelines, rules, regulations and procedures guiding the overseeing and management of the information life cycle: that is, the production, collection, distribution/dissemination, retrieval, use and retirement, including the preservation, of information.

This study demonstrates that information strategy and information policy, in terms of strategic policy, will provide a framework policy to support the organizational resources, human resources and ICT resources to achieve the overall objectives of TTC. Therefore, this study agrees with Orna (1999) when she stated that *"information strategy is a detailed expression of information policy in terms of objectives, targets, and action to achieve them, for a defined period ahead. Therefore, information strategy provides the framework for the management of information. Information strategy, contained within the framework of an organisational policy for information and supported by appropriate systems and technology, is the 'engine' for: maintaining, managing and applying the organisation's information resources; and supporting its essential knowledge base and all who contribute to it, with strategic intelligence, for achieving its key business objective".*

8.2.2 Organisational Resources

Information management is the implementation of strategic policy in order to meet information objectives within the overall constraint of the available resources. The main area of information management includes the management of information resources, the management of information technology, the management of information processes, and the management of information standards and policies (see Section 3.3.3). In this study, the organisational resources at TTC include administrative and financial affairs, and records management, according to the problem situation as seen in the Rich Picture (Figure 7.1); this was grouped into four problem themes (see Section 7.2.2.3).

In fact, the focus group analyses (see Section 6.4.1) confirmed that the general process of information management at TTC depends on a traditional system, there is a lack of policy related to creating files, information processes take a long time, and it is difficult to access and retrieve information from files. Information is delivered to the departments in many forms (e.g. general official letters, students' papers, complaints, reports and examination results) and from both internal and external resources. It is often left to the operational staff in the departments to cope with information as they see fit. They always do not manage this information and put it into appropriate files, with the result that the information is often difficult to find, access and retrieve. Therefore, TTC needs to manage its information resources adequately, starting from the collection of data, to processing the information and sending it to the right person at the right time until it is stored or disposed of in a suitable way. Therefore, this study is in agreement with the Information Management Associates (2003) when they asserted that the goals of information management are: to get the right information to the right person, at the right time, from the right source, in the right amount, in the right order, in the right form, in the right medium, with optimal accuracy, as quickly as possible and at the lowest reasonable cost.

Table 6.8 shows that around 18% of student respondents indicated that they could not obtain help from staff when they needed it. Moreover, Table 6.10 illustrates that around 48% of student respondents indicated that their impression concerning the time taken to process information was that it was not good or they were unable to find the information they needed (see Section 6.6). The main reason for this is that when staff deal with students' needs, they must act in an official way to avoid further problems. Also, new students, who come from high school, do not have any expertise in dealing with TTC official procedures, particularly those related to paperwork. Moreover, the number of staff was limited when compared with the number of students (one staff member should deal with around 52 students to satisfy legal requirements).

Furthermore, 55% of student respondents stated that their impression regarding the exchange information among departments was that it was not good or indicated that they had no knowledge of this (Table 6.11). The reason for this was that students have limited interaction with other departments and they may face difficulties in exchanging information between departments, particularly when students at TTC change or pass information from one department to another. Consequently, it is important to establish a Student Office with the philosophy of establishing 'Accurate Information', 'Quick Response', and 'Just-in-Time' services as these could play an important role in improving communication, not only between students and operational staff, but also between academic and operational staff. This study agreed with that of Nojoum (2005) when he described a Call Centre as a set of functions or actions that can be carried out in many ways using multiple delivery channels such as telephone, fax, e-mail, or the Internet to provide and receive information coming to and from organisations and users in order to provide high-quality services.

However, the document analysis (see Section 6.2) demonstrated that TTC, like other government organisations, obtains its budget from the Saudi government. Thus, all Colleges are asked to prepare and provide estimates of the funding required to run their operations and programmes. These estimates are examined by the Middle Management Committee at the Ministry of Education before being presented to the relevant government committee. The relevant committee then decides on the allocation the College will obtain. TTC is officially dependent on the Ministry of Education's budget which, in turn, is managed by the Under-secretary for Girls' Education at the Education Ministry. This government fund is then operated by the Department of Administrative and Financial Affairs under the supervision of the Dean and Deputy Dean for this department. The analysis of the interviews (see Section 6.3) showed that there is a clear shortage of funds to support all TTC's operations and therefore, the Dean and her Deputies run a local shop to increase their funds. This study recommends that, to avoid the funding shortage, TTC should accept contributions from the private sector (e.g. private schools) in order to encourage them to participate in developing the lifecycle of education when they benefit from employing TTC graduates.

Moreover, the analysis of both the interviews and the focus groups illustrated that there were a number of requests to the financial affairs department to reward staff and set up training courses, to develop a Local Area Network for computers and telephones, to set up multimedia facilities in classrooms, and to update ICT equipment and software applications. The main reason for the funding shortage is that the Deputy of Administrative and Financial Affairs is concerned only with the short-term management of the administration and the finances and does not care about finding alternative sources of funding. Instead, the department operates in a traditional way regarding the exchange of information, which takes much effort and cost, and is too busy with unimportant paperwork. Therefore, it is important for the manager of administrative and financial affairs at TTC have the professional skills to manage information and finance effectively, as well as searching for other sources of funding. Hence, this study agrees with Al-Sheheri (2003) when he recommended that the private sector should be encouraged to offer donations or funding to all levels of education and, in addition, to contribute to research projects in the field of education.

From the discussion above, TTC needs to establish a strategic policy related to administration and finance that will give heads of department and supervisors guidelines for achieving TTC objectives in both the short and the long term. Moreover, TTC should provide the financial and administrative department with qualified and highly skilled staff to operate and manage both the information process and financial resources effectively. In addition, the mission, objectives and strategic policy of the Student Office should be established carefully; this should depend on the users' requirements, not only for the short term but also for long term. A Student Office at TTC would help to improve the information processes and the exchange of information among TTC departments and students; it would also aid in integrating information and avoiding duplication, offer a quick response to students' requirements, and improve the overall control of information from its gathering, organising and retrieving, to its archiving. Therefore, a Student Office should be provided with professional staff with ICT skills and equipment in order to help obtain information from accurate sources; organise and store it in appropriate media; retrieve it in the shortest time and with the lowest cost and effort; and present it in good condition to the students or staff. Moreover, it is important for the Middle Management Committee to allow all Colleges to accept contributions from the private sector in order to encourage its participation in developing the cycle of education, particularly with regard to the education of girls.

Records management can play an important part in information management because it deals with all types (either hard or soft records) of information organisation. The main objective of records management is to ensure that all records are correctly handled during their creation, reception, indexing, usage, storage, short- and long-term retention, and disposal. Therefore, records management can reduce the overall cost to the organisation by avoiding duplication, improving efficiency by decreasing retrieval time, maintaining control over what is held, and ensuring that all historically significant records are protected for permanent use.

The interview analysis (see Section 6.3) and the focus group analyses (see Section 6.4) illustrated that the major problems facing TTC include the rapid increase (by up to eight times) of records; different types of media storage; the lack of a proper indexing system which means it takes time when searching for and/or retrieving information; a lack of training related to records management; the absence of back-up records; and unwanted records that have been stored in cupboards and drawers which might be affected by insects and mice (i.e. in an improper environment). These problems are related to the fact that operational staff do not have sufficient skills in managing records; they also do not have time to attend training courses. Furthermore, some operational staff believe that attending courses is a waste of time and effort. In addition, heads of department deal with unwanted records as they see fit as TTC does not have a clear plan for records management.

The observation analysis (see Section 6.5), as seen in Table 6.2, illustrates the duplication of paper-based information which is stored on shelves in a wooden cupboard. Some of the files have labels on the outside bearing the name of the file and the year, some of these labels were written by hand in different colours and in different directions, and some of the files opened from right to left while the rest opened from left to right. This is because the Dean, the Deputy Deans and Heads of Department are responsible for creating files according to their particular roles and experience. This leads them to create different files in different offices related to the same issue. As a result, staff time and effort is wasted in indexing, money is wasted in copying information, there has been a rapid increase in the number of records and many are duplicated and there is a lack of integration between records that leads to difficulties in finding completed records on specific issues.

Moreover, the observation analysis showed that there were ten copy machines scattered throughout departments and operational offices. This means it is easy to duplicate records but leads to difficulties in managing them. In addition, all departments have to store a large amount of copy machine paper in the offices to support their requirements; this takes up more storage space. Moreover, some record files, which had limited use but were still stored in the offices, were created every year. This is related to the lack of records management skills, leading to staff creating records in their own way. In fact, the problems above are related to the lack of a standardisation policy in creating and maintaining the records; this, in turn, is a result of the absence of a strategic policy related to records management. Therefore, this study agrees with Sprehe (2005) who noted that:

> *"many organisations believe that they must adopt good records management as part of their essential infrastructure for the basic reason that keeping good records protects the organisation from harmful damage and ensures regulatory compliance. Risk management by itself is an inadequate rationale for enterprise-wide records management because it is essentially a defensive strategy".*

The analysis of the questionnaires (see Section 6.6), illustrated in Table 6.25, shows that the majority of academic staff (78%) and operational staff (89%) agreed that centralising information would affect the efficiency of TTC. There are a number of factors that may contribute to this impression, including: it would lead to standardisation and good overall control of records from their creation to their storage or destruction; it would help to avoid duplication and reduce the number of paper files; it would reduce time, cost and effort spent in accessing and retrieving information; and it would help to prevent records from coming to harm. Therefore, it is a vital for TTC to establish a Record Centre with clear objectives and a master plan. This will help to improve, not only services, but also the integration of information, the cost of storage, the control of the overall growth of records (inactive and semi-active) by avoiding duplication, it will ensure that records are kept securely in a proper environment, that they are easy to access when they are needed, and will help in getting them back quickly in the event of a disaster. TTC should provide a Record Centre with qualified and highly skilled staff who can manage and operate records. This study agrees with work carried out by The University of Texas Medical Branch

(2007) which stated that a Record Centre provides departments with a cost-effective method of storing inactive records in paper, electronic and microfilm formats.

8.2.3 Human Resources

People play an important role in any organisation and constitute one of the main elements of the overall resources which can affect the success of the organisation. A well-motivated, well-trained, and loyal staff can make an organisation a top leader, by making it financially strong and efficient. It is important for TTC to create and maintain the work environment so that people feel comfortable and have no difficulty in working as a team. Therefore, TTC should show concern for its human resources by offering good training and education courses in order to satisfy the needs of its staff since staffing, training and users' needs are the main elements of human resources at TTC.

The Dean, Deputies, Heads of Departments and Supervisors (see the analysis of the interviews in Section 6.3), as well as academic and operational staff (see the focus groups analysis in Section 6.4), pointed out that TTC has a clear shortage of operational staff, particularly staff with skills in ICT and records management. This problem exists because TTC does not have its own staffing system and new staff can only work in line with the staffing procedures in the region found in the General Management for College Affairs. These staffing procedures take a long time, and create a great deal of paperwork and effort on the part of TTC. Unfortunately, some of staff applications have been refused because TTC has a limited budget; furthermore, TTC has sometimes been supplied with unqualified staff. Therefore, TTC should have its own staffing system to ensure that departments have the right people in the right place with the right skills in order to meet their objectives. This study agrees with that of Carlson and Connerley (2003) when they established the Staffing Cycle Framework (SCF). They described it as a sequence of decisions that included choosing an individual to enter the workforce and an organisational decision-maker filling a position, through to matching an individual to a position, to the individual or the decision-maker deciding to end that match.

The Dean and Deputies (see the interview analyses, Section 6.3) complained that current staff (both academic and operational) had been offered insufficient training courses related to ICT and records management. Moreover, some Heads of Department stated that most academic staff attended training courses in TTC related to ICT but gave up after the first lesson. Furthermore, some did not attend training courses because they perceived them to be of no benefit if they were not able to practise what they had learnt. In line with this, Table 6.7 (the questionnaire analysis, shown in Section 6.6.2) confirmed that only a small proportion of academic staff (7%) and operational staff (5%) had learned to use computers by attending TTC training courses. The main reasons for this is that the communication between the instructor and trainees is poor because they use closed-circuit television and so it is difficult to follow instructions; they also lacked a basic knowledge of computer equipment and how to use it, together with a lack of familiarity with computer terminology. Therefore, it is important for TTC to evaluate its current training system by setting up criteria for evaluating and improving these training courses by providing qualified instruction with useful materials conducted at a proper place and at a suitable time.

In addition, TTC should offer trainees the incentive of obtaining some personal benefit from attending such courses; in other words, keeping the staff satisfied should be a priority. This study agrees with Juang *et al.*'s research (2007) when they said that training aims should include specialist technologies for employees, and skills and knowledge development. Training should change attitudes, provide motivational education and improve willingness to work. Moreover, Juang *et al.* outlined three levels of training: the hierarchic level, which includes managing; the supervising level, and the operating level.

MIM Stage 2 (see Section 7.2.2) summarised a number of requirements necessary to improve human resources. These included increasing the number of academic, operational and ICT staff; providing training courses, particularly in ICT and records management; utilising training in the right place with a suitable instructor at the right time and using appropriate teaching methods; providing motivation and rewards for attending training courses; and exchanging knowledge and experience among staff. So, it is a vital, not only to provide TTC with qualified and professional staff according to the requirements of departments, but also to improve the ICT skills of current staff. The Middle and Lower Management Committees at TTC should develop a clear strategic policy related to human resources in both the short and the long term. In this, the study agrees with Juang *et al.* (2007) who asserted that training policy should include education, training and development. In accordance with the concept of life-long learning, employee training programmes need systematic planning and proper course design. They also pointed out that education must focus on the potential needs of the organisation and, through long-term training, helping the individual to gain general knowledge. Training should emphasise the immediate needs of the organisation and help the individual to obtain professional knowledge according to the concept of "learn now and apply immediately." Development means to expand the ideas and increase the ability as a whole through long-term development.

The second part of MIM (the evaluation) declared that the Middle and Lower Management Committees at TTC should evaluate the human resources system. This evaluation should include a needs evaluation, a formative evaluation and a summative evaluation. In addition, these committees should set up criteria for evaluation with the aim of improving performance and efficiency, satisfying users' needs thus leading to job satisfaction, and fulfilling TTC's objectives. These criteria should be based on validity, reliability, sensitivity, utility and usefulness (see Section 7.3).

8.2.4 ICT Resources

All organisations apply ICT to support information processing tasks by building an integrated information resources system. ICT should include software applications to store and retrieve information, hardware to run software applications, and a network that help to transfer information inside or outside organisation. In addition, people can be a powerful element in ICT so information professionals should have both technical and organisational knowledge to guide decisions about how technologies can solve an organisation's problems. ICT resources should support the goals of all systems and should direct systems on how the organisation must run their functions and activities.

MIM Stage 2 and the rich picture (see Section 7.2.2) indicated that there is a lack in the current information system related to ICT resources. This includes the following: the lack of a LAN and a telephone network; poor ICT infrastructure; lack of hardware and software equipment; and the lack of Internet services. These problems are related to the absence of a strategic policy related to the ICT infrastructure and therefore TTC should establish and improve its ICT infrastructure at a strategic policy level by developing clear objectives and plans. In addition, ICT policies should be established to give the Lower Management Committee guidelines and a framework to inform the use, operation and maintenance of the ICT infrastructure. This study agrees with that of Stewart (2006) when he stated that many organisations invest heavily in ICT to improve competitiveness and profitability. However, many of these organisations do not benefit from ICT and yet they are dissatisfied with their ICT investments; this dissatisfaction is the result of a lack of strategic ICT planning. However, it is important for TTC to determine the needs of both departments and staff in order to support them in using their knowledge to carry out their work sufficiently well. This study thus agrees with Orna (2004) when she stated that:

> *"ICT is always considered after information content, information use, and the people who use information. The sequence is a deliberate choice, because it is in a logical order. We have to know what material we want to work on, and what we want to make with it, before we can decide what are the right tools for the job".*

MIM Stage 2 and the rich picture showed that information overload is a major problem at TTC; this results from a lack of integration between information resources because there is duplication of the same information in both paper and electronic files which takes time and effort on the part of staff. This is related to an inability in determining the requirements of departments and a lack of information professionals in database applications to integrate information; it is also related to insufficient hardware to run such applications and a network to transfer information. However, ICT can not manage information on its own but it can provide maximum access to information to help staff gather, create, access, store and retrieve information. Information professionals can help to manage, organise, operate, decide on and solve technical and soft problems related to managing information resources from their creation, indexing, storage, retrieval and disposal. In other words, information professionals should have high-level qualifications, training, experience and ICT knowledge and skills. This study agrees with that of Siskos *et al.* (2007) when they stated that information professionals should have knowledge of database applications, e-mail, the Internet, network technologies, hardware and software installations, presentation software, spreadsheets, word processing, Windows and programming, as well as basic skills, such as expressing themselves verbally, a knowledge of arithmetic, critical thinking, and sensibility in the detection of problems, etc.

MIM Stage 2 and the rich picture (see Section 7.2.2) outlined a number of problems related to the issue of security. These included: using unlicensed software applications; no back-up and lack of planning to destroy unwanted files; no plan for security systems and anti-virus applications; ease of access to staff PCs; no plans in case of disasters; and a lack of a secure environment for information. This is also related to the absence of a strategic policy related to security issues, a lack of funding, and the fact that the Dean and the Deputies think only of the short rather than the long term. Consequently, the Lower Management Committee should understand the importance of security issues to prepare TTC in the case of any problems caused by human error, technical mistakes, or disasters in both the short and the long term. This study shows that security systems can play a vital role in information systems that aim to provide physical security, soft security and data security (see Section 7.2.4.2). Therefore, a security system could prevent TTC information from coming to harm in the case of a disaster by establishing a clear master plan for recovery. This study thus agrees with Drevin *et al.* (2007) when they outlined the six fundamental objectives of ICT security awareness. These include: (1)

maximise the integrity of data; (2) maximise the confidentiality of data; (3) use electronic communication resources effectively and efficiently; (4) maximise the availability of hardware and software; (5) maximise the acceptance of responsibility for actions; and (6) maximise the use of resources.

However, the study demonstrated that it is important to establish a clear strategic policy related to ICT resources, which are concerned with the short and the long term, and to set up criteria for evaluating and/or measuring achievement. This can be achieved by establishing an ICT resources system which aims to achieve a better exchange of information and communication between TTC users, to integrate databases, and to prevent information from coming to harm. This can be achieved by developing and operating ICT databases and security systems. Lower management levels should develop ICT resources after obtaining the agreement of middle management while lower and operational management levels are responsible for their operations (see Chapter 7, Table 7.4). The ICT infrastructure and databases should be integrated, easy to use, and should satisfy the needs of departments and users. Establishing a Help Desk at TTC could provide a single point of contact for system users, could prevent and solve problems at a low cost in a limited time, whether these problems were the result of technical or user error (see Section 5.3.1.5). This study agrees with González *et al.* (2005) when they pointed out that:

> *"a Help Desk serves an important role in an information technology department by providing the primary point of contact for clients to contact analysts to help them resolve problems with information technology including hardware, software, and networks".*

This study has outlined both technical and social issues. Technical issues covered ICT resource systems, which considered ICT systems, database systems and security systems, while social issues looked at human resource systems, which examined staffing and training systems and user needs systems. MIM was concerned with the balance and integration of ICT and human resources, which contributed to the multi-methodology used in this study. ICT resources aim to improve the performance and efficiency of the system while human resources aim to satisfy users' needs that lead to job satisfaction and fulfilling efficiency objectives. This study agrees with that of Kunda (2001) and Mumford (2003) when they stated that the human subsystem and the technical subsystem should interact with each other in an integrated manner to produce work systems which are both technically efficient and have social characteristics; this leads to higher job satisfaction.

8.3 Taking Action

In order to formulate an information system at TTC, it is important to consider the holistic approach to aspects such as integrated management, human issues and technical requirements, related to the TTC context. There are four types of possible change that need to take place in order to achieve the full integration of information systems at TTC; these are structural, procedural, policy and human activity changes.

8.3.1 Structural Changes

To fulfil the objectives of an information system, it is vital to establish a Student Office, a Help Desk, and a Records Centre. The Student Office should be a part of the Student Affairs area, under the supervision of their Deputy, in order to improve communication between students and TTC. The Student Office could be described as a central information point where all TTC departments can gather information about students to use this information when needed. The Student Office could be useful in many ways as it could use multiple delivery channels such as telephone, fax, post, e-mail or the Internet.

There are several advantages of establishing a Student Office at TTC. These include: it would be easy to obtain and retrieve integrated information; it would save time, costs and effort in obtaining information; it would enable the standardisation of services and products across all channels; it could support multiple lines of processing; it would maximise opportunities to serve students and staff, and help decision makers to do routine jobs; it would provide real time statistics and reporting; and it would help to build a good relationships between TTC and their students.

The Help Desk should be a part of the department of Administrative and Financial Affairs under the supervision of their Deputy. It would aim to provide technical support to students and staff in order to resolve problems related to ICT and human activities. The main advantages of establishing a Help Desk are: it would give quick answers related to technical problems; it would offer first-line incident support; it would aid in using ICT; it would offer management reporting on the quality of ICT services; it would reduce the time taken to resolve incidents; it would identify problem areas more effectively, and would satisfy users' needs.

The Record Centre should be a part of the department of Administrative and Financial Affairs under the supervision of their Deputy and would aim to provide TTC departments with the cost-effective storage of inactive and semi-active records in both paper and electronic forms. The main advantages of establishing a Records Centre are: all records can be managed by records coordinators and can be stored, organised, accessed and retrieved at any time; this would free office space for other uses by moving inactive and semi-active records to the Records Centre and free staff to carry out other important tasks; it would provide a secure environment for inactive records by storing them in a properly and professionally maintained facility to ensure their continuity in the case of disasters; and would provide historically, legally, administratively and fiscally relevant documents for students and staff.

8.3.2 Procedural Changes

Creating an information system at TTC requires a number of procedural changes to take place via a number of meetings of the High-level Management Committee. The meetings should be increased to at least twice every year to ensure that the overall goals of the education system have been achieved. The Middle Management Committee should meet at least four times a year to ensure that College goals are accomplished effectively and efficiently. Furthermore, the Lower Management Committee should meet every two weeks to make sure that all specific tasks are achieved while the Operational Control Committee should meet weekly to make sure that all day-to-day tasks are carried out successfully and professionally. The main reasons for increasing the number of meetings are: to improve the efficiency and effectiveness of the processes; to facilitate the identification and resolution of problems that may arise during the processes; to report to upper management about the current situation and to get support when necessary; and to improve the communication between each hierarchical level.

The Middle and Lower Management Committees should outline the aims and objectives of the Student Office, the Help Desk, and the Record Centre in order to achieve the College's objectives. Moreover, it is vital to provide the Student Office, the Help Desk, and the Record Centre with appropriate environments, professional staff and proper equipment so that support is available when it is needed. The Lower Management Committee should establish the procedural frameworks of the Student Office, the Help Desk, and the Record Centre to make sure that they achieve their objectives by setting up criteria to measure success. The Operational Control Committee should carry out framework procedures and all day-to-day operations so that they are applied in a successful and professional way. Furthermore, the Operational Control Committee should be supervised by the Lower Management Committee and should obtain recommendations when they are needed.

8.3.3 Policy Changes

The Middle and Lower Management Committees are responsible for evaluating current TTC policies; they work hard to improve or develop policies which fit in with changes, particularly with regard to financial and administrative matters, records management and databases, ICT and security, training and staffing, and users' needs. Furthermore, the Lower Management Committee should establish policies for the Student Office, the Help Desk, and the Record Centre; they should also provide clearly documented guidelines to achieve TTC's objectives. The Operational Control Committee should apply these policies to avoid any errors that might arise during day-to-day operations, reporting any issues that are not covered by document policies. The Lower Management Committee should make sure that all policies are applied successfully and should offer support to the Operational Control Committee when needed.

8.3.4 Human Activity Changes

The implications of human activity changes for information systems at TTC are important. Human activity changes can be carried out through education and training; this aims to satisfy users' needs, to deal with the new information system, and to improve organisational culture.

All people in the TTC should be educated about the new information system and the services provided to them to satisfy their needs. The education can be carried out by way of a number of lectures according to the qualifications of participants, by identifying the reasons for change and informing them about any progress, while the training can be carried out through training methods such as lectures and seminars, and by on-the-job and on-line training that aim, not only to teach users how to use the information system, but also how to improve their ICT skills. Moreover, it is important to motivate staff to attend training courses, particularly if they get individual benefits, such as an increase in salary, better working conditions, and recognition from others.

Gaining users' views is vital throughout the development of an information system to avoid any negative attitudes such as non-use of the system. To achieve better attitudes it is necessary to use research techniques (such as interviews, questionnaires and focus groups, for example). The Student Office and the Help Desk will improve communication between TTC users by provide trained staff, and proper equipment and information.

Chapter 9

Conclusions and Recommendations

9.1 Introduction

The final chapter presents the main conclusions of the study, the recommendations regarding the design of an information system at TTC, and suggestions for further work.

9.2 Conclusions

The aims of this research were to study the methodological context in which recommendations for change could be made, and to apply an appropriate methodology (or multi-methodology) to the development of an information system for use in the Teachers' Training College in Makkah Al-Mukkaramah. This final chapter offers the main conclusions concerned with the objectives outlined in Chapter 1. These were as follows.

Objective 1: To investigate the use and limitations of established systems methodologies for application to the management of change.

To fulfil this first objective, Chapter 3 outlined a general background of methodologies and multi-methodologies, together with types of multi-methodology. It was found that a methodology could be defined as a collection of procedures, techniques, tools and documentation aids which help system developers in their efforts to implement a new information system. A multi-methodology, on the other hand, can be defined as a process of linking together or combining a number of different management science methodologies (such as SSM, VSM, ETHICS etc), possibly from different underlying paradigms, within a single intervention or piece of research. Moreover, there were four types of multi-methodology which included (1) Methodology combination: using two or more methodologies within an intervention; (2) Methodology enhancement: using one main methodology but enhancing it by importing methods from elsewhere; (3) Single-paradigm multi-methodology:

combining parts of several methodologies, all from the same paradigm: (4) Multi-paradigm multi-methodology: as above, but using methods from different paradigms.

Objective 2: To review the systems literature to provide an insight into the problem issues.

To fulfil this objective, Chapter 4 presented an overall description of Systems Thinking, 'Hard', 'Soft' and 'Critical' System Thinking, SSM, ETHICS and VSM. It was found that system thinking is a framework for investigating a problem, looking to the system as a whole, understanding its parts, and examining the relationships between the parts of the system. Systems thinking displays three different kinds of system approaches: 'hard systems thinking', 'soft systems thinking' and 'critical systems thinking'. In addition, SSM, ETHICS and VSM were introduced. This part included a definition and an historical overview, philosophy and theory, stages, and features and weaknesses of these approaches. It was found that SSM aims to examine problem situations in a way which will lead to decisions concerning actions at the level of both 'what' and 'how'. ETHICS aims to design a new system with the dual objectives of improving job satisfaction (the social system) and work efficiency (the technical system). VSM, on the other hand, can be used to diagnose organisational problems, but was principally used in MIM to design new organisational structures and processes.

Objective 3: To develop a novel systems-based multi-methodology to accommodate the change processes at Teachers' Training College in Makkah Al- Mukkaramah.

To achieve this objective, Chapter 5 offered the definition and an historical overview, the philosophy and theory, and stages of the MIM. It was found that MIM aims to explore different worldviews relevant to a real-world situation and contrast these views in a process of debate (SSM); to improve job satisfaction (the social system), work efficiency (the technical system), cultural support and political approval (ETHICS); and to use the cybernetic principle of viability to design new organisational structures and processes (VSM). Therefore, MIM combines a functionalist paradigm (VSM) with an interpretive paradigm (SSM and ETHICS). MIM can also be classified as a pluralism Multi-methodology. It was found that MIM comprises two main strands: process and evaluation. The process-oriented strand consists of five stages: planning, analysis, design, implementation and maintenance. Evaluation, however, consist of needs evaluation, formative evaluation and summative evaluation which run in parallel with process-oriented stages.

Objective 4: To complete an information audit in the Teachers' Training College in Makkah Al- Mukkaramah.

This objective was achieved by using MIM, which was developed in Chapter 5. Five methods were used to collect primary data sources compatible with the structure and culture of the TTC. Chapter 6 described the analysis of the primary data sources including, firstly, document analysis. This aimed to provide a general background of the TTC environment and was a useful starting point for analysing the current situation, as well as providing a sound overview of the uses of the TTC system. Secondly, semi-structured interviews were used to understand the experience of other people; they also provided access to the context of people's behaviour which would probably not have been accessible using other techniques. Thirdly, the aim of the focus group was to gather more in-depth qualitative data in order to clarify and add meaning to the interviews, as well as exploring people's opinions, attitudes, beliefs, values, discourses and understanding of things as valid in their own right. Fourthly, an obtrusive observation was used to understand and explore the current processes and uses of the information system by watching, describing and analysing. Finally, questionnaires were used to collect quantitative data from a large number of people in a relatively short period of time; these also allowed them to express honestly their opinions relating to information system services and resources, as well as to their own information use behaviour. It was found that these five methods could express the problem situation from different angles in order to give an holistic view and in order to build the Rich Picture.

Chapter 7 applied MIM to design an information system in TTC. The aims and objectives of the development of an information system at TTC, established in the planning stage, included six steps: to develop a strategic plan; to forecast information needs; to establish the aims and objectives of the project; to produce the project plan; to secure financial resources; and finally, to seek agreement from the upper-level managers of the organisation. The second stage was to analyse the current problem situation from different viewpoints; this also included three steps: finding out the problem (the problem situation unstructured); creating the Rich Picture (the problem situation structured); and extracting problem themes. The third stage was to design an information system that included five steps: the root definition, the conceptual model, the comparison of the model to the rich picture, the use of VSM to define System 1 to System 5, and the use of VSM to define the whole system. The fourth stage, the implementation of the information system at TTC, included four steps: planning, testing, training and changeover. The final stage in the process-oriented strand was the maintenance of the information system at TTC. The aim of this was to ensure that the infrastructure and functions of the information system were at a satisfactory level of reliability and control in order to enable operational objectives to be achieved and to document the modification of the information systems over time.

However, the evaluation strand was in parallel to the process-oriented strand which aimed to provide the most suitable and reliable information to middle and lower management about the information system at TTC. The result of Chapter 7 was a novel, wider information system at TTC which consists of four systems: a strategic policy system, an organisational resources system, a human resources system, and an ICT resources system. The strategic policy system constitutes the initial stage that will help to achieve all other systems in the model. Following the implementation of the strategic policy system, organisational resources can be implemented and, when these two systems have been implemented, the human resources system can be put into practice. Subsequently, the ICT resource systems can be organised. Feedback can help to improve and maintain each system, while monitoring, controlling and conducting performance management can help to improve and measure performance in the overall model.

Objective 5: To establish a roadmap for further work.

This chapter (Chapter 9) offers recommendations (below) that follow from this study and establishes the potential for further work. Although a detailed plan is not given, an outline of how further studies could develop, implement and evaluate an information system for any Teacher Training College in Saudi Arabia is described.

9.3 Recommendations

9.3.1 Strategic Policy

This study showed that it is clear that TTC needs to develop a strategic policy system which aims to ensure that there is a strong and flexible information infrastructure that can support all TTC processes in satisfying their objectives. Consequently, strategic policy at TTC should be concerned with a mission and objectives, resources (financial, human, ICT and information), and the external environment (the Saudi culture, Saudi regulations, Saudi Arabia's Development Plans, and The Ministry of Education's Ten-Year Plan in Saudi Arabia). Strategic policy should include the following strategies: information, policy, administrative and financial, records management, staffing and training, user needs, ICT, database, and security strategies. It is recommended that TTC needs to develop a clear strategic policy, particularly one containing strategies related to organisational resources, human resources and ICT resources. These strategic policies should be integrated and work together within a general framework to achieve TTC objectives. In addition, the strategic policy should be developed by the Middle Management Committee and should obtain approval from the High Management Committee to allow it to gain support when needed, in order to operate and achieve TTC objectives. Therefore, the strategic policy aims to provide plans, laws, regulations and guidelines to carry out the demands of TTC, authorised by the Middle Management Committee, to support the objectives of the TTC in both the short and the long term. Furthermore, it is recommended that the number of meetings between the High and Middle Management Committee should be increased to at least twice every year to ensure that the overall goals of the strategic policy system have been achieved and to give support to Middle Management when it is needed.

9.3.2 Organisational Resources

This study found that TTC needs to improve its organisational resource system in order to achieve sufficient support for all its plans and operations. It is recommended that the administrative and financial systems should be improved and provided with highly skilled financial and management professionals to operate, manage and deal with financial resources and information processes. Moreover, the Department of Administrative and Financial Affairs should search for sources of funding and accept contributions from the private sector (e.g. private schools) in order to encourage them to participate in developing the life cycle of education from which they have benefited as TTC graduate students. Student Offices should be established at TTC with clear aims and objectives to improve information processes and also to exchange information between TTC departments and its students, to integrate information, to avoid duplication, to provide a quick response to student requirements, and to improve the overall control of information from gathering, organising, retrieving etc., to archiving.

It is recommended that a records management system should be established at TTC the aim of which is to manage any information captured either on paper or in electronic files from their creation, to their retention and until their disposal, in order to meet TTC's needs. Moreover, it is recommended that a Records Centre should be established at TTC to provide a secure environment that is a well-managed and cost-effective form of storage for inactive and semi-active records on paper and in electronic format.

Increasing the number of meetings between members of the Middle and Lower Management Committees would not only help to improve the relationships between members at the same level, but also between members at different levels. Therefore, it is recommended that Middle and Lower Management Committees should meet at least four times a year to ensure that strategic policies are accomplished effectively and efficiently.

9.3.3 Human Resources

It appears, from this study, that TTC needs to develop a human resources system in order to achieve better qualified staff with a range of diverse skills in order to provide users with high standards of service. It was found that the current staffing and training procedures at TTC take a long time, cause a great deal of paper work and effort, have a limited budget, and that TTC is supplied with unqualified staff. Therefore, it is recommended that TTC should have its own staffing and training system to ensure that departments have the right people in the right place with right skills to fulfil their objectives. This study also recommends that TTC should evaluate its current training system by setting up evaluation criteria and that it should also improve the training courses by providing qualified instruction with useful materials in a proper place at a suitable time. In addition, it is recommended that TTC should offer the trainees personal benefits from attending such courses.

Moreover, to satisfy users' needs, this study recommends that TTC needs to understand the needs of departments, simplify the process for accessing information, and provide new services with accurate information and quick response at the right time. This study believes that developing a Student Office will greatly help to satisfy the immediate needs of users. It is recommended that the Student Office should use suitable techniques such as questionnaires or focus groups to measure users' satisfaction.

9.3.4 ICT Resources

This study found that TTC needs to improve its current ICT and provide well-qualified information professionals. It should also establish a LAN and the use of Internet services, establish integrated database systems, increase electronic information resources, develop back-up and destroy unwanted files, develop a security system and provide an anti-virus application, establish plans in the case of disaster, and provide a secure environment for information. Therefore, it is recommended that TTC needs to develop an ICT resources system in order to achieve a better exchange of information and communication among TTC users, to integrate databases, and to prevent information from coming to harm. Moreover, this study recommends establishing a Help Desk at TTC with clear aims and objectives that can provide a single point of contact for system users; can prevent and solve problems at a low cost in a limited time, whether these problems are the result of technical difficulties or user error; and offer assistances as needed. The Help Desk should offer access to many different sources of information and knowledge, including files (hard or soft), databases, ICT, and the knowledge of Help Desk staff. The Lower Management Committee should establish criteria to measure the success of this Help Desk in achieving its objectives by using suitable techniques such as questionnaires or focus groups for evaluation.

The study recommends that using Internet services as a communication channel between TTC and its users is vital. Therefore, establishing Internet services in classrooms can be a great help in enhancing educational operations. In addition, it is recommended Internet services should be provided to the library and department offices to help in exchanging information and access to remote information sources. Moreover, the study recommends increasing the number of computer labs with Internet services to help students gain access to electronic resources and to offer them facilities at a low cost.

This study recommends that the Lower Management Committee and the Operational Control Committee should meet every two weeks to make sure that all specific tasks are achieved. It is recommended also that the Operational Control Committee should meet weekly to ensure that all day-to-day tasks are carried out successfully and professionally. The main reasons for increasing the number of meetings is to improve the efficiency and effectiveness of the process, to facilitate the identification and resolution of problems that can arise during the process, to report to upper management about current situations in order to get support when needed, and to improve communication between each hierarchical level and among hierarchical levels.

9.4 Contribution of this Thesis to Wider Knowledge

This study presents, in context, a detailed review of the literature related to system theory, methodology and multi-methodology, system thinking, Soft Systems Methodology (SSM), Effective Technical and Human Implementation of Computer-based Systems (ETHICS), and the Viable System Model (VSM). The intention was to contribute to a better understanding of methodological systems approaches in order to innovative a new multi-methodology for the development of information systems.

A new multi-methodology (the Mandoora Iterative Multi-methodology: MIM) was developed to explore different worldviews relevant to a real world situation and then contrast them in a process of debate (SSM, Mode 1). This is in order to: improve job satisfaction (the social system); improve work efficiency (the technical system); gain cultural support and political approval (ETHICS); and apply the cybernetic principle of viability to design new organisational structures and processes (VSM).

MIM combines a functionalist paradigm (VSM) with an interpretive paradigm (SSM and ETHICS). Therefore, MIM is classified as a pluralism Multi-methodology because it uses two different methodological approaches (SSM and ETHICS) and one model (VSM) in combination, and respected the different strengths of the various strands of systems thinking. MIM's classification has been built according to Mingers and Gill (1997) and Reed (1985) when they described four developmental strategies for management science. These were: isolationism, imperialism, pragmatism and pluralism. In addition, Mingers and Gill (1997) define pluralism as interpreted in the broadest sense of the use of different methodologies, methods and /or techniques in combination. In addition, Jackson (2001) indicates that SOSM established 'pluralism' as central tent of critical systems thinking. It recognized that pluralism could be achieved based on methodologies (hard, cybernetic, soft, etc.) that were developed from more than one paradigm. Table 5.1 (Chapter 5) explains the philosophical assumptions of SSM, ETHICS, VSM and MIM, according to the ontology, epistemology and axiology adapted from Mingers (2003). Therefore, MIM is an integration of the systems approaches used to understand and intervene in an existing informatics system in a purposeful, semantic manner.

The evaluation strand can run in parallel with all stages of MIM, while other methodologies, such as the ETHICS methodology, are only concerned with evaluation at the end of stages, or do not care at all with evaluation (as in the cases of SSM and VSM). There are three stages of evaluation with MIM: needs evaluation, formative evaluation, and summative evaluation. Firstly, the needs evaluation is conducted in the early stages of MIM (planning and analysis); this aims to establish planning for short- and long-term evaluation to improve organisational performance and efficiency. Secondly, formative evaluation is conducted at the design stage and in the early steps of the implementation stage. This is a process of ongoing feedback on performance which aims to identify problems that arise during the design, thus allowing for modification. Finally, a summative evaluation is conducted at the end of MIM (i.e. the implementation and maintenance stages); it focuses on the value or worth of the outcome of the system and is designed for the purposes of accountability and/or continuation.

The major advantages of MIM are that: it can deal with complex problems and is heavily involved in people interaction; MIM is concerned with soft issues such as social and human activities, together with hard issues, such as computers and networks, and with environments, such as cultural and political environments; MIM utilises the knowledge of people who essentially work with the system, as well as the users who benefit from it; it improves the quality of the final system; MIM can help to develop a new or improved information system in a large- or medium-sized organisation. The main limitations of MIM include: it takes time, effort and money to implement; it also requires professional skills for its application.

The Teachers' Training College (TTC), like any women's government organisation in Saudi Arabia, is supervised by men (the Middle and High Management Committees). It has a complex problem situation related to information issues such as management, technology, policy, security and human problems. MIM, applied at

TTC, has investigated the current problem situation regarding the aim to design and implement an information system. This study used five soft techniques (document analysis, interviews, focus groups, questionnaires and observation) to consider the people's perspective and put forward their opinions concerning the design and implementation of the final information system. The major strength of using the five soft techniques mentioned above is that every technique can express the problem situation from a different position. The researcher used her supervisory experience and guidelines, as well as personal relationships with the senior management at TTC, to integrate these five techniques in order, first, to express the real world problem; second, to give an holistic view; and third, to build the Rich Picture.

This is the first study of its kind that depends on the collective strength of SSM (Mode 1), ETHICS and VSM to innovative a new multi-methodology for the development of information system. In fact, SSM, ETHICS and VSM were developed in the 'western world' and used as a tool to develop or design information systems by considering their use in different cultures. Thus, MIM can be used to develop or design information systems in any medium or large organisation, not only in the 'western world' but also in the multi-cultural of the developed and developing world.

9.5 Areas of Further Work

A number of further studies could investigate TTC in more detail. These include:

- Developing and implementing a strategic policy system;
- Developing and implementing an organisational resources system;
- Developing and implementing a human resources system;
- Developing and implementing an ICT resources system;
- Establishing, implementing and evaluating the Student Office;
- Establishing, implementing and evaluating the Records Centre;
- Establishing, implementing and evaluating the Help Desk.
- Providing the summative evaluation of the work described in this thesis to arrive at an impact analysis on the use of MIM and its recommendations.

At more general level, this study could lead to further investigation related to developing a national information system for all Teacher Training Colleges in Saudi Arabia by adopting the Mandoora Iterative Multi-methodology which incorporates components of Soft System Methodology, Effective Technical and Human Implementation of Computer-based Systems, and the Viable System Model.

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Appendix 1

Department of Information Science
Loughborough University
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Loughborough University

Interview Questions

Date: / / *Time:* ☐ *AM* ☐*PM*

Name: .... *Department:* ....

Type of interviewee : ☐*Heads of department* ☐ *Operation staff*

Part I: General Background

1. What are the aims of the department (TTC)?
2. What are the current functions of the department?
3. What are the activities you undertake towards achieving these functions?
4. How are these activities achieved?
5. Is your activities related to other activities in TTC?

Part II: Current Information System

6. Who is formally responsible for the records management at the department such as created, store, or disposal martial?
7. How long have you been using your current operating system?

Part III: Current Problem

8. Are their any problems related to:
    - Information and records management
    - Information Communication Technology (Hardware and Software)
    - Information security
    - people

Part V: Suggestions

8. What are your suggestions to wards improve current information system related to:
    - Information and records management
    - Information Communication Technology
    - Information security
    - people
9. What is your opinion about Centralize of information and Help desk at TTC?
10. Do you have any suggestions you want to add?

Appendix 2

Department of Information Science
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Loughborough University

Uses of Information Communication Technology Questionnaire at the Teachers Training College

The present research aims to develop an information system at TTC in Makkah Al-Mokkarmah, Saudi Arabia. This would help staff and student to access information thy required easily and more effectively.

Instructions:

Please read the question carefully, look at the given options then answer by putting a " 3" in the appropriate boxes.

Part I: General information

Research Use

1. Which one of the following are you

1 ☐ Academic Staff 2 ☐ Staff 3 ☐ Student

2. In which department are you now? *(Tick one please)*

1 ☐ Holy Quran and Islamic Studies 2 ☐ Arabic Language and Social Science
3 ☐ Science and Math 4 ☐ Home Economics and Art
5 ☐ Children Care 6 ☐ Education and Psychology
7 ☐ Administrative Affairs

3. What is your highest academic qualification?

1 ☐ Secondary 2 ☐ Diploma 3 ☐ Bachelor
4 ☐ Master 5 ☐ PhD

4. Do you have a computer at home? 1 ☐ Yes 2 ☐ No

If No go to Part II

5. How did you learn to use a PC? *(Tick more than one if appropriate)*

1 ☐ On my own 2 ☐ As part of my study 3 ☐ Friends
4 ☐ Private courses 5 ☐ TTC training 6 ☐ Others please state:.......................

6. How long have you been using a PC? *(Tick one please)*

1 ☐ Less than 1 year 2 ☐ Less than 3 years 3 ☐ More than three years

Part II: Current Information Systems

What is your impression about the following?

	1. Excellent	2. Acceptable	3. Not good	4. Not found	
7. Staff dealing with your require	☐	☐	☐	☐	☐
8. Information process	☐	☐	☐	☐	☐
9. Time to process the information	☐	☐	☐	☐	☐
10. Exchange information between departments	☐	☐	☐	☐	☐
11. Computer centre at TTC	☐	☐	☐	☐	☐
12. IT skills at operation staff	☐	☐	☐	☐	☐
13. Training courses at TTC	☐	☐	☐	☐	☐

14. Comment and Observations in the current Information Systems

....
....
....

Department of Information Science
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Loughborough University

Part III: Current Information Technology (IT) Skills

How well do you understand the following?

	1. Reasonably well	2. Have used	3. Difficult to use	5. Not at all	
Software Packages:					
15. Word Processing **(Microsoft Word)**	☐	☐	☐	☐	☐
16. Spreadsheets· **(Microsoft Excel)**	☐	☐	☐	☐	☐
17. Presentation software **(Microsoft Power Point)**	☐	☐	☐	☐	☐
18. Databases **(Microsoft Access)**	☐	☐	☐	☐	☐
Internet Services:					
19. E-mail	☐	☐	☐	☐	☐
20. Using Search Engine	☐	☐	☐	☐	☐

21. Comment and Observations to Improve (IT) skills ☐

....

....

....

Part V: Your Opinion

Indicate the extent to which you agree that each of the following will affects the efficiency of TTC

	1. Strongly agree	2. Agree	3. No opinion	4. Disagree	5. Strongly disagree	
22. Staff knowledge of English language	☐	☐	☐	☐	☐	☐
23. Access to internet services	☐	☐	☐	☐	☐	☐
24. Developing information strategy	☐	☐	☐	☐	☐	☐
25. Improve training	☐	☐	☐	☐	☐	☐
26. Centralizing of information	☐	☐	☐	☐	☐	☐
27. Developing computer network	☐	☐	☐	☐	☐	☐
28. Developing help desk	☐	☐	☐	☐	☐	☐
29. Improve communication between departments	☐	☐	☐	☐	☐	☐

30. Comment and Observations to Improve Information Systems ☐

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Thank you very much for your Co-operation

Appendix 3

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__Focus Groups Interviews Questions__

Date: / / *Time:* ☐ *AM* ☐*PM*

Department: ………………………….

1. **__Formal information process at TTC:__**

2. **__Department needs:__**

3. **__Existing problems:__**

4. **__Suggestions and opinion to improve the problem situation:__**

Appendix 4

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Obtrusive observation checklist

Date:……… Time:……….. Department or office name……………………………… Observer name………………………

1. **Physical surrounding**

Level……… Number of rooms…… Total room size:………

Number of tables……… Number of chairs…………….. Number of cupboard………..

Comments:……………………………………………………………………………………………

………

………

2. **Characteristics of participants**

People	Number	Attitudes	Skill and knowledge level	Current situation	People comments
Operation staff					
Academic staff					
lower management					

Comments:……………………………………………………………………………………………

………

3. **Information communication technology**

Type of media	Uses	Maintenance	Training	Current situation	Uses comments
PC					
Printers					
Local Area Network					
Fax					
Copy machine					
Local Telephone Network					
Search engine					
Website					
E-mail					

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Comments:..
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....
....

4. **Information resources**

Type of media	Creation	Indexing	Access	Storage	Retrieve	Uses comments
Files						
Forms						
Reports						
Books						
Copy machine paper						
Electronic files						

Comments in software application:..
....
....

Comments in pack up:...
....

Comments in information security:..
....

5. **Information process (internal or external)**

Appendix 5

Summary of Interviews with Dean and Deputes

Interview issues	Issues	Dean	Deputy DAFA:	Deputy DSA
General background	**Aim**	To promote the teachers scientifically, educationally and in terms of religion to teach at primary school.	To facilitate all issues such as administrative management, financial, staff affairs and academic departments.	To assist all concerns related to students including admission and registration, students' box appeals and students' problems.
	Functions	• Supervise all activities related to TTC • Provide information requested by Middle Management Committee • Apply Ministry of Education policy.	• Follow up administrative and financial affairs. • Manage issues related to the curriculum • Promote cooperation between departments • Provide reports.	• Assist students in improving their skills, knowledge and education • Link students with TTC management and education operation practices.
	Activities	Overall supervision of departments' activities.	• Receive and send documents among lower management committee members • Improve educational planning or examination tables • Tackle lack of academic staff • Provide annual report such as employees' annual report.	Manage and run activities to achieve the function such as: • Lectures and courses • Knowledge of competition • Workshops and fieldwork.
Current information system	**System and record management**	Conventional system depends on manual indexing to distribute and collect official matter between departments by using signature in special record books designed for these purposes. PCs in use since 2002.	Create files according to the job request such as departments' employees, general official letters, students, complaints, statistics, examinations and financial information.	Create files according to the job request such as admissions, registrations, students' box appeals, students' problems, general official letters, examinations and part-time students' details.
	Indexing file	Depends on the papers written at the beginning of each file. This contains: serial number of each document, date, document subject and document number. The documents in each file have been sorted by date.	As Dean's office indexing files.	As Dean's office indexing files.
	Responsible	Dean's office operational staff	Two secretaries	Secretary and staff department
	Established	1982 until now	Since 2002	1982 until now

Summary of Interviews with Dean and Deputes

Interview issues	Issues	Dean	Deputy DAFA:	Deputy DSA
Current problems	**Information and records management**	• Rapid increase in number of papers • Traditional processing to exchange information.	• Duplication of records • Records stored on Dean's office PC • Records take time to retrieve.	• Search information takes time and effort • Lack of storage space • Use of inappropriate storage space.
	Technology (Hardware and Software)	• No local area network • Lack of funds	There is: • PCs, telephone and fax • E-mail in Dean's office • Local area network and Internet services (recently).	• No telephone network between academic staff offices and upper management • Limited number of computers • Limited use of computer services
	Information security	• No information security planning.	• Information stored in archive, CD and floppy disk • There are pack up files in Dean's office and other departments.	• No pack up files.
	People	• Limited number of ICT staff • Lack of training courses related to ICT and record management.	• Academic and operation staff are trained • There is an institute for computers inside TTC • Limited number of operational staff against the jobs they have to do.	• Limited number of information professionals • Work overload.
Suggestions to improve current IS		• Increase number of staff • Reduce the routine for exchanging information • Create record centre • Develop local area network • Develop information centre and help desk.	• Expand use of Internet service • Use documented fax services.	Same as Dean stated.

Summary of Interviews with Heads of Departments and Supervisors

Interview	Question	Heads of Departments	Supervisor of Staff and Financial Affairs	Supervisor of Student Affairs	Supervisor of ICT
General background	Aim	Each department has its own aims and objectives.	• Gather staff information • Manage financial staff processes • Make annual statistical report • Provide departments with information.	• Manage students' information • Provide information services to students and departments • Make statistical reports.	Facilitate the TTC operation management which helps to store and retrieve information in a timely and specific way.
	Functions	Every department has particular functions related to their aims and objectives.	Creating and managing staff files.	Developing files for students.	• Providing training courses • Teaching computer subjects • Carrying out maintenamce.
	Activities	Academic lectures, workshops, field practice, research, seminars, exhibitions and discussion groups.	• Managing staff records • Managing staff financial issues • Making staff statistical reports.	• Managing students' record. • Managing financial students' issues • Making students' statistical reports.	• Lectures • Training courses • Providing maintenance services.
Current information system	System and record management	• Use wooden cupboard to store different files related to different subjects • The documents in their files have been organised by date received.	• The files are grouped into academic and operational staff • Number and name of the staff have been written on outside of the files • Others files related to different subjects and to different areas • The documents in their files have been organised by date received.		
	Indexing file	Each file has an index page, which has a serial number, date and the subject of the documents.	Same as Heads of departments.	Same as Heads of departments.	
	Responsible	Head of department and one or two academic staff.	Staff	Staff	ICT supervisor
	Established	Since 2002	2004	1998	1997

Summary of Interviews with Heads of Departments and Supervisors

Interview	Question	Heads of Departments	Supervisor of Staff and Financial Affairs	Supervisor of Student Affairs	Supervisor of ICT
Current problems	**Information and records management**	• Large amount of general official letters • Duplication of records • Delay in exchanging information • Rapid increase in number of files in the department.	• Lots of paper work • Lack of information management • Lack of time to update information • No back up files • No enough space for storing files.	• Duplication of students' information in computer and paper files • Uses traditional way of exchanging information from and to the departments • No enough space for all files at the offices.	
	Technology (Hardware and Software)	• No telephone network between departments and their academic staff • No use of ICT in the class.	• Lack of use of computer applications • Limited number of computers • Limited number of copy machines • No direct telephone line.	Same problems as for Supervisor of Staff and Financial Affairs.	• Lack of using original application software and training materials • Lack of funds.
	Information security	No information security planning.	No information security planning.	No information security planning.	No information security planning.
	People	There are difficulties in attending training courses. These difficulties include: Lack of basic knowledge to use computer equipment and its terminology, and lack of time.	• Limited number of staff • Limited training courses.	Same problem as for Supervisor of Staff and Financial Affairs.	Limited number of ICT staff and trainers.
Suggestions to improve current IS		• Develop strategic planning for information security • Use updated technology • Establish local telephone network • Use Internet services • Provide TTC with qualified staff particularly in ICT skills.	• Develop local area network • Use Internet services • Increase number of operational staff • Provide training courses.	Same as for Supervisor of Staff and Financial Affairs.	Same as for Supervisor of Staff and Financial Affairs.

Focus group summary

Focus group issues	Academic staff	Operational staff
Formal information process at TTC		The general process: • process at operational staff of the Dean's office. • process at operational staff of the Deputies' offices. • process at operational staff of the Heads of Departments' offices.
Department's needs	• use appropriate ICT in classrooms. • provide training courses. • establish educational multimedia centre. • provide PCs for all academic staff. • provide a copy machine in each department. • establish a local telephone network between academic staff offices and departments. • increase number of academic staff and motivation. • reduce paper work. • remove or destroy unwanted files. • offer new building with new services related to educational operations.	• increase number of operational staff with ICT skills. • increase number of PCs with Local Area Network. • use Internet services. • increase number of training courses. • use database management system. • decrease number of files. • use suitable environment to store information. • take out inactive files and destroy unwanted files. • reduce duplication of files.
Existing problems	• using formal communication inside TTC which takes time, effort and money. • duplicating the same information in different departments in different formats. • using manual index files. • difficulties in retrieving information. • lack of training courses. • lack of ICT equipment and services. • no multimedia services in classrooms. • no Internet services in the computer centre. • limited number of ICT staff.	• using traditional process of information which wastes time. • duplication of the same information in PC and files. • no back up files. • rapid increase of paper work and files. • lack of time for indexing. • limited number of operational staff. • no time for training. • limited number of PCs. • using official letters for formal communication which takes time and effort.
Suggestions and opinions	• use Internet services for communication between TTC and its students. • TTC management should evaluate information process at least every two years. • direct TTC into centralised information management. • provide TTC with (up-to-date) Local Area Network. with proper ICT (Hardware and Software). • Provide TTC with professional information. • Provide TTC with suitable training courses with motivation.	• establish integrated information system to help staff gain the quality information they need in a timely, flexible and effective fashion. • Reduce paper work between different levels of management. • use suitable files to store documents. • remove unwanted files to proper archive with proper environment. • remove inactive files from staff room to proper place at TTC to make access easy when staff need it.

Appendix 6

بسم الله الرحمن الرحيم

المملكة العربية السعودية
الرئاسة العامة لتعليم البنات
الإدارة العامة لتعليم البنات بمكة المكرمة
كلية إعداد المعلمات

عدد : ٨٦ /ط/م
التاريخ : ٢٣/١/١٤٢٣هـ
لفة : (٩)

الموضوع : الموافقة على إجراء بحث المواطنة/ فاتن بنت أكرم مندورة في كلية المعلمات بمكة المكرمة.

المكرمة الأخت/ فاتن بنت أكرم بن عبد الله مندورة المحترمة

السلام عليكم ورحمة الله وبركاته ....وبعد:

إشارة إلى خطابكم رقم / بدون / وتاريخ ١٤٢٢/١١/٢١هـ والمتضمن طلب الموافقة على إجراء بحثكم الذي تقدمتم به للحصول على درجة الدكتوراه بعنوان :

((إنشاء طريقة منهجية جديدة لإنشاء نظام معلومات يستخدم بكلية إعداد المعلمات بمكة المكرمة ، المملكة العربية السعودية))

بجامعة لقبرة بالمملكة المتحدة .

وقد تم عرض ذلك على مجلس الكلية العاشر المنعقد يوم الأحد الموافق ١٤٢٢/١٢/٢٦هـ حيث وافق المجلس بالإجماع على إمكانية قيامكم بإجراء البحث بالكلية لما يأتي :

- يساهم كثيراً في توفير الوقت والجهد والمال .
- يزود الموظفات بالمعلومات الدقيقة بأسلوب منظم وسريع .
- يربط جميع الأقسام ببعضها مع شئون الطالبات والإدارة ، وهذا بدوره سيمهد لربطها مستقبلاً بشبكة معلومات أوسع مع إدارة تعليم البنات بمكة المكرمة ثم مع الرئاسة العامة لتعليم البنات .
- إنشاء هذا النظام يتوافق مع سياسة المملكة في مواكبة علوم العصر الحديث وبخاصة فيما يختص بنظم المعلومات الذي نحن في أمس الحاجة إليه حالياً ومستقبلاً ويعتبر عصباً رئيسياً لحضارة الأمة .

وقد جاء الأمر بتسهيل إجراء مهمة تطبيقكم للبحث المشار إليه بموجب خطاب سعادة مدير عام تعليم البنات بمكة المكرمة رقم ٢٢/د ت وتاريخ ١٤٢٣/١/١٣هـ المرفق صورته.

ونحن إذ نبلغكم بذلك نتمنى لكم التوفيق والنجاح في الحصول على درجة الدكتوراه ليتسنى لكم خدمة هذا الوطن الغالي .

للتكرم باستلامه وإكمال اللازم .... وشكراً ،،،،،،

عميدة كلية المعلمات بمكة المكرمة

د/ فاطمة بنت صديق نجوم

١٤٢٣/١/٢٣هـ

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426

استبانه استخدام نظم المعلومات في كلية إعداد المعلمات بمكة المكرمة

يهدف البحث الحالي إلى إنشاء نظام معلومات متكامل في كلية إعداد المعلمات بمكة المكرمة ، وسوف يساعد هذا النظام الموظفات والطالبات في الحصول على المعلومات بسهولة وأكثر فاعلية حين الحاجة إليها.

التعليمات: الرجاء قراءة السؤال بعناية والنظر إلى الاختيارات المعطاة ومن ثم الإجابة بوضع الإشارة " √ " في المربعات المناسبة.

استعمال الباحثة

الجزء الأول: معلومات عامة

1. هل أنت:- (اختيار واحد فقط)

1 ☐ عضو هيئة التدريس 2 ☐ موظفه 3 ☑ طالبة — 3

2. في أي قسم أنت:- (اختيار واحد فقط)

1 ☐ قسم القرآن الدراسات إسلامية 2 ☐ قسم اللغة العربية والعلوم الاجتماعية
3 ☐ قسم العلوم والرياضيات 4 ☑ قسم الاقتصاد المنزلي والتربية الفنية
5 ☐ قسم رياض الأطفال 6 ☐ قسم التربية وعلم النفس
7 ☐ قسم الشؤون الإدارية — 4

3. ما هي أعلى درجة علمية حاصلة عليها:-

1 ☑ ثانوية 3 ☐ دبلوم 4 ☐ جامعي 5 ☐ ماجستير 6 ☐ دكتوراه — 1

4. هل لديك جهاز حاسب آلي في المنزل ؟ 1 ☐ نعم 2 ☑ لا — 2

-إذا كانت الإجابة (لا) اذهبي إلى الجزء الثاني

5. كيف تعلمت استخدام الحاسب الآلي ؟ :- (اختيار أكثر من واحد)

1 ☐ بنفسي 2 ☐ جزء من دراستي 3 ☐ الأصدقاء
4 ☐ دورات خاصة 5 ☐ دورات تدريبية في الكلية 6 ☐ أخرى :............

6. منذ متى وأنت تستخدمين الحاسب الآلي ؟

1 ☐ اقل من عام 2 ☐ اقل من ثلاث سنوات 3 ☐ ثلاث سنوات فأكثر

الجزء الثاني : نظم المعلومات الحالية في الكلية

ما هي انطباعاتك حول ما يلي :

	1. ممتازة	2.مرضية	3. غير مرضية	4. غير موجودة	
7. تعامل الموظفات معك	☑	☐	☐	☐	1
8. الخطوات المتبعة لانجاز المعاملة	☐	☑	☐	☐	2
9. الوقت المستغرق في انجاز المعاملة	☐	☑	☐	☐	2
10. الطرق المتبعة في تبادل المعلومات بين الأقسام	☐	☐	☐	☑	4
11. معامل الحاسب الآلي في الكلية	☐	☐	☑	☐	3
12. مهارة موظفي الحاسب في استخدام الحاسب الآلي	☐	☑	☐	☐	2
13. الدورات التدريبية في الكلية	☐	☐	☐	☑	4

14.أي ملاحظات أو انطباعات حول النظم الحالية بالكلية :-..
....
.... — ٥

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الجزء الثالث:المهارات الفردية في استخدام تقنية المعلومات

ما هي قدرتك على إجادة

	1. أجيدها	2. استخدمها	3.صعبة الاستخدام	4. لا اعرفها	استعمال الباحثه
برامج الحاسب الآلي مثل:					
15. Word Processing				✓	4
16. Spreadsheets (Excel)				✓	4
17. Presentation (Power Point)				✓	4
18. Databases (Access)				✓	4
خدمات الانترنيت مثل:					
19. البريد الإلكتروني E-mail				✓	4
20. البحث عن المعلومات في Internet				✓	4
21. البحث في قواعد المعلومات				✓	4

22. أي ملاحظات أو اقتراحات حول تطوير المهارات الفردية في استخدام تقنية المعلومات:-

....

....

الجزء الثالث: رأيك الشخصي

في رأيك الشخصي ما مدى تأثير الأمور التالية على نجاح نظم المعلومات في الكلية ؟

	1. موافق بشدة	2. موافق	3. لا أعرف	4. غير موافق	5. غير موافق بشدة	استعمال الباحثه
23. معرفة الموظفات باللغة الانجليزية		✓				2
24. استخدام خدمات الانترنت				✓		4
25. إنشاء إستراتجية للمعلومات (خطط مستقبلية)	✓					1
26. تطوير الدورات التدريبية		✓				2
27. تمركز إدارة المعلومات		✓				2
28. إنشاء شبكة حاسب آلي	✓					1
29. إنشاء مكتب لتقديم الخدمات الحاسوبية	✓					1
30. تطوير وسائل الاتصال بين الأقسام		✓				2

31. أي ملاحظات أو اقتراحات حول تطوير نظم المعلومات:- 0

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....

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شكرو جزيلا على حسن تعاونكم ... وجزاكم الله كل خير.