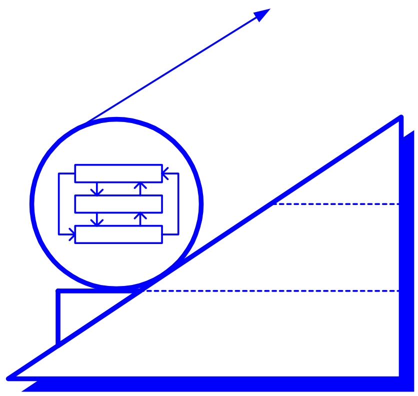
Improving ICT Management in Public Universities in Kenya



G.N.W. Wanyembi

Improving ICT Management in Public Universities in Kenya

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Dedicated to my late parents Andrea and Lucrezia and sister Nasimiyu

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Preface

With the rapid infusion of information and communication technology (ICT) in Kenya in the recent past, organizations are now realizing the critical role that management, control and maintenance of ICT play in providing and improving ICT services to the user communities. Public universities as agents of technological transfer in the developing world are organizations that play key roles in the filed of ICT. Much is expected from them by other organizations to provide leadership in the management and utilization of the new technology in addition to scholarship and research in ICT.

This thesis forms part of pioneering research work conducted in the area of ICT management, control and maintenance in public universities in Kenya and as part of a doctoral study program in the area in the Department of Information Systems and Software Engineering, Delft University of Technology, The Netherlands. The thesis attempts to provide some answers to the problem associated with the management of ICT, arising from the rapid introduction and use of the new technology. Three case studies are examined, one in which the problem space was conceived and formulated, and the model solution developed, and two case studies where the model solution was applied. Conceptually, the model solution comprises four functions, i.e. depiction of the current situation, qualification of the current situation, definition of the future situation and transformation from current to the future situations.

The proposed model solution was constructed from requirements formulated by the user community in the first case study and integrated with concepts of the management paradigm, which formed the core of the research. Building upon the success of earlier work in the field, the model drew from existing models and extended the concepts to include the four functions that form the hallmarks of the model solution. There are theoretical and some practical implications resulting from the application of the model in the two case studies. To make the model practical, its first three functions were developed into an automated tool. As an instrument the model provides the practitioners with a new and ready tool to use as they come to terms with the unfamiliar computing technology. For the theoretician the model opens new doors for further research and inquiry into new geographical areas and societies where wholly new challenges and problems previously unknown to the outside world may present. Partnerships in ICT management research should become the logical stage in dealing with these challenges to provide solutions to the problems that will no doubt increase with the increase in complexity and sophistication of new technology.

List of abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ADD	Architecture, Design and Development
AFRALTI	African Advanced Level Telecommunication Institute
ARIS	Academic Register Information System
AVLM	Availability Management
AVU	African Virtual University
CACO	Chief Academic Officer
CAD	Computer Aided Design
CADO	Chief Administrative Officer
CAM	Computer Aided Manufacture
CAPM	Capacity Management
CCTA	Central Computer and Telecommunications Agency
CCK	Communication Commission of Kenya
CHE	Commission for Higher Education
CHG	Change Management
CHPK	Chepkoilel Campus
CI	Configuration Item
CIDA	Canadian International Development Agency
CF	Complexity Factor
CMDB	Configuration Management Database
CMM	Capability Maturity Model
CONF	Configuration Management
CONT	Contingency Planning
COTU	Central Organization of Trade Unions
CSTM	Cost Management
DBA	Database Administrator
DN	Daily Nation newspaper
DSL	Definitive Software Library
DSS	Decision Support System
DVC	Deputy Vice Chancellor
EAS	East African Standard newspaper
ESM	Extended State Model
EU	Egerton University
FDDI	Fibre Distributed Data Interface
FHS	Faculty of Health Sciences
FKE	Federation of Kenya Employers
FOT	Faculty of Technology
FRWM	Forest Resources and Wildlife Management
GDP	Gross Domestic Product
GMP	Good Management Practice
HACQP	Hazard Analysis Critical Control Point
HLP	Helpdesk
ICS	Institute of Computer Science
ICT	Information and Communication Technology
IMF	International Monetary Fund
IPP	Information Policy and Planning
IRM	Information Resource Management
IS	Information System
ISO	International Standardization Organization
ISP	Internet Service Provider
ITIL	Information Technology Infrastructure Library
ITU	International Telecommunication Union
JABIS	Joint Admissions Board Information System
JKML	Jomo Kenyatta Memorial Library
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KARI	Kenya Agricultural Research Institute
KEBS	Kenya Bureau of Standards
KCSE	Kenya Certificate of Secondary Education

KEFRI	Kenya Forestry Research Institute
KEMRI	Kenya Medical Research Institute
KNEC	Kenya National Examinations Council
KPLC	Kenya Power & Lighting Company
KSC	Kenya Seed Company
KU	Kenyatta University
LAN	Local Area Network
LS	Learning Site
MAU	Maseno University
MC	Main Campus
MCM	Management, Control and Maintenance
MHO	Joint Financing Programme for Cooperation in Higher Education (Dutch)
MTL	Margaret Thatcher Library
MU	Moi University
NUFFIC	Netherlands Organization for International Cooperation in Higher Education (Dutch)
OLT	Object Link Technology
OM	Operational Management
OOS	Occupational Overuse Syndrome
PRB	Problem Management
RINAF	Regional Informatics Network for Africa
RFC	Requests For Change
ROI	Return On Investment
RS	Real System
RSI	Repetitive Strain Injury
SCD	Software Control and Distribution
SLA	Service Level Agreement
SLM	Service Level Management
SM	Strategic Management
SSA	Sub Sahara Africa
SWA	Student Welfare Association
SWOT	Strengths, Weaknesses, Opportunities and Threats
TM	Tactical Management
TQM	Total Quality Management
UIP	University Investment Project
ULIS	University Library System Information System
UNB	University Network Backbone
UoN	University of Nairobi
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPS	Uninterrupted Power Supply
VC	Vice Chancellor
WB	World Bank
WBC	World Bank Computerization project
WWW	World Wide Web

1 Introduction

1.1 The emerging issues in ICT management in public universities in Kenya

The worldwide spread and evolution of information and communication technology (ICT) during last 40 years has been rapid and challenging to top corporate and ICT management [Applegate99]. During this period, new industries have emerged, new structures have been created, new problems have cropped up, new responsibilities have been defined and relocated, and new management strategies have been introduced. New systems have been, and are being developed, which profoundly affect the ways in which organizations operate leading to the need for innovative organizational and ICT management. The effects of the new technology are profound and have been felt far and wide, including public universities in Kenya.

The rapid infusion and diffusion of information and communication technology into public universities in Kenya raise important management issues for top management and the technical staff. Although ICT is employed in organizations to gain an advantage over old ways of doing things [Lucas97], and modern approaches to management of information systems, which recognize distinct *arenas* of functional areas, application areas and technical areas are used ([Looijen98], [Sprague93]), the establishment of many computer centres in public universities without clear aims, objectives and control, has led to an alienation of these units from their organizations causing them to operate largely independently of the organizations they are intended to serve. This is due, in part, to misalignment of objectives ([Wexelblat99], [Earl89]). Based on information gathered by the author from numerous internal reports, minutes of meetings and committee reports, at Moi University (MU); and from national newspaper reports (Kenya's *Daily Nation, [DN], East African Standard, [EAS])*, complaints from government officials, academics, practitioners, politicians and opinion leaders on declining academic standards, and through observation as a concerned participant in one of the public universities, a lot needs to be done as far as management of ICT in particular, and other resources in general, are concerned.

According to the writer's conservative estimates, each public university now has over 1000 PCs of various makes, types and capacities scattered over several campuses, in administrative offices, computer laboratories, in various faculties and/or departments. Many ICT resources are out of order for lack of management, control and maintenance and vital replacement parts. In a small number of cases, PCs are connected to form local area networks (LANs). The rest are a virtual collection of autonomous islands of technology isolated from other units although they structurally belong to, and should be used to support, the same organizations.

Aiyepeku et al [Aiyepeku94] state that the strong interest in the adoption of ICT to provide information services emerged in Sub-Saharan Africa (SSA), including Kenya, for three reasons: one, the revolution in ICT has resulted in computer hardware becoming cheaper and, therefore, more widely available. At the core of this development is the ever powerful and ubiquitous microprocessor. Two, the substantial, value added, utility of ICT in the provision of, and access to, information services for improved planning and organizational management has become more widely recognized. Three, the international development agencies and donor countries have exerted significant pressure upon many governments, institutions of higher learning and other recipients of their aid, covertly and overtly, in developing countries to adapt the extensive use of ICT to improve their workforce performance and organizational management. The limited knowledge of ICT found at the level of top management compounds the situation even more, especially on technical issues and investments in ICT. Many senior and influential university officials with positions of responsibility requiring decision-making, received their education and early work experiences well before the advent of, and wide-scale introduction of the computer technology. They also did so in environments where the capabilities of what IT was available, were very limited indeed compared with those of today. It is, therefore, not surprising that these officials lack sufficient grasp of the issues related to ICT resources and its management, and struggle to provide adequate and effective managerial direction and support that is so much needed.

The lack of trained and experienced technical personnel to manage, control and maintain the increasingly large numbers of these resources means that their utility values, effectiveness and efficiency, cannot be ascertained. The lack of theoretical knowledge and practical management, control and maintenance skills of ICT staff leads to these units being managed, controlled and maintained virtually on *trial* and *error* basis. Looijen [Looijen98] points out that in the field of education, i.e. universities and high schools, a lack of standards, and pseudo 'standards' that differ enormously, introduce real challenges to achieve a decrease in the capacity and effort required to use the facilities optimally. In addition, the rapid increase in quantities of ICT resources and establishment of ICT units in many organizations across the country has created a rapid turnover of the few available trained technical personnel and leading the less financially well endowed organizations to fail to attract and retain competent computer staff. Consequently, this creates huge management problems for the public universities since they depend on the government for staff salaries, which are low.

It must be noted that the manner in which information and communication technology was introduced in Kenyan public universities was initially piecemeal, uncoordinated, and in most cases haphazard. Top university management officials often had little control over the acquisitions of ICT as agreements were largely made bilaterally between external donors and the respective departments and faculties concerned. To-date, there exist very few budgets for the development and management of information and communication technology in faculties and departments. This points to a lack of recognition by the university management of the importance of ICT to their organizations. Often, there are no policy frameworks, at either organizational or national level, to guide the adoption of this technology to realize its full potential benefits [*DN* 9 July 2001]. Within a short period of time, public universities in Kenya have had to cope with a diversity of new ICT related problems over and above their old *'normal'* problems on the economic, social, governmental and political fronts. The new problems, which are closely linked with the introduction of the computer technology, include low computer literacy among staff, securing and installing the information and communication technology (ICT) resources, hiring and training technical personnel, and managing, controlling, and maintaining ICT within a rapidly changing environment. The effects of globalization mean that organizations in Kenya have to deal with more problems than their western counterparts in their effort to catch up with the developed world. The result is that the external supporters (donors) and other stakeholders fail to understand why their financial, material and other forms of aid have not brought about the desired results of enhanced performance.

Little is known about the planning, development, implementation, utilization, exploitation, management, control and maintenance of information systems in many public universities in Kenya. The external donors and other stakeholders have little knowledge of the decision-making processes, university activities, including teaching, research, and administration, which the donated ICT is, in theory, intended to support, nor of the situational or contingency factors that act on the processes and activities in the universities within the milieu that they operate. An examination of Kenyan university documents on ICT reveals in many cases that hardly any policy framework exists to guide the development, adoption and management of information and communication technology. Various parts of a university develop their own information systems independent of others with no common standards. In many cases the technical staff that manage the information systems lack the necessary skills and knowledge and experience required to manage, control and maintain ICT, to support their organizations, effectively and efficiently. One observation in these universities, as in many other organizations, is that, due to their lucrative nature, the top positions in IT projects are currently held by personnel who are themselves non-IT experts, and this poses a major problem in the development, utilization and exploitation of ICT. A lot of these officials have very little knowledge of ICT itself and in most cases have no experience at all of managing ICT projects.

Most of the ICT technical staff train initially, not in computers, but in other technical fields such as electronics, librarianship, or mechanics and only later on switch over to managing computers, creating a continuity and credibility gap between professions. To add to this, users have yet to fully adapt and to internalize the new technology and make it one of their own day-to-day instruments of work. The lack of computer culture in public universities impedes rapid diffusion of the new technology. Very often the aims of the ICT management units and those of the universities as organizations are not aligned, creating autonomous units that consume huge financial resources but which do not result in many benefits for their organizations; however, this argument does not imply that there is lack of appetite for computer technology in Kenya. On the contrary, one may indeed hypothesize that all human societies abhor a technological vacuum, and based on this proposition, the Kenyan society, once it has acquired it, may not be prepared to give it up unless there is a better technology to replace it.

1.2 The research problem

The above discussion, which is largely based on practical experience and the scant literature available on management of ICT in Kenya, led to the formulation of the following research problem.

Use of information technology in public universities in Kenya is increasing rapidly. The various ICT resources acquired over a period from early 1980s to date differ in models, ages, and other characteristics and this increases the complexity of managing the resources in the dynamic world of ICT and the global economy. The lack of a close relationship between the processes, the ICT, and ICT management, often adds to the challenge.

Thus stated, the problem justifies further research into the management of information systems in a new "ecologically" different world, public universities in Kenya, in the hope that full benefits can be realized in the implementation and management of information systems. The research problem stated above naturally leads one to pose the following general research question:

> *How can we improve the management of the new computing technology in public universities in Kenya?*

Several initiatives towards finding solutions to ICT service support and ICT service provision in Kenya have been attempted on a number of occasions supported by donor agencies but these have largely had little real effect as the following section illustrates.

1.3 Search for solutions

Several attempts to contain and resolve the problems mentioned above have been made, however, these initiatives have had little effect on the overall performance of the institutions under the study. A few examples serve to emphasize this point. From the documentary evidence gathered from the mid 1980's to date, several ICT consultancy firms, both local and foreign, were contracted to give training to ICT staff at public universities in Kenya. In particular, Moi University (MU), where the case study was undertaken for this thesis, with financial support from donors such as World Bank, MHO (Dutch), Regional Informatics and Networks for Africa (RINAF) and ODA (British), has conducted a number of ICT related user and management training seminars, some of which the researcher participated in. Training of staff was often included as part of major ICT projects, and it was aimed at equipping the staff with the skills necessary to enable them to use and manage the ICT resources effectively. Local firms, such as Informatics for Partnership in Africa, ICL Kenya, and local MU in-house training staff, being new in the field of ICT management and lacking the necessary capital and experience, often prove to be largely ineffective. Most of the training tasks were not completed, and the few that were, were poorly done and left the intended users and technical staff with few ICT skills despite the fact that the firms were often fully paid for the work. The lack of a strong legal system in Kenya means that such firms often get away without being held accountable. The foreign ICT companies are usually more expensive than the local ones and they lack knowledge of the local conditions. The case of ICL (UK), contracted in 1994 to train staff and service ICT of the British government funded Margaret Thatcher Library (MTL) project at Moi University, is one such case.

Due to the high costs involved, the periods of contract periods are often reduced. This leaves the recipient institutions with uncontained and unresolved problems and instead the problems keep growing and threaten to get out of hand. The researcher, who participated in some of the projects, can bear witness to some of the cases cited above.

On the individual level, users try to find solutions using the few sources of literature on ICT but the literature is often out of date and lacking relevant material since local conditions were not taken into account. Attendance at in-house or local and international workshops is popular but this is often short in duration and irregular. They are also prohibitively expensive and only a small number of staff can be allowed to attend them. With the dwindling financial donor support situation, it is unlikely that things will improve much. These examples clearly highlight the ICT related problems faced in the Kenyan public universities, and also that the solutions attempted to date are inadequate and lack relevance. Since this also, by extension, affects other real processes in the universities, the poor performance in ICT inevitably affects the performance of these activities. This also clearly shows that there has been no lasting solution to the growing problems despite many attempts having been made to find one. One concludes that there is a compelling need for alternative solutions to the ICT problems found in Kenya's public universities.

1.4 Alternative solutions

The establishment, development, funding and staffing of public universities in Kenya represents a huge investment. It is estimated that each university costs the government over $10 million a year, and being non-profit-making public institutions, their returns on investment (ROI) are difficult to determine since it is not possible to quantify in monetary terms the trained personnel produced by the universities. Over the past years, a poor economic situation has forced the Kenyan government to reduce its spending on public universities and it now expects the universities to find alternative ways to supplement the reduced funding. This consequently implies that many of the universities are compelled to search for alternative sources of funding including *income-generating activities*, and increased *support from external donors*. They are also expected to restructure and streamline their operational activities to survive in a fast changing world. As part of the restructuring programme, staff retrenchment to enable the universities to operate effectively and efficiently with a leaner staff, is underway; consequently information and communication technology will now offer a new and opportune alternative to overcome some of these problems in a manner that could not have been foreseen. *Apart from making a direct contribution to improving the performance of Kenya's universities, an important consequence of this doctoral study is the benefit it will bring in the form of improvement of the universities' curriculum through teaching and research activities in the new ICT management field.* This new alternative is the focus of the research presented in this thesis.

1.5 The focus of research and key assumptions

It is clear from the previous section that the attempts made so far to solve the ICT problems found in Kenya's public universities have had little effect. This observation provided a reason and motivation for the research presented here. The underlying conviction is that a solution lies somewhere within the academic domain. Of course the ICT related problems are not the only problems facing Kenya's public universities; and solving the ICT related problems will not mean that all problems in the public universities have been solved, however, if a special study of the ICT problem can provide a solution, and other problems are solved in similar or different ways, then in the end most, if not all, of the problems in Kenya's public universities will be solved. For ICT related problems, use of consultancy cannot be under-rated. Consultancies are very useful especially in the new information and communication technological era and should indeed be continued and encouraged. This does not, however, preclude seeking solutions from academia where a high reputation in the area of management of information systems has been established. Use of modelling techniques has proved to be a very effective and modern way of solving problems. This technique is, however, little known in developing countries and was, therefore, explored for this research as possible application to the ICT problem in Kenya's public universities. The problem domain and focus are depicted in Figure 1.1.

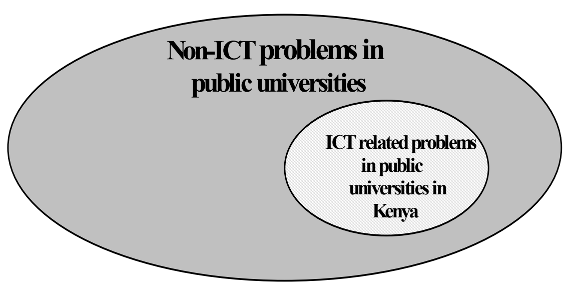


FIGURE 1.1: FOCUS OF THE RESEARCH

1.6 The research question

The research problem, stated in Section 1.2, provides a unique opportunity to examine how information and communication technology (ICT) can be managed, controlled and maintained to support, effectively and efficiently, public universities in Kenya. To state the research question, research objectives and the purpose of the research we follow a modified approach adopted from [Verschuren86]. This approach is illustrated in Figure 1.2.

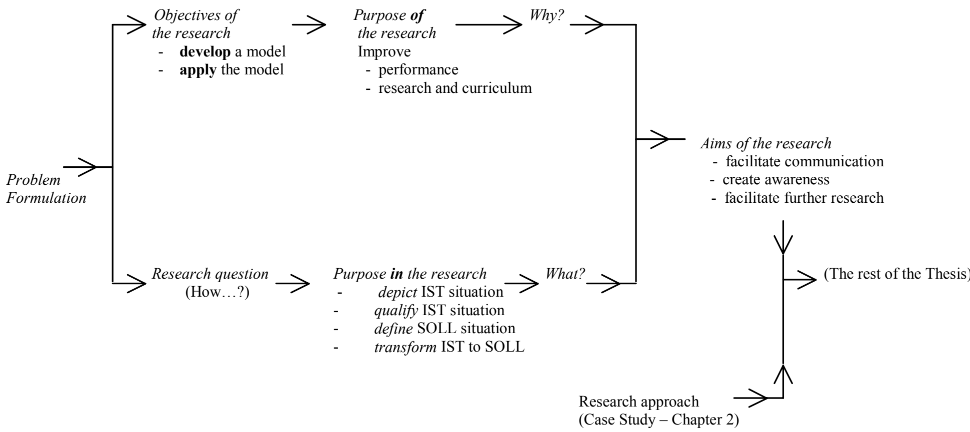


FIGURE 1.2: FORMULATION OF THE RESEARCH QUESTION
(MODIFIED FROM *[VERSCHUREN86]*.)

Proceeding from the problem domain formulated in Section 1.2, we will now delineate and state the research question (See Figure 1.3) and the objectives of the research. Implicit in the research question are two objectives of the research: (1) to develop, and (2) to apply, a model that can be used to perform some specific functions. In the field of computing, we are particularly interested in abstract systems as they are widely used to represent, describe, or specify applications in organizations and computer-based systems. Such abstract systems are referred to as models [Flynn92]. To find answers to the research question, we also need to state the *purpose* in *the research*, which seeks to answer the question: *what* functions we do expect the model to perform at the end of the research? These functions are identified as *depiction* of the current, or using the German term IST situation, *qualification* of the IST situation, *definition* of the future, or using the German term SOLL situation, and the *transformation* from the IST to SOLL situations. The objectives of the research and the *purpose* of *the research*, provide the answer to *why* the research is conducted. Simply stated, the *purpose of the research* is to *improve* (1) performance in ICT management at the Kenyan public universities, and (2) research and curriculum in ICT in the same universities. Finally, we identify the general aims of the research which are threefold: (a) to facilitate communication among stakeholders, (ii) to create awareness among stakeholders, and (iii) to provide an agenda for further research in ICT utilization and management in Sub-Saharan Africa. Combining the aims of the research and the research approach adopted for the research in this case the CASE STUDY methodology, (outlined in Chapter 2) a study plan for the thesis can be realized.

Following this argument, the general research research question posed earlier, can be rephrased more specifically as follows:

How can we develop a model of ICT related issues that can enable a public university in Kenya to:

(a) **depict** its current ICT related issues ?
(b) **qualify** its current ICT related issues?
(c) **define** its new and improved ICT situation?
(d) **transform** its current ICT situation to a new and improved situation?

FIGURE 1.3: THE RESEARCH QUESTION

Consequently, the following activities were pursued to provide answers to the research question:

- The development of a model to describe a public university in Kenya in relation to its requirements for information and communication technology (ICT), the ICT, the management of ICT, and the relevant relationships between the university as an organization, ICT, and ICT management. The model had also to be able to examine the impact of external influences on ICT usage in the university. Thus, the model had to give a picture of the current situation in relation to ICT, give some qualification of the current situation, and transform the current situation to a better future situation. The development of the model was undertaken at one public university, Moi University.
- The model was then applied in two different public universities, Kenyatta University and Nairobi University.
- An automated tool related to the model was developed as an aid to support its application

The overall aims of the research question are threefold:

- One, to create an awareness among the many stakeholders of the university, donors, students, staff, customers, suppliers, of the various situational and contingency factors and issues pertaining to information and communication technology that often impact the public universities, but which have hitherto been little understood or received little attention from researchers.

- Two, to provide a practical tool that can be used by management, academic, administrative and technical staff in a real system, the utilization, management, control and maintenance of ICT, the ICT resources, the relationships between these components, and the influences that act on them in their respective institutions, faculties/departments or sections.

- Three, to provide an agenda for further research in ICT utilization and ICT management in Sub-Saharan Africa.

1.7 An outline of the thesis

A research strategy comprises a plan, which, after it has been carried out, leads to the answers to research question(s) posed and which in turn meets the stated research objectives. The thesis consists of seven chapters. Chapter 1 introduces the problem area and the research question. Chapter 2 presents the methodology followed in this research.

Chapter 3 reviews the trends in ICT and ICT management and discusses in depth MU case study with special reference to its situational factors. The model designed for application in this research is developed in depth in Chapter 4 with emphasis on its functions to *depict, qualify,* ICT related issues in the current (IST) situation, to *define* the future (SOLL) situation and to *transform* the IST situation to the SOLL situation. The *applicability* of the model of ICT in two public universities, and especially how a given ICT situation can be improved, are examined in Chapters 5 and 6. The Epilogue, Chapter 7, concludes this thesis with a discussion of the research findings, conclusion of the research question, implications of the findings on the theory and practice of ICT management in organizations in Kenya, and finally some indications of agenda for further research.

1.8 Conclusion

This chapter laid the foundation for this thesis by giving an outline of the problem (formulated in Section 1.2) related to ICT in public universities in Kenya. The limitations of the study were stated and the key assumption(s). The chapter stated the research problem and formulated the research questions and objectives. A brief statement of the purpose and overall objective of the research and an outline of the rest of the thesis were presented. Based on this foundation, the thesis proceeds with a detailed description of the research methodology in the next chapter.

2 Methodology

2.1 Introduction

The stage was set for this research in Chapter 1, where the problem area was described and from which emerged a statement of the problem. A research question was formulated for which answers must be sought to address the research problem. To find a solution to a scientific inquiry, a clear set of tested methods, techniques and strategies need to be reviewed and followed. Such a research approach of necessity requires that a set of instruments be employed to collect, analyze and interpret the results. Furthermore, the inquiry must rest upon a sound theoretical foundation. Such a foundation must be reliable and this can be determined by choosing a foundation that has a successful track record for similar problem areas. The methodology followed in this research is outlined and described in this chapter. A methodology is defined in this research as a *collection of methods, procedures, (techniques,) and standards that defines an integrated synthesis of engineering approaches to the development of a product* [SEI95, p. 360]. The chapter starts with a discussion of the theoretical foundation, followed by an outline of the strategy used for the research and finally a description of the instruments used for the model development and application.

2.2 Theoretical basis of the case study methodology

A theoretical basis must underlie any research undertaken to study a phenomenon. This theoretical underpinning determines to a great extent the kind of knowledge that is likely to be gained from an inquiry and also determines the limits of the knowledge [Vreede95] that might be gained. Many research methods exist for a researcher to choose from, but the most common distinction between methods is whether they are *quantitative* or *qualitative*. Quantitative methods were originally developed in the natural sciences to study natural phenomena such as forces of gravity, tabulation of the natural elements, electrical currents, optical measurements, and so on. Currently quantitative methods are now accepted in the social sciences including field surveys of human psychology. Qualitative or "naturalistic" research methods, on the other hand, were developed in the social sciences to enable researchers to study social and cultural phenomena, and include case study methods, action research and ethnography. The techniques used include observation, qualitative interviews and questionnaires, and the researcher's impressions and reactions. The major distinguishing aspect between the qualitative and quantitative methods is the realization that human beings have the ability to communicate in a way that can give qualified information as opposed to the natural world, which cannot. Lusthaus et al [Lusthaus95] suggest that both qualitative and quantitative methods should be utilized, and that a combination of both methods is important, for unless tempered by other measures, quantitative measures considered in isolation can erode confidence in the measurement processes for which they are used, thus by inter-weaving the two methods, a deeper understanding of a phenomenon can be gained.

2.3 Case Study Research

Case study research is the most commonly applied qualitative, *positivist*, method in information systems ([Orlikowski&Baroudi91], [Alavi&Carlson92]). Its scope is defined by Yin [Yin94] in the following terms.

> "A Case study is an empirical inquiry that:

- investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident" ([Yin 1994, p. 13]).

It has been argued that case studies are the preferred strategy when *"how"* or *"why"* type of questions are posed and when "the investigator has little control over events" [Yin94, pp. 1-13].

The object of the information systems discipline is the study of information systems in organizations, in the case of this research in public universities in Kenya. It is to be noted that "interest has shifted to organizational rather than technical issues" [Benbasat87]. When organizations are large, making it difficult to cover effectively all their parts, a few parts of the organization are selected for in-depth study. The parts selected form an *embedded case design* with each case serving as a mini-case [Yin94]. In embedded case study designs, attention is given to sub-units within each case, allowing examination of specific phenomenon in operational detail within the context of each case [Yin94, pp. 41-44]. The body of literature on case study research is primitive and limited [Yin94], in comparison to that of experimental or quasi-experimental research. In the latter research, data collection and analysis methods are known to hide some details [Stake95]. Case studies are designed to bring out the details from the viewpoint of the participants using multiple sources of data. In addition, the requirements and inflexibility of experimental forms of research make case studies the only viable alternatives in some instances.

Case study research is also called a triangulated research strategy. Snow and Anderson (cited in [Feagin, Orum & Sjoberg 1991]) assert that triangulation or corroboration, can occur with data, investigators, theories, and even methodologies. Stake [Stake95] states that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of processes. In case studies, this can be done by using multiple sources (instruments) of data [Yin94]. Benbasat et al [Benbasat90] argue that in information systems research, several research strategies can be applied to investigate the research topic under consideration, and give examples of such strategies as case studies, field studies, field experiments and laboratory experiments. (pp. 205.)

Denzin [Denzin84] identifies four types of triangulation: *data triangulation* - when the researcher looks for the data to remain the same in different contexts; *investigator triangulation* - when several investigators examine the same phenomenon; *theory triangulation* - when investigators with different viewpoints interpret the same results; and *methodological triangulation* - when one approach is followed by another, to increase confidence in the interpretation.

Following Morgan [Morgan83] and Orlikowski and Baroudi [Orlikowski&Baroudi91] it can be concluded that the application of multiple instruments (pluralism) is a suitable strategy to use in case study research.

Case studies can assume either single- or multiple-case designs. Single cases are used to confirm, challenge or refute a theory, or to represent a unique or extreme case [Yin94]. Single cases are also ideal for revelatory cases where an observer may have access to a phenomenon that was previously inaccessible

Case study can be seen to satisfy the three tenets of the qualitative method: *describing, understanding,* and *explaining.* In addition, Yin [Yin93] has identified some specific types of case studies: *Exploratory*, *Explanatory* and *Descriptive*. In exploratory case studies, fieldwork and data collection may be undertaken prior to the definition of the research questions and hypotheses. The existence of "*how*" types of research question makes the research an *explanatory* case study. Due to this argument we conclude that this research is *explanatory* since its research question seeks to understand how we can develop a model.

Research instruments

A research strategy by itself is not useful unless it is backed up by theory and appropriate means to execute it. Each research method or strategy uses one or more techniques for collecting empirical data. Note that the term '*empirical materials'* is increasingly becoming the preferred term since most of the qualitative data collected are non-numeric. Stake [Stake95] and Yin [Yin94] have identified seven sources of empirical evidence in case studies.

- *Documents*

  Written material sources include published and unpublished documents, company reports, memos, letters, agendas, administrative documents, departmental/faculty reports, e-mail messages, newspaper articles, or any document that is germane to an investigation.
- *Archival records*

  Archival documents can be service records, organizational record, and lists of names, survey data, and other such records.
- *Interviews*

  An interview can be used for three purposes: as an exploratory device to help identify variables and relations, as the main instrument of the research and as a supplement to other methods [Kerlinger86]. Interviews were conducted for the present study for the first and third purposes. As a method it is one of the most important sources of information for a case study: open-ended, focussed, and structured or survey. In this study various forms were combined.
- *Questionnaires*

  These are structured questions written and supplied to a large number of respondents, commonly spread over a large geographical area for consideration in advance. Respondents fill in the blank spaces and return the questionnaires to the researcher either by post or in person. Sometimes inducements, such as a small gift, are used to encourage recipients to complete the questionnaires.
- *Direct observation*

  This occurs when a field visit is conducted during the case study. This technique is useful for providing additional information about a topic being studied. Reliability is enhanced when more than one observer is involved in the task.
- *Participant-observation*

  Participant-observation turns the researcher into an active participant in the events being studied.
- *Physical artefacts*

  Physical artefacts can be tools, instruments, or some other physical evidence that may be collected during the study as part of the field visit.

Use of a number of these instruments to obtain data from the same source provides for *triangulation* as defined in [Densin84].

For this research, the *interview, questionnaire, review of documents* and *observation* techniques, were used as they were considered to be most appropriate for the case study.

2.4 Application of case study method

Yin [Yin94] gives four applications for the case study method.

- To explain complex causal links in real life interventions
- To describe the real-life context in which the intervention has taken place
- To describe the intervention
- To explore those situations in which the intervention being evaluated has no clear set of outcomes

All four applications can be used to study information and communication technologies (ICT). Application 2 was adopted for this research based on the fact that real-life contexts, i.e. public universities, have experienced a new intervention, information and communication technology, which the study seeks to describe and explain with the objective of improving the situation. The introduction of ICT in Kenya, as elsewhere, is an intervention, which has had an impact on many organizations. If left uncontrolled, the intended benefits accruing from this intervention may not be realized. The application of the model is seen as a minor intervention within the global context and it is aimed deliberately at ensuring that the situation does not get out of hand but instead helps to reap the benefits that come with ICT.

In particular, for this research, the case study method was used to describe three important entities, the relationships between these entities and the influences that impact on the entities. The 3 entities, introduced in full in Chapter 4, are the real system (RS), the information system (IS/ICT), and the management, control and maintenance (MCM) of IS/ICT, while the relationships between the entities include real system and information system and vice versa, real system and management, control and maintenance and vice versa, and information systems and management, control and maintenance and vice versa. The influences also impact on the organization as a whole and they include managerial, donor, technological, economic and cultural influences. These concepts are also introduced in Chapter 4.

2.5 The research strategy

Any research requires a research strategy to be executed effectively. A research strategy in essence comprises the logical steps that a researcher takes to arrive successfully at the conclusion of an inquiry. It consists of research instruments, which are employed to collect and analyze data on the phenomena studied [Vreede95]. The choice of a strategy is greatly influenced by the nature of the problem to be solved. The problem area and the problem statement formulated in this study were ill structured, and this determined the strategy used in this study, which consists of an exploratory study and analysis, literature review, model development, model application, and the research findings (See Figure 2.1). The diagram shows the seven chapters developed to present the research. These chapters are briefly described below.

Chapter 1: Introduction

This introduction gives an overview of the entire thesis. Before any research can be conducted in an area that has not been researched before, it is necessary that an exploratory study be carried out to determine its suitability and feasibility. Towards this end, a study area, management of information and communication technology, was selected and a literature review of the field was made. Arising from this study, the problem statement was deliniated and an appropriate research question formulated. The research question determined and shaped the thesis, which forms a written presentation of the research inquiry.

Chapter 2: Methodology

To carry out research into a selected area and find answers to the research question, it is essential that an appropriate methodology is designed and executed. Chapter 2 contains an explanation, some details of the methodology followed in this inquiry and the underlying philosophical basis.

Chapter 3: The Moi University (MU) Case Study and the emerging research issues

A review of research issues and trends in ICT and management of ICT, together with the exploratory case selected in Chapter 1 at Moi University (MU), are given and discussed in this chapter. In particular, the MU case study is covered in depth to include a description of its situational factors coupled with a study of current research in the of management of information and communication technology (ICT). The results of a pilot study conducted at MU into the requirements of information and communication technology, which inspired the study to be carried forward, are also reported.

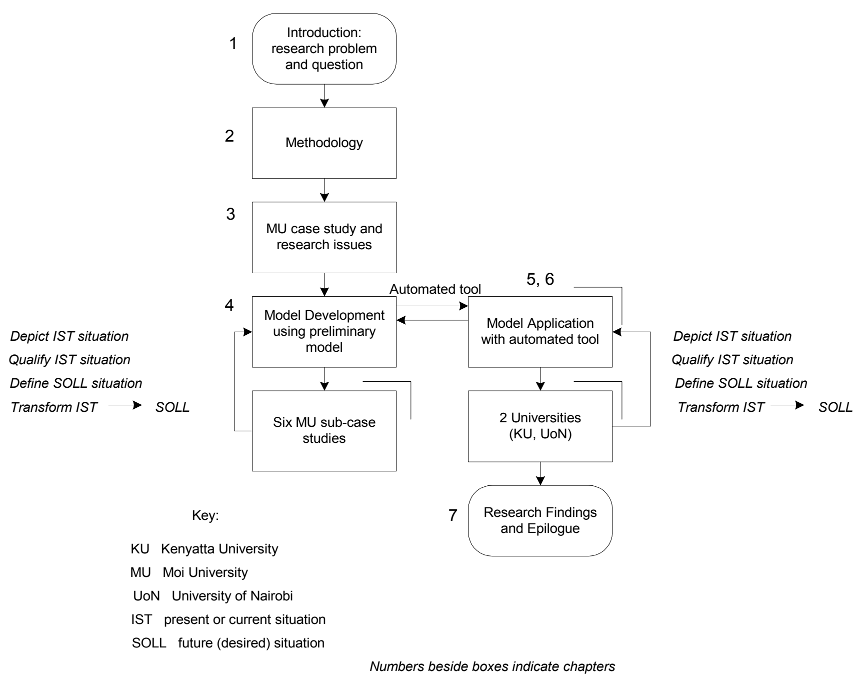


FIGURE 2.1: OUTLINE OF RESEARCH STRATEGY AND APPROACH

Model development is a vital part of strategy when searching for solution(s) to an identified problem. As a technique, modelling has yet to be established in much of Sub-Saharan Africa, including Kenya. The decision to use modelling as a technique was heavily influenced by the research into strategic information systems and management of information systems being carried out at Delft University of Technology, Faculty of Information Technology and Systems, in the Department of Information Systems & Software Engineering, where it is well established as one of the core research areas. To model ICT for public universities in Kenya, it was first determined that a preliminary model should be developed, which would form the basis of the model to be developed. An iterative approach of six steps was adopted and used with a similar number of embedded sub-cases selected from the case study (Moi University). The sub-cases are the student information system called Academic Register Information System, ARIS, and ICT management unit called Information Resource Management, IRM, Faculty of Technology, FOT, Faculty of Forest Resources and Wildlife Management, FRWM, the Margaret Thatcher Library, MTL, and the World Bank Computerization project, WBC. The preliminary model consisted of issues in the following entities: the real system, information and communication technology, the management, control and maintenance (MCM) of information and communication technology, relationships between entities, and the influences upon them, all which are introduced in Chapter 4. By the term entity is meant something that exists as a distinct, independent, or self-contained unit. These are shown in Table 2.1.

SUB-CASE STUDY ***Issues in Entity***	ARIS	IRM	FOT	FRWM	MTL	WBC
Real System	√	√	√	√	√	√
Information and Communication Technology	√	√	√	√	√	√
Management of ICT	√	√	√	√	√	√
Relations between entities	√	√	√	√	√	√
External influences	√	√	√	√	√	√

TABLE 2.1: MATRIX OF ISSUES IN ENTITIES AND SUB-CASE STUDIES
(Marked by √)

In all sub-cases the methods used to collect data included interviews, questionnaires, review of documents, and observation.

The model development process

The process of developing the model involved two main stages, the creation of the preliminary model, and the interaction of the preliminary and subsequent models with six embedded sub-case studies.

Stage A: creation of the preliminary model based on proven concepts
In this stage of model development, the preliminary model was created from proven models of the management paradigm, which is at the core of this research. The paradigm provides a framework of entities that form the foundation upon which the final model was built. According to Verschuren [in Hemmen97], all research must be based on a framework. The entities of the paradigm are the real system (RS), information and communication technology (ICT) including the extended state model and associated complexity factors, and the management, control and maintenance of ICT (MCM). In addition, the relationships between these entities, and the external influences were included in the model development process. The preliminary model is denoted by the symbol M_0.

Stage B: interaction of the preliminary and subsequent models with embedded sub-case studies
This stage consists of integrating the preliminary model created in Stage A, with six embedded sub-case studies. The purpose of selecting six sub-case studies is to create a broad awareness of the issues related to ICT. Four functions were involved – *depiction* of the IST situation, *qualification* of the IST situation, *definition* of the SOLL situation, and the *transformation* from IST to SOLL situations. The process involved six steps each corresponding to one of the sub-case studies. This process is depicted in Figure 2.2.

Step (i): interaction of the preliminary model with ARIS
Taking the first case, ARIS, a sub-case of the information system, issues and aspects of information systems in the preliminary model, M_0, were compared with those in the ARIS sub-case and a checklist of terms was produced to represent the issues. The terms include components of information and communication technology (ICT), their characteristics, both static and dynamic, states of the information system on the extended state model, including utilization, exploitation, and maintenance, and type of information system. The items in the preliminary model, which were not found in the ARIS, were added to the checklist, and vice versa. This process resulted in model, M_1.

Step (ii): interaction of model M_1 *with IRM*
Taking model M_1 and the second sub-case, IRM, which is a management component in the MCM paradigm, the process of building the same checklist of issues and aspects was again followed. The issues included MCM processes at strategic, tactical and operational levels, ITIL service support and service delivery processes. This step resulted in model M_2.

Step (iii): Interaction of model M_2 with *FOT*
The faculty of technology (FOT) was the first sub-case that represented the real system, and one which especially distinguishes the university from other organizations. The issues in the real system include the user requirements, preconditions, and situational factors. This process resulted in model M_3. A precondition is defined as a circumstance or something that is necessary for a subsequent result.

Step (iv): interaction of model M_3 *with FRWM*
The fourth step involved the second faculty, FRWM, which is located on another campus. This was designed to emphasize the importance of faculties and to cover

activities carried out in a different faculty in another campus. It is possible to add more detail to the model, which results in model by comparing and contrasting the real system issues listed in model M_3 to give M_4.

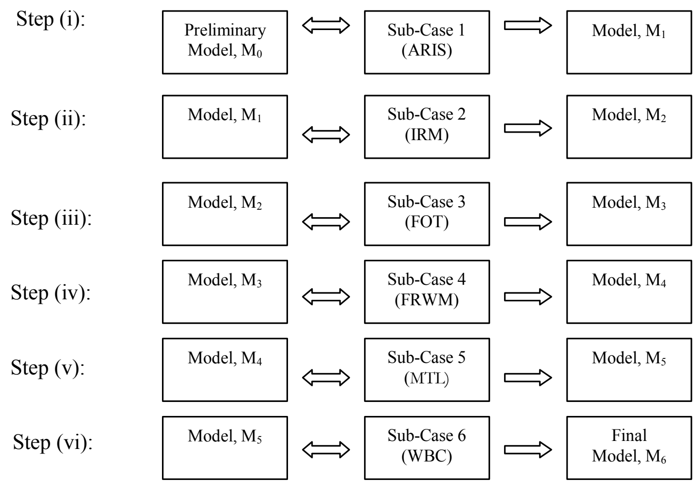


FIGURE 2.2: STEPS IN THE MODEL DEVELOPMENT PROCESS

Step (v): Interaction of model M_4 *with MTL*
This step involved the fourth sub-case, MTL, the university library, which in essence is an information system like ARIS though of a different type. A university library is an important repository of knowledge, and an automated library is of great interest in a study of this kind. The model produced in Step 4 was again extended by filling in the items that are peculiar to this type of information system. This step yielded model M_5.

Step (vi): interaction of model M_5 *with WBC*
The final step in the process of model development involved the WBC, which is essentially an ICT project with 250 PC, an assortment of printers, and some uninterrupted power supply units, UPS, acquired with a donation from the World Bank. The data collected augmented the earlier data to complete the model development process, which resulted in Model $M_{6.}$ This model was applied at KU and UoN and the results are presented in Chapters 5 and 6, respectively. To conclude this chapter, an automated tool, written in object-oriented language C++, was developed to augment the application of the model in the subsequent case studies.

Chapter 5: Model application (KU)

An approach similar to the one followed in model development process is followed with two units - African Virtual University (AVU), and the IT Office, at Kenyatta University. One notable difference between the two institutions is the fact that at Moi University the ICT resources and their management have a high degree of decentralization. In contrast the structure at Kenyatta University has a high degree of centralization and all resources with the exception of the AVU are managed from the IT Office. This allowed the model to be applied in two institutions, which are structurally different from one another.

Chapter 6: Model application (UoN)

Similar in content and form to the previous chapter, the application of the model at the second public university, UoN, is presented in this chapter. The results are significant in the sense that the final model is a tool resulting from the experiences gained from its application in the first two case studies.

Chapter 7: Research findings and Epilogue

The final chapter comprises a discussion of the research findings and the answer(s) to the research question posed in Chapter 1. Implications of the research for the theory and practice of the management of information and communication technology in public universities in Kenya together with future research agenda are presented.

2.6 Summary and conclusion

The methodology used in this research was described. The theoretical foundations upon which the research methodology was given together with rational choice of available alternatives within the case study methodology, were presented. A brief description of the stages of the methodology, which also corresponds to the chapters of this research, was given. The details of the stages of the methodology (will) appear in their corresponding and subsequent chapters.

3 The Moi University case study

3.1 Introduction

In the previous chapter the methodology for this thesis was presented in which the case study approach was advocated as the option of preference suitable for research in the study of information systems. Current research issues in management of information systems vary widely, depending on the approach and the methodology followed. In keeping with this choice this chapter examines the Moi University (MU) case study and the emergent research issues in management of information systems at the university. The objectives of this chapter are as follows.

- To present the causality relationship between situational factors and risks.
- To describe MU in terms of its situational factors using the contingency approach.
- To describe the specific situational factors related to MU, i.e. age, mission and objectives, geographical location, size, sector type, organizational culture, organizational structure, power and decision-making process, and technology environment.
- To describe the generic situational factors related to MU, i.e. stakeholders, power supply and distribution, telecommunication infrastructure, integration of voice, video and text, standardization, sociological/cultural environment, economic environment, political environment, regulatory/legal environment, and labour unions.
- To identify the relevant ICT related research issues that can form the basis of, and be incorporated into, the proposed model.

3.2 Contingency approach to management of ICT

Situational or contingency factors, terms which are used synonymously in this thesis, are key to the understanding and the successful implementation and management of any system in general, and in particular the management of ICT, in organizations. Since ICT represents heavy investment on the part of the organization, it is important to consider these factors due to the many risk factors associated with them. According to [Veroef99], situational factors are the root causes of risks. Risk is defined as the possibility of suffering loss. Risk management as an approach to problem analysis and problem solving, weighs risk in a situation by using risk probabilities to give a more accurate understanding of the risks involved. Risk management includes risk identification, analysis, prioritization, and control. Situational or contingency factors also contribute to the complexity and uncertainty of ICT projects and the management and delivery of ICT services. In his doctoral dissertation de Wijs [Wijs95], extensively discusses the problem of risk in the management of information systems. The causality relationship between situational factors and risks is illustrated in Figure 3.1. In this thesis, the term s*ituational factors, in the context of public universities and in relation to management of ICT, is defined* in a specific sense, i.e. pertaining to and being unique to the specific case, and in the generic or general sense. In the specific sense *these factors include the aggregate of age [Mintzberg79] and historical perspective, geographical location, size [Mintzberg79], sector type, organizational culture, organizational structure, power [Mintzberg83] and decision-making process, technology environment, i.e. computer literacy and management of ICT,* acting on the organization. In contrast, the generic factors include a general *description of stakeholders, other organizations with which the university has dealings, electric power supply and distribution, communication infrastructure and digitization, integration of voice, video, and text,* *striving towards standardization, socio-cultural environment, economic environment, political environment, regulatory/legal environment, and labour unions.*

We adapt the Euromethod definition of complexity, i.e. the difficulty encountered in managing the available knowledge or situation [Euromethod94]. Uncertainty, on the other hand, is defined as lack of knowledge needed to manage the problem situation, or the difference between the amount of information required to perform the task and the amount of information already possessed by the organization [Galbraith77]. Both of these factors - complexity and uncertainty – can potentially cause other risks. Furthermore, risks are also known to cause other risks. Verhoef et al [Verhoef99] have used a systemic approach to managing risks within the acquisition of service and systems and describe how this approach was elaborated.

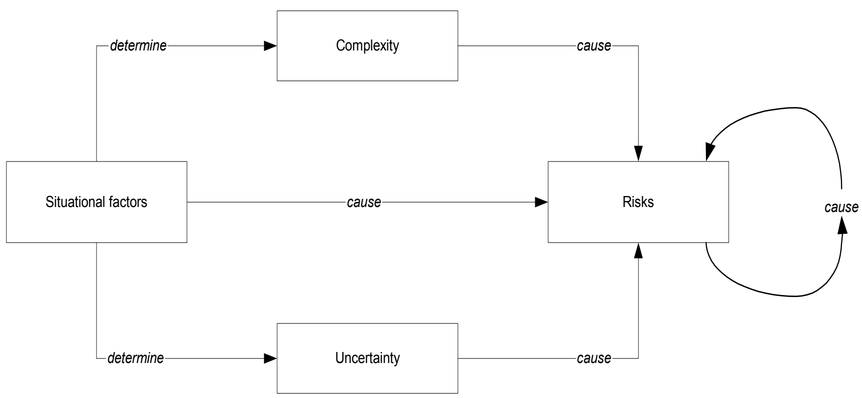


FIGURE 3.1: THE CAUSAL RELATIONSHIP BETWEEN SITUATIONAL FACTORS AND RISKS [Source: Euromethod94]

It is now widely recognized that management is contingency-based. This means that there is no "best" way in which information systems can be managed in all situations, in every organization, under every situation, and at all times. Management of any kind is contingent or dependent, upon the prevailing circumstances or practical situations. Looijen [Looijen98] emphasizes this point when he states that *situational factors determine what management functions need* to be performed. Effective management of information systems requires that managers adapt to the situational and contingency factors and the constraints in force at any particular time, implying that it must embrace both the theory and the practice of management of ICT to be effective and efficient. The design of management, and in particular management that involves risk, must be based on an analysis of the existing situational factors and follow contingency approaches [Ahituv84], [Alter78], [Boehm91], [Davis 1982], [Gibson84], [MacFarlan82], [Ropponen93] and [Saarinen92]. No organization can exist in a vacuum. Each is set in a particular country or region to which it is inextricably linked. This external environment provides a multitude of contexts, which influence the way an organization performs, (how) and what it produces. The external environment is a major contingency variable for two reasons: to survive and evolve, an organization must adapt effectively to the changes that take place in its external environment; and two, conversely, an inability to adapt to the external environment can seriously erode its effectiveness and its ability to grow and this can threaten its very existence. An analysis of the external environment is, therefore, an attempt to understand the forces outside an organization's immediate or proximal environment (boundaries), i.e. those that are facilitating or constraining the performance of the organization.

3.3 Moi University

One of the public universities in Kenya, Moi University (MU), was selected for the case study in this research. Five reasons motivated the researcher to select this university. *One*, the researcher has an intrinsic interest in the institution by virtue of his employment in the institution. As an employee of the institution, he is acquainted with many of its problems, especially in the implementation of information and communication technology. *Two*, it is young (15 years old) and its establishment was based on scientific and technological foundations, to provide scientific and technological solutions especially to rural problems. This provided the researcher with a reason to want to know how, as a scientific institution, it ought to plan, implement, utilize, manage, control and maintain its information systems. *Three*, many donor communities, from within Kenya and overseas, have vested interests in its activities, and support the institution. This research is, therefore, of great interest to donors, as it will enable them to know how well their donations are utilized. *Four*, the success of this research model should lead to multiple beneficial effects for similar organizations in Kenya. *Five*, the study was undertaken at doctoral level, and thus its impact on future curricula and new research initiatives in the public universities should be highly beneficial since this kind of expertise is lacking in the Sub Saharan Africa academic institutions.

3.4 Specific situational factors

3.4.1 Historical perspective

Moi University (MU) came into being in 1984 through an act of parliament following the recommendations of the Presidential Working Party on the Establishment of the Second University in Kenya under the chairmanship of Prof. Colin B. Mackay of Canada, hereafter referred to as the Mackay Report [Mackay84]. Prior to this, Kenya had only one public university, the University of Nairobi, and no private university. It became clear that due to increased demand for higher education locally, and the demand for high level manpower, in both the public and private sectors, which was not being met that an additional university was necessary not just to meet the growing demand for skilled manpower but also to cut down on the high cost of sending young people abroad for tertiary education. The Mackay Report recommended that the new university should, inter alia, *introduce new areas of learning, which would help meet the high level manpower requirements of a modern and technological society.* The working party reported that it had *found overwhelming support in the country for the establishment of a university, which is technically, oriented* focussing on problems of rural development in its training and research programmes. The report also recommended that as a technological university, MU should *develop linkages with other institutions,* both locally and overseas. The working party also recognized that *science and technology must be blended with social and cultural orientation.* These recommendations form the foundation upon which MU was built and acts as its guiding principles for current and future programmes.

3.4.2 The mission and objectives of MU

The mission of MU is to *"produce graduates who are practical, well informed, self reliant, capable of functioning in, and contributing effectively to, development efforts both in rural and urban environments; offer experiences in areas of national development, promote science and technology, without losing track of its commitment to excellence in erudite teaching, research and scholarship" [MU97].* This mission statement provides the rationale behind all activities and processes that take place throughout the university.

The university has defined the following broad functions and objectives to accomplish this mission:

- To provide university education aimed at producing mature and conscientious graduates with the skill, ability, and desire to contribute to the well being and development of the people of Kenya in accordance with the national philosophy of mutual social responsibility
- To provide education for national service and development which reflect the national cultural heritage
- To develop and transmit knowledge and skills through research and training at undergraduate and postgraduate levels, either directly or through the medium of connected colleges, schools, or institutes
- To foster national consciousness and unity
- To preserve, produce process, transmit and disseminate knowledge and stimulate the intellectual life and cultural development of Kenya
- To conduct examinations, and to grant degrees, diplomas and other awards of the university
- To determine who may teach, what may be taught and how it may be taught in the university
- To play an effective role in the development and expansion of opportunities for Kenyans wishing to continue with their education

The university is operating at a time when rapid technological changes are taking place to deal with which place a lot of demand on the university.

3.4.3 Geographical location

Moi University, near Eldoret town, lies about 300 km. to the west of the capital, Nairobi. Due to its elevation (about 2000 metres above sea level) it enjoys a cool climate throughout the year. Temperatures range from 12 - 25 deg. C. It is located between two sharply contrasting types of vegetation: the evergreen forest found near Kakamega to the west and the dry Rift Valley to the east. It is served by a good road network that connects it to other towns such as Kisumu, Nakuru, and Lodwar towards the Sudan, and Kampala in Uganda. The power supply from the national grid (Kenya Power & Lighting Co. - KPLC) is reliable by Kenyan standards although frequent blackouts arising from power surges are common. These affect electrical appliances and systems that depend on electricity such as computers and communications. Telecommunication is provided mainly by the Communication Commission of Kenya (CCK), previously a government monopoly, but one that is now undergoing liberalization through privatization and opening up the market to private investors. The capacity and quality of communication lines are low. Since the university has three campuses, communication and transportation of staff and students between them are serious problems. The area around Eldoret town was previously sparsely populated but due to the establishment of industries, settlements, commercial centres, an international airport, and several public institutions in and around Eldoret, the population is growing fast, and is drawn from many communities in Kenya.

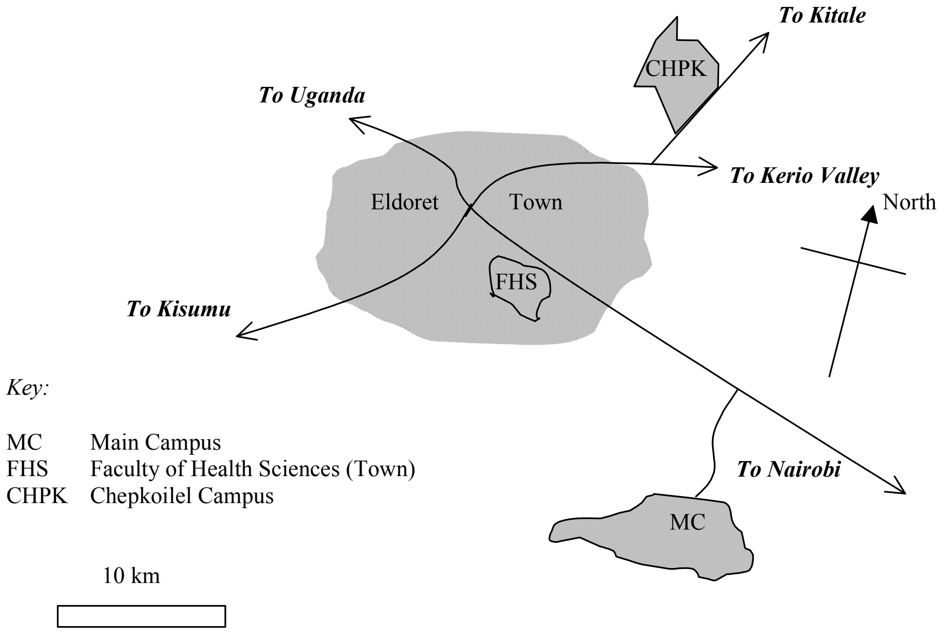


FIGURE 3.2: LOCATION OF MOI UNIVERSITY CAMPUSES

The university has three campuses (illustrated in Figure 3.2), the main campus [MC] is located about 37 km. to the south east of Eldoret town, the Chepkoilel campus [CHPK] is located about 15 km to the north of Eldoret town, while the Faculty of Health Sciences [FHS], is located within Eldoret town.

3.4.4 Size

From the analytical point of view, organizational size, like many other environmental variables, tends to be treated as a control variable; however, studies that deal with size suggest that it is an influential factor that either accentuates or diminishes other relationships. For example, Carter's [Carter84] survey of managing editors of newspapers and Zmud's [Zmud83] study of development groups in organizations found impacts of computer technology to be more pronounced in larger organizations. The size of an organization has implications on the kind of leadership it will have and the way it absorbs regulations [Mintzberg83]. Mintzberg also maintains that small organizations tend to have an autocratic kind of leadership while larger ones tend to have a more democratic kind of leadership. Moi University has a total of about 600 academic staff and about 1300 administrative staff. The number of undergraduate student is about 6000 while post-graduates number about 500. Currently, there are 8 faculties (agriculture [CHPK], education [MC], forest resources and wildlife management [CHPK], health sciences [FHS], information sciences [MC], law [MC], science [CHPK], and technology [MC]), 3 schools (graduate studies [MC], environmental studies [MC], and socio-cultural and development studies [MC]), and 2 institutes (human resource development [MC], and public health [FHS]). The style of leadership is characteristically democratic and relies on consensus in decision-making process.

3.4.5 Sector type

In Kenya, organizations are categorized broadly into two sectors, public and private. By virtue of their teaching and research vocation, universities belong to educational sub-sector, which in turn belong to either public or private sector. Other organizations are categorized as being profit-making or non-profit making non-governmental organizations depending on whether they are commercially oriented or not. Public universities belong to non-profit making organizations since they are not motivated by profit in their activities. A further classification is that some organizations are service-oriented while others are product-oriented. Within the service sector, several sub-sectors exist such as educational, cultural, social, hotel, and transport. Public universities clearly belong to the educational sub-sector within the service sector. Figure 3.3 shows a simple division of organizations into sectors.

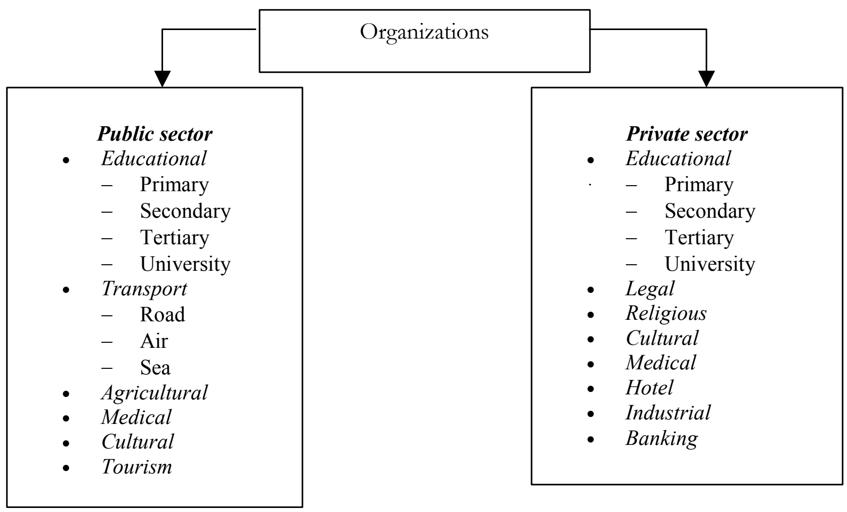


FIGURE 3.3: PUBLIC AND PRIVATE SECTOR ORGANIZATIONS

3.4.6 Organizational culture

Hemmen [Hemmen97] defines culture as the *whole of values, norms, (rites and rituals), opinions, attitudes and visions of reality, that have an influence on the behaviour of companies*, and adds *that usually several cultures can be distinguished in large companies.* Nakakoji defines culture as *the beliefs, value system, norms, mores, myths, and structural elements of a given organization, tribe, or society* [Nakakoji96]. He argues that as long as people stay both physically and conceptually within their native culture, they perceive their way of life as the only possible way; they do not realize the boundary of their own culture until they experience another culture. Based on these definitions, MU can be described as an organization that comprises different cultures brought about by the various groups of employees, students and academic staff drawn from 42 distinct cultural communities in Kenya and others from foreign countries. These groups introduce and try to perpetuate their beliefs and practices into the university environment sometimes positively and at other times negatively. The effects of culture are felt when a group of staff from one ethnic community dominates a department or section. Failure to harness and blend the cultural mix for purposes of conserving cultural heritage is seen as a drawback. Much of the research in ICT is focussed on situations in developed countries, in particular the US and Western Europe [Pinsonneault89, Raman92]], with very little attention paid to situations with different cultural backgrounds and orientation in the developing world. Yet, research in other disciplines such as psychology, and sociology, has shown that groups from different cultural backgrounds display different forms of group behavior [Hofstede80].

There are numerous evidences of culture in organizations and studies [Liebowitz99] show that

- corporate culture has significant impact on an organization's long-term economic performance
- corporate culture will remain an increasing factor in determining the success or failure of organizations in future
- management can force corporate culture to become more performance enhancing, though it may be difficult to do so

For MU, absenteeism from, or late arrival at, a person's place of work, taking long periods of time to perform simple tasks, is commonplace. At the end of the day, often a person in reality accomplishes very little in terms of productivity. The implication of this is that there is lack of appreciation for the importance and value of time, few incentives, a lack of reward for hard work, and a lack of close supervision. The end result is general apathy, which has become a corporate culture. The positive corporate culture that values time, rewards commitment to work and develops a sense of belonging, has yet to be cultivated. Organizationally, this lack of positive work ethics is viewed as a serious setback to the successful implementation of ICT projects in the university. The situation requires change and the creation of a new culture.
According to Liebowitz, creating a new performance-enhancing culture requires

- leadership from the top
- motivation and convincing from top management
- sharing of values of top management
- behavior and practice change
- continuous communication among leaders to preserve the emerging culture, which may take from 5-15 years to create

The crucial role top management plays in creating a new culture is clearly evident.

3.4.7 Organizational structure

The governing body of the university is the University Council, which is chaired by the University Council Chairman. The day to day running of the university is invested in the Vice Chancellor (VC) who is assisted by the Deputy Vice Chancellor (DVC). They are both located at the main campus. A principal heads the Chepkoilel campus while a dean heads the Faculty of Health Sciences campus. Deans or directors head the 12 faculties, schools and the institute. Below the deans come the heads of the academic departments. Illustrated with aid of Mintzberg's logo, MU organizational structure is depicted in Figure 3.4.

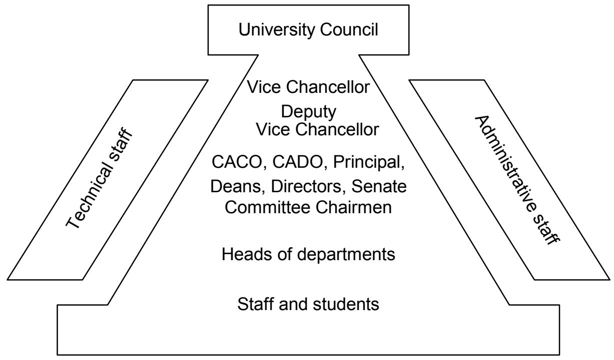


FIGURE 3.4: MU ORGANIZATION STRUCTURE

The university is divided into 2 divisions: Academic division, headed by the Chief Academic Officer - CACO, and the administrative division, headed by the Chief Administrative Officer - CADO. The former division deals with all academic matters in the university, namely teaching, research, student discipline, and examinations, while the administrative division concerns itself with financial, personnel and other purely administrative functions that support the running of the university. These include processing salaries, providing transport for staff, processing student admissions, and dealing with general personnel matters.

In addition to the 2 divisions stated above, the university has set up various committees to help it achieve its objectives. These committees include the following:

- The University Council, i.e. the overall governing body
- The Finance and General Purposes Committee
- Buildings and Development Committee
- Appointments and Promotion Committee
- Disciplinary Committee
- Sealing Committee
- Honorary Degrees Committee
- Senate and its Standing Committees

From time to time, various *ad hoc* committees are established to deal with specific issues and submit reports to the standing committees responsible after which they are disbanded. Issues such as student action, which occurs from time to time, are considered part of contingency factors and are dealt with in this manner. At faculty and departmental levels, various committees and sub-committees of different types exist to perform various functions. Membership of these committees is drawn from the relevant divisions, sections, faculties, or departments in accordance with their respective requirements. In some cases, government officials, students and staff are represented.

3.4.8 Power and decision-making process

At MU power revolves around the offices of top officials and certain influential personalities, including the vice chancellor (VC), deputy VC, CACO and CADO. Two important organs also exercise power, the *university council* and the *senate.* The latter organ concerns itself with academic matters in particular and other related matters in general while the former deals with all matters referred to it by the senate for approval.

These two organs have already been cited in the organizational structure in Sub-Section 3.5.7.

3.4.9 Technology environment

Two factors in relation to the technology environment are considered for MU, computer literacy and management of information and communication technology.

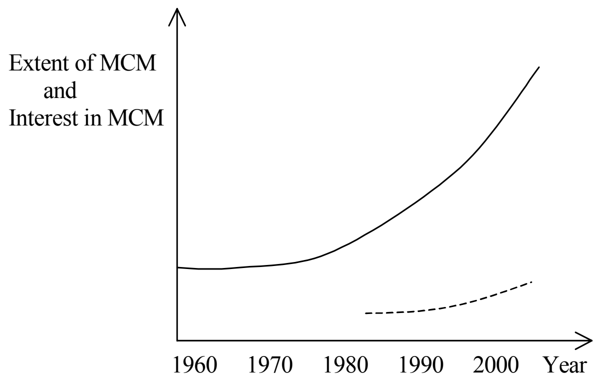
- *Computer literacy*

The low computer literacy among staff and the disparities among the departments in terms of ICT resource distribution, add to the complexity of the ICT situation. In an early survey, intended to gather data on user computer literacy among the administrative staff, it was found that the majority of senior staff had a lower computer literacy rating than junior staff members. The university has embarked on an aggressive computer literacy training programme supported with funds from donors such as the World Bank, MHO and the British Government for its entire management staff. Furthermore, requirements imposed on staff for computer literacy certification as a condition for promotion creates an atmosphere of competition, however, there is general dissatisfaction with the provision, availability, maintainability and serviceability of information systems. These user requirements constitute the ICT related issues examined in Chapter 4.

The rapid technological developments that characterize the present era have left a great impact on public institutions in Kenya. The winds of technological change keep blowing in the direction of public universities as they do in those of other organizations, not only in the developed world but also in the developing world. The Internet and the World Wide Web (WWW) now play a significant role in the transfer of technology, however, although the kinds of hardware and software that MU has are comparable to those found elsewhere in the developed world, technology absorption is slow and has yet to be fully internalized. Lack of funds represent a serious obstacle in the process of technology adoption, utilization and management. For example, due to lack of funds, the university is not able to replace the old ICT resources, such as Intel 80286, and 80386, first acquired in early 1980s and instead tries to maintain both the old and the new technology that now includes Intel 80486, Pentium, Pentium II and Pentium III, thereby creating a complexity that is increasingly becoming difficult to sustain. The university has achieved a high degree of development with respect to ICT, in particular the acquisition of hardware and software and the setting up of local area networks (LANs) mainly as donations. The linking of the three campuses using a radio network is particularly important due to the fact that there was previously a serious lack of inter-campus communication.

- *Management of information and communication technology*

The management of information systems is a key component of successful implementation and utilization of ICT in an organization. [Looijen98] addresses the question of the necessity for management, control and maintenance (MCM) of information systems by maintaining that ICT budgets are growing exponentially. The rapid changes in technology, economy, and organization, also present a challenge to many organizations. Consequently, MCM of ICT has become an indispensable discipline, attracting a great deal of attention and interest and gaining in prominence in ICT field.



Key:

________ MCM of ICT in the developed world

--------- MCM of ICT in Kenya (based on author's perception)

FIGURE 3.5: GROWTH OF INTEREST IN MCM
(MODIFIED FROM [LOOIJEN98])

While Figure 3.5 represents the estimation of the situation in the developed world, the position in Kenyan public universities has only just began to be felt, partly due to the recent influx of ICT products and the effects of globalization. Currently, management of ICT in Kenya is still low compared to the situation in the developed world, but interest is gradually picking up.

3.5 Generic Situational Factors

3.5.1 Stakeholders

In pursuit of its objectives, the university vigorously pursues teaching, research and other related activities in its entire academic programmes supported by administrative activities. The departments and faculties develop academic programmes, and these are discussed and passed through the Senate. This requires much coordination. The university also encourages the forging of collaborative links between the faculties and departments, and other universities and research institutions both locally and internationally. The following are examples of local links:

- Kenya Forestry Research Institute (KEFRI),
- Kenya Agricultural Research Institute (KARI)
- Kenya Medical Research Institute (KEMRI)
- Kenya Seed Company (KSC)

International links include the following:

- DAAD (German aid agency)
- CIDA (Canada)
- Ford Foundation (USA)
- United Nations Environmental Programme (UNEP)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- University of Linkoping (Sweden)
- Indiana University (USA)
- Maastricht University and Delft University of Technology, both in the Netherlands under the MHO program.

A number of the stakeholders have established projects in the university through which staff, both academic and administrative, have been trained, equipment and other materials procured, and networks set up, but as the university is relatively young, its research activities are still at an embryonic stage. Each faculty or department develops and conducts its own research programme supported by donor funds and/or the committee of deans.

In addition to the above collaborative academic and research linkages, MU has established commercial and consultative links with local communities to which it provides and in return it receives goods and services in pursuit of its stated objectives of providing services to the local communities. The secondary schools and colleges countrywide also hold some interests in the university. Other public universities in Kenya as competitors for funds, staff, and students are clearly stakeholders in whatever takes place in the university.

3.5.2 Electrical power supply and distribution

ICT relies on stable supply and distribution of electrical power. In Kenya, as in many other developing countries, power supply is limited to mostly urban areas (92%) especially to industries requiring power and to providing electricity to homes more cost-effectively due to high concentrations of populations in urban areas. In rural areas, the situation is different. Few areas, 8% of the population [*DN* May 2000], are supplied with electricity despite much effort being put into this project by the government. In addition, the sources of electricity, which are mostly *hydroelectric*, and to a small extent *geothermal electric*, are few, have limited power and, for hydroelectric, are seasonal. A small percentage of power is imported from Uganda. During the long dry season, when the level of water is low, power rationing becomes the norm. This affects industries and institutions alike. In addition, the erratic and unstable nature of the power supply affects many electrical appliances such as computers. For this reason many organizations spend a lot of money on uninterrupted power supply (UPS) units and maintaining the damaged ones; a small number of organizations have their own standby generators as a strategic measure to provide continued service. The power sector has, however, been liberalized, so that various private companies have now been established to supply electrical power to supplement that which is produced locally, and with this development the situation is likely to change in the near future. In this respect the KenGen Company has been created to oversee the generation of electricity in the country. The distribution of electricity is the responsibility of Kenya Power and Lighting Company (KPLC), which is state owned.

3.5.3 Telecommunication infrastructure

The telecommunication sector in Kenya is the responsibility the Communication Commission of Kenya (CCM). Prior to 1998, the defunct Kenya Posts and Telecommunication Corporation (KPTC), a state corporation was the sole provider of basic telecommunications services and the X.25 data services (KenPac). Now the sector has also been liberalized and there are private companies entering the market.

Kenya's telephone network has about 400,000 lines for 28 million people. The quality of the network has improved substantially over the past few years and recently KPTC modernized the national and international digital leased line service (KenStream). It has also established a VSAT (Very Small Aperture Terminal) network called KenSat for outlying areas, which will be able to connect to the public switched network and KenPac or KenStream. With the decline of the analog system, the digital network now serves all areas. Mobile telephones have also made their debut in Kenya and the sector is expanding fast. Kenya hosts the African Advanced Level Telecommunication Institute (AFRALTI), an intergovernmental International Telecommunication Union (ITU) Anglophone sub-regional training centre. In addition, there is a local training institute, Kenya Communications Institute (KCI), which provides local training in telecommunications, while the Gilgil Telecommunication Institute (GTI), assembles and produces telecommunication equipment, such as modems, handsets, for the local and regional markets. With the liberalization of the market and the establishment of Internet Service Providers (ISP), access to the World Wide Web (WWW) is becoming common, but many people still have neither telephones nor electricity in their homes, and this is a limiting factor for their access to the WWW. Fewer still are those who can afford a personal computer (PC).

3.5.4 Integration of voice, video and text

It is now possible for voice, video images and text to be transmitted over the communication network, however, due to the low capacities and high cost of leased lines, rate and volume of transmission are still restrictive. In addition, many people still cannot access the Internet due to several factors, including high levels of poverty, poor infrastructure, and restrictive tariffs. As a consequence, the Internet and WWW are not accessible to many, especially in the rural and small urban areas. Yet the concept of electronic commerce (e-commerce) has started to receive widespread attention, especially in large towns like Nairobi, Mombasa, Kisumu and Eldoret.

3.5.5 Striving towards standardization

Kenya is a signatory to international standardization treaties, including ISO. To this end it has established the Kenya Bureau of Standards (KEBS) to oversee and control the quality of manufactured products, pollution, technical services, food processing, and so on. In the food industry, for example, the challenge is to upgrade food-processing units to ISO 9000 standards and implement TQM or Total Quality Management. The Kenya Bureau of Standards and the Federation of Kenya Employers (FKE) have initiated ISO 9000 and TQM awareness so that Kenyan companies are as good as any in the world and Kenyan products from these companies can readily enter sophisticated markets of the West [Bushan98]. Two other programmes in the same direction are:

- Good Management Practices or GMP for raw material control and final product inspection except for the multi-nationals following practices from their parent companies.
- Hazard Analysis Critical Control Point (HACQP) which is of great importance in hotel industry, fish processing, dairy and meat industry.

In public universities, standards of teaching are maintained through a system of examinations, which are monitored both internally and externally. For tertiary colleges and secondary schools, a national examinations body, Kenya National Examinations Council (KNEC), sets and administers examinations, including examinations in computer studies.

In the ICT sector much still has to be done, for example, there are no standards set to monitor the quality of ICT and management of ICT. This thesis aims to address part of this problem.

3.5.6 *Sociological/cultural environment*

Kenya has 42 ethnic communities each with its own language. *Kiswahili* is the national language and most Kenyans can communicate in this language, while English as the official language is spoken widely by many Kenyans. Due to their great cultural diversity, there exists at the university a cultural mix that at times adversely affects its performance. The more dominant a particular community is in a department /division the greater the cultural effect of staff members on the workplace practices.

3.5.7 *Economic environment*

The structural adjustments that were introduced in the mid 1980's and continue to the present day have had a great impact on the economy mainly due to the withholding of funds by the World Bank (WB) and the International Monetary Fund (IMF). The rate of inflation since 1991 has averaged about 20.3 % per annum while GDP over the same period averaged only 2.5 % per annum. Opportunity costs in terms of revenue from tourism caused by lack of good governance, negative publicity and lack of investments, and so on, are high.

The Kenya economy has not been performing well in the last 10 years, according to published figures [ES98], [CBSK97, [*DN*99]. Table 3.1 and Figure 3.6 below show the percentage rates of inflation and the Gross Domestic Product (GDP) for the period 1990-1999.

Year	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Rate of inflation	-	19.6	27.5	46.0	28.8	1.6	9.0	10.0	6.6	3.5
Gross Domestic Product	4.3	2.1	0.5	0.2	3.0	4.8	4.6	2.3	1.8	1.3

TABLE 3.1: INFLATION AND GDP IN KENYA: 1990-1999
(Source: [CBSK97], [DN99], [DN00], [ES98], [PANA00]).

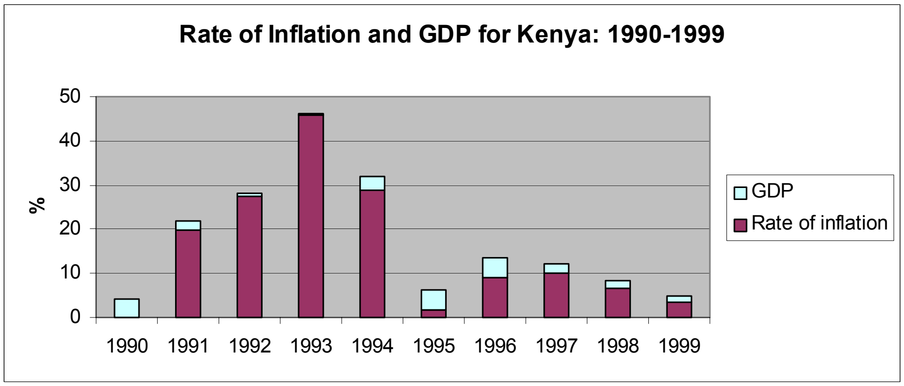


FIGURE 3.6: RATE OF INFLATION AND GDP FOR KENYA
(Sources: [CBSK97], [*DN* 99], [ES98], [PANA00]).

Unemployment in 1998 was 50% of all employable adults, while the percentage of the population living below the poverty line was recorded as 48% [Bushan98]. The poor states of the infrastructure, roads, railways, airports, due to bad weather, poor maintenance and neglect also contributes to the poor performance of the economy. The effects of AIDS epidemic have added to the problem as it hits hard the more productive members of the society in the age group 19-49.

3.5.8 Political environment

In Kenya the president appoints all vice-chancellors of public universities. This constitutional provision has its drawbacks, however, as these officials are regarded as being pro-government.
In addition, the government provides funds to meet operational costs such as payment of salaries for employees in the public universities through the Commission for Higher Education (CHE). The level of this funding, however, has been dwindling and is expected to continue to fall in the foreseeable future. This forces public universities to consider other income-generating activities to supplement dwindling funds and to manage its various systems, including information systems more efficiently and effectively.

On the political front the country changed from a one-party state to a multi-party system in 1992 and this opened the way for competitive politics. More political reforms are expected as the country's constitution goes through a review.

3.5.9 Regulatory/legal environment

Public universities in Kenya are established by acts of parliament [MU97]. University statutes govern the organizational structure and establish the various offices of the university including the vice chancellor, deputy vice chancellor, principals, deans of faculties and so on. Structural changes in the universities can only be effected through established procedures. On technology development, the lack of a clear national ICT policy to provide a legal framework for the development of ICT is a serious hindrance to this fast changing sector. A national ICT policy, established by the government, can serve as a guiding principle, and adopted by public universities and other organizations, to influence and determine decisions related to ICT development and utilization.

3.5.10 Labour unions

Labour unions in Kenya provide the means and mechanism for workers to represent their interests to their employers and the government, and in the event of disputes seek redress in courts of law. Several labour unions have been registered, which represent various sectors of the economy such as transport, local government, teaching, agricultural, institutional, including technical staff, and so on. All labour unions are members of an umbrella union called the Central Organization of Trade Unions (COTU). However, labour laws and agreements are commonly ignored due to the poor performance of the economy.

3.6 Pilot study

The above sections give an indication of MU in terms of its situational / contingency factors against which ICT has been introduced. Since little or no literature on computer usage and its impact on end-users in such an environment exists, and to gain some insight into ICT related issues at MU and establish if a special study was feasible, a pilot study was conducted in the early stages of this study. The pilot study consisted of interviews and a questionnaire (See Appendix A) using the approach advocated by [Remenyi93] and the management issues suggested by [Looijen98].

The interview questions were targeted at the top university officials, i.e. the vice chancellor, deputy vice chancellor, chief administrative officer, chief academic officer, finance officer, university librarian, Chepkoilel campus principal, and the faculty of health sciences dean. The main objective of the interview was to determine the level of top university commitment and support for ICT development and utilization in the university.

The questionnaires were used to solicit information from the MU administration staff, i.e. middle level and operating level administration, spread over its three campuses, main, Chepkoilel, and faculty of health sciences. The main objective of the questionnaires was to determine the level of user awareness regarding their requirements for ICT in their workplaces using the 5-point Likert scale.

Results of the pilot study

- *Interviews*

Results from the interviews indicated that the top management officials of the university were not only aware of the key role the information and communication technology played in the university but also they were very supportive of its widespread use. This position was corroborated by the fact that the top ten officials of the university, including the vice-chancellor, his deputy, and the chief administrative and academic officers, had undergone a computer literacy course organized in-house. They spelt out the strategies they had planned for ICT development and utilization in the university, which included expansion of facilities; training of all staff in computer literacy, and improving terms of service to attract and retain the scarce ICT qualified personnel in Kenya. Some of these strategies have since been accomplished through the implementation of World Bank and other donor funded projects.

- *Questionnaires*

Out of a total of 100 questionnaires sent out to respondents in the middle and lower level cadre of administrative staff, a total of 43 were returned, giving an acceptable response rate of 43%. Part of the reasons for non-response from 57% of the questionnaires was attributed to the organizational culture, lack of interest, the novelty of the research as respondents were not accustomed to this kind of research, and partly the length and detailed nature of the questionnaire.

The responses indicated that the average number of years the respondents had used a computer was 1.3 and the average number of years working with a network was only 0.4, clearly showing that the problem of computer literacy at the time of the interview was significant. Of those few cases that had some computer skills, 11 (or 26% of respondents) acquired their training in computer literacy from self-study, and 17 (or 39% of respondents) attended some formal training, normally from one of the several private training centres that have sprung up in major urban areas. The rest of the respondents, 15 (or 35% of respondents) were computer illiterate. The average length of training in computer literacy was 10.5 weeks and most of this training (25 cases or 58.1%) was at an elementary level. Only in 4 cases was the computer literacy training at higher-level cases (2 at intermediate and 2 at advanced levels).
The average length of time per week spent on using a computer at the work place was found to be 5.3 hours, and given that only a small number of users had access to computers this gives cause for concern. The majority of the users were secretaries in administrative departments who used PC mostly for word-processing. Very few other

application software were used (spreadsheet - 3 cases, and databases - 2 cases). Asked whether PC's were useful or not, an overwhelming number of them (42 or 97.7%) agreed in the affirmative and only one (or 2.3%) disagreed.

Although the university has developed an information technology policy plan, many of the respondents (25 or 58.1%) said they were not aware of its existence. This indicated that users were either not involved in its preparation, or the university has not disseminated its contents to existing and potential end-users.

Regarding the information systems that end-users were using and the ones that they required respondents indicated the following attributes, privacy of personal data, integrity of personal records, the right of access to their personal data, restriction of access to personal data to only authorized persons, confidentiality of personal data and protection of identities of individuals, clearly the respondents are aware of their own personal records. The results of the study on personal records are summarized in Table 3.2. The low values on the 5-point Likert scale corresponding to CURRENT as opposed to higher values for REQUIRED indicate that users have a clear perception of their concerns regarding what they have and what they believe they ought to have. In either case, responses ranged from 1 (strongly disagree) to 5 (strongly agree), with 3 being neutral.

	SUMMARY OF RESULTS							
	MC		CHPK		FHS		COMBINED	
ATTRIBUTE	current	required	current	required	current	required	current	required
Privacy of personal data	2.84	4.38	2.90	4.20	1.00	5.00	2.76	4.38
Integrity of personal records	2.70	4.54	2.73	4.40	1.50	5.00	2.64	4.54
Right of access to personal data	2.58	4.56	2.91	3.50	3.00	5.00	2.70	4.32
Authorized access to data	2.60	4.65	3.42	4.36	3.67	5.00	2.94	4.32
Use of personal data	3.23	4.83	3.80	4.50	4.33	5.00	3.46	4.75
Protection of individuals identities	2.83	4.45	2.90	3.40	3.00	5.00	2.86	4.20

Key:
MC Main Campus
CHPK Chepkoilel Campus
FHS Faculty f Health Sciences

TABLE 3.2: CURRENT AND REQUIRED INFORMATION ATTRIBUTES CONCERNING PERSONAL DATA

With regard to information systems users indicated that they were concerned about the shortage of, and/or the low opinion they held about the current information systems. Similarly, by indicating high values for the kind of information systems they required, they showed that they were keenly aware of their own needs.

On whether the end-users were aware of the constraints that their organization faced in providing them with adequate information systems, respondents again gave their opinions on 16 items, which are shown in Table 3.3. In this particular case the Likert scale ranged from 1 (least likely) to 5 (most likely). Lack of information policy plan was used to triangulate similar data asked for elsewhere and it indicated that the users were clearly not all aware of the existence of the information policy plan.

CONSTRAINT	MC	CHPKL	FHS	COMBINED
1. high cost of hardware and software	4.28	3.50	3.67	**4.05**
2. poor communication infrastructure	3.69	3.40	5.00	**3.71**
3. high cost of ICT training	3.62	3.30	4.00	***3.56***
4. lack of funds for ICT and training	4.08	3.90	4.00	**4.03**
5. lack of priority by top management	3.77	3.70	3.67	**3.74**
6. lack of security for ICT	2.58	2.80	2.33	**2.62**
7. lack of support from users	3.38	3.70	3.67	**3.49**
8. lack of interest from users	2.36	1.80	1.00	**2.11**
9. lack of confidence in users by management	2.52	2.70	3.67	**2.65**
10. uncaring and wasteful attitude	2.62	1.90	3.00	**2.46**
11. lack of ICT management	2.96	3.10	5.00	**3.16**
12. reluctance to change on the part of users	2.69	3.20	3.67	**2.90**
13. lack of clear university ICT policy	3.75	4.30	3.67	**3.89**
14. poor remuneration for ICT staff	3.15	3.40	2.33	**3.15**
15. wide geographical locations of campuses	3.29	1.89	3.67	**2.97**
16. among others (poor work ethics)	4.00	5.00	N/A	**4.17**

Key:

MC	Main Campus
CHPK	Chepkoilel Campus
FHS	Faculty f Health Sciences
N/A	Not Available

TABLE 3.3: MEAN SCORE OF CONSTRAINTS ON A LIKERT 5-POINT SCALE

Regarding the features and benefits of information systems that users currently had compared to those that they thought they required, twenty of these items were given to which the respondents indicated by giving their values on the 5-point Likert scale for each campus, where 1 represented LOW, and 5 HIGH, ratings. The overall indicator of current information system features and benefits is either **good** if the mean values are 3 or over, or **poor** if the mean values are less than 3 on the 5-point Likert scale. The attributes were classified into these two categories by performing an hypothesis testing. For samples of the size returned, 43 out of 100, this can be done by adding two standard errors (s.e.) to the mean values *(m)* of the attributes, achieving the same result as that obtained from carrying out a one tailed t-test on the mean at 2.5% level of significance. Standard error, or root-mean-square, is calculated from $\sigma / \sqrt{n}$, where σ is the standard deviation of the sample, and n the size of the sample [Mack66]. The results obtained were found to be consistent with those reported in similar work [Remenyi93]. These results are summarized in Table 3.4. In each case the mean *(m)*, standard deviation *(σ.)* and standard error *(s.e.)* are calculated. The researcher used the observation method to record the work processes of users and their computers.

Attribute	MAIN CAMPUS			CHEPKOILEL CAMPUS			FHS			COMBINED		
	Cur	***Req.***	***gap***	**Cur.**	***Req.***	***gap***	**Cur**	***Req***	***gap***	**Cur.**	***Req***	***gap***
Acceptance												
1. access to ICT facilities	2.04	*4.56*	***-2.52***	1.60	*4.71*	***-3.11***	1.00	*4.33*	***-3.33***	1.84	*4.59*	***-2.75***
2. Availability of ICT	2.12	*4.58*	***-2.46***	1.91	*4.55*	***-2.64***	2.00	*4.67*	***-2.67***	2.05	*4.58*	***-2.53***
3. Flexibility of ICT	1.84	*4.40*	***-2.56***	2.55	*4.00*	***-1.45***	1.67	*4.33*	***-2.66***	2.03	*4.29*	***-2.26***
4. Satisfaction of ICT	2.52	*4.48*	***-1.96***	1.89	*4.40*	***-2.51***	1.33	*4.00*	***-2.67***	2.26	*4.42*	***-2.16***
5. Control over my job	1.91	*4.76*	***-2.85***	2.73	*4.55*	***-1.82***	2.33	*4.33*	***-2.00***	2.46	*4.92*	***-2.46***
Utilization												
6. Efficiency of ICT	2.52	*4.88*	***-2.36***	2.83	*4.73*	***-1.90***	3.00	*5.00*	***-2.00***	2.66	*4.85*	***-2.19***
7. Effectiveness of ICT	2.65	*4.80*	***-2.15***	2.80	*4.55*	***-1.75***	3.00	*4.50*	***-1.50***	2.72	*4.71*	***-1.99***
8. Accuracy of ICT	3.00	*4.72*	***-1.72***	3.09	*4.50*	***-1.41***	2.67	*4.50*	***-1.83***	3.00	*4.65*	***-1.65***
9. Internal communication	2.43	*4.67*	***-2.24***	2.64	*4.55*	***-1.91***	2.67	*4.00*	***-1.33***	2.51	*4.59*	***-2.08***
10. External communication	2.17	*4.64*	***-2.47***	2.64	*4.45*	***-1.81***	3.50	*4.50*	***-1.00***	2.39	*4.59*	***-2.20***
Maintenance												
11. Adaptability of ICT	2.05	*4.46*	***-2.41***	2.60	*4.08*	***-1.48***	1.67	*4.50*	***-2.83***	2.17	*4.34*	***-2.17***
12. Training in ICT mgt.	2.14	*4.74*	***-2.60***	2.90	*4.75*	***-1.85***	2.33	*4.50*	***-2.17***	2.43	*4.73*	***-2.30***
13. Improved image	2.95	*4.70*	***-1.75***	3.10	*4.17*	***-1.07***	1.67	*4.00*	***-2.33***	2.89	*4.49*	***-1.60***
14. Reliability of ICT	2.55	*4.95*	***-2.40***	3.00	*4.55*	***-1.55***	2.00	*4.50*	***-2.50***	2.63	*4.50*	***-1.87***
15. Durability of ICT	2.52	*4.42*	***-1.90***	2.80	*4.25*	***-1.45***	1.33	*5.00*	***-3.67***	2.50	*4.39*	***-1.89***
Exploitation												
16. Reduced paperwork	2.24	*4.62*	***-2.38***	3.36	*3.80*	***-0.44***	1.33	*5.00*	***-3.67***	2.51	*4.36*	***-1.85***
17. Reduced op. costs	3.12	*4.41*	***-1.29***	2.36	*4.10*	***-1.74***	2.00	*5.00*	***-3.00***	2.42	*4.41*	***-1.99***
18. Advantage of new ICT	2.43	*4.70*	***-2.27***	2.80	*4.22*	***-1.42***	3.33	*4.50*	***-1.17***	2.62	*4.56*	***-1.94***
19. Improved customer service	2.62	*4.79*	***-2.17***	3.00	*4.60*	***-1.60***	3.00	*5.00*	***-2.00***	2.76	*4.81*	***-2.05***
20. Competitive advantage	2.57	*4.65*	***-2.08***	3.09	*4.90*	***-1.81***	3.00	*4.00*	***-1.00***	2.72	*4.69*	***-1.97***
m	2.42	4.65		2.68	4.42		2.24	4.51		2.48	4.57	
σ	*0.35*	*0.15*		*0.44*	*0.28*		*0.73*	*0.34*		*0.29*	*0.17*	
s.e. $= \sigma/\sqrt{n}$	0.078	0.034		0.098	0.062		0.163	0.077		0.065	0.039	
$\sigma + 2$ ***s.e.***	**2.57**	4.71		**2.88**	4.55		**2.57**	4.66		**2.61**	4.65	
Indicator	**Poor**			**Poor**			**Poor**			**Poor**		

Key: *Cur.* = *Current* *Req.* = *Required* *m* = mean σ = standard deviation
s.e. = standard error *n* = *sample size* FHS = Faculty of Health Sciences

TABLE 3.4: CURRENT AND REQUIRED FEATURES OF INFORMATION AND COMMUNICATION TECHNOLOGY PER CAMPUS

It became apparent that a lack of maintenance staff was a real problem. Minor technical hardware or problems easily lead to prolonged computer downtimes. In some cases computers assigned to some departments were not in use due to a lack of qualified personnel to use them. Senior officials had accumulated PCs from various projects and kept them in their offices while their junior officer did without. This indicated a lack of willingness to share resources equitably on the part of the senior officials; however, there were indications that the majority of staff who had PCs in their offices made good use of them and were clearly deriving great benefits from them.

3.7 Emerging research issues

The pilot study for the MU case study was selected with the objective of deriving from it pertinent research issues. The study showed that the introduction of computer technology has created an awareness among the end users and that the top management officials were aware of user requirements. The top officials were also supportive of the development and widespread utilization of ICT in the university. Both groups, however, were aware of the problems that the university faced. Since the ICT situation was shown to be generally poor with regard to the current user requirements, the study indicated the need for the following further research into ICT related issues:

- the real issues including user requirements, university preconditions, situational / contingency factors
- information system characteristics and complexity factors such as geographical locations
- management of information systems
- relationships between various entities, i.e. top management/real processes, ICT, and management of information systems
- the influences
- improving the management processes and other ICT related issues

The study also indicated the need for a model solution to the existing problems. These issues are examined more closely in the subsequent chapters.

3.8 Conclusions

The conclusions of this chapter can be summarized as follows:

- There is a clear causality relationship between situational/contingency factors and risks that needs to be considered when implementing ICT in organizations
- Knowledge of the pertinent prevailing situational / contingency factors, which constitute the environment in which the university exists, is key to successful development, implementation and utilization of ICT
- The situational/contingency factors can be classified into specific and generic factors, with the former class of factors being more specific/pertinent to the university while the latter refer to more general factors that affect other organizations
- The pilot study conducted in the university showed there was need for a solution to the problem of management of information systems in the university
- The pilot study identified ICT research issues, which include user requirements for ICT, preconditions associated with ICT, hardware, software, states of ICT, complexity factors, management of information systems, relationships between entities, and external influences

The main conclusion of this chapter is that there is a need for a model solution to the existing ICT related problems at Moi University, which can be applied in other public universities in Kenya. This conclusion is based on the observation that the other Kenyan public universities are faced with similar problems and depend on the same sources, government and external donors, for financial and other forms of support, they also get their students and staff from the same pool of communities in Kenya. The model solution must, therefore, take into account the requirements that have been identified by the top management officials and end-users. Thus, a two-stage problem must be tackled to realize the solution indicated in this research:

- To develop a model that addresses these concerns using embedded sub-case studies within the main MU case study.

- To apply the model in similar situations in a number of institutions of higher learning in Kenya, for purposes of improving their current ICT situations.

A choice must be made between the status quo, i.e. allowing the technological changes to take place unchecked as it has been the case in the past, and the situation whereby the public universities make deliberate, conscious and concerted efforts to shape the development, utilization, exploitation and maintenance of ICT supported by appropriate ICT policy frameworks and models. The latter approach is advocated in this thesis.

4 Model development

4.1 Introduction

A model for improving ICT management based on existing models is developed and presented in this chapter. The main objective of the model is to facilitate the process of improving ICT services within the context of a public university in Kenya. The motivation to model the improvement of ICT management was based on empirical results from the pilot study made at MU, the case study of this research. There, it was concluded that such a model would be not only be desirable but also beneficial to the institutions of higher learning. The modelling approach discussed in this chapter partly follows the framework proposed by Sol [Sol90], which consists of the way of thinking, the way of modelling and the way of working. In this thesis, the focus is on the way of modelling. According to Vreede [Vreede95], the way of modelling describes the different types of models that are constructed during the modelling study. In this regard, a clear distinction is drawn between *conceptual* models and *descriptive* models. Conceptual models define and mark the boundaries of the issues within the problem area to be focussed upon. Descriptive models allow the analysis, description and diagnosis of the issues, which are useful for leading to deeper understanding of the situation under investigation, to determine what must be done and to offer possible solutions to the problem(s) under consideration [Checkland81]. Based on the classic 'divide and conquer' principle, the model facilitates the division of a situation into smaller parts, using the concepts of input/output process, each part partitioned from other systems using the concept of systems boundary and environment.

The rest of the chapter is organized as follows. The functional specifications that the model is designed to perform when completed are defined and described in Section 4.2. These specifications include *depiction* of the current situation, *qualification* of the current situation, *definition* of the future situation and the *transformation* from the current ICT situation to the improved future situation. A *conceptual* model based on the MCM paradigm, which defines the ICT related issues to be focussed upon is introduced in Section 4.3. The depiction of ICT related issues in the current situation, discussed in Section 4.4 is designed to reveal lucidly and/or describe the ICT issues. A simple criterion of *existence* is used to attain this objective. This is followed in Section 4.5 by a qualification of the current situation based on the criteria of efficiency and effectiveness. Many issues related to development of information systems have in the past focussed mainly on *efficiency*, and in particular on data processing, and much less on issues related to effectiveness of information systems. Use of the criterion of *effectiveness* seeks to redress this imbalance by giving the two criteria roughly equal emphasis. The definition of the required future situation is given in Section 4.6. An attempt is made to look ahead and visualize the situation in which the organization, while dissatisfied with the current situation, wishes to be, given that it is capable of improving itself. The final stage in the improvement process occurs when specific and practical steps are taken, starting with the selection of the ICT issue(s) to be improved, and ending with the attainment of the goal or objective of the improvement process. This process is covered in Section 4.7. To facilitate a speedier and more accurate implementation of this model, and to enhance a wider dissemination of this tool in an institution of higher learning, an automated tool of the same model is developed in Section 4.8. The chapter is concluded with a summary in Section 4.9.

4.2 Functional specifications of the model

In this section an attempt is made to provide an answer to the question: what do we want a model of ICT support to do in the public universities? To answer this question, it is necessary to observe that a model is created and used to achieve some stated objectives. Apart form attaining these objectives it is of little use to those who create it or use it. Therefore, a model for the management of ICT and application in institutions of higher learning in Kenya must fulfil four functional specifications, which must be identified as being necessary to accomplish the improvement of ICT management. These functional specifications are:

- **Depiction** of the current (IST) situation
- **Qualification** of the IST situation
- **Definition** of the future (SOLL) situation
- **Transformation** of the IST to SOLL situation

where IST and SOLL are German words for current and future situations, respectively. The functions are illustrated in Figure 4.1.

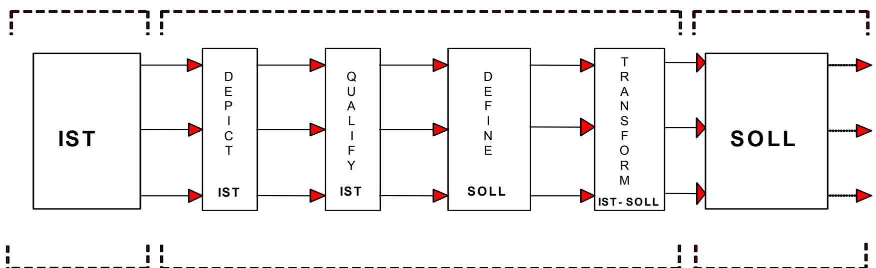


FIGURE 4.1: FUNCTIONS OF THE MODEL

The improvement process must be continuous such that once the IST situation attains the SOLL situation the latter becomes the IST for a new improvement cycle and the process proceeds repeats the cycle all over again, with the current values as input to the next phase. Thus the process is, in essence, recursive in nature. Every effort is made to prevent the situation from deteriorating through continuous monitoring and taking preventive actions.

- **Depiction of the IST situation**

With the overall objective being the improvement of ICT and ICT management in the Kenyan public universities, the first objective is to determine, by way of depiction, what ICT resources and ICT management processes exist in a given institution or part thereof. Depiction of the IST situation takes the form of performing a checklist of issues listed in the model to determine if they exist.

- **Qualification of the IST situation**

The second step is to qualify the IST situation. The purpose of qualifying is to assign values or attributes to the issues that have been shown to exist. In this way it is be possible to determine whether or not the IST situation requires improvement.

- **Definition of the SOLL situation**

Thirdly, having qualified the IST situation the definition of the future (SOLL) situation needs to be defined. The SOLL situation so defined should be one that the organization aspires to be and in comparison must be a better situation that the current (IST) situation.

- **Transformation from IST to SOLL**

The fourth logical step is the realization of the SOLL situation. This is achieved by carrying out a series of specific actions aimed at bringing the current situation to the desired level. In this function, the benefits, costs and consequences of transformation are outlined to draw the attention of the implememnter of the model to possible pitfalls, consequences as well as real benefits of using it.

We will now consider what constitutes the IST situation. To gain an insight into what issues need to be included in the IST situation we employed the management paradigm, which is discussed in more detail in the next section.

4.3 Creating a preliminary model

In this section we present a process in which we create a preliminary model, which forms the basis of the model envisaged in this study. The process of creating the preliminary model relies partly on the results of the pilot study covered in the previous chapter and partly on the conceptual models developed at Delft University of Technology, Department of Information Systems and Software Engineering (ISSE). It was concluded in Chapter 3 that a model approach was required to address the problem of ICT management in public universities in Kenya. We also need to augment the findings with proven models in the process of model development envisaged in this research. The results from the pilot study are only indicative of the underlying problems in ICT management in public universities and do not constitute a model. This step is necessary to strengthen the end result, which is a model for improving ICT management in Kenyan public universities. In attempting to create the preliminary model we needed to carry out the following activities:

- Create a comprehensive framework of issues from established models and from the pilot study
- Select from the comprehensive list and retain a prioritized list of issues based on relevance and limitations of the research

From the pilot study it is clear that, from the point of view of users in the university, the requirements summarized in Table 3.4 are critical and give us the direction in which the research should proceed.

Using proven models, similar issues have been researched and shown to be relevant to ICT management. Such issues include preconditions that must exist before any meaningful ICT management can be contemplated. Also, user requirements need to be well defined and formulated within an environment that consists of a variety of situational factors since the management of ICT is contingent upon these factors. Yet ICT facilities consist of components with characteristics and they in turn exist in well-defined states, which need to be determined. ICT facilities are also associated with a host of complexity factors, which need to be understood to implement, utilize, exploit, manage and maintain ICT successfully. A distinction must be made between the term complexity as it is understood in mathematics and its usage in ICT management. In mathematics, complexity is a property of both real and imaginary numbers. In ICT management, however, complexity is a property of only the real world issues related to ICT. Understanding the tasks and processes and what they are composed of, including complexity factors associated with them, becomes critical to successful utilization, exploitation and maintenance of ICT. The inclusion of a study of these factors is considered to be vital and a necessary step in the entire process of creating the preliminary model. Various entities in the organization need to be linked together. Many organizations have parts that bear no direct relationships with other parts and this creates weaknesses in the entire enterprise. As organizations do not exist in a vacuum, there is a need to study the external environment to develop strategies that can help the organization to survive in the turbulent world. Thus by examining both strands we can gain a perception of what should constitute a preliminary model. In summary, we create a preliminary model by taking the following steps:

Step 1: Create a comprehensive list of issues in each entity using the management paradigm and the results from the pilot study:

Issues from proven models	**Issues from the pilot study**
• **User Requirements**	***User Requirements***
	Accessibility
Availability of ICT facilities	*Availability (item 2 in Table 3.4)*
Adaptability of ICT	*Adaptability* (*item 11 in Table 3.4*)
Compatibility of ICT facilities	*Internal communication* (*item 9 in Table 3.4*)
Confidentiality of ICT	(*items in Table 3.2*)
Continuity of ICT functions	
Controllability of ICT	*Control (see also item 5 in Table 3.4)*
Exclusivity of ICT	
Flexibility of ICT integrity of ICT	*Flexibility (item 3 in Table 3.4)*
Interoperability of ICT	*Internal communication* (*item 9 in Table 3.4*)
Maintainability of ICT	
Performance of ICT	
Portability of ICT	
Reliability of ICT	*Reliability (item 14 in Table 3.4)*
Robustness of ICT	*Durability (item 15 in Table 3.4)*
Safety of people	*Lack of safety/security (item 6 in Table 3.3)*
Security of hardware, software, data sets	*Lack of security (item 6 in Table 3.3)*
Transparency of use of ICT	
User-friendliness of ICT	

Expanded list of issues

Comparing and contrasting the list of issues obtained from the two sources indicated above, it was concluded that the list needed to be expanded to cover additional issues from which to select those to be incorporated in the preliminary model. The additional issues thus include:

- **Preconditions**

  Preconditions are statements in a policy framework of user requirements formulated by senior management and include:
  - information policy and plan
  - centralization and decentralization of activities
  - centralization and decentralization of hardware and software
  - concentration and de-concentration of hardware and software
  - financial resources

- hardware and software supply lines and sources
- personnel allocation
- safety and security directives
- standardization directives
- service level agreements.

- **Situational factors**

  Situational factors, also called contingency factors, are the aggregate of biological, psychological, and socio-cultural factors acting on an individual or group to condition behavioral patterns. In an organization, situational factors influence the ways in which ICT is managed. Consequently, recommendations, directives, principles and rules are not formulated without reference to the situational factors. We distinguish between two types of situational factors:
  - Specific factors include age, size, location, technology environment, culture, communication infrastructure
  - Generic factors include stakeholders, electric power supply and distribution, communication infrastructure and digitization, integration of voice, video, and text, striving towards standardization, socio-cultural environment, economic environment, political environment, legal framework, labor unions.

- **ICT components**

  ICT is defined as a consisting of five components:
  - hardware i.e. PCs, printers
  - software i.e. basic, application
  - data sets
  - procedures
  - people

  Each ICT component has its static characteristics, which do not change significantly with time, while implemented ICT has dynamic characteristics, which change considerably with time.

- **Network components**

  Network is a collection of PCs connected together by network components such as routers, bridges, hubs, satellite dishes, fibre optics, and cables.

- **State(s) of ICT**

  ICT may exist in one or more of the following states:
  - IPP: Information Policy and Planning
  - D: Development
  - AI: Acceptance and Installation
  - U: Utilization of ICT
  - E: Exploitation of ICT i.e. operational uptime of ICT to meet user requirements and preconditions
  - M1/M2: minor /major Maintenance of ICT initiated from states U / E, respectively

- **Complexity factors:**

  These are factors associated with the level of difficulty encountered in utilizing, exploiting and maintaining ICT, or the way ICT is viewed as separate components. The complexity factors include:
  - quantity of ICT
  - distribution of ICT
  - diversity of ICT
  - dynamics of ICT
  - utilization of ICT
  - ownership of ICT
  - cohesion of ICT
  - functionality of ICT

- **Management of ICT**

  Management of ICT is defined in terms of the following forms of management and processes:

  Forms of management

  These include:
  - functional management, FM, at strategic level, SL, tactical level, TL, and operational level, OL
  - application management, AM, at strategic level, SL, tactical level, TL, and operational level, OL
  - technical management, TM, at strategic level, SL, tactical level, TL, and operational level, OL

  Information Technology Infrastructure Library (ITIL) processes

  Processes are sequenced tasks performed under ICT management forms. ITIL processes are organized in sets which include:
  manager's set, service support, service delivery, software support, networks, computer operations, environmental strategy, environmental management, and office environment. A choice of sets is needed for focus in this research.

- **Relationships**

  Various parts of an organization need to work together in harmony to create a supportive environment. Relationships between the parts are key to understanding and identifying problems related to ICT in an organization. The relationships, shown in *italics*, include how:
  - real business processes *exploits* ICT
  - ICT *supports* real business processes
  - ICT *supports* technical staff
  - management *manages* ICT
  - university management *employs* the technical staff
  - members of technical staff *respond to* user requests.

- **Influences**

  Organizations exist in changing environments, which exert varying pressure and intensity on them. The objective in this issue is to investigate the existence of the following influences in relation to ICT:
  - economic influences
  - managerial influences
  - technological influences
  - donor influences
  - contractual influences
  - organizational influences
  - stakeholder influences
  - inter-university influences.

Step 2: Select from the comprehensive list, and retain a prioritized list of issues based on relevance and limitations of the research. Selected issues are underlined.

- **User requirements**

  - Availability of ICT facilities
  - Adaptability of ICT
  - Compatibility of ICT facilities
  - Confidentiality of ICT (in response to user demand shown in Table 3.2)
  - Continuity of ICT functions
  - Controllability of ICT
  - Exclusivity of ICT
  - Flexibility of ICT integrity of ICT
  - Interoperability of ICT
  - Maintainability of ICT
  - Performance of ICT
  - Portability of ICT
  - Reliability of ICT
  - Robustness of ICT
  - Safety of people
  - Security of hardware, software and data sets
  - Transparency of use of ICT
  - User-friendliness of ICT
- **Preconditions**

  - information policy and planning
  - centralization and decentralization of activities
  - centralization and decentralization of hardware and software
  - concentration and de-concentration of hardware and software
  - financial resources
  - hardware and software supply lines and sources
  - personnel allocation
  - safety and security directives
  - standardization directives
  - service level agreements

- **Situational factors**

  - specific i.e. size, age, location, technology environment, culture, communication infrastructure
  - generic situational factors i.e. stakeholders, electric power supply and distribution, communication infrastructure and digitization, integration of voice, video, and text, striving towards standardization, socio-cultural environment, economic environment, political environment, legal framework, labor unions

- **ICT components**

  - hardware (PCs, printers)
  - software (basic, application)
  - data sets
  - procedures
  - people
  - characteristics i.e. static, dynamic
  - network components i.e. routers, bridges, hubs, satellite dishes, fibre optics, cables

- **State(s) of ICT**

  - IPP: Information Policy and Planning
  - D: Development
  - AI: Acceptance and Installation
  - U: Utilization of ICT
  - E: Exploitation of ICT i.e. operational uptime of ICT to continuously meet user requirements and preconditions
  - M1/M2: minor/major maintenance of ICT initiated from states U/E, respectively

- **Complexity factors**

  These include quantity, cohesion, distribution, diversity, dynamics, functionality, ownership, and utilization

- **Management of ICT**

  Forms of management

  - functional management, FM, at strategic level, SL, tactical level, TL, and operational level, OL
  - application management, AM, at strategic level, SL, tactical level, TL, and operational level, OL
  - technical management, TM, at strategic level, SL, tactical level, TL, and operational level, OL

  Information Technology Infrastructure Library (ITIL) processes

  manager's set, service support, service delivery, software support, networks, computer operations, environmental strategy, environmental management, and office environment.

- **Relationships**

  - real business processes *exploits* ICT
  - ICT *supports* real business processes
  - ICT *supports* technical staff
  - management *manages* ICT
  - university management *employs* the technical staff
  - members of technical staff *respond to* user requests

- **Influences**

  - economic influences
  - managerial influences
  - technological influences
  - donor influences
  - contractual influences
  - organizational
  - stakeholder influence
  - inter-university influence

Carrying out the above steps resulted in the preliminary model denoted by $\mathbf{M_0}$.

Summary of issues in the preliminary model, $\mathbf{M_0}$

- **Requirements**

  - Availability of ICT facilities
  - Flexibility of ICT integrity of ICT
  - Maintainability of ICT
  - Performance of ICT
  - Reliability of ICT
  - Security of hardware, software and data sets

- **Preconditions**

  i.e. information policy and plan, centralization and de-centralization of activities, concentration of H/W and S/W, de-concentration of H/W and S/W, financial resources, personnel allocation, safety, standardization, service level agreements

- **Situational factors**

  specific i.e. age, size, location, technology environment, culture, communication infrastructure

- **ICT components**

  - hardware (PCs, printers)
  - software (basic, application)
  - network components i.e. routers, bridges, hubs, satellite dishes, fibre optics, cables

- **State(s) of ICT**

  - U: Utilization of ICT

- E: Exploitation of ICT i.e. operational uptime of ICT to continuously meet user requirements and preconditions
- M1/M2: minor/major maintenance of ICT initiated from states U/E, respectively

- **Complexity factors**

  i.e. quantity, distribution, diversity, dynamics, utilization, ownership, cohesion functionality

- **Management of ICT**

  Forms
  - functional management, FM, at strategic level, SL, tactical level, TL, and operational level, OL
  - application management, AM, at strategic level, SL, tactical level, TL, and operational level, OL
  - technical management, TM, at strategic level, SL, tactical level, TL, and operational level, OL

  ITIL processes
  - service support
  - service delivery

- **Relationships (*in italics*)**

  - real business processes *exploits* ICT
  - ICT *supports* real business processes
  - ICT *supports* technical staff
  - management *manages* ICT
  - university management *employs* the technical staff
  - members of technical staff *respond to* user requests

- **Influences**

  - *economic influences*
  - *managerial influences*
  - *technological influences*
  - *donor influences*

The conceptual model, which builds on the above framework, is presented in more detail in the following sub-sections.

4.3.1 The conceptual model

Models can be classified as conceptual or non-conceptual, depending on whether they are based on a concept or not. Further, conceptual models can be descriptive or prescriptive, depending on whether they can be used to describe an object, idea, or event, or prescribe an object, idea or event. Examples of conceptual models include the MCM paradigm, which is at the core of research in the Department of Information Systems and Software Engineering, Faculty of Information Technology and Systems, Delft University of Technology, The Netherlands. The MCM paradigm, Figure 4.2 [Looijen98], or simply the management paradigm, provides the top-level view or concepts of an organization on ICT related issues.

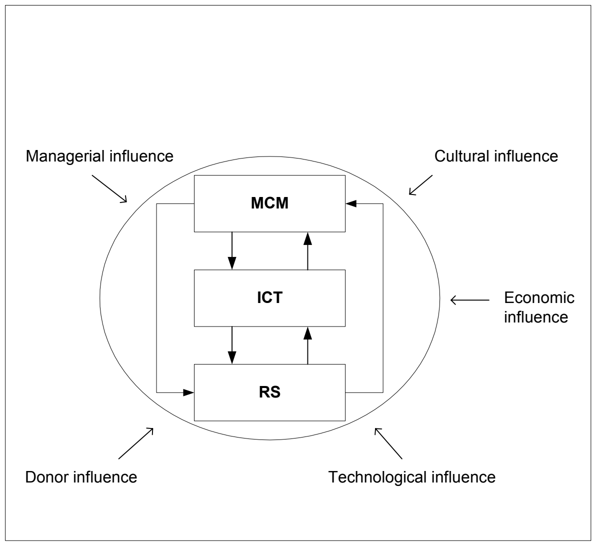
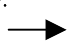
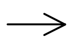


FIGURE 4.2: THE MANAGEMENT PARADIGM

Key:

 *Relationships between entities*

 *External influences*

In this research, the paradigm is used to characterize a worldview, a lens through which we are able see everything [Glazier92]. Essentially, the management paradigm consists of three basic entities: the real system (RS), the information system (IS) or using the modern term information and communication technology (ICT), and the management, control, and maintenance of information systems (MCM). In addition to the three entities, the relationships between entities and the external influences constitute vital parts of the paradigm. In the following sub-sections, we present models of the entities, relationships and the external influences.

4.3.2 Modelling the real system (RS)

In modelling the RS, we adapt the systems perspective on organizations and organizational processes; and according to this perspective, an organization can be viewed as a system of related objects [Ackoff71, Checkland81, and Sol82]. In an organization, one will find people, often referred to as *actors*, equipment and materials used, also called *objects*, and activities that they perform, known as *processes*. In the entity RS critical issues related to ICT are the user requirements for ICT services and resources that they (users) demand from their organizations to support their day-to-day operational activities (processes). From the point of view of users in their working environments, it is the availability of ICT services and resources, the functionality and flexibility and its maintainability, performance, reliability, and security, that really count. These are considered prerequisites for effective performance of users. These requirements exert pressure on an organization to adapt an integral as opposed to an isolated approach to guarantee some measure of satisfaction to users. To realize optimal benefits, the organization should strive towards synergy, transparency and sharing of ICT resources to ensure greatest exploitation, while users, though connected to the same ICT infrastructure, strive towards autonomy to control the availability, reliability, and security of their own ICT resources [Wijs95]. In the same entity RS, preconditions, information policy and planning, policies on centralization or de-centralization of activities, finances and personnel, dictate to a large extent the manner in which ICT usage can be realized. Additional preconditions include policies on concentration or de-concentration of ICT resources, safety, standardization of hardware/software, and service level agreements (SLA). Existing situational factors under which users operate are critical aspects. The situational (or contingency factors) include the organization's age, size, [Mintzberg79], location, technology environment, organizational culture, and general communication infrastructure. These factors must be recognized for the role they play and impact they have on users and accordingly taken into account during implementation and utilization of ICT. The issues and factors cited above can be effectively modelled in the RS entity of the paradigm.

4.3.3 Modelling the information and communication technology (ICT)

In the entity ICT we model the *ICT,* including its *components, the states in which they exist, and the complexity factors within which they are utilized, exploited and managed.* First, we define our perception of ICT as provided by [Brussard80, Sol82, and Looijen98], that is, as *all the hardware with the relevant basic software and application software, datasets, procedures, and persons involved in the control/support of the real system or business processes*. As Land et al emphasize, it is fruitful to think of ICT as not a goal in itself, but as social systems: a complex web of interpersonal relations that produces, utilizes and communicates information [Land83].

As separate items, ICT components exhibit their own individual characteristics, which remain practically constant over a period of time. These characteristics are termed static to distinguish them from dynamic characteristics that are associated with implemented ICT. The concept of performance and behavior characteristics of ICT was first introduced by van Hulzen and De Moel [Hulzen87], from which framework such concepts as availability, continuity, integrity, accessibility, and timeliness were formulated. Then Delen and Rijsenbrij [Delen90] made a distinction between static product characteristics and dynamic product characteristics of ICT. Static product characteristics such as processor speed, memory size, are considered relevant to technical and operational staff while dynamic product characteristics such as availability, responsiveness of ICT, are concerns of the user environment.

The latter characteristics can be seen to vary over a period of time and for that reason require to be controlled for them to continue providing the services required. Among the static characteristics are the size, capacity, and speed of individual components, while the dynamic characteristics include the availability, performance, operability, and reliability of implemented ICT.

The Extended State Model (ESM), can also be modelled within the entity ICT, which essentially describes the life cycle of ICT and the states in which ICT may exist at any given point in time. The *Extended State Model*, see Figure 4.3, consists of the states information policy and planning *(IPP),* development *(D),* acceptance and implementation *(AI),* utilization *(U1, U2),* exploitation *(E1, E2),* minor maintenance *(M1),* and major maintenance*, (M2).*

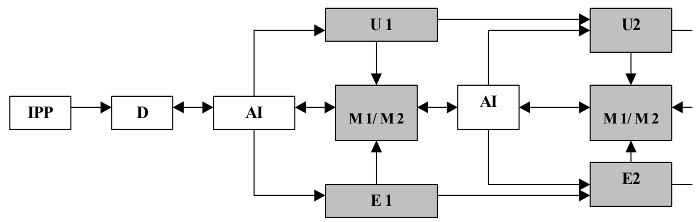


FIGURE 4.3: THE EXTENDED STATE MODEL
(STATES FOCUSSED UPON IN SHADE)

The state IPP is essentially a document that provides a policy formulation framework on the development, implementation, utilization, management, control and maintenance of ICT for the entire organization. The state development (D) represents the realization of ICT in terms of acquisition of ICT resources, training and laying of the infrastructure. The testing and acceptance of ICT by the organization takes place in the state acceptance and implementation (AI). The state utilization (U) involves the users of ICT in their day-to-day activities as they make use of the functions of the information systems. At the organizational level, the state exploitation (E) takes place when the organization takes full advantage of ICT to realize its goals. Whenever there are minor problems or modifications to be addressed concerning users and ICT, these are brought to maintenance (M1) while major modifications regarding the extension of ICT for greater exploitation of ICT from the phase E2 are addressed in the state M2. The states AI, U1, E1, and M1/M2 can be repeated as many times as desired depending on the circumstances. In this research the states U, E, and M are relevant and will be focussed upon as they relate to user requirements more directly than other states.

Complexity factors

ICT exhibits complexities to users and management staff alike, both in its utilization and as separate components. Understanding how it functions under the prevailing circumstances constitutes a difficult problem for many users. Most importantly, comprehending how to manage, control and maintain ICT is not always straightforward for many technical staff members. Eight complexity factors related to ICT management can be identified. These factors relate to the separate ICT components, their interrelations and their usage. The eight complexity factors include the large numbers of ICT resources i.e. quantity, which can differ in type, make or origin, i.e. diversity, and be centralized or de-centralized to a high degree, i.e. distribution, and regularly be subject to changes, i.e. dynamics. Other complexity factors are the variety of functions that ICT can have, which also must be mastered by users and technical staff alike, i.e. functionality, and are supplied by a number of linked components, i.e. coherence. Finally, in a large enterprise, some ICT components may be possessed by different owners, i.e. ownership and users can make different demands and stipulate different preconditions, i.e. usage.

It is instructive to note that an implemented information system need not necessarily have a technical aspect; however, when it does have a technical aspect, it is the social part that plays a crucial role in determining how ICT is utilized [Checkland90]. The various types of information systems or ICT commonly found in a public university i.e. student, financial, decision support, transport, medical, personnel are all subsumed under the term ICT and no special reference is made to any one type in particular.

4.3.4 Modelling the management, control and maintenance (MCM)

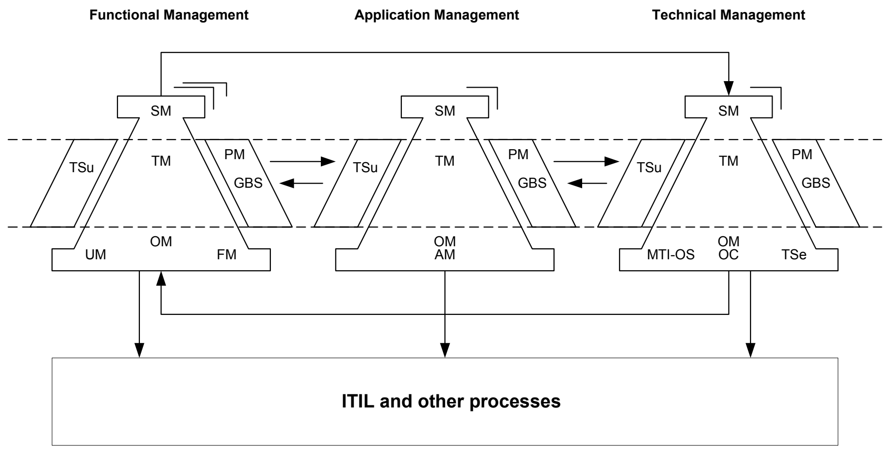
The entity MCM is defined as entailing the management, control and maintenance of implemented ICT in accordance with the requirements and preconditions imposed by the utilization, the situational factors, complexity factors and characteristics of ICT components. The entity offers services most effectively and efficiently, and positively influences the goals of the organization. Three forms of MCM are identified: Functional Management (FM), Application Management (AM), and Technical Management (TM). Their common structure can also be modelled using Mintzberg's logo. These forms are depicted in Figure 4.4.

Functional Management: this involves managing the functional specifications and the functionality of ICT, i.e., all management tasks that are necessary to support and advise user environments within the framework of the utilization of ICT. The level of ICT utilization determines to a large extent the functionality of ICT.

Application Management: this involves the management, control and maintenance of application software and database structures [Wijs95, Looijen98]. Changes can be initiated by faults reported by users, and the need to extend the functionality of the software. The latter is referred to as application software maintenance.

Technical Management: this involves managing the hardware, the technical infrastructure and the systems software, i.e. all the tasks that are necessary to implement, to accept, and to operate the technical infrastructure. Optimization of the technical infrastructure as a consequence of faults, expansion or replacement is also part of technical management.

Within each of the three forms in the entity MCM are twelve task areas distributed in five basic elements – the strategic apex, the middle line, the operating core, the techno-structure and the support staff. The task areas are listed in Figure 4.4. In an organization, there can be a multiplicity of each of the forms of management, a fact that is indicated by dimensions in each form.



Key: task areas

SM	Strategic Management	UM	Utilization Management
TM	Tactical Management	FM	Functional Maintenance
OM	Operational Management	AM	Application Maintenance
PM	Personnel Management	OC	Operational Control
GBS	General Business Support	MTI-OS	Maintenance Technical Infrastructure and Operational Support
TSu	Technical Support	TSe	Technical Services

FIGURE 4.4: FORMS OF MANAGEMENT AND ITIL PROCESSES

ITIL Processes

The Information Technology Infrastructure Library (ITIL) sets of processes [CCTA90] and similar processes developed by different authorities, including Bootstrap and Spice [Kuvaja94], [Kuvaja99], ISO [Emamand98], Trillium [Trillium96], can also be modelled within the entity MCM. In the case of ITIL nine sets of ICT management processes have been developed by Central Computer and Telecommunication Agency (CCTA) of the United Kingdom for use in organizations, in government agencies. These sets have been adopted and are currently widely used in The Netherlands. They include the manager's set, service support, service delivery, software support, networks, computer operations, environmental strategy, environmental management, and office environment. Two of these sets, service support and service delivery, were selected for application in this model to focus on problems of increasing user requirements for quality ICT services. As stated in its introduction [CCTA99], the primary objective of the ITIL is to establish *'the best practices and a standard of IT service quality that customers should demand and providers should seek to supply'.* ITIL processes as well as processes recognized by other bodies bear a close relationship with the three forms of management, functional, application, and technical [Looijen98]. The relationship between the forms of management and ITIL processes can be visualized as illustrated in Figure 4.4.

Modelling ITIL processes

The two sets of ITIL process, service support (Set 2) and service delivery (Set 3) provide the processes considered essential in meeting user requirements. Set 2 processes include *Change Management (CHG), Configuration Management (CONF), Help Desk (HLP), Problem Management (PRB), and Software Control & Distribution (SCD),* while Set 3 processes are *Availability Management (AVLM), Capacity Management (CAPM), Contingency Planning (CONT), Cost Management (CSTM), and Service Level*

Management (SLM). In either case, the order in which the processes are presented is arbitrary.

The processes in the entity MCM can be modelled in a similar fashion as other ICT related issues to reflect their organization and operations. In the following sub-sections we model ITIL's sets 2 and 3 processes.

Set 2: Service Support processes

Modelling the process change management

The purpose of change management (CHG) is to control modifications and to improve the quality, productivity of, and decreasing the cycle time for, service support processes. Change management involves acceptance of change requests, planning and evaluation, and co-ordination and termination of changes. The requests may come from other processes such as help desk, and problem management and may also refer to existing ICT infrastructure and services, or they may come directly from the user organization management to implement new functions as part of the user requirement.

The change management process depends on the accuracy of the configuration data to ensure that full impact of making changes is known. For this reason the process change management bears close relationships with other processes including service level management, problem management, configuration management, capacity management, and software control and distribution. Details of the change management process are documented in SLAs to ensure that users are conversant with the procedures for making requests for change (RFC) and the estimated time between making the requests and the fulfilment of the requests as well as the impact of implementing the change. The details of the change process also ought to be known by the help desk to enable it to communicate with users.

The justification of this process in public universities in Kenya is based on the observation that technological changes take place very often and there is a clear need to be able to keep abreast of the changes when they occur without losing out on quality; however, this process is either not well-established in Kenya institutions or if established it is not enforced, hence and its introduction and application will improve the quality of service to users.

Modelling the process configuration management

The purpose of configuration management (CONF) is to establish and maintain the integrity of ICT resources in an organization. CONF involves identifying the configuration and descriptions of hardware and software at given points in time, systematically controlling changes to the configuration. This process requires that there be no ambiguity regarding the integrity and reliability of all hardware and software resources stored in the form of configuration items (CIs). All CIs are required to be stored in Configuration Management Database (CMBD). Other processes closely associated with CONF are management of CMDB, verification and status control to determine the location and status of which CIs, including are in use, damaged, under repair, on loan, or disposed of. Since CONF is an integral part of all other processes it (the process in question) has relationships with other processes including change management, software control and distribution, help desk and problem management. Change management in particular can be integrated with Configuration Management and as a minimum it is recommended that the logging and implementation changes be done under the control of a comprehensive CONF system and that the impact assessment of changes is done with the aid of a CONF system. All changes should, therefore, be entered in the CMDS and the records updated as the change request progresses through to implementation.

Introducing and implementing the process configuration management will be particularly significant in Kenyan public universities. The process will greatly assist the technical staff involved in the management of ICT, and the university management in determining the location and status of all their ICT services and resources at any given time. Although various departments in public universities keep inventories of ICT and other resources, they vary in form, quality and content. The process will introduce an element of structure and uniformity, which, when enforced, can lead to improvement in maintaining records of ICT resources and services.

Modelling the process help desk

In the strictest sense, helpdesk is an organization rather than a process; however, in this dissertation, it is viewed as a process along with other processes defined by ITIL. The purpose of helpdesk (HLP) as a process is to offer support to users of ICT services. Primarily, HLP must manage, coordinate and resolve incidents as quickly as possible and ensure that no requests are lost, forgotten or ignored. Users' questions, complaints and incidents are dealt with at the HLP, and this involves incident registration, classification and allocation of incidents, investigation and diagnosis, solution and repair, termination, and incident progress control including reporting. Due to the central importance of this process in an organization HLP relates to many other processes including service level management, operations, configuration management, and problem management. *Helpdesk* (or Service desk), viewed as an organization, is *the single point of contact* between the service providers and users. It is also a focal point for reporting incidents and making service requests. Consequently, the HLP has an obligation to keep the users informed of services, events, actions taken, and opportunities that are likely to impact their abilities to carry out their daily activities.

The process HLP in many public universities is still poorly organized, *impromptu* in nature, and uncoordinated. In many cases it is located in a technician’s office where often it is combined together with other technical work. The process is hardly documented, making follow-up of cases increasingly difficult. The introduction of this process in public universities will transform many situations into better-organized centres where incidents are handled more professionally.

Modelling the process problem management

The purpose of problem management (PRB) is to classify incidents and investigates the cause of the problem. PRB involves error identification, problem registration, problem classification, problem investigation, error management, and reporting. To this end PRM can be regarded as proactive in nature. Once a fault or error has been identified a change request has to be drawn up to overcome the problem or failure. As with other processes PRM is related to several other processes including service level management, configuration management, availability management, and change management.

The PRM process requires accurate and comprehensive recording of incidents to identify effectively and efficiently the cause of incidents and incident trends. PRM also needs to liaise with availability management process to identify the trends and instigate remedial actions.

The introduction of ICT in public universities has brought with it many problems from users and technical staff. In many cases there are no specific procedures for dealing with these problems and the result is usually more frustration and a compounded problem. Establishing a PRM process will, therefore, streamline the problem solving tasks and reduce the creation of new ones, leading to more satisfactory fulfillment user requirements.

Modelling the process software control and distribution

The purpose of software control and distribution (SCD) is to deal with the acceptance, management, and distribution of operational software. It can, in this sense, be viewed as an extension of the configuration management; SCD involves management of software library, acceptance tests, distribution, implementation and reporting. As in other cases, SCD bears relationships with other processes including service level management, change management, configuration management, and operations.

Although practiced in a variety of forms, SCD process in many Kenyan public universities is hardly performed in the manner stated here. This form introduces a standard, at present lacking, will lead to better management of software.

Set 3: Service Delivery processes

Modelling the process availability management

The purpose of availability management (AVLM) is to control the availability of ICT services and resources in accordance with the relevant agreements laid down in the service level agreements; AVLM involves the design, planning the availability of ICT services and resources, measurement, and management and control of ICT services and resources, supervision, and co-operation with the problem management to take precautionary measures on a proactive basis. The primary objective of AVLM is to ensure that stated business requirements are consistently met and this requires an understanding of the reasons why ICT services occur and the time to resume the service after disruption.

Problem management provides a key input to ensure appropriate corrective actions are processed. The measurements and reporting of ICT availability ensures that the level of availability delivered meets the service level agreements due to the fact that availability management supports SLM process by providing measurements and reporting.

With increasing demand for ICT services and resources in increasingly complex situations at Kenyan public universities, the availability of ICT services and resources can be a serious challenge. The high demand from users for ICT means that a well organized strategy for making available the few and limited ICT services and resources needs to be developed. This will make availability management an indispensable process in a public university.

Modelling the process capacity management

The purpose of capacity management (CAPM) is to provide sufficient ICT capacity to meet business needs in the right place, at the right time, in the proper quantity, and at justifiable costs. CAPM involves performance management, resource management, demand management, workload control, application sizing and capacity planning. Processes related to CAPM include service level management, operations, and network service management.

The number of staff and students who demand ICT services and resources is increasing rapidly in Kenyan public universities. To meet this demand, given the limited ICT services and resources available, a well-devised strategy is critical if disappointment of users is to be avoided or minimized. The process CAPM offers such a strategy.

Modelling the process contingency planning

The purpose of contingency planning (CONT) is to ensure that there are effective technical, financial and organizational provisions, so that the continuity of ICT services can be guaranteed in case of some calamity. CONT involves risk analysis, risk control, disaster planning, and reporting to inform all parties concerned. Contingency planning is concerned with managing an organization's ability to continue to provide a pre-determined and agreed level of ICT services to support the minimum activities required in the organization in the wake of disruption(s). For CONT to be effective, a study of risk analysis followed by a balance of risk reduction measures such as resilient ICT systems and a robust recovery program with clear options including back-up facilities.

Configuration data is essential to facilitate prevention of disruptions and planning of recovery activities. Changes in infrastructure and business activities should be assessed for their impact on the contingency plans and ICT plans should be subject to change management procedures. The help desk plays a key role in the CONT activities.

The reliability and stability of many services in Kenya, such as continuous supply of electricity, are not guaranteed. Disruptions of services are frequent and have devastating consequences. Standby generators are few and mostly unreliable. In addition, ICT services and resources can become suddenly unavailable due to a variety of other reasons. To guard against such disruptions, a strategy aimed at providing alternative services and resources becomes desirable. The CONT process in the manner defined here, will provide a strategy that will minimize such risks, and where disruptions have taken place, their effects.

Modelling the process cost management

The purpose of cost management (CSTM) is to offer economic data, so that an optimal balancing of price against performance of the ICT services can be realized. CSTM involves drawing up annual estimates and working towards the realization of the estimates. CSTM is responsible for accounting for the costs of providing ICT services, such as e-mail, printing, photocopying, and for any aspects of recovering the costs from the users, referred to as *charging*. To assess true costs this process requires close interfacing with capacity management, configuration management, for data on assets, and service level management. The cost/financial manager liaises with ICT director to discuss ICT budgets and with persons in charge of user relations to communicate the cost information to users.

The cost of ICT services and resources are increasing for Kenyan public universities. Funds needed to cover the cost of hardware maintenance, accessories and associated materials are in short supply. To maintain the quality of ICT services the introduction of a charging system whereby the users agree to meet part of the costs, e.g. for e-mail services, must be devised. For this system to be effective, it must be well managed and supported by appropriate authorities.

Modelling the process service level management

The purpose of service level management (SLM) is to effect service level agreements between the MCM of information systems (ICT management) and the ICT service users, and to see to it that the agreements that are reached are controlled and evaluated. SLM involves the identification of ICT requirements, verification of the feasibility of drawing up of service level agreements, controlling the standards agreed upon in service level agreements and reporting.

SLM is responsible for ensuring that SLAs and other underpinning agreements or contracts are satisfied, or in case of breach of contract, any adverse impacts and effects are minimized. SLM also involves assessing the impacts of change management, before changes are introduced and after the implementation of changes, upon the quality of service and SLAs. An important point to note is that SLM acts as the hinge for the Service Support and Service Delivery processes and because of this it cannot function in isolation from other processes as its existence is predicated upon the effective and efficient working of other processes.

In the context of Kenyan public universities, the concept of service level agreements and service level management, except between organizations and suppliers, are not formally recognized; however, SLM has the potential to play a crucial role in binding and holding the other processes together and ensuring that the quality of service in each process is maintained.

Organization of ITIL processes in an ICT centre

The ten ITIL processes described in this section can be organized in an ICT center to provide quality service to users. An example of such a center is depicted in Figure 4.5. The diagram shows the relationships between the processes and how they relate to vendors (suppliers) and users through service level agreements. To illustrate how the processes are performed in a real life situation, the following scenario is depicted:

(a) the *help desk,* being first line of support, receives a call from a user to report an *incident,* a malfunction or a fault related to hardware and/or software;
(b) if the *incident* cannot be resolved at this point, the *incident* is referred to the process problem management;
(c) the *problem management* process (second line of support) investigates the incident to determine the underlying cause. In this process, a request for change (RFC) may be made if necessary; this activates *capacity management* to assist. Henceforth, the *incident* is referred to as a problem. *Service level management* is informed that an SLA has been violated;

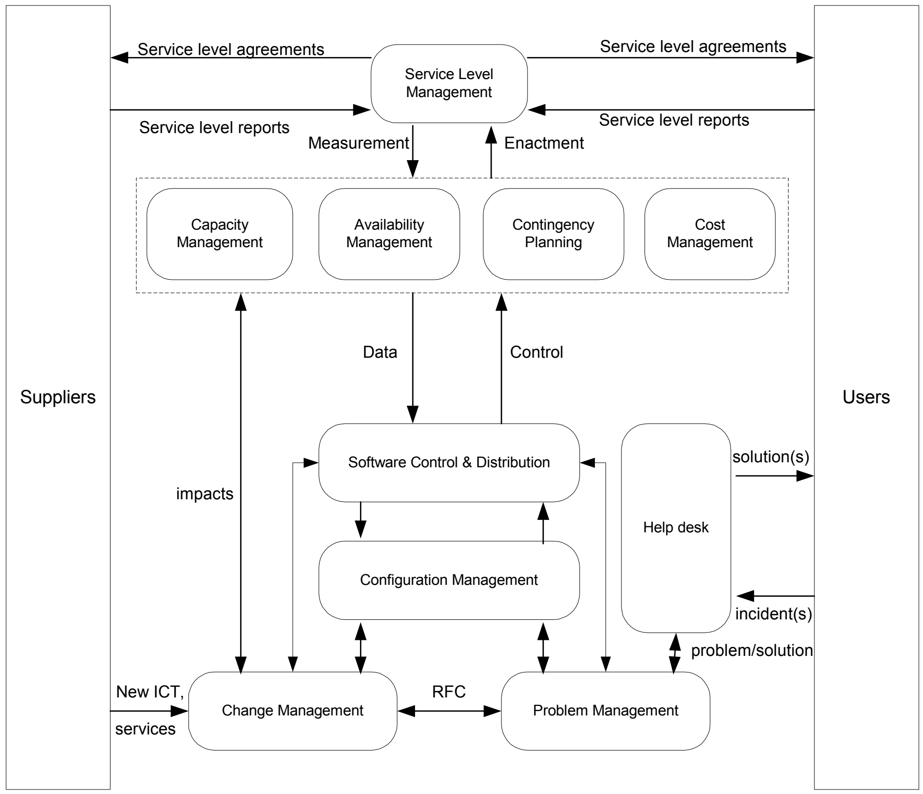


FIGURE 4.5: ORGANIZATION OF ITIL PROCESSES IN AN ICT CENTRE

(d) *the change management* process coordinates the request for change (RFC), which runs in parallel with the process *configuration management(see below). The change management process* determines the impacts of the change on the quality of existing ICT service and on the service level agreements. This relates change management to *Service level management process;*
(e) *the cost management* process assists, through service level management process, with the business cost justification for hardware/software upgrade with suppliers, who then provides new ICT components or services to provide an answer/solution to the problem;
(f) *the contingency planning* process becomes involved in change management process either to ensure recovery of services or maintenance of ICT service at acceptable levels as per SLAs;
(g) *the software control and distribution* (SC&D) controls the implementation of the change by rolling out the replacement hardware and software. SC&D also updates *configuration management* with details of new releases and versions;
(h) *the availability management* process becomes involved in considering hardware/software upgrade to ensure it meets the required availability and reliability levels;
(i) for *configuration management* process, the capacity management, availability management, contingency planning, and cost management processes provide vital data on cost, quality of ICT services, and impacts due to changes. These four processes are also involved in *enactment* of service level agreements between ICT organization and users/suppliers;
(j) *the configuration management* process ensures CMDB information is upgraded throughout.

In implementing new processes in sub-case studies, the centre presented in Figure 4.5 act as a model and example of how an 'ideal' ICT management should be. In this regard processes in the sub-case studies will be compared to the above 'ideal' situation and assessed according to the extent to which they compare.

4.3.5 Modelling relationships between entities

The importance of modelling relationships between and within entities (See Figure 4.6) in the management paradigm lies in its ability to reveal the strengths and weaknesses of the various parts of an organization with regard to ICT issues. These relationships are key to understanding the problems associated with the management of ICT in an organization. Weak or negative relationships among entities within an organization impact on the organization negatively while strong and positive relations impact on the organization in a positive way. Lack of any relationship between entities indicates independence of existence among the entities and this equally impacts on an organization in a negative way leading to poor management while strong and positive relationships result in enhanced ICT management. These relationships can be modelled in the paradigm by the arrows between and among the entities.

Each of the basic entities can be viewed as consisting of sub-entities. In the entity RS, the sub-entity mission/goal of an organization *defines* the sub-entity activity, which in essence *executes* the sub-entity decision(s) made by the management. The decision(s) in turn *guide* the activities performed in the organization. Taken together, the activities *accomplish* the goal(s) and mission of the organization.

In the entity ICT people (users) *utilize* the hardware and software which *process* data into useful information to *support* decision-making and other activities in the organization in the entity RS. In so doing the people (users) use or follow established procedures.

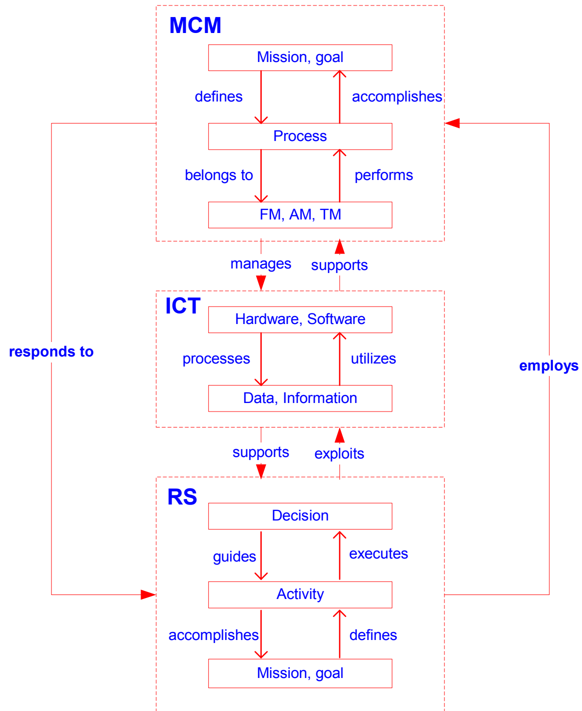


FIGURE 4.6: CONCEPTUAL RELATIONSHIPS BETWEEN AND WITHIN ENTITIES

Key:

Relationship between entities
Sub-relationship between entities

In the entity MCM, technical staff *perform* functional, application and technical management (F,A,T) tasks, and when these tasks are sequenced into recognized processes they *accomplish* the stated mission / goals of the entity MCM. In turn the mission / goals *define* which processes are required to achieve the mission and set goals. The various processes *belong to* one or more of the three forms of management (FM, AM, TM). In this study we equate these processes to ITIL's service support and service delivery processes.

Overall, the entity RS ***exploits*** the new technology in the entity ICT, and in turn the new technology in the entity ICT ***supports*** organizational activities in the entity RS. The resources in the entity ICT also ***support*** the personnel in the entity MCM by providing timely information on their management activities to enable them to take appropriate actions. That is, to achieve optimum levels of ICT management, the technical personnel in the entity MCM ***manage*** ICT partly by monitoring deviations from the norm, scanning both the internal and external environments for signs of deviations from the norm or improvement in ICT and taking preventive (proactive), corrective or any other appropriate actions necessary to maintain quality of ICT service in their organizations. Finally, the entity RS ***employs*** the entity MCM to manage its resources in the entity ICT and in turn the MCM ***responds to*** requests or inquiries made by users in the entity RS.

It is considered desirable that the goals of entity MCM should be aligned to the goals of the entity RS for effective and efficient management and utilization of ICT to achieve the overall mission and objectives of the organization. In summary, the following relationships between the entities are defined and used as follows (the arrow $\rightarrow$ indicating the relationship defined between entities):

RS→ICT	users in the entity real system impose requirements for resources in the entity ICT to enable users to perform their day-to-day activities, i.e. RS *exploits* ICT
ICT → RS	information and communication technology resources in the entity ICT support the activities in the entity RS through enhancing effectiveness and efficiency i.e. ICT *supports* RS
ICT→MCM	information and communication technology resources in the entity ICT provide useful information required for ICT management to the personnel staff in the entity MCM i.e. ICT *supports* MCM
MCM→ICT	personnel staffs in the entity MCM manage the information and communication technology resources in the entity ICT, i.e. MCM uses or *manages* ICT
RS→MCM	the entity RS *employs* the entity MCM to manage its information and communication technology resources.
MCM→RS	technical staff members in the entity MCM *respond to* requests in RS.

The above six relationships play a significant role in effective and efficient management of information and communication technology. Problems related to ICT in organizations can commonly be traced to breakdowns in communication between the relevant entities.

4.3.6 Modelling the external influences

There are always external influences (hereafter simply referred to as influences) that act on all organizations. A university receives materials, resources, students, employees, system of laws, finances, and so on from its external environment, and gives back to the same environment trained manpower, feedback information in the form of reports, research findings, and so on. Any significant perturbation in the external world is bound to impact on a university, either positively or negatively, depending on the nature, and intensity or magnitude of the influence. Among the influences identified for inclusion in this study are managerial, donor, technological, economic and cultural influences (See Section 4.3).

Managerial influences are particularly significant because public universities are government owned and, therefore rely on taxpayers for their existence in Kenya. The government enacts laws and statues that govern the organizational structures of its universities and the hiring and retirement of senior university officials are vested in the government.

Donor agencies provide a significant part of university funding and other forms of support. The donors include foreign governments acting through their appointed agencies, international bodies and local institutions. These organizations play an important role in providing vital funds for training, equipment, learning materials and travel.

Technological influences: The rapid changes in information and communication technology and the effects of globalization affect public universities in two ways: one, the universities must adjust their curricula to the changes and, two, as consumers the universities must try to keep up with the changes in technology. All public universities now offer many ICT based courses in all their undergraduate programmes, irrespective of whether the programmes are core courses or not. Due to this fact any changes that take place in ICT are bound to affect the curricula, and since many public universities are now consumers of ICT products any changes, such as new products, will also affect the universities and thus make the latter susceptible to the changes.

*Economic influences: E*conomic influences, national and global, impact on Kenyan public universities in significant ways, because the public universities depend largely on public funds rather than privately generated funds. Any negative changes in the economy of the country adversely affect the universities. Pay increases for staff and better terms of service depend on the performance of the economy, and when such pay increases are not forthcoming, members of academic, administrative and technical staff leave the public universities for the so-called 'greener' pastures' either elsewhere within the country or abroad, leading to a serious brain drain from the public universities. This also makes it difficult for the universities to attract, hire and retain suitably qualified staff. Development projects also stall for the same reasons, giving this type of influence an added significance.

Cultural influences: Cultural influences were not originally part of the preliminary model as they were incorporated into the model as a result of applying the preliminary model in the case study. In the context of any society that comprise different communities and nationalities with varying cultural backgrounds and orientations, cultural influences in an organization are of particular significance. Their impact on the organization can be positive if the organization can view diversity as a resource to be turned into a positive asset. Yet cultural influences can have a negative impact if the differences between the cultures are emphasized and taken advantage of by self-interested parties, especially those in positions of responsibility in an organization, for purposes of personal gain and economic exploitation. This fact is especially true in much of the developing world in which utilization of ICT is still a novel idea with far reaching effects upon those who have knowledge of ICT or have access to ICT resources. This marks out those who will succeed economically from those who will not and cultural influences play a significant role in this process. The ICT or digital divide, is, therefore, not just an issue of concern between the developed countries and developing countries, it is probably even more pronounced between those who have access to, and can use, ICT, and those who do not in the developing countries even if, as yet, the available technology is very limited in comparison to ICT in the developed world.

4.4 The model in perspective

In a Kenyan public university context, the conceptual descriptive model (See Section 4.3) can be used to describe a real life situation using the concepts contained in the model. An example of a conceptual descriptive model is illustrated in Figure 4.7. Details of the focal concepts emerge at the descriptive level. The figure shows the three entities of the real system (RS), the information system (IS/ICT) and the management system (MCM). Thus the management paradigm can be used fully to describe a real life case study ([Delen92] and [Looijen98]). As observed earlier, there are within the real system entity, five basic elements – the strategic apex, the middle line, the operating core, the techno-structure and the support staff [Mintzberg89].

The ICT entity comprises the structured composition of implemented hardware, software, data sets, procedures and people to control, to improve and to achieve a better understanding of the real system processes [Hemmen97], and its state in the extended state model. The states utilization, exploitation and maintenance (shaded in Figure 4.7) are relevant to users when managing ICT and for this reason these states will be focussed upon in this study. The MCM entity comprises the functional management, application management, and technical management (FAT) at three levels, strategic, tactical, and operational, distributed among the five Mintzberg's elements at the strategic apex, tactical level, techno-structure, operating core and service support.
The multiplicity of dimensions in the entities RS, IS, and MCM indicates that the paradigm can be applied to various universities, or campuses and faculties within a university. In summary Figure 4.7 brings together all the main concepts that constitute the model envisaged in this chapter.

Note: Mintzberg's logo [Mintzberg79] is assumed in both the real system (RS) and MCM entities of the paradigm.

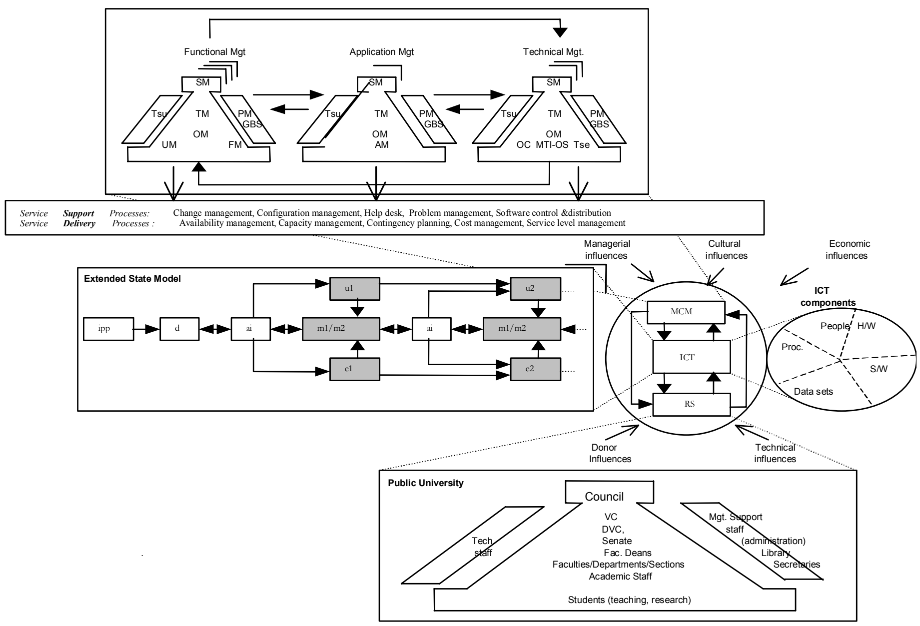


FIGURE 4.7: CONCEPTUAL DESCRIPTIVE MODEL

The relevant ICT related issues of the conceptual model are shown in the relevant entities in Figure 4.8. Their selection is based on the fact that they are considered critical in providing solutions to the problem posed in this research and for addressing the concerns raised in the pilot study covered in Section 3.6.

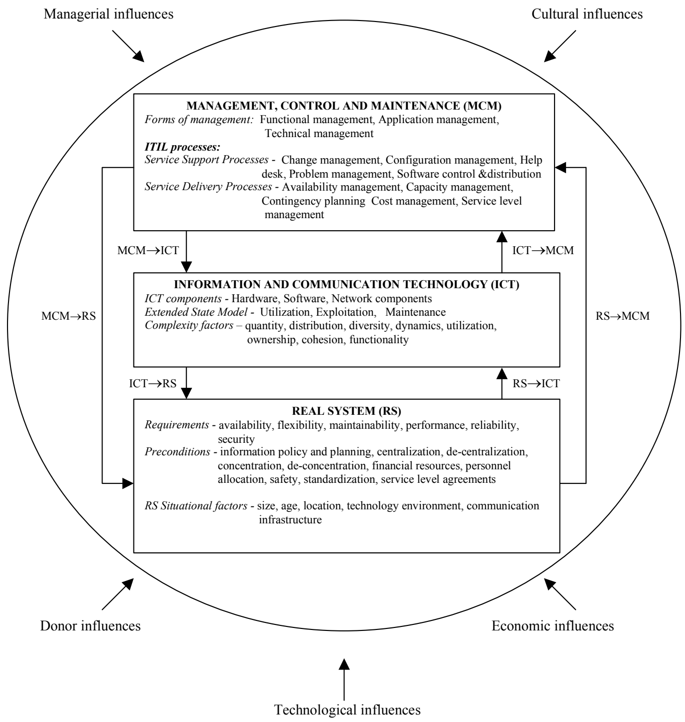


FIGURE 4.8: CONCEPTUAL MODEL
(Preliminary model $\mathbf{M_0}$)

Thus, in summary the conceptual framework comprises the three main entities of the management paradigm, viz, the real system (RS), the information and communication technology, ICT, and management, control, and maintenance (MCM). In addition, the relationships between the entities and the influences that act on the entities together comprise the framework that now becomes the IST (current) with entities RS-1, ICT-1 and MCM-1 in Figure 4.9. This situation becomes the focus for qualification and transformation into the SOLL situation with corresponding entities RS-2, ICT-2 and MCM-2. The conceptual model in Figure 4.8 is derived from the descriptive model given in Figure 4.7. The conceptual model, in effect, is the preliminary model, M_0.

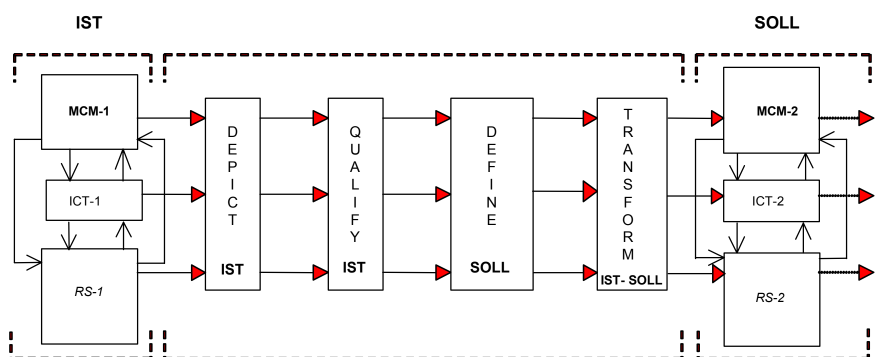


FIGURE 4.9: MODEL FOR IMPROVING ICT INCORPORATING MANAGEMENT PARADIGM

The ICT related issues in the management paradigm, are depicted for the IST situation in the next section.

4.5 Function 1: The depiction of the IST situation

4.5.1 What to depict in the IST situation

The first step in the function depiction of the IST situation is to determine what to describe. This step is necessary if a clear picture of the IST situation is to emerge. We also need to distinguish between the issues that are critical for ICT from those issues that are non-critical.

(i) *Real System:* in the real system (RS) entity, user requirements and preconditions imposed by ICT utilization and the management are key issues. User requirements considered in this thesis include availability, flexibility, maintainability, performance, reliability, and security of ICT. It can be recalled that users of ICT in MU case study during the pilot study formulated some of these requirements. Preconditions imposed by utilization and management include information policy and planning, centralization and de-centralization of activities, concentration and de-concentration of ICT, financial resources, personnel allocation, safety of staff and users, standardization of ICT, and service level agreements concerning ICT services. These preconditions make up the initial framework from which to examine other factors contingent upon the case studies. Other concepts related to ICT in the entity RS include the situational or contingency, factors, which impact on the utilization and management of ICT. These include age of the university, its size and location [Mintzberg79], the technology environment, university (organizational) culture, and the general level of communication infrastructure in and around the university.

(ii) *Information and Communication Technology:* in the ICT entity, the concepts considered vital for inclusion are the hardware, software and the network components based on their demand, common utility and usage. The user requirements for ICT, i.e. availability, maintainability, performance, reliability, and security of ICT, are included to correspond to ICT service support and service delivery processes that fall under ITIL processes. A service is defined herein as *an essentially intangible set of benefits or activities that are sold or provided by one party to another* [Niessink00]. Unlike a product, a service cannot be seen, felt, tasted, or touched. Consequently, a service cannot be (a) inventoried, (b) patented, (c) readily displayed or communicated, and (d) easily priced. Further the ICT issues are depicted to determine their states in the Extended State Model. The states selected for focus include *utilization, exploitation* and *maintenance* of ICT as these concern users more directly than other states. In addition to the above, complexity factors (CFs) associated with ICT are examined. The list of CFs include quantity, cohesion, distribution diversity, dynamics, functionality, ownership, and utilization of ICT [Looijen99]. The level of CFs in the entity RS and in the entity ICT determines to a large extent the way ICT can be managed. It is desirable that for less costly ICT management, the level of complexity be reduced, however, not all complexity factors need be reduced, but with knowledgeable understanding, proper assessment of the complexity factors becomes easier to handle.

(iii) *Management, Control and Maintenance:* in MCM functional management (FM), application management (AM), and technical management (TM), at Strategic Level (SL), Tactical Level (TL) and Operational Level (OL), defined in 4.4 above, form an important part of management of information systems. They are included to emphasize the important role that they play in ICT service provision; however, discussion of tasks, task areas and task fields at the three levels is implicitly assumed within MCM processes.

Information Technology Infrastructure Library: according to [Hemmen97], the aim of an Information Technology Infrastructure Library, commonly known as ITIL, is *to facilitate improvements in efficiency and effectiveness in the provision of quality ICT services and the management of ICT infrastructure within any organization [CCTA90]*. ITIL defines ICT infrastructure as the *total of technological components, the system and application software, the documentation and all the procedures that are necessary to realize one or more ICT services.*

Over forty processes or objects are recognized, and processes in turn are grouped into sets. Each set makes reference to other related sets. Two sets in particular, Service Support Processes, and Service Delivery Processes, have been selected for special application in this research. The basis of their selection is dictated by the need to support and deliver effective and efficient ICT services to users in Kenya's public universities. In addition, the ITIL processes form the basis of ICT service provision based on 'the best practice' philosophy. The processes contained in the two sets are:

<u>Service Support set:</u> change management, configuration management, helpdesk, problem management, software control and distribution, and

<u>Service delivery set:</u> availability management, capacity management, contingency planning, cost management, and service level management.

The processes in the 2 sets are defined in Section 4.6.

(iv) *Relationships:* (RS→ICT, ICT→RS, *ICT→MCM, MCM→ICT*, RS→MCM, MCM→RS) and donor influences in the provision of technical expertise.

(v) *Influences:* the internal and external environment impact on the university in a variety of ways – managerial, donor community, technological, economic and cultural.

The issues included in the preliminary model for depiction can be summarized as follows:

RS:

- current requirements, i.e. use of operational information systems or separate ICT components i.e. availability, flexibility, maintainability, performance, reliability, and security
- current preconditions i.e. information policy and planning, centralization and de-centralization of activities, hardware, and software, concentration of hardware, and software, de-concentration of hardware, and software, financial resources, personnel allocation, safety, standardization, and service level agreements
- current situational factors i.e. size, age, location, technology environment, culture, communication infrastructure

ICT:

- current hardware - PCs, printers

- current software - basic, application
- current network components
- current State(s) of ICT on the Extended State Model
  - U: Current utilization of ICT
  - E: current exploitation of ICT i.e. operational uptime of ICT continuously to meet user requirements and preconditions
  - M1/M2 Current modifications or maintenance of ICT initiated from U and E
- Current complexity factors i.e. quantity, cohesion, distribution, diversity, dynamics, functionality, ownership, utilization

MCM:

- Current functional management, FM, at strategic level, SL, tactical level, TL, and operational level, OL
- Current application management, AM, at strategic level, SL, tactical level, TL, and operational level, OL
- Current technical management, TM, at strategic level, SL, tactical level, TL, and operational level, OL
- Current ITIL Service Support Processes i.e. change management, configuration management, help desk, problem management, and software control and distribution
- Current ITIL Service Delivery Processes i.e. availability management, capacity management, contingency planning, cost management, service level management

Relationships:

- Current RS→ICT: real business processes *exploit* ICT
- Current ICT→RS: ICT *supports* real business processes
- Current ICT→MCM: ICT *supports* technical staff by way of processing and providing accurate information
- Current MCM→ICT: management *manages* ICT through their expertise
- Current RS→MCM: university *employs* the technical staff in entity MCM
- Current MCM→RS: members of technical staff *respond to* user requests

Influences:

- current *economic influences* – both national and global economies influence
  the purchasing powers of public universities)
- current *managerial influences* – administrative changes in universities initiated
  by the government affect the university
- current t*echnological influences* – rapid changes in technological developments taking place in the world become known thereby changing people's perceptions and affect universities

- current d*onor influences* – public universities have traditionally depended on
  donors, both internal and external, to support their operations
- current c*ultural influences* – employees/students different communities bring in a cultural mix of individuals from various backgrounds and associations. The university also develops its own traditions and beliefs that shape its destiny and impact on ICT development

4.5.2 How to depict the IST situation

The second step in the depiction function is to determine how the IST situation is depicted. In this step, which involves 6 sub-case studies from the pilot case study – Moi University, a criterion for depiction is clearly necessary. The criterion selected for depiction is *existence*. This simple criterion is predicated on the premise that before we can determine what issues within the ICT framework requires improvement, there is need to determine if the issues do indeed exist. If the issue *exists*, then a values *1* is assigned and if it does *not exist* then a value *0* is assigned. A checklist of all the above ICT related issues in the framework is created and the values are tallied accordingly. The overall result indicates the number of issues that exist in the IST (current) situation. This depiction, which includes verification of the issues, forms the basis upon which qualification of the IST situation, definition of the SOLL situation and transformation from IST to SOLL, depend.

The six sub-case studies at MU were selected on the basis that:

(a) they differ in important respects:
  - ARIS is a student information system within the university
  - IRM is an organization in charge of managing, controlling and maintaining ICT in the university
  - FOT is a faculty, an example of a real system, based in the main campus of the university
  - FRWM is a faculty based in Chepkoilel campus of the university
  - MTL is a university library based in the main campus of the university
  - WBC is donor supported project

(b) the sub-cases are typical situations commonly found in public universities

The main objective of using the six sub-case studies is to modify (where necessary) the preliminary model to make it more relevant to the situation-specific problems that it is expected to deal with. The development of this model was reported in [Wanyembi00] and its application in one case study in [Wanyembi02].

4.5.2.1 Sub-Case 1: The Academic Register Information System (ARIS)

ARIS is an information system being developed as part of the MHO (Dutch) project. Its objective is to give support in *planning academic and research programmes, developing curriculum, allocation of courses, enrolling students, registering students for courses, evaluating students' progress, maintaining student records, and administering scholarships* at Moi University. Using the preliminary model, M_0, ARIS was depicted:

Note: In this sub-case study, we examine issues from the perspective of the entire university, since ARIS is intended to serve all the faculties

RS:

- ***User requirements:***
  availability of ARIS - ARIS is required whenever necessary
  flexibility of ARIS - ARIS is required to facilitate extensions or variations to ARIS
  maintainability of ARIS - ARIS is required to facilitate adaptability and extension resulting from maintenance
  performance of ARIS - ARIS is required to indicate response rate at which data and results are processed
  reliability of ARIS - ARIS is required to be reliable with respect to correctness, completeness, timeliness and authorization
  security of ICT - security of ICT is required to protect them from theft, environmental hazards, fire

- ***Preconditions:***
  information policy and planning - to facilitate development, utilization, exploitation and ICT maintenance
  centralization of activities - centralization of activities in response to demands from users
  de-centralization of activities - de-centralization of activities in response to demands from users
  concentration of ARIS - concentration of ARIS for control and security
  de-concentration of ARIS - de-concentration of ARIS for autonomy and control over ARIS resources
  financial resources - supported by MHO project
  personnel allocation – technical staff allocated
  safety of staff/equipment - provision of safety of staff/equipment to protect them from injury/damage
  standardization of ARIS - standardization of ARIS to improve services across the university
  Service level agreements (users, vendors) - no SLAs between ARIS and university, no SLAs between users and university

- ***Situational factors:***
  age - young university, started in 1984
  size - university has about 6,000 students, 700 academic staff, and 1,200 administrative staff
  location - university has 3 campuses separated by long distances
  technology environment - the university adopts scientific/technological approaches
  organizational culture - students, staff contribute to its organizational culture
  communication infrastructure - its location contributes to its communication infrastructure problems
  student unrest - this is a regular occurrence in public universities in Kenya

ICT:

- *Hardware:* PCs, printers, constitute the main hardware
- *Software :* Common basic and application software (MS products) are the main software; special software (Delphi 4.00) is also available for developing ARIS
- ***Network components:*** LAN and Internet components are provided for local communication and access to WWW and Internet
- ***Extended State Model (ESM) states***
  utilization - ARIS is in the state *Utilization,* on the ESM
  exploitation - ARIS is in the state *Exploitation,* on the ESM
  maintenance - ARIS is in the state *Maintenance* on the ESM
- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ARIS resources
  distribution - due to wide geographical locations of campuses
  diversity - not significant, no diversity exists at time of research
  dynamics - changes to hardware and software are made
  utilization - utilization takes place
  ownership - not significant, ownership is not in contest
  cohesion - not significant, linked parts work coherently with each other
  functionality - a variety of functions exist

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided
  Tactical level - tactical FM is provided
  Operational level - operational FM is provided
- ***Application management (AM):***
  Strategic level - strategic AM is provided
  Tactical level - tactical AM is provided
  Operational level **-** operational AM is provided
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided
  Tactical level - tactical TM is provided
  Operational level - operational TM is provided

- ***Service support processes:***
  change management (CHG) - CHG exists, new versions are incorporated
  configuration management(CONF) - CONF exists, for software and hardware
  help desk (HLP) - HLP exists, to attend to incidents
  problem management (PRB) - some form of PRB exists, to solve hardware and software problems
  software control & distribution(SCD) - some form of SCD exists, as an extension of CONF

- ***Service delivery processes:***
  availability management(AVLM) - AVLM exists to provide services to users
  capacity management (CAPM) - CAPM does not exist
  contingency planning (CONT) - CONT exists in form of backups, UPS, to deal with emergencies
  cost management (CSTM) - CSTM for services does not exist
  service level management (SLM) - SLM exists between university and vendors

Relationships between entities:

RS→ ARIS **-** the university *exploits* ARIS for its own benefit
ARIS →RS **-** ARIS *supports* in organizing activities related to students
ARIS →MCM **-** ARIS *supports* the technical staff (IRM) by supplying data/
MCM→ ARIS **-** technical staff in IRM *manage* ARIS for the university
RS→MCM **-** the university *employs* technical staff (IRM) to manage ARIS
MCM→RS **-** technical staff members in IRM *respond* to users requests in RS

Influences:

managerial - structural decisions made by university/Kenya/Dutch govt. influence ARIS
donor - decisions made by donors (Dutch) on level of funding influence ARIS
technological - technological developments made elsewhere influence ARIS
economic - economic changes in Kenya and the world influence ARIS
cultural - organizational culture within the university influences ARIS

Observation:

The following issues were depicted and found relevant in this sub-case study:

- In the RS entity, user requirements, preconditions and situational factors, with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements, SLA. Missing are SLAs between users and university. Student unrest is a significant situational factor in Kenyan public universities.
- In the ICT entity, the hardware, software and network components. In particular, the model was able to describe ARIS as *an information system for managing student affairs in the university.*
- In the MCM entity, the forms of management of the triple model of MCM, and ITIL processes, though not widely known by these terns, were recognized as essential part of ICT management for ARIS. Missing is capacity management (CAPM)
- all the relationships were recognized as important and therefore relevant to the sub-case study.
- the most important influences were listed as managerial, donor, technological, economic and cultural.

The result from the preliminary model, M_0, after application to ARIS is model M_1, which becomes the input for sub-case 2 (IRM).

4.5.2.2 Sub-Case 2: Information Resource Management (IRM)

The Information Resource Management is part of the MHO (Dutch) project in the university. Its primary function is to develop, manage, control and maintain the campus-wide ICT resources, which include the network, that links the 3 campuses. Also included in the same project is a new LAN within the main administrative building that extends to the MTL through an optic . The two buildings are connected by a high-speed fibre optic connection for fast access and transmission of data. The total number of modern (Pentium II) PCs under the charge of IRM is 3 net servers and 6 workstations located in the MTL building. In addition there are PCs (Intel 486 and Pentium) located in various offices in each of the 3 campuses all supported under the same MHO (Dutch) project. The software running on these platforms include the MS Office 97, and Windows 95/98. There are two staff members who manage, control and maintain the resources. They include a Dutch expatriate network engineer.

Note: In this sub-case study, we examine issues from the perspective of the entire university, since IRM is intended to maintain the network for the entire university.

RS:

- ***User requirements***
  availability of network - the network is required to be available when and where necessary
  flexibility of network - the network is required to facilitate extensions or variations to the network
  maintainability of network - the network is required to facilitate adaptability of network components resulting from maintenance
  performance of network - the network is required to indicate speed at which data/info is transmitted
  reliability of network - the network is required be reliable with respect to correctness, completeness, timeliness and authorization while in use
  security of ICT – networks and data/info are required to be protected from loss

- ***Preconditions***
  information policy and planning - IPP is required to facilitate development, utilization, exploitation and maintenance of networks in the university
  centralization of activities - centralization of university activities is required to maintain control
  de-centralization of activities - de-centralization of activities is required to distribute resources and personnel
  concentration of network components - concentration of network components for control and security
  de-concentration of network components- de-concentration of network components for autonomy and control
  financial resources - supported by MHO
  personnel allocation – technical staff allocated
  safety of staff/equipment - safety of staff/equipment is required to protect from, or compensate them for, injury
  standardization of network components - standardization of network components is required to improve services across the university
  Service level agreements (users, vendors) - SLAs between network vendors and university, no SLAs between network users and university

- ***Situational factors:***
  age - the university was started in 1984
  size - the university has about 6,000 students, 700 academic staff, and 1,200 administrative staff
  location – the university has 3 campuses separated by long distances
  technology environment - the university adopts scientific/technological approaches
  organizational culture - students, staff members contribute to its organizational culture *communication infrastructure* - the location of the university contributes to its communication infrastructure problems
  student unrest - student unrest is a regular occurrence in public universities in Kenya

ICT:

- *Hardware:* PCs, printers, constitute a major component of hardware
- *Software :* Common basic and application software (MS products) are the main software
- *Network components:* LAN and Internet components are provided for local communication and access to WWW and Internet
- ***Extended State Model (ESM) states***
  utilization: IRM manages the network in the state *Utilization,* on the ESM
  exploitation: IRM maintain the network in the state *Exploitation,* on the ESM
  maintenance: IRM maintains the network in the state *Maintenance* on the ESM

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources and network components
  distribution - wide geographical locations of campuses
  diversity - diversity in network components exists
  dynamics - some changes in network components take place
  utilization - utilization of the network takes place
  ownership - ownership is not in contest
  cohesion of ICT - linked parts work in coherence
  functionality - a variety of functions on the network exist

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by IRM management team
  Tactical level - tactical FM is provided by IRM tactical staff
  Operational level - operational FM is provided by IRM operational staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by IRM management team
  Tactical level - tactical AM is provided by IRM tactical staff
  Operational level **-** operational AM is provided by IRM operational staff
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided by IRM management team
  Tactical level - tactical TM is provided by IRM tactical staff
  Operational level - operational TM is provided by IRM operational staff

- ***Service support processes:***
  change management (CHG) - CHG exists, new network components are often incorporated
  configuration management(CONF) - CONF exists, for software and hardware

and network components

help desk (HLP) - HLP exists, to attend to incidents in the network

problem management (PRB) - PRB exists to solve hardware, network components and software problems

software control & distribution(SCD) - some form of SCD exists, as an extension of CONF

- ***Service delivery processes:***

availability management(AVLM) - AVLM exists to provide network services to users

capacity management (CAPM) - CAPM does not exist

contingency planning (CONT) - CONT exists in form of backups, UPS, to deal with network interruptions

cost management (CSTM) - CSTM for services exist, charging for network services

service level management (SLM) - SLM exists between university and vendors

Relationships between entities:

RS→ network - the university *exploits* network for its own benefit

network →RS - the network *supports* communication between campuses and the outside world

network →MCM **-** the network *supports* the technical staff in IRM by supplying data status

MCM→network **-** technical staff in IRM *manage* the network on behalf of the university

RS→MCM **-** the university *employs* technical staff in IRM to manage the network

MCM→RS **-** technical staff in IRM *responds* to users requests in the entity RS

Influences:

managerial - structural decisions made by university, Kenya/Dutch govt. influence IRM

donor - decisions made by donors (Dutch) on funding impact on IRM

technological - technological developments made elsewhere influence IRM

economic - economic changes in Kenya and the world influence IRM

cultural - organizational culture within the university influences IRM

Observation:

After applying the model, M_1, to sub-case IRM, the following issues in the model were depicted, described and found to be relevant:

- In the RS entity, user requirements, preconditions and situational factors with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements (SLA) between IRM and users, which were considered to be new concepts for the users. Student unrest is a significant situational factor in Kenyan public universities.
- In the ICT entity, the hardware, software and network components were well known to users. In particular, the model was able to depict and describe the components, features, functions and characteristics of the

network backbone as an information system, which enables communication between MU campuses (intra-net) and the outside world, through e-mail, Internet and WWW.

- In the MCM entity, the forms of management of the triple model of MCM, though not widely known by these terns, were recognized as essential parts of ICT management for ARIS and other ICT resources in the university. Missing in the entity MCM is the capacity management process.
- In the relationships between entities, all the relationships were recognized as important and therefore relevant to the sub-case study. Without the relationships entities exist in isolation and thus fail to accomplish the objectives of utilizing ICT in the university.
- In the entity influences, the most important influences were listed as managerial, donor, technological, economic and *cultural*. With regard to cultural influences, it was observed that they played a critical role in public universities in shaping their destinies. Consequently, they are included among the external influences.

The result from the model, M_1, after application to IRM is model M_2, which becomes the input for sub-case 2 (FOT).

4.5.2.3 Sub-Case 3: Faculty of Technology (FOT)

The Faculty of Technology is located on the main campus. It was selected to demonstrate a typical part of a public university. As a faculty, its stated objectives are twofold: (1) to equip students with both formal academic skills and practical training which serve to integrate theory and practice and help to develop a correct professional attitude in the students, and (2) to broaden the students' understanding of the natural, human and societal contexts in which an engineering career must grow and with which it must interact. There are six departments within this faculty which are (1) Chemical & processing Engineering (2) Civil & Structural Engineering (3) Computer Services and Instrumentation (4) Electrical & Communications Engineering (5) Production Engineering (6) Textile Engineering. The faculty offers both bachelor of technology and master of philosophy degree programmes. It is supported in its activities by a variety hardware and software platforms including MS Office, Windows 95/98, CAD/CAM. The faculty had a total of 60 academic staff, 28 technical staff and 494 students at the time the study was conducted in 1999.

Note: In this sub-case study, we examine issues from the perspective of the FOT, since ICT is intended to support the faculty activities.

RS:

- ***User requirements***
  availability of ICT - the ICT to be available when and where necessary
  flexibility of ICT- the ICT to facilitate extensions or variations to ICT
  maintainability of ICT - the ICT to facilitate adaptability of ICT components resulting from maintenance
  performance of ICT - the ICT to indicate speed at which data/info is processed
  reliability of ICT - the ICT with respect to correctness, completeness, timeliness and authorization while in use
  security of people - safety of users to protect themselves from dangerous situations

- ***Preconditions***
  information policy and planning - no IPP to facilitate development, utilization, exploitation and maintenance of the ICT
  centralization of activities - centralization of activities related to the ICT in response to demands from users
  de-centralization of activities - faculty activities are de-centralized in various departments
  concentration of network components - concentration of ICT components for control and security exists
  de-concentration of network components- de-concentration of ICT components for autonomy and control exists
  financial resources - supported by various donors
  personnel allocation – some technical staff allocated
  safety of staff/equipment - safety of staff/equipment to protect from, or compensate them for injury
  standardization of network components - standardization of ICT components to improve services across the faculty
  service level agreements (users, vendors) - no SLAs between ICT vendors and university, no SLAs between ICT users and university
- ***Situational factors:***
  age - the faculty was founded in 1986
  size - the faculty has about 500 students and 60 academic staff, 28 technical staff

location - the faculty is located in main campus but students travel to Chepkoilel campus to attend lectures
technology environment - the faculty is technological oriented
organizational culture - students, staff contribute to faculty organizational culture
communication infrastructure - its location contributes to its communication infrastructure problems
student unrest - a regular occurrence in some public universities in Kenya

ICT:

- *Hardware:* PCs, printers, constitute a major component of hardware
- *Software :* Common basic and application software (MS products) are the main software, special software (incl. CAD/CAM) appropriate in engineering is also available
- *Network components:* LAN and network components are provided for e-mail communication

- ***Extended State Model (ESM) states***
  utilization - technical staff members manage ICT while in the state *Utilization*
  exploitation - technical staff members maintain ICT in the state *Exploitation*
  maintenance - technical staff members maintain the ICT in the state *Maintenance*

▪ ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources and network components
  distribution - not significant, faculty located in main campus
  diversity - several types of ICT components exist
  dynamics - some changes in ICT components take place
  utilization - utilization of the ICT takes place
  ownership - not significant, ownership is not in contest
  cohesion of ICT - not significant, linked parts work in coherence
  functionality - a variety of functions with regard to ICT exist

MCM:

- ***Functional management (FM):***
  Strategic level: FOT technical management team provides strategic FM
  Tactical level: FOT tactical staff provides tactical FM
  Operational level: FOT operational staff provides operational FM
- ***Application management (AM):***
  Strategic level: FOT technical management team provides strategic AM
  Tactical level: FOT tactical staff provides tactical AM
  Operational level: FOT operational staff provides operational AM
- ***Technical management (TM) :***
  Strategic level: FOT technical management team provides strategic TM
  Tactical level: FOT tactical staff provides tactical TM
  Operational level: FOT operational staff provides operational TM

- ***Service support processes:***
  change management - CHG exists, new ICT components are often incorporated
  configuration management - CONF exists, for software and hardware and network components

help desk - HLP exists, to attend to incidents in the network
problem management - PRB exists to solve hardware, software and network problems
software control & distribution - form of SCD exists, as an extension of CONF

- ***Service delivery processes:***
availability management - AVLM exists to provide ICT services to users
capacity management - CAPM does not exist
contingency planning - CONT exists in form of backups, UPS, to deal with power supply interruptions
cost management - CSTM for services exists, charging for e-mail
service level management - SLM exists between faculty and vendors

Relationships between entities:

RS→ICT **-** the faculty *exploits* network and ICT for its own benefit
ICT→RS **-** the network and ICT *support* faculty activities
ICT→MCM **-** the network and ICT *support* the technical staff (FOT) with status data/ info
MCM→ICT **-** technical staff in FOT *manages* ICT on behalf of the faculty
RS→MCM **-** the faculty *employs* technical staff to manage ICT
MCM→RS **-** technical staff in FOT *responds* to users requests in the faculty

Influences:

managerial - structural decisions made by university, Kenya govt. influence FOT
donor - decisions made by donors (Dutch) on level of funding influence FOT
technological - technological developments made elsewhere influence FOT
economic - economic changes in Kenya and the world influence FOT
cultural - organizational culture within the university influences FOT

Observation:

After applying the model, M_2, to sub-case FOT, the following issues in the model were depicted, described and found to be relevant:

- In the RS entity, user requirements, preconditions and situational factors, with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements (SLA) between FOT and users, which were considered as new concepts to the users. In particular the model enabled the depiction and description of the activities and processes of the faculty as an essential entity in the university. Missing are SLAs between the faculty and users. Student unrest is a significant situational factor in Kenyan public universities.
- In the ICT entity, the hardware, software and network components, which were well known to users. In particular, the model was able to depict and describe the components, features, functions and characteristics of the ICT resources and available local area networks that support the faculty in their day-to-day activities and as an information system, which enables communication between MU campuses and the rest of the world.
- In the MCM entity, the forms of management of the triple model of MCM, though not widely known by these terns, were recognized as essential parts of management of faculty ICT resources. Missing is capacity management process.

- In the relationships between entities, all the relationships were recognized as important and therefore relevant to the sub-case study. Without the relationships entities exist in isolation and thus fail to accomplish the objectives of utilizing ICT in the university.
- In the entity influences, the most important influences were listed as managerial, donor, technological, economic and *cultural*. With regard to cultural influences, it was observed these played a critical role in public universities in shaping their destinies. Consequently, they are included among the external influences.

The result from the model, M_2, after application to FOT is model M_3, which is the input for sub-case 4 (FRWM).

4.5.2.4 Sub-Case 4: Forest Resources and Wildlife Management (FRWM)

The faculty of Forestry and Wildlife Management is located in Chepkoilel campus. As in the case of FOT, this faculty was selected to examine the real system core activities undertaken by an academic part of the university. FRWM has a total of five departments which are (1) Wildlife Management, (2) Fisheries, (3) Forestry, (4) Wood Science and Technology, (5) Tourism. The choice of FRWM also demonstrates the unique courses that the university offers in the East African region. To support its unique programmes, which are conducted at both undergraduate and post-graduate levels, the faculty has a total of 41 PCs of different makes and ages running on MS Office products and other specialized software. The faculty has a total of 53 academic staff, 20 technical and 20 support staff and 319 students.

Note: In this sub-case study, we examine issues from the perspective of the FRWM, since ICT is intended to support the faculty activities.

RS:

- ***User requirements:***
  availability of ICT - users require ICT to be available when and where necessary
  flexibility of ICT- this requirement is needed to facilitate extensions or variations to ICT
  maintainability of ICT - to facilitate adaptation of ICT components resulting from maintenance
  performance of ICT – this requirement is needed to indicate speed, accuracy and throughput with which data/info is processed
  reliability of ICT – this is needed with respect to correctness, completeness, timeliness and authorization while in use
  safety of people – security of ICT must be provided against loss, fire, or environmental hazards

- ***Preconditions:***
  information policy and planning - IPP to facilitate development, utilization, exploitation and ICT maintenance
  centralization of activities - centralization of activities related to the ICT in response to demands from users
  de-centralization of activities - de-centralization of activities related to ICT in response to demands from users
  concentration of network components - concentration of ICT components for control and security
  de-concentration of network components- de-concentration of ICT components for autonomy and control
  financial resources - partly self supporting and partly supported by donors
  personnel allocation – some technical and academic staff available
  safety of staff/equipment - safety of staff/equipment to protect from, or compensate them for, injury
  standardization of network components - standardization of ICT components to improve services across the faculty
  service level agreements (users, vendors) - SLAs between ICT vendors and university exist; no SLAs between ICT users and university exist

- ***Situational factors:***
  age - university was started in 1984

size - faculty has about 320 students and 53 academic staff, 20 administrative staff, 20 technical staff
location - the faculty is located at Chepkoilel campus 50 km away from main campus
technology environment - the faculty adopts scientific/technological approaches
organizational culture – students, staff members contribute to its faculty organizational culture
communication infrastructure - its location contributes to its communication infrastructure problems
student unrest - this factor is a regular occurrence at this public university

ICT:

- *Hardware:* PCs, printers, constitute a major component of hardware
- *Software :* common basic and application software (MS products) are main software
- *Network components:* LAN and Internet components are provided for local communication and access to WWW

- ***Extended State Model (ESM) states***
  utilization - faculty technical staffs manage the ICT in the state *Utilization*
  exploitation - faculty maintains ICT in the state *Exploitation*
  maintenance - faculty maintains ICT in the state *Maintenance*

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources and network components
  distribution - not significant, the faculty is located at Chepkoilel campus only

  diversity - a diversity of ICT components exists
  dynamics - some changes to ICT components take place
  utilization - utilization of the ICT takes place
  ownership - not significant, ownership is not in contest
  cohesion of ICT - not significant, linked parts work in coherence
  functionality - a variety of functions with regard to ICT exist

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by FRWM academic and technical staff
  Tactical level - tactical FM is provided by FRWM academic and tactical staff
  Operational level - operational FM is provided by FRWM operational staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by FRWM academic and technical staff
  Tactical level - tactical AM is provided by FRWM academic and tactical staff
  Operational level - operational AM is provided by FRWM operational staff
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided by FRWM academic and technical management staff
  Tactical level - tactical TM is provided by FRWM academic and tactical staff
  Operational level - operational TM is provided by FRWM operational staff

- ***Service support processes:***
  change management (CHG) - CHG exists, new ICT components are often incorporated
  configuration management(CONF) - CONF exists, for software and hardware components
  help desk (HLP) - HLP exists, to attend to incidents in ICT

  problem management (PRB) - some form of PRB exists, to solve hardware, software and problems
  software control & distribution(SCD) - some form of SCD exists, as an extension of CONF

- ***Service delivery processes:***
  availability management(AVLM) - AVLM exists to provide ICT services to users
  capacity management (CAPM) - CAPM does not exist
  contingency planning (CONT) - CONT exists in form of backups, UPS, to deal with power interruptions
  cost management (CSTM) - CSTM for ICT services does not exist
  service level management (SLM) - SLM exists between university and vendors

Relationships between entities:

RS→ICT **-** the faculty *exploits* ICT for its own benefit
ICT→RS **-** the ICT *support* faculty activities
ICT→MCM **-** the ICT *support* the technical staff (FRWM) by supplying status data/ info in the faculty
MCM→ICT **-** technical staff in FRWM *manage* ICT on behalf of the faculty
RS→MCM **-** the faculty *employs* technical staff to manage ICT
MCM→RS **-** technical staff in FRWM *responds* to users requests in the faculty

Influences:

managerial - structural decisions made by university, Kenya govt. influence FRWM
donor - decisions made by donors on level of funding influence FRWM
technological - technological developments made elsewhere influence FRWM
economic - economic changes in Kenya and the world influence FRWM
cultural - organizational culture within the university influences FRWM

Observation:

Having applied model, M_3, to sub-case FRWM, the following issues in the model were depicted, described and found to be relevant.

- In the RS entity, user requirements, preconditions and situational factors, with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements (SLA) between FRWM and users, which were considered to be new concepts for the users. In particular the model enabled the depiction and description of the activities and processes of the faculty as an essential entity of the university located at another campus of the same university. Student unrest is a significant situational factor in Kenyan public universities.

- In the ICT entity, the hardware, software and network components, were well known to users. In particular, the model was able to depict and describe the components, features, functions and characteristics of the ICT resources and available local area networks that support the faculty in their day-to-day activities and as an information system, which enables communication between MU campuses and the rest of the world.
- In the MCM entity, the forms of management of the triple model of MCM, though not widely known by these terns, were recognized as essential parts of management of faculty ICT resources.
- In the relationships between entities, all the relationships were recognized as important and therefore relevant to the sub-case study. Without the relationships entities exist in isolation and thus fail to accomplish the objectives of utilizing ICT in the faculty.
- In the entity influences, the most important influences were listed as managerial, donor, technological, economic and *cultural*. With regard to cultural influences, it was observed that it played a critical role in public universities in shaping their destinies. Consequently, also, it is also included among the external influences.

The result from the model, M_3, after application to FRWM is model M_4, which becomes the input for sub-case 5 (MTL).

4.5.2.5 Sub-Case 5: Margaret Thatcher Library (MTL)

The MTL is the central repository for learning and study materials in the university. The objectives of the library are: (1) to support the learning and research activities in the university through the provision of learning materials and a suitable environment for readers (2) to provide information seeking skills to enable users to access, retrieve and utilize information, and (3) to create awareness of the available information. With a total of about 130,000 volumes of books and bound journals, 14 CD-ROM titles and audio visual materials, the library has emerged as an important centre for research, a meeting place and a learning centre. The head of the library is the University Librarian who is supported by a staff of about 140 full-time employees. It has a total of about 60 PCs running on various software platforms, including Tinlib, MS Windows 3.11, Windows 95/98, Dbase IV. The purpose of selecting it as a sub-case study is further to demonstrate the library as another example of an information system, which differs from ARIS in significant ways.

Note: In this sub-case study, we examine issues from the perspective of the entire university, since ICT in MTL is intended to support the whole university library activities.

RS:

- ***User requirements***
  availability of ICT - the ICT to be available when and where necessary
  flexibility of ICT - the ICT to facilitate extensions or variations to ICT
  maintainability of ICT - the ICT to facilitate adaptability of ICT components resulting from maintenance
  performance of ICT - the ICT to indicate speed at which data/info is processed
  reliability of ICT - the ICT with respect to correctness, completeness, timeliness and authorization while in use
  security of ICT - safety of users to protect them from dangerous situations

- ***Preconditions***
  information policy and planning - PP to facilitate development, utilization, exploitation and ICT maintenance
  centralization of activities - centralization of activities related to the ICT in response to demands from users
  de-centralization of activities - de-centralization of activities related to the ICT in response to user demands
  concentration of network components - concentration of ICT components for control and security
  de-concentration of network components - de-concentration of ICT components for autonomy and control
  financial resources - supported by donors and partly self-supporting
  personnel allocation – technical staff allocation available
  safety of staff/equipment - safety of staff/equipment to protect from, or compensate them for, injury
  standardization of network components - standardization of ICT components to improve library services
  service level agreements (users, vendors) - SLAs between ICT vendors and library exist,
  no SLAs between ICT users and library exist

- ***Situational factors:***
  age - university was started in 1984
  size - the library has 136 staff serving a student population of 6,000, 700 academic staff, and 1200 administrative staff
  location - the library system has 3 sub-branches and is spread over 3 campuses located at great distances from one another
  technology environment - the library adopts scientific/technological approaches
  organizational culture - students, staff contribute to its library organizational culture
  communication infrastructure - its location contributes to its communication infrastructure problems
  student unrest - a regular occurrence in public universities in Kenya

ICT:

- *Hardware:* PCs, printers, and network components constitute a major component of hardware
- *Software :* common basic and application software (MS products) are the main software
- *Network components:* LAN and Internet components are provided for local communication and access to WWW
- ***Extended State Model (ESM) states***
  utilization - MTL technical staff manage the ICT in the state *Utilization*
  exploitation - MTL technical staff maintain ICT in the state *Exploitation*
  maintenance - MTL technical staff maintain the ICT in the state *Maintenance*

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources and network components
  distribution - the library is located in 3 campuses
  diversity - a diversity of ICT components exists
  dynamics - some changes to ICT components take place
  utilization - utilization of the ICT takes place
  ownership - not significant, ownership is not in contest
  cohesion of ICT - not significant, linked parts work in coherence
  functionality - a variety of functions with regard to ICT exist

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by MTL technical staff
  Tactical level - tactical FM is provided by MTL tactical staff
  Operational level - operational FM is provided by MTL operational staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by MTL technical staff
  Tactical level - tactical AM is provided by MTL tactical staff
  Operational level **-** operational AM is provided by MTL operational staff
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided by MTL technical management staff
  Tactical level - tactical TM is provided by MTL tactical staff
  Operational level - operational TM is provided by MTL operational staff

- ***Service support processes:***
  change management (CHG) - CHG exists, new ICT components are often incorporated

configuration management(CONF) - CONF exists, for software, hardware and network components
help desk (HLP) - HLP exists, to attend to incidents in ICT and network
problem management (PRB) - some form of PRB exists, to solve hardware, software & network problems
software control & distribution(SCD) - some form of SCD exists, as an extension of CONF

- ***Service delivery processes:***
availability management(AVLM) - AVLM exists to provide ICT services to users
capacity management (CAPM) - CAPM does not exist
contingency planning (CONT) - CONT exists in form of backups, UPS, to deal with power interruptions
cost management (CSTM) - CSTM for ICT services does not exist
service level management (SLM) - SLM exists between library and vendors; no SLM between users and library

Relationships between entities:

RS→ICT - the university and the library *exploits* ICT for their own benefit
ICT→RS - the ICT *support* library activities
ICT→MCM **-** ICT *support* the technical staff (MTL) by supplying status data/ info in the library
MCM→ICT **-** technical staff in MTL *manage* ICT on behalf of the library
RS→MCM **-** the library *employs* technical staff to manage ICT
MCM→RS **-** technical staff in MTL *responds* to user requests in the library

Influences:

managerial - structural decisions made by university, Kenya govt. influence MTL
donor - decisions made by donors on level of funding influence MTL
technological - technological developments made elsewhere influence MTL
economic - economic changes in Kenya and the world influence MTL
cultural - organizational culture within the university influences MTL

Observation:

After applying the model, M_4, to sub-case MTL, the following issues in the model were depicted:

- In the RS entity, user requirements, preconditions and situational factors, with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements (SLA) between MTL and library users, which were considered to be new concepts for the users. In particular the model enabled the depiction and description of the library activities, e.g. circulation, indexing, and processes of the library as an essential part of entity in the university. Student unrest is a significant situational factor in Kenyan public universities.
- In the ICT entity, the hardware, software and network components, were well known to users. In particular, using the model it was possible to depict and describe the components, features, functions and characteristics of the ICT resources and available local area networks that support the library

users in their day-to-day activities. The model also allowed depiction of the library as an information system, which enables users to access information and knowledge within and outside of the library, i.e. communication between MU campuses and the rest of the world.

- In the MCM entity, the forms of management of the triple model of MCM, though not widely known by these terns, were recognized as essential parts of management of library ICT resources and services.
- In the relationships between entities, all the relationships play a crucial role in ICT utilization, exploitation and management. Therefore they are relevant to the sub-case study. Without the relationships between entities, entities tend to exist in isolation and thus fail to accomplish the objectives of utilizing ICT in the library.
- In the entity influences, the most important influences are listed as managerial, donor, technological, economic and *cultural*. With regard to cultural influences, it was observed that these played a critical role in public universities in shaping their destinies. Consequently, also, they are also included among the external influences.

The result from the model, M_4, after application to MTL is model M_5, which becomes the input for sub-case 6 (WBC).

4.5.2.6 Sub-Case 6: World Bank Computerization (WBC) project

The WBC project was initiated by the university in conjunction with other Kenyan public universities to improve performance of the universities using ICT. The WBC project is part of the University Investment Project (UIP) and is supported by the World Bank. The WBC project brought in 250 PCs, which were distributed throughout the academic and administrative departments on all 3 campuses of MU to support their respective activities. In particular, finance management, personnel management, and transport management activities among the administrative departments benefited from this project. As a project mainly concerned with the procurement of information systems components including the training of personnel, it was selected to demonstrate further the information and communication technology part of the management paradigm. Since the project has no technical personnel to manage, control and maintain the PCs, each department is responsible for its own PCs. In addition to maintaining ICT resources under MHO project, the IRM has been co-opted to include the WBC resources.

Note: In this sub-case study, we examine issues from the perspective of the entire university, since the ICT in the WBC project is intended to support the whole university activities

RS:

- ***User requirements***
  availability of ICT - ICT is available when and where necessary
  flexibility of ICT - ICT is flexible to facilitate extensions or variations to ICT
  maintainability of ICT - ICT is maintainable to facilitate adaptability of ICT components
  performance of ICT - ICT performs with speed and accuracy in processing data/information
  reliability of ICT - ICT is required to be reliable with respect to correctness, completeness, timeliness and authorization while in use
  security of ICT - security of ICT is required for protection against theft, fire, environmental hazards

- ***Preconditions***
  information policy and planning - IPP exists to facilitate development, utilization, exploitation and maintenance of ICT
  centralization of activities - centralization of activities related to the ICT in response to demands from users
  de-centralization of activities - de-centralization of activities related to the ICT in response to user demands
  concentration of network components - concentration of ICT components for control and security
  de-concentration of network components - de-concentration of ICT components for autonomy and control
  financial resources - donor (World Bank) supported
  personnel allocation – technical staff allocate from various faculties
  safety of staff/equipment - safety of staff/equipment to protect from, or compensate them for, injury
  standardization of network components - standardization of ICT components to improve services in the university
  service level agreements (users, vendors) - SLAs between ICT vendors and the university exist, no SLAs between ICT users and the university exist

- ***Situational factors:***
  age - university was started in 1984
  size - the university has 6,000 students, 700 academic staff, and 1200 administrative staff
  location - the university has 3 campuses located at great distances from one another
  technology environment - the university adopts scientific/technological approaches
  organizational culture - students, staff contribute to the overall university culture
  communication infrastructure - its location in town and in rural area is a significant
  Student unrest - this is a regular occurrence in public universities in Kenya

ICT:

- *Hardware:* PCs, printers constitute a major component of the hardware
- *Software :* common basic and application software (MS products) are main software
- *Network components:* LAN components in some faculties are provided for local communication using e-mail and access to WWW

- ***Extended State Model (ESM) states***
  utilization - university technical staff manage the ICT in state *Utilization*
  exploitation - university technical staff maintain ICT in state *Exploitation*
  maintenance - university technical staff maintain the ICT in state *Maintenance*

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources and network components
  distribution - the WBC project is spread over 3 campuses
  diversity - a diversity of ICT components exists
  dynamics - some changes to ICT components take place
  utilization - utilization of the ICT takes place
  ownership - not significant, ownership is not in contest
  cohesion of ICT - not significant, connected parts from various vendors work in coherence
  functionality - a wide variety of ICT functions exist

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by university technical staff
  Tactical level - tactical FM is provided by university tactical staff
  Operational level - operational FM is provided by university operational staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by university technical staff
  Tactical level - tactical AM is provided by university tactical staff
  Operational level **-** operational AM is provided by university operational staff

- ***Technical management (TM) :***
  Strategic level - strategic TM is provided by university technical management staff
  Tactical level - tactical TM is provided by university tactical staff
  Operational level - operational TM is provided by university operational staff
- ***Service support processes:***

change management (CHG) - CHG exists, new ICT components are incorporated
configuration management(CONF) - CONF exists, for software, hardware and network components
help desk (HLP) - HLP exists, to attend to incidents in ICT and LANs
problem management (PRB) - some form of PRB exists, to solve hardware, software & network problems
software control & distribution(SCD) - a form of SCD exists, as extension of CONF

- ***Service delivery processes:***
  availability management(AVLM) - AVLM exists to provide ICT services to users
  capacity management (CAPM) - CAPM does not exist
  contingency planning (CONT) - CONT exists in form of backups, UPS, to deal with power interruptions
  cost management (CSTM) - CSTM for ICT services does not exist
  service level management (SLM) - SLM exists between university and vendors, no SLM exists between users and WBC

Relationships between entities:

RS→ICT **-** the university *exploits* ICT for its own benefit
ICT→RS **-** the ICT *supports* university activities
ICT→MCM **-** the ICT *supports* the university technical (WBC) by supplying status data/ information
MCM→ICT **-** technical staff in the university *manages* ICT
RS→MCM **-** the university *employs* technical staff to manage ICT
MCM→RS - technical staff in the university *responds* to user requests

Influences:

managerial - structural decisions by university, Kenya govt. influence WBC
donor - decisions made by donors on level of funding influence the university
technological - technological developments impact on the university
economic - economic changes in Kenya and the world influence the university
cultural - organizational culture within the university influences the university

Observation:

After applying the model, M_5, to sub-case WBC, and based on the experience of the researcher the following issues in the model were depicted:

- In the RS entity, user requirements, preconditions and situational factors, with the exception of the contents of precondition information policy and planning, the preconditions standardization, and service level agreements (SLA) between WBC and university users, were considered to be new concepts to the users. In particular the model enabled the depiction and description of the university core activities, e.g. research, teaching, and extension service, and support processes of the university as an essential part of RS entity in the university. Student unrest is a significant situational factor in Kenyan public universities.
- In the ICT entity, the hardware, software and network components, were well known to users. In particular, using the model it was able to depict

and describe the components, features, functions and characteristics of the ICT resources and available local area networks that support the university users in their day-to-day core and support activities. The model also depicted the WBC as a corporate-wide information system, which enables users to access information and knowledge within and outside of the university, i.e. communication between MU campuses and the rest of the world.

- In the MCM entity, the forms of management of the triple model of MCM, though not widely known by these terns, were recognized as essential parts of management of university ICT resources and services.
- In the relationships between entities, all the relationships were recognized as relevant to the sub-case study. Without strong relationships entities exist in isolation and thus fail to accomplish the objectives of the university.
- In the entity influences, the most important influences were listed as managerial, donor, technological, economic and *cultural*. With regard to cultural influences, it was observed that these played a critical role.

The output from the model, M_5, after application to WBC becomes the model M_6, which is the final model used to qualify the IST situation.

<u>Summary: depiction of 6 sub-case studies</u>

The six sub-case studies covered in the previous sections had the objective of depicting typical cases found in public universities in Kenya. These cases are summarized as follows:

Sub-case	*Depiction*
ARIS	ARIS as a special case of entity ICT, cultural influences are included
IRM	IRM as an example of entity MCM
FOT	FOT as a typical case of entity RS
FRWM	FRWM as a typical case of entity RS
MTL	MTL as special type of entity ICT
WBC	WBC as an example of ICT project in entity ICT

After depicting the six sub-case studies using the model we can conclude that that the model is a suitable tool for describing ICT related issues in a public university in Kenya. The model demonstrated its ability to give a clear picture of the existing IST situation to enable further examination of the issues. In the next section we apply the second function of the model to the issues - qualification of the IST situation.

4.6 Function 2: Qualification of the IST situation

In this section we discuss the issues that we need to qualify and how to qualify them in the IST situation. The first step is to determine what issues to qualify in each entity and the second step is how to qualify the issues, in the respective entities.

4.6.1 What to qualify in the IST situation

In this section we seek to qualify the issues depicted in the last section. In doing so, we isolate the issues in each of the entities.

In the entity RS, the main focus is on the *actors* or players, who make demands, referred to as requirements, for ICT to enable them perform their activities. Hence, in *user requirements*, the focus is on whether the users are aware of their own requirements. Also, we seek to determine whether user requirements have been formulated.

In *preconditions,* we seek the levels of user awareness and the formalization of user requirements in a framework, called preconditions, often by senior management officials, that has been achieved. These include IPP, centralization of activities, de-centralization of activities, concentration of ICT, de-concentration of ICT, financial resources, personnel allocation, safety of staff, standardization of ICT, and service level agreements.

In *situational factors,* we seek an indication of whether the factors have had an impact on the utilization, exploitation and maintenance of ICT, in the university.

In the entity ICT, the focus is on the quality and states of the *objects* or ICT resources, i.e. if and to what extent the hardware, software, and network components are utilized, exploited and maintained by the organization. Considering the available hardware resources, PCs, printers, network components, and software, i.e. basic and application, under the prevailing situational factors as depicted in the IST situation, it is critical to consider whether these resources are effectively and efficiently utilized, exploited and maintained or not. Hence, in summary, we seek to determine:

- whether the available objects, i.e. ICT resources - hardware, software and network components, and functions are utilized by the university, given the ICT is in the *utilization* state
- whether the available objects, i.e. ICT resources - hardware, software and network components, and functions are exploited by the university, given the ICT is in the *exploitation* state
- whether the available objects, i.e. ICT resources - hardware, software and network components, and functions are maintained by the university, given the ICT is in the *maintenance* state
- whether complexity factors impact on utilization, exploitation and maintenance of ICT

In the entity MCM, the primary focus is on the forms of management and *processes*. The forms of management are Functional Management (FM), Application Management (AM), and Technical Management (TM) and ITIL's sets 2 and 3 processes, which were introduced and modelled in Section 4.3. Both the forms of management and ITIL processes are simply referred to as processes in this research.

In determining what to qualify in this entity, the capability maturity model approach is adopted. According to this approach, each process is qualified according to whether it is at Level 1 (Initial), Level 2 (Repeatable), or Level 3 (Defined). These capability levels are defined later in this section. Thus in this entity, we need to establish whether:

- the processes are recognized
- they are cost effective, and on schedule
- they are planned, and practiced
- the technical staff are trained in them
- the processes are enforced and measured
- the processes are performed pragmatically
- before any process commences, there are any preparedness criteria
- the processes are documented
- the processes are standardized
- peer reviews on each process are conducted
- on completion of any process, there are any criteria for completion
- the processes are related to SLAs
- the services provided under the processes are predictable
- there are structured actions
- the processes are organized as a service

In the relationships between entities, we seek to determine the strength of the relationships between entities. Clearly, strong and positive relationships between entities are more desirable than weak or negative ones. Strong relationships indicate greater awareness of ICT issues in the organization as opposed to weak or negative relationships, which indicate a lack of awareness and thus possible source of problems in the organization with regard to ICT issues. It is, therefore, worth investigating and designating values to the relationships with a view later to understanding the level of involvement of various entities in the support and delivery of ICT services in the organization.
Thus, in the relationship between entities, the key issues are whether:

- the university *exploits* ICT for its own benefit
- the ICT *supports* the activities in the university
- the ICT *supports* ICT management activities
- the technical staff members have the required skills and knowledge to *manage* ICT
- the management in the university *employs* and offer support to technical staff
- the technical staff *respond to* user requirements and demands

In the external influences, i.e. managerial**,** donor, technological, economic, and cultural, the focus is on whether:

- the influences impact on ICT utilization, exploitation and maintenance in the university

The discussion on what to qualify in the IST situation has covered all the five entities of the management paradigm. Rather than qualifying individual aspects separately, the procedure examined the issues in relation to their impact on the utilization, exploitation and management of ICT in an organization. In effect, this holistic approach yields more informative qualification than the sum of individual qualification taken separately. In the next sub-section we examine the manner in which the qualification of the same issues is carried out.

4.6.2 How to qualify the IST situation

Different design approaches for standardization are proposed in the qualification of the IST situation for different entities. Standardization provides a benchmark against which measurements or comparisons can be made. This is made necessary by the fact that issues in different entities differ remarkably and can also differ within the same entities. These issues, therefore, require different frameworks for qualification.

In the entity RS we seek to determine, in the case of *actors* (users), the level of their awareness regarding their own requirements for ICT. We also seek to establish the level to which these requirements have been formulated.
Regarding *preconditions,* we seek to determine what levels of formulation of user requirements have been achieved. In particular, we seek to determine the level of financial resources allocated to ICT, and the number and quality of technical staff allocated to manage ICT.

In the case of *situational factors,* we need to establish the level of impact of the factors on utilization, exploitation and maintenance of ICT in the university.

Since standards of comparison of ICT related issues have not been developed to a significant degree in Kenya and much of the developing world for issues in the entity RS, a normative approach to qualification is proposed [Chekland81]. This implies that, in the absence of an existing standard by which to compare the current IST situation, we base the qualification on what, in our opinion, it should be, which we take to be the norm for that particular issue. The norm becomes the standard measure, and according to the issues in the entity RS, the norm is assigned the values HIGH or 3. Other possible measures include MEDIUM or 2, and LOW or 1, relative to the norm. In the absence of the issue in question, either the value MISSING or 0 is assigned.

The qualification of RS issues is illustrated in Figure 4.10(a).

HIGH:
Well defined user requirements, high level of user awareness, well formulated preconditions, high positive impact of situational factors on utilization, exploitation and maintenance of ICT with strategic, tactical and operational plans to deal with them. Adequate financial resources, allocated highly skilled personnel in ICTfields in sufficient numbers.
Overall contribution of the issue to organizational effectiveness and efficiency is high.

MEDIUM:
Limited definition of user requirements, moderate level of user awareness, limited formulated preconditions, moderate positive impact of situational factors on ICT utilization, exploitation, and maintenance with tactical or operational plans to deal with them. Barely adequate financial resources, allocated moderately skilled personnel in ICT fields in limited numbers.
Overall contribution of the issue to organizational effectiveness and efficiency is medium.

LOW:
Vague user requirements defined, low level of user awareness, unformulated preconditions, low positive impact of situational factors on utilization, exploitation and maintenance of ICT with limited or no operational plans to deal with them. Inadequate financial resources, allocated low-skilled personnel or of irrelevant non-ICT qualifications, in insufficient numbers.
Overall contribution of the issue to organizational effectiveness and efficiency is low.

ABSENT:
No user requirements, no user awareness, no preconditions, no positive impact of situational factors on utilization, exploitation and maintenance of ICT with no operational plans to deal with them. No financial resources, no personnel allocation of any kind.
Overall contribution of the issue to organizational effectiveness and efficiency zero.

FIGURE 4.10(A): QUALIFICATION OF RS ISSUES IN THE IST SITUATION

In the case of entity ICT, we seek to determine the level of hardware and software technology used, the extent to which ICT is utilized, exploited and maintained to support the university in its activities. Hence we need to determine:

- The quality and standard of the available ICT resources - hardware, software and network components
- The level of the state of implemented ICT resources - hardware, software and network components, and how well defined the management tasks are
- The extent of impact of complexity factors on utilization, exploitation and maintenance of ICT

The qualification of ICT issues is illustrated in Figure 4.10(b).

HIGH:
ICT: up-to-date state-of-the-art standardized ICT (hardware, software and network components) by less than 5 years across organization whose functions are well utilized, exploited and maintained
Extended State Model: enhanced ICT utilization, exploitation or maintenance and management tasks are well defined
Complexity factors: high levels of complexity factors : quantity, distribution, diversity, dynamics, utilization, ownership, cohesion between ICT components, and functionality - all with high negative impact on ICT ulitization, exploitation and maintenance.
Overall contribution of ICT issues to organizational effectiveness and efficiency is high.

MEDIUM:
ICT: lagging state-of-the-art hardware, software and network components by a few years (5-10) functions are partially utilized, exploited and maintained
Extended State Model: limited ICT utilization, exploitation or maintenance and management tasks are barely defined
Complexity factors: moderate levels of complexity factors - quantity, distribution, diversity, dynamics, utilization, ownership, cohesion between ICT components, and functionality - all with moderate negative impact on ICT ulitization, exploitation and maintenance.
Overall contribution of ICT issue to organizational effectiveness and efficiency is medium.

LOW:
ICT: outdated non-standard hardware, software and network components by more than 10 years functions are not well utilized, exploited and maintained
Extended State Model: poor ICT utilization, exploitation or maintenance and management tasks are not defined
Complexity factors: low levels of complexity factors - quantity, distribution, diversity, dynamics, utilization, ownership, cohesion between ICT components, and functionality - all with low negative impact on ICT ulitization, exploitation and maintenance.
Overall contribution of ICT issue to organizational effectiveness and efficiency is low.

ABSENT:
ICT: no hardware, software and network components - only manual system
Extended State Model: no utilization, exploitation or maintenance of any kind
Complexity factors: no presence of complexity factors, i.e. quantity, diversity, distribution, dynamics, cohesion, ownership, utlization, and functionality.
Overall contribution of ICT issue to organizational effectiveness and efficiency zero.

FIGURE 4.10(B): QUALIFICATION OF ICT ISSUES IN THE IST SITUATION

In the entity MCM, the approach used in the qualification of the IST situation is based on the concept of capability maturity model (CMM) levels. While the concept of CMM is defined in terms of software development, in this research, the first three capability maturity model levels are defined in terms of ICT management [Looijen00] as follows:

Level 1(Initial): At this level there are no management processes and reactions to events happen in an *ad hoc* manner. The management is completely in the hands of operational “authorities” who decide what has to be done. The workload is most of the time high, and the work is carried out in an uncoordinated way. The latter doesn’t necessarily mean that all efficiency is ignored. The point is that it cannot be measured, because each separate realization is strongly influenced by the individuals who carry it out.

HIGH:
preparedness criteria, documented, standardized across orgnanization, peer reviewed, completion critieria, related to SLAs, predictable, structured actions, service organization. Well-defined tasks.
Overall contribution of process to organizational effectiveness and efficiency is high.

MEDIUM:
Processes are on schedule, cost-effective, planned, practiced, trained, enforced, measured, process-like, recognized, pragmatic processes which repeat earlier successes. Moderately defined tasks.
Overall contribution of process to organizational effectiveness and efficiency is medium.

LOW:
No processes, ad hoc and chaotic situation, 'authorities' decide, uncoordinated work, efficiency not measured, personalized, command/control and bureaucratic form of ICT management. No tasks defined.
Overall contribution of process to organizational effectiveness and efficiency is low.

ABSENT:
No processes, no authorities, no work, no ICT management. No tasks.
Overall contribution of process to organizational effectiveness and efficiency is nil.

FIGURE 4.10(C): QUALIFICATION MCM PROCESSES IN THE IST SITUATION

Level 2 (Repeatable): At this level the work is done in a processes-like manner, but there are no formal process descriptions. The management recognizes the importance of processes like incident management, problem management, change management, configuration management and software control and distribution, and carries them out in a pragmatic way. The decision-making with regards to this is mostly inspired by the fact that similar processes in other organizations or in other situations seemed useful and looked susceptible to repetition, hence the name *repeatable*.

Level 3 (Defined): At this level the management processes are documented and standardized, they are related to Service Level Agreements (SLA), which are established between the management and the users of the services. This implies that the services of the management are more predictable and that action is taken in a structured way on issues like performance improvement, problem resolution, transmission of data and data storage capacity. Due to this, the service users consider ICT management to be a service organization.
The qualification of MCM processes is shown in Figure 4.10(c).

These attributes constitute the process parameters required to qualify individual processes. Four numerical values are used to qualify attributes within the maturity levels 2 and 3 for the purposes of computing capability maturity levels for the MCM processes, based on effectiveness and efficiency criteria:

0	if the attribute is absent
1	if the attribute is rated LOW
2	if the attribute is rated MEDIUM

3 if the attribute is rated HIGH.

The criterion *effectiveness* is used to refer to the extent to which the goals and objectives of an organization are being achieved. It addresses the outputs from the organization or its units. Sudit [Sudit96] argues that effectiveness of a purposeful entity is conceptualized in terms of the degree to which it attains its end-objectives and that with most entities having multiple end-objectives, overall measures of effectiveness must invariably be multi-dimensional. To be effective, therefore, management of entities must think in terms of addressing the needs of their constituencies systematically, and in a participative and responsive manner. Remenyi et al define *efficiency* as putting emphasis on reducing the labor required to achieve a certain objective, with the result of reducing routine and tedious work. The benefits derived from efficiency are greater speed in output, greater accuracy, better customer service, and greatly reduced costs [Remenyi93].

Weighting process attributes

Weighting of process attributes is necessary to differentiate process attributes that are considered more important from those that are less important according to the perceptions of the person(s) conducting the qualification. There is no fixed rule governing the weighting (W_i) hence it can be varied as desired. These weights are multiplied by the values entered (X_i) and summed up to $\Sigma(W_i . X_i)$ for all the attributes at both Level 2 and Level 3. The process capability level, L, is computed from the weights according to the equation [1].

$$L = \Sigma(W_i . X_i) / \Sigma(W_i) \quad \ldots\ldots\ldots [1]$$

The values for each process are added up and the average value for each process is determined. This value indicates the capability level for the specific process. These values are rational and range from 1.0 to 3.0 inclusive (expressed to 1 d.p.). The standard deviations from the mean are also calculated. By convention, all capability maturity level values below 1.0 are regarded as being at Level 1.0. These are the values that are entered in the qualification sheet as LOW (if less than 2.0), MEDIUM (if 2.0 or more but less than 3.0) and HIGH (if 3.0).

An example of how capability maturity levels are calculated is shown in Table 4.1.

In this table, the attributes of the management processes are listed in the first column, each within its level. The second column consists of weighted values of the attributes, which may be adjusted. In this example, the weights take integral values 1, 2 and 3. The management forms FM, AM, and TM are treated as management processes for purposes of evaluation. The other processes are Service Support processes and Service Delivery processes.

Entries are made in the table for each process. If a process is absent, a value 0 is entered in each of the attributes. Otherwise, values 1, 2, or 3 are entered according to whether they are judged to be LOW, MEDIUM or HIGH, respectively. The calculations for capability maturity level, L, for each process are made and entered at the bottom of each column. An overall average value for the capability maturity model level for all the processes is also calculated to give an indication of the general level of ICT management.

If desired, the average capability level for all the processes can be obtained to show, in general terms, the extent to which the organization has implemented the processes. This will provide some information about what processes require improvement and the extent of the improvements required.

	X1 INFORMATION SYSTEM																			
	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	1	0	1	0
has structured actions	**3**	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	1	0	1	0
has predictable services	**3**	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is peer review ed	**2**	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	2	0
processes are standardized	**2**	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1	0
processes documented	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
have preparedness criteria	**1**	1	1	1	1	1	1	2	2	2	0	1	1	1	1	1	2	0	1	0
Level 2																				
repeats earlier success	**3**	1	1	1	2	2	2	1	1	1	0	1	2	1	1	2	2	0	1	0
is performed pragmatically	**3**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is recognized	**3**	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	2	0	1	0
activities are processes-like	**3**	1	1	1	2	2	2	1	1	1	0	1	1	1	1	1	1	0	1	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	**2**	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	1	0	0	0
process is trained	**2**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is practiced	**2**	1	1	1	2	2	2	2	2	2	0	1	1	1	1	1	1	0	1	0
process is planned	**2**	1	1	1	2	2	2	2	2	2	0	1	1	1	1	2	2	0	2	0
processes is cost-effective	**1**	1	1	1	2	2	2	1	1	1	0	1	1	1	1	2	1	0	1	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	2	0
Level 1																				
Efficiency not measured	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Uncoordinated w ork																				
High w orkloads	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Authorities decide																				
ad hoc reactions	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
No MCM processes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
	MCM Pr	SM	TM	OP	SM	TM	OP	SM	TM	OP	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.4**	**1.0**	**1.4**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.2**	**1.0**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level	Service Support Processes		Service Delivery Processes	
0	Missing	SM Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH		prb	Problem Management	cstm	Cost Management
			scd	Softw are Control and Distrit	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3					x	Non-improvement parameter

TABLE 4.1: CALCULATIONS OF CAPABILITY MATURITY LEVELS FOR ICT MANAGEMENT PROCESSES

HIGH:
ITC viewed as an asset, full ICT support for activities , well co-ordinated 'healthy' entity relationships.
Overall contribution of relationship to organizational effectiveness and efficiency is high.

MEDIUM:
ITC emerges as an asset, limited ICT support for activities , limited entity relationships.
Overall contribution of relationship to organizational effectiveness and efficiency is medium.

LOW:
ITC viewed as a cost centre, poor ICT support for activities, poor or suspicious entity relationships.
Overall contribution of relationship to organizational effectiveness and efficiency is low.

ABSENT:
No discernible view of ITC centre, no ICT support for organization's activities, no discernible entity relationships.
Overall contribution of relationship to organizational effectiveness and efficiency is zero.

FIGURE 4.10(D): QUALIFICATION OF RELATIONSHIPS BETWEEN ENTITIES IN THE IST SITUATION

In the relationship between entities, the focus is on the extent to which the relationship serves to support and strengthen relationships between entities. Thus we need to establish to what extent,

- the university *exploits* ICT for its own benefit
- the ICT *supports* the activities in the university
- the ICT *supports* ICT management activities
- the technical staff members have the required skills and knowledge to *manage* ICT
- the management in the university *employs* and offers support to technical staff
- the technical staff members *respond to* user requirements.

The qualification of issues in relationships is illustrated in Figure 4.10(d).

As in the case of issues in the entity RS, a normative approach is adopted, under which, the current situation is compared with what ought to be. A scale of values ranging from LOW or 1, MEDIUM or 2, to HIGH or 3, is used. In the case of the absence of a relationship, a value 0 is assigned.

In the external influences, i.e. managerial, donor, technological economic, cultural, the focus is on the extent to which:

- the influences have impacted on ICT in the state utilization, exploitation and maintenance in the university.

HIGH:
close monitoring of external environment - strategic plans in place to gauge level of impact of influences on ICT utilization, exploitation and maintenance. High impact of influence on ICT utilization, exploitation and maintenance.
Overall contribution of influence to organizational effectiveness and efficiency is high.

MEDIUM:
limited monitoring of external environment - tactical or operational plans in place to gauge level of impact of influences on ICT utilization, exploitation and maintenance. Medium impact of influence on ICT utilization, exploitation and maintenance.
Overall contribution of influence to organizational effectiveness and efficiency is medium.

LOW:
volatile unmonitored external environment - no strategic or tactical plans in place to gauge level of impact of influences on ICT utilization, exploitation and maintenance. Low impact of influence on ICT utilization, exploitation and maintenance.
Overall contribution of influence to organizational effectiveness and efficiency is low.

ABSENT:
No discernible positive impact of external influences, i.e. managerial, donor, technological, economic, cultural, on ICT utilization, exploitation, and maintenance.
Overall contribution of influence to organizational effectiveness and efficiency is zero.

FIGURE 4.10(E): QUALIFICATION OF EXTERNAL INFLUENCES IN THE IST SITUATION

It is noted through experience that external influences have impacted on ICT projects in Kenyan public universities to varying degrees in the recent past, in some cases, such as managerial, economic and cultural, negatively, while others, such as technological and donor influences, positively.

The qualification of issues in external influences is illustrated in Figure 4.10(e).

The criteria used in each case are effectiveness and efficiency. The qualification is based on experience and observation of the relationships between entities.

The CODE represents the qualifications in contained in Figures 4.10 (a) – 4.10 (e).

4.6.2.1 Sub-Case 1: The Academic Register Information System (ARIS)

RS:

- ***User requirements:***

availability of ARIS	HIGH
flexibility of ARIS	HIGH
maintainability of ARIS	HIGH
performance of ARIS	HIGH
reliability of ARIS	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of ICT	HIGH
de-concentration of ICT	MED
financial resources	MED
personnel allocation	LOW
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	MED

- ***Situational factors:***

age of university (est. 1984)	LOW
size	HIGH
location	HIGH
technology environment	LOW
organizational culture	HIGH
communication infrastructure	LOW
student unrest	LOW

ICT:

• *Hardware:*	MED
• *Software :*	MED
• *Network components:*	MED

- ***Extended State Model (ESM) states***

utilization	MED
exploitation	LOW
maintenance	MED

- ***Complexity Factors (CFs):***

quantity	LOW
distribution	HIGH
diversity	LOW
dynamics	LOW
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	HIGH
functionality	LOW

MCM:

(Refer to **Table B1 in Appendix B** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

• ***Functional management (FM):***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Application management (AM):***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
Technical management (TM) :	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Service support processes:***	
change management	Level 1
configuration management	Level 1
help desk (HLP)	Level 1
problem management	Level 1
software control & distribution	Level 1
• ***Service delivery processes:***	
availability management	Level 1
capacity management	Not Available
contingency planning	Level 1
cost management	Level 1
service level management	Not available

Relationships between entities:

RS → ARIS:	MED
ARIS →RS:	MED
ARIS →MCM:	LOW
MCM→ ARIS:	LOW
RS→MCM:	MED
MCM→RS:	LOW

Influences:

managerial	MED
donor	HIGH

technological	MED
economic	HIGH
cultural	HIGH

Observation:

In this sub-case study, we observe that user awareness of what they expect from ICT is high, indicating that users realize the important role ARIS plays in improving their performance.

Formulation of preconditions varies considerably between low and medium level, indicating that some efforts have been made towards this end largely influenced by the donor.

Significant situational factors include size, location, and organizational culture. Two important preconditions are personnel allocation and funding.

The processors are in the category of the first and second generation Pentiums, while the network components comprise Ethernet based LAN configurations.

The presence of a network expert on contract and under the same donor supported project means that maintenance is comparatively better in spite of the many impeding factors.

Most of MCM forms of management and processes have yet to be implemented as required. Only rudimentary forms of these processes are discernible from the outside.

Relationships between entities indicate strong university exploitation and high appreciation of ARIS to support effectively and efficiently its activities.

Donor influence remains strong and encouraging.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.6.2.2 Sub-Case 2: The Information Resource Management (IRM)

RS:

- ***User requirements:***

availability of network	HIGH
flexibility of network	HIGH
maintainability of network	HIGH
performance of network	HIGH
reliability of network	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of network components	LOW
de-concentration of n/w components	MED
financial resources	MED
personnel allocation	LOW
safety of staff/equipment	MED
standardization of network	MED
service level agreements	MED

- ***Situational factors:***

age of university (est. 1984)	LOW
size	HIGH
location	HIGH
technology environment	LOW
organizational culture	HIGH
communication infrastructure	LOW
student unrest	LOW

ICT:

• *Hardware:*	MED
• *Software :*	MED
• *Network components:*	MED

- ***Extended State Model (ESM):***

utilization	MED
exploitation,	LOW
maintenance	MED

- ***Complexity Factors (CFs):***

quantity	LOW
distribution	HIGH
diversity	LOW
dynamics	LOW
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)

cohesion of ICT functionality	HIGH LOW

MCM:

(Refer to **Table B2 in Appendix B** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Application management (AM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Technical management (TM) :***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Service support processes:***

change management	Level 1
configuration management	Level 1
help desk (HLP)	Level 1
problem management	Level 1
software control & distribution	Level 1

- ***Service delivery processes:***

availability management	Level 1
capacity management	Not available
contingency planning	Level 1
cost management	Level 1
service level management	Not available

Relationships between entities:

RS→ network:	LOW
network →RS:	LOW
network →IRM:	LOW
IRM→ network:	MED
RS→ IRM:	MED
IRM →RS:	LOW

Influences:

managerial	MED
donor	HIGH
technological	MED
economic	HIGH
cultural	HIGH

Observation: user awareness is high, but formulation of preconditions varies considerably between low and medium, indicating that efforts have been made in this regard due largely to the influence of the donor.

Two significant preconditions, personnel allocation and funding are low and ; shortage of staff remains a significant problem.

Significant among these are size of the university, geographical location, and organizational culture.

The hardware, software and network components used in IRM are also graded medium to indicate that although they are modern, they still lag behind the present state of the art.

The qualification of utilization, and maintenance is medium given that it is still under development and ICT components are relatively modern.

Significant complexity factors include distribution on account of the geographical locations of the campuses, utilization and cohesion of ICT.

Most of MCM forms of management and processes have not been implemented according to the model. Only rudimentary forms of these forms of management and processes can be discerned.

Relationships between entities indicate weaker university exploitation of the network as expected to improve intra- and inter-campus communication.

As noted above, donor influence is strong and positive.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.6.2.3 Sub-Case 3: The Faculty of Technology (FOT)

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of ICT	LOW
de-concentration of ICT	MED
financial resources	LOW
personnel allocation	LOW
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	MED

- ***Situational factors:***

age of faculty (est. 1986)	LOW
size	MED
location	LOW
technology environment	MED
faculty culture	MED
communication infrastructure	MED
student unrest	LOW

ICT:

• *Hardware:*	MED
• *Software :*	MED
• *Network components:*	MED

- ***Extended State Model (ESM) states***

utilization	MED
exploitation	MED
maintenance	MED

- ***Complexity Factors (CFs):***

quantity	MED
distribution	LOW
diversity	LOW
dynamics	MED
utilization (usage)	MED

ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:

(Refer to **Table B3 in Appendix B** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Application management (AM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Technical management (TM) :***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Service support processes:***

change management	Level 1
configuration management	Level 1
help desk	Level 1
problem management	Level 1
software control & distribution	Level 1

- ***Service delivery processes:***

availability management	Level 1
capacity management	NOT AVAILABLE
contingency planning	Level 1
cost management (CSTM)	Level 1
service level management	NOT AVAILABLE

Relationships between entities:

RS $\rightarrow$ ICT:	MED
ICT $\rightarrow$ RS:	HIGH
ICT $\rightarrow$ MCM:	MED
MCM $\rightarrow$ ICT:	MED
RS $\rightarrow$ MCM:	MED
MCM $\rightarrow$ RS:	MED

Influences:

managerial	MED
donor	HIGH
technological	MED
economic	HIGH
cultural	HIGH

Observation: users appreciate the importance of ICT in their work processes. Formulation of preconditions varies considerably between low and medium level, indicating that efforts have been made in this regard due largely to the influences of the donor communities.

Important preconditions are financial resources and personnel allocation ; they remain a significant problem. This explains why there are wide disparities between departments regarding ICT.

Situational factors that impact on the management, control and maintenance of ICT in the faculty include the size of the faculty, technology environment, faculty culture, and communication infrastructure.

The hardware, software and network components used in the faculty are quite modern and thus graded medium to indicate that although they are modern, they still lag behind the present state of the art.

The level of utilization of ICT is medium, mainly on academic and administrative activities, while exploitation is also medium, aimed at achieving the faculty objectives.

Significant complexity factors are quantity of ICT that technical staff members have to deal with, dynamics and functionality given that in this faculty many types of sophisticated software are used.

Significant complexity factors include distribution on account of the geographical locations of the campuses, utilization of ICT and cohesion.

. There is a need to initiate and establish new MCM processes within the faculty to support and improve delivery of services to the next level (Level 2).

Relationships between entities indicate strong faculty exploitation of ICT on its academic and administrative activities to achieve its objectives.

As noted above, donor influence is strong and positive.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.6.2.4 Sub-Case 4: Forestry Resources and Wildlife Management (FRWM)

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of ICT	LOW
de-concentration of ICT	MED
financial resources	LOW
personnel allocation	LOW
safety of staff/equipment	LOW
standardization of ICT	LOW
service level agreements	MED

- ***Situational factors:***

age of university (est. 1984)	LOW
size	MED
location	HIGH
technology environment	LOW
faculty culture	MED
communication infrastructure	LOW
student unrest	LOW

ICT:

• *Hardware:*	LOW
• *Software :*	LOW
• *Network components:*	LOW

- ***Extended State Model (ESM) states***

utilization	LOW
exploitation	LOW
maintenance	LOW

- ***Complexity Factors (CFs):***

quantity	MED
distribution	LOW
diversity	LOW
dynamics	LOW
utilization (usage)	LOW
ownership	NOT APPLICABLE

cohesion of ICT	LOW
functionality	LOW

MCM:

(Refer to **Table B4 in Appendix B** for details of qualification of MCM processes.)

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Application management (AM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Technical management (TM) :***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Service support processes:***

change management	Level 1
configuration management	Level 1
help desk (HLP)	Level 1
problem management	Level 1
software control & distribution	Level 1

- ***Service delivery processes:***

availability management	Level 1
capacity management	NOT AVAILABLE
contingency planning	Level 1
cost management	Level 1
service level management	NOT AVAILABLE

Relationships between entities:

RS → ICT:	MED
ICT →RS:	MED
ICT →MCM:	LOW
MCM→ ICT:	LOW
RS→MCM:	LOW
MCM→RS:	LOW

Influences:

managerial	MED
donor	HIGH
technological	LOW

economic	MED
cultural	MED

Observation: user awareness remains high, indicating high appreciation of the importance of ICT by users in their work processes.

Formulation of preconditions is rated mostly low; some efforts have been made towards this goal. Key preconditions, financial resources and personnel allocation , are both low, indicating that, they remain a significant problem.

Situational factors that impact on ICT in the faculty include size of faculty, technology environment (computer usage and applications), faculty culture, and communication infrastructure.

The hardware, software and network components vary greatly in age, capacities, speeds, and origin; network components comprise dial-up telephone connections only.

There is insufficient level of personnel allocation, leading to academic staff to perform technical duties, for which they are not trained.

Significant complexity factors include quantity of ICT that the few staff members have to deal with.

Most of MCM forms of management and processes have not been implemented according to requirements of this model. Only rudimentary forms of processes could be detected.

Relationships between entities indicate strong faculty exploitation of ICT in its academic and administrative activities to achieve its objectives.

Donor influence is strong and positive.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.6.2.5 Sub-Case 5: The Margaret Thatcher Library (MTL)

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of ICT	HIGH
de-concentration of ICT	LOW
financial resources	MED
personnel allocation	LOW
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	MED

Situational factors:

age of university (est. 1984)	LOW
size	MED
location	HIGH
technology environment	MED
organizational culture	MED
communication infrastructure	MED
student unrest	LOW

ICT:

• *Hardware:*	MED
• *Software :*	MED
• *Network components:*	MED

- ***Extended State Model (ESM) states***

utilization	MED
exploitation	MED
maintenance	MED

- ***Complexity Factors (CFs):***

quantity	MED
distribution	HIGH
diversity	LOW
dynamics	MED
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW

functionality	MED

MCM:

(Refer to **Table B5 in Appendix B** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***
  - *Strategic level* — Level 1
  - *Tactical level* — Level 1
  - *Operational level* — Level 1
- ***Application management (AM):***
  - *Strategic level* — Level 1
  - *Tactical level* — Level 1
  - *Operational level* — Level 1
- ***Technical management (TM) :***
  - *Strategic level* — Level 1
  - *Tactical level* — Level 1
  - *Operational level* — Level 1
- ***Service support processes:***
  - *change management* — Level 1
  - *configuration management)* — Level 1
  - *help desk (HLP)* — Level 1
  - *problem management* — Level 1
  - *software control & distribution* — Level 1
- ***Service delivery processes:***
  - *availability management* — Level 1
  - *capacity management* — NOT AVAILABLE
  - *contingency planning* — Level 1
  - *cost management* — Level 1
  - *service level management* — NOT AVAILABLE

Relationships between entities:

RS $\rightarrow$ ICT:	MED
ICT $\rightarrow$RS:	MED
ICT $\rightarrow$MCM:	MED
MCM$\rightarrow$ ICT:	MED
RS$\rightarrow$MCM:	MED
MCM$\rightarrow$RS:	MED

Influences:

managerial	MED
donor	HIGH
technological	MED

economic	MED
cultural	MED

Observation: level of user awareness for ICT services is high, indicating high appreciation of the importance of ICT by users in their work processes, including book circulation, searching and indexing.

Formulation of preconditions has been achieved indicating that some positive steps have been taken towards this goal.

Preconditions financial resources and personnel allocation , are medium and low, respectively, they remain a significant problem.

Situational factors that impact on ICT include size of the library, location, technology environment (computer usage and applications), library culture, and communication infrastructure.

The hardware, software and network components used in the library are of modern industry standard types and thus graded medium; network components comprise Ethernet based technology.

The level of utilization, mainly on library based activities, exploitation, and maintenance of ICT is medium, indicating realization of benefits that the technology brings through automation.

Forms of management and processes have not been implemented according to the model. Existing processes include cost management, help desk, problem management, and contingency planning.

Relationships between entities indicate strong library exploitation of ICT on its activities to achieve its overall objectives.

As noted above, donor influence is strong and positive, while other influences, with the exception of technological, are high or medium but negative, indicating a volatile and challenging environment.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.6.2.6 Sub-Case 6: The World Bank Computerization Project (WBC)

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions:***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	LOW
concentration of ICT	HIGH
de-concentration of ICT	LOW
financial resources	MED
personnel allocation	LOW
safety of staff/equipment	LOW
standardization of ICT	MED
service level agreements	MED

- ***Situational factors:***

age of university (est. 1984)	LOW
size	HIGH
location	HIGH
technology environment	LOW
organizational culture	HIGH
communication infrastructure	LOW
student unrest	LOW

ICT:

• *Hardware:*	MED
• *Software :*	MED
• *Network components:*	MED

- ***Extended State Model (ESM) states***

utilization	MED
exploitation	MED
maintenance	LOW

- ***Complexity Factors (CFs):***

quantity	HIGH
distribution	HIGH
diversity	LOW
dynamics	LOW
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW

functionality LOW

MCM:

(Refer to **Table B6 in Appendix B** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***
  Strategic level Level 1
  Tactical level Level 1
  Operational level Level 1
- ***Application management (AM):***
  Strategic level Level 1
  Tactical level Level 1
  Operational level Level 1
- ***Technical management (TM) :***
  Strategic level Level 1
  Tactical level Level 1
  Operational level Level 1

- ***Service support processes:***
  change management Level 1
  configuration management Level 1
  help desk (HLP) Level 1
  problem management Level 1
  software control & distribution Level 1
- ***Service delivery processes:***
  availability management Level 1
  capacity management NOT AVAILABLE
  contingency planning Level 1
  cost management Level 1
  service level management Level 1

Relationships between entities:

RS → ICT: LOW
ICT →RS: LOW
ICT →MCM: LOW
MCM→ ICT: LOW
RS→MCM: MED
MCM→RS: LOW

Influences:

managerial MED

donor	HIGH
technological	MED
economic	MED
cultural	MED

Observation: level of user awareness for ICT services is high, indicating high appreciation of the importance of ICT by users in the university in their work processes, including academic, administrative, communication and research.

Formulation of preconditions has been achieved to between low and medium levels, indicating that some positive steps have been taken towards this goal.

IPP, personnel allocation, safety of staff/equipment and financial resources, which are rated low indicate that they remain significant problems.

Situational factors that impact on ICT in the faculty include the size of the university, location on account of distances between campuses, and university culture.

Hardware, software and network components are industry standard types (second generation Pentium processors) and thus graded medium; network components comprise Ethernet based technology.

The level of utilization, mainly on academic and administrative activities, exploitation, and maintenance of ICT is medium, indicating realization of benefits through increased automation.

Significant complexity factors include quantity of ICT, distribution, utilization that impacts on dynamics arising from heavy and continuous use of ICT.

Forms of management and processes have not been implemented according to this model. There is, therefore, an urgent need to initiate, establish, enforce practice and measure them.

Relationships between entities indicate weak university exploitation of ICT on its activities to achieve its overall objectives.

Donor influence remains strong and positive.
Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

4.7 Function 3: Definition of the SOLL situation

The main objective of this function is to specify the future (SOLL) situation for actors, objects or processes, in effect, *what* needs to be done to get to the SOLL situation. To achieve this, it is necessary to examine each issue and identify the aspects that are missing regarding that issue. In effect, if, for example, the IST situation for a given issue is LOW, then the SOLL situation for that issue should be at least MEDIUM, if IST qualification is MEDIUM, then the SOLL situation should be defined as HIGH. In the event that the IST situation is HIGH, then the SOLL situation is defined as HIGH. This procedure applies to the issues that have positive impact on ICT. In case of those issue that have negative impact on management of ICT such as preconditions (centralization of activities, concentration of ICT), situational factors, and external influences, the reverse is true, in which case the SOLL situation should aim at minimizing their impact. These concepts are illustrated in Tables 4.5 and 4.6

Qualification of IST	**Definition of SOLL**
LOW	*MEDIUM (OR MED)*
MEDIUM (OR MED)	*HIGH*
HIGH	*HIGH*

TABLE 4.5: DEFINITION OF THE SOLL SITUATION (POSITIVE IMPACT)

Qualification of IST	**Definition of SOLL**
LOW	*LOW*
MEDIUM (OR MED)	*LOW*
HIGH	*MEDIUM (OR MED)*

TABLE 4.6: DEFINITION OF THE SOLL SITUATION (NEGATIVE IMPACT)

With regard to MCM processes, two possibilities can be used to define the SOLL situation.

Let us first suppose that the IST situation is qualified at Level 1 and the attributes attempted, rather unsatisfactorily, in Levels 2 and 3 as the cells shown in Table 4.7 (reproduced) indicate.

In the first option, the SOLL situation can be defined as performing all the attributes at Level 2 and 3 as before but aiming at value at value 2 or 3 in each cell as illustrated in Table 4.8.

X1 INFORMATION SYSTEM

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	1	0	1	0
has structured actions	**3**	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	1	0	1	0
has predictable services	**3**	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is peer reviewed	**2**	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	2	0
processes are standardized	**2**	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1	0
processes documented	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
have preparedness criteria	**1**	1	1	1	1	1	1	2	2	2	0	1	1	1	1	1	2	0	1	0
Level 2																				
repeats earlier success	**3**	1	1	1	2	2	2	1	1	1	0	1	2	1	1	2	2	0	1	0
is performed pragmatically	**3**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is recognized	**3**	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	2	0	1	0
activities are processes-like	**3**	1	1	1	2	2	2	1	1	1	0	1	1	1	1	1	1	0	1	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	**2**	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	1	0	0	0
process is trained	**2**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
process is practiced	**2**	1	1	1	2	2	2	2	2	2	0	1	1	1	1	1	1	0	1	0
process is planned	**2**	1	1	1	2	2	2	2	2	2	0	1	1	1	1	2	2	0	2	0
processes is cost-effective	**1**	1	1	1	2	2	2	1	1	1	0	1	1	1	1	2	1	0	1	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	2	0
Level 1																				
Efficiency not measured	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Uncoordinated work																				
High workloads	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Authorities decide																				
ad hoc reactions	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
No MCM processes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MCM Pr		SM	TM	OP	SM	TM	OP	SM	TM	OP	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.4**	**1.0**	**1.4**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.2**	**1.0**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

TABLE 4.7: CALCULATIONS OF CAPABILITY MATURITY LEVELS FOR ICT MANAGEMENT PROCESSES (CF. TABLE 4.1)

X1 INFORMATION SYSTEM																			
	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery			
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
has structured actions	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
has predictable services	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is related to SLA	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
has completion criteria	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is peer reviewed	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
processes are standardized	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
processes documented	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
have preparedness criteria	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Level 2																				
repeats earlier success	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
is performed pragmatically	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is recognized	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
activities are processes-like	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is measured	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is enforced	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is trained	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is practiced	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
process is planned	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
processes is cost-effective	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
processes is on schedule	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Level 1																				
Efficiency not measured																				
Uncoordinated work																				
High workloads																				
Authorities decide																				
ad hoc reactions																				
No MCM processes																				
	MCM Pr	SM	TM	OP	SM	TM	OP	SM	TM	OP	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
MEAN OVERALL LEVEL		2.0																		
s.d.		0.0																		

KEY:

Qualification of attributes		Management Level	Service Support Processes		Service Delivery Processes	
0	Missing	SM Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH		prb	Problem Management	cstm	Cost Management
			scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3					x	Non-improvement parameter

TABLE 4.8: SOLL SITUATION FOR MCM PROCESSES (OPTION 1)

In the second option, the SOLL situation can be prescribed as aiming at concentrating all effort on Level 2 attributes. In this case the objective is to raise values of all attributes at this level to the highest value possible in each cell, 3. This option is illustrated in Table 4.9.

	X1 INFORMATION SYSTEM																			
	WT.	**Funct. Mgt.**			**Appl. Mgt.**			**Tech. Mgt.**			**Service Support**					**Service Delivery**				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	3																			
has structured actions	3																			
has predictable services	3																			
process is related to SLA	3																			
has completion criteria	2																			
process is peer review ed	2																			
processes are standardized	2																			
processes documented	1																			
have preparedness criteria	1																			
Level 2																				
repeats earlier success	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
is performed pragmatically	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is recognized	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
activities are processes-like	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is measured	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is enforced	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is trained	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is practiced	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
process is planned	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
processes is cost-effective	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
processes is on schedule	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Level 1																				
Efficiency not measured																				
Uncoordinated w ork																				
High w orkloads																				
Authorities decide																				
ad hoc reactions																				
No MCM processes																				
MCM Pr		SM	TM	OP	SM	TM	OP	SM	TM	OP	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
MEAN OVERALL LEVEL		**2.0**																		
s.d.		**0.0**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Softw are Control and Distrit	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

TABLE 4.9: SOLL SITUATION FOR MCM PROCESSES (OPTION 2)

Both options have strengths and weaknesses.

In option 1, the strong point to note is that it represents the reality in many of the sub-case studies as shown in Table 4.6 where each attribute is attempted though not to the same degree as desired. Its disadvantages include the large of attributes involved, and the lack of resources, financial, technical and time required to improve all the attributes in most of the sub-case studies.

In option 2, it should be noted that it will in the end cheaper to concentrate on fewer attributes at level 2 given the limited resources at their disposal and technical expertise compared to the first option. However, this option forces the organization to abandon the attributes that they already have attempted to perform before.

In either case the SOLL situation is characterized by the absence of Level 1 attributes.

In this study, the second option is recommended based on the requirement that as a prerequisite, all Level 2 attributes must be fulfilled before Level 3 attributes are attempted. This requirement is similar to that which applies to software engineering [SEI95]. Further, for reasons of limitations of resources in most public universities in Kenya the option is selected. The choice of this option does not, however, prevent the organization from practising some of Level 3 attributes.

4.7.1.1 Sub-Case 1: The Academic Register Information System (ARIS)

Using the model, M_6, the SOLL situation for ARIS was defined as follows:

RS:

- ***User requirements***

availability of ARIS	HIGH;	ARIS should be made more widely available to users
flexibility of ARIS	HIGH;	more flexible ARIS for users
maintainability of ARIS	HIGH;	better maintained ARIS for users
performance of ARIS	HIGH;	high performance ARIS to improve throughput
reliability of ARIS	HIGH;	more reliable ARIS
security of ARIS	HIGH;	more secure ARIS

- ***Preconditions***

information policy and planning	MED; formulated IPP on ICT management be disseminated
centralization of activities	LOW; critical activities should be centralized
de-centralization of activities	MED; some activities must be de-centralized for effectiveness
concentration of ICT	MED; critical ICT should be concentrated for security/control
de-concentration of ICT	HIGH; ICT be de-concentrated various strategic locations
financial resources	HIGH; increased funding for ICT
personnel allocation	MED; more qualified and experienced staff in adequate numbers
safety of staff/equipment	HIGH; safety measures should be instituted and guaranteed
standardization of ICT	HIGH; ICT be standardized for effectiveness and efficiency
service level agreements	HIGH; enhanced SLAs with vendors, new SLAs with users

- ***Situational factors:***

age of university (est. 1984)	LOW; adapt proactive, innovative policies for increased impact
size	MED; more ICT to provide for increasing numbers of users
location	MED; distances between campuses overcome by way of networking
technology environment	MED; increased computer literacy making use of technology
organizational culture	MED; higher degree of work ethics among users, e.g. time management
communication infrastructure	MED; improved communication infrastructure across the campuses
student unrest	MED; student unrest kept low

ICT:

- *Hardware:* HIGH; hardware to be upgraded to the state-of-the-art level

- *Software :* HIGH; software to be upgraded to the state-of-the art level
- *Network components:* HIGH; network components to be upgraded to the state-of-the-art level

- ***Extended State Model (ESM) states***
  - *utilization* HIGH; utilization of ARIS by users to be increased , well defined tasks
  - *exploitation* MED; increased exploitation of ARIS, well defined tasks
  - *maintenance* HIGH; improved quality of maintenance of ARIS, well defined tasks
- ***Complexity Factors (CFs):***
  - *quantity* LOW; anticipated increase in quantity of ICT with better management
  - *distribution* MED; overcome distances between campuses by networking
  - *diversity* LOW; industry standard ICT to be maintained to keep complexity low
  - *dynamics* LOW; only necessary changes to be made to ICT
  - *utilization (usage)* LOW; better trained users in ICT to make full utilization of ICT
  - *ownership* N/A; no dispute
  - *cohesion of ICT* MED; industry standard ICT to be maintained to keep complexity low
  - *functionality of ICT* LOW; better trained user base to take advantage of functions of ICT

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; implementation of policies on users
  - *Operational level* Level 2; operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on data sets
  - *Operational level* Level 2; operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on technical issues
  - *Operational level* Level 2; operational tasks related to technical issues
- ***Service support processes:***
  - *change management* (CHG) Level 2; improve attributes enforcement / measurement
  - *configuration management* Level 2; initiate CONF as a new process
  - *help desk* Level 2; improve attributes practising /

	training/measuring
problem management	Level 2; initiate planning, enforcing, and measuring
software control & distribution	Level 2; initiate process schedule, cost-effectiveness, plan

- ***Service delivery processes:***

availability management	Level 2; train, enforce, measure, and improve other attributes
capacity management	Level 2; initiate CAPM as a new process
contingency planning	Level 2; train, enforce, measure, and improve other attributes
cost management (CSTM)	Level 2; train, enforce, measure, and improve other attributes
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

RS → ARIS:	HIGH; realization of university exploitation of ARIS
ARIS →RS:	HIGH; increased support of ARIS for university activities
ARIS →MCM:	MED; increased support of ARIS for technical staff
MCM→ ARIS:	MED; more experienced and better qualified staff to manage ARIS
RS→MCM:	HIGH; university management to support technical staff
MCM→RS:	MED; increased university management response to user requests

Influences:

managerial	LOW; reduced effects of structural changes by government and the university
donor	HIGH; donor role in influencing ICT should be encouraged
technological	HIGH; technological developments should impact positively
economic	MED; minimize effects of economy, implement policies and strategies
cultural	MED; cultural influences should be changed and turned into an asset

4.7.1.2 Sub-Case 2: The Information Resource Management (IRM)

Using the model, M_6, the SOLL situation for IRM was defined as follows:

RS:

- ***User requirements:***

availability of network	HIGH*;*	network to be more widely available to users
flexibility of network	HIGH*;*	more flexible network for users
maintainability of network	HIGH*;*	better maintained network for users
performance of network	HIGH*;*	high performance network to improve data traffic
reliability of network	HIGH*;*	more reliable network
security of network	HIGH*;*	more secure network against vandalism, fire and weather

- ***Preconditions:***

information policy and planning	MED;	formulated IPP on ICT management and disseminated
centralization of activities	LOW;	centralized critical activities but at a lower level
de-centralization of activities	MED;	de-centralized activities for effectiveness
concentration of ICT	MED;	critical ICT should be concentrated
de-concentration of ICT	HIGH;	de-concentrated ICT to give users control over their work
financial resources	HIGH;	increased funding from various sources
personnel allocation	MED;	better qualified staff required in sufficient numbers
safety of staff/equipment	HIGH;	safety measures be provided at a higher level
standardization of ICT	HIGH;	standardized ICT for better maintenance
service level agreements	HIGH;	enhanced SLA with vendors, new, enhanced SLAs with users

- ***Situational factors:***

age of university (est. 1984)	LOW;	take advantage of young age and adapt proactive policies
size	MED;	more ICT for increasing numbers of users
location	MED;	reduced effects of distances between campuses by networking
technology environment	MED;	increased computer literacy, maximize use of technology
organizational culture	MED;	higher degree of work ethics among users, e.g. time management
communication infrastructure	MED;	improved communication infrastructure across the campuses
student unrest	LOW;	check student unrest to prevent disruptions in the university

ICT:

- *Hardware:* HIGH; hardware to be upgraded to the state-of-the-art
- *Software :* HIGH; software to be upgraded to the state-of-the-

art

- *Network components:* HIGH; network components to be upgraded to the state-of-the-art level

- ***Extended State Model (ESM) states***

utilization	HIGH; enhanced utilization of network by users, well defined tasks
exploitation	MED; exploitation of network at a higher level, well defined tasks
maintenance	HIGH; improved quality of network maintenance by IRM, define tasks

- ***Complexity Factors (CFs):***

quantity	LOW; anticipated increase in quantity of ICT with better management
distribution	MED; implement networking between campuses
diversity	LOW; industry standard ICT be maintained
dynamics	LOW; only necessary changes to be made to ICT
utilization (usage)	LOW; better trained users in ICT to make full utilization of ICT
ownership	N/A; no dispute
cohesion of ICT	MED; industry standard ICT to be maintained
functionality	LOW; better trained user base to take advantage of functions of ICT

MCM:

- ***Functional management (FM):***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; implementation of policies on users
Operational level	Level 2; operational tasks related to users

- ***Application management (AM):***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; policy implementation on data sets
Operational level	Level 2; operational tasks related to data sets

- ***Technical management (TM) :***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; policy implementation on tech. issues
Operational level	Level 2; operational tasks related to technical issues

- ***Service support processes:***

change management (CHG)	Level 2; improve attributes enforcement / measurement
configuration management	Level 2; initiate CONF as a new process
help desk (HLP)	Level 2; improve attributes practising / training/measuring
problem management	Level 2; initiate planning, enforcing, and

	measuring
software control & distribution	Level 2; initiate process schedule, cost-effectiveness, plan

- ***Service delivery processes:***

availability management	Level 2; train, enforce, measure, and improve other attributes
capacity management	Level 2; initiate CAPM as a new process
contingency planning	Level 2; train, enforce, measure, and improve other attributes
cost management	Level 2; train, enforce, measure, and improve other attributes
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

RS→ network:	MED; improved exploitation of network, better infrastructure
network →RS:	MED; improved network support for university communication
network →IRM:	MED; improved network data for IRM
IRM→ network:	HIGH; improved IRM management of the network
RS→ IRM:	HIGH; more attention by university to IRM
IRM →RS:	MED; improved university responsiveness to user requirements

Influences:

managerial	LOW; reduced effects of structural changes initiated by government, senate
donor	HIGH; donor influence on ICT should be maintained at a high level
technological	HIGH; technological developments should have high positive impact on IRM
economic	MED; economic influences should be overcome with adequate policies
cultural	MED; positive cultural influences should be encouraged

4.7.1.3 Sub-Case 3: The Faculty of Technology (FOT)

Using the model, M_6, the SOLL situation for FOT was defined as follows:

RS:

- ***User requirement:***

availability of ICT	HIGH;	ICT to be more widely available to users
flexibility of ICT	HIGH;	more flexible ICT for users
maintainability of ICT	HIGH;	better maintained ICT by technical staff
performance of ICT	HIGH;	high performance ICT to improve productivity
reliability of ICT	HIGH;	more reliable ICT for users
security of ICT	HIGH;	more secure ICT against vandalism, fire and weather

- ***Precondition:***

information policy and planning	MED; formulate IPP on ICT be widely disseminated to faculty users
centralization of activities	LOW; critical activities should be centralized
de-centralization of activities	MED; some activities should be de-centralized to medium level
concentration of ICT	LOW; critical ICT should be concentrated
de-concentration of ICT	HIGH; non-critical ICT should be de-concentrated in departments
financial resources	MED; increased funding from more sources
personnel allocation	MED; qualified and experienced staff in adequate numbers
safety of staff/equipment	HIGH; safety measures should be provided at a higher level
standardization of ICT	HIGH; highly standardized ICT for better effectiveness and efficiency
service level agreements	HIGH; enhanced SLA with vendors, and new SLAs with users

- ***Situational factors:***

age of university (est. 1986)	LOW; authorities should adapt proactive ICT policies
size	LOW; increased ICT resources for increasing numbers of users
location	LOW; networking to overcome long distances between campuses
technology environment	HIGH; increased computer literacy among users
organizational culture	LOW; higher degree of work ethics among users, e.g. time management
communication infrastructure	HIGH; improved communication infrastructure between campuses
student unrest	LOW; student unrest kept low to prevent disruptions in the university

ICT:

- *Hardware:* HIGH; hardware upgraded to state-of-the-art

- *Software :* HIGH; software upgraded to state-of-the-art
- *Network components:* HIGH; network components upgraded to state-of-the-art

- ***Extended State Model (ESM) states***
  utilization HIGH; enhanced utilization of ICT by users, well defined tasks
  exploitation HIGH; enhanced exploitation of ICT by the, well defined tasks
  maintenance HIGH; enhanced maintenance by technical staff, well defined tasks

- ***Complexity Factors (CFs):***
  quantity LOW; increased quantities with better management
  distribution LOW; adequate networking, LANs and campus-wide
  diversity LOW; maintained industry standard ICT
  dynamics LOW; anticipate more changes to ICT with better change management
  utilization (usage) LOW; higher level of computer literacy among users, full utilization
  ownership N/A; no dispute
  cohesion of ICT LOW; maintain industry standard ICT
  functionality LOW; higher computer literacy, higher level of functional management

MCM:

- ***Functional management (FM):***
  Strategic level Level 2; decision making, policy formulation
  Tactical level Level 2; implementation of policies on users
  Operational level Level 2; operational tasks related to users

- ***Application management (AM):***
  Strategic level Level 2; decision making, policy formulation
  Tactical level Level 2; policy implementation on data sets
  Operational level Level 2; operational tasks related to data sets
- ***Technical management (TM) :***
  Strategic level Level 2; decision making, policy formulation
  Tactical level Level 2; policy implementation on tech. issues
  Operational level Level 2; operational tasks related to technical issues

- ***Service support processes:***
  change management (CHG) Level 2; improve planning, training, enforcement, measuring
  configuration management Level 2; improve measuring and other attributes at this level
  help desk Level 2; planning, practicing, training,

	enforcing, measuring
problem management	Level 2; emphasis on measuring problem parameters
software control & distribution	Level 2; emphasis on schedule, enforce, measure

- ***Service delivery processes:***

availability management	Level 2; emphasis on training, measuring, and improvement
capacity management	Level 2;initate CAPM as a new process
contingency planning	Level 2; emphasis on training, measuring, and improvement
cost management	Level 2; emphasis on training, enforcing, and improvement
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

RS → ICT:	HIGH; enhanced exploitation of ICT in the faculty
ICT →RS:	HIGH; maintain high impact of support of ICT for faculty activities
ICT →MCM:	HIGH; high impact of ICT support for technical staff
MCM→ ICT:	HIGH; high training and experience of staff in ICT management required
RS→MCM:	HIGH; faculty management should pay more attention to ICT management
MCM→RS:	HIGH; high faculty responsiveness to user requests is required

Influences:

managerial	LOW; low impact of structural changes initiated by senate on FOT
donor	HIGH; continued donors influence on ICT
technological	HIGH; positive impact of changes in technology to be maintained
economic	MED; impact of economy on ICT should be contained with adequate policies
cultural	MED; impact of culture on ICT to be contained with appropriate work ethics

4.7.1.4 Sub-Case 4: Forestry Resources and Wildlife Management (FRWM)

Using the model, M_6, the SOLL situation for FRWM was defined as follows:

RS:

- ***User requirements:***

availability of ICT	HIGH*;* more available ICT for users in the faculty
flexibility of ICT	HIGH*;* more flexible ICT for users in the faculty
maintainability of ICT	HIGH*;* more maintainable ICT by technical staff
performance of ICT	HIGH*;* high performance ICT to improve user productivity
reliability of ICT	HIGH*;* more reliable ICT for users
security of ICT	HIGH*;* more secure ICT against vandalism, fire and weather

- ***Preconditions***

information policy and planning	MED; formulated IPP on FRWM should be made available to users
centralization of activities	LOW; critical activities should be centralized t
de-centralization of activities	LOW; non-critical activities be de-centralized for effectiveness
concentration of ICT	LOW; critical ICT be concentrated
de-concentration of ICT	HIGH; non-critical ICT should be de-concentrated
financial resources	MED; increased funding from more sources
personnel allocation	MED; qualified and experienced staff in adequate numbers
safety of staff/equipment	HIGH; enhanced safety measures should be provided
standardization of ICT	MED; enhanced standardize ICT for effectiveness and efficiency
service level agreements	HIGH; enhanced SLA with vendors; new, enhanced SLAs with users

- ***Situational factors:***

age of faculty (est. 1984)	LOW; adapt adequate ICT policies at an early stage
size	LOW; increased ICT resources with high level management skills
location	MED; networked campuses to overcome geographical problems
technology environment	MED; increased computer literacy among users
faculty culture	LOW; improved work ethics
communication infrastructure	MED; improved communication infrastructure
student unrest	LOW; reduced student unrest

ICT:

• *Hardware:*	MED; upgraded hardware to state-of-the-art
• *Software :*	MED; upgraded software to state-of-the-art
• *Network components:*	MED; upgraded network components to state-of-the-art

- ***Extended State Model (ESM) states***

utilization	MED; enhanced utilization of ICT by users, well defined tasks
exploitation	MED; enhanced exploitation of ICT by the faculty, well defined tasks
maintenance	MED; enhanced maintenance by faculty technical, well defined tasks

- ***Complexity Factors (CFs):***

quantity	LOW; increased quantities of ICT with enhanced ICT management
distribution	LOW; adequately networked environment
diversity	LOW; industry standard ICT required to reduce complexity
dynamics	LOW; increased changes with high level change management process
utilization (usage)	MED; improved usage of ICT with high level functional management
ownership	N/A; no dispute
cohesion of ICT	MED; wide use of industry standard ICT
functionality	MED; better trained user base on ICT functionality

MCM:

- ***Functional management (FM):***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; implementation of policies on users
Operational level	Level 2; operational tasks related to users

- ***Application management (AM):***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; policy implementation on data sets
Operational level	Level 2; operational tasks related to data sets

- ***Technical management (TM) :***

Strategic level	Level 2; decision making, policy formulation
Tactical level	Level 2; policy implementation on tech. issues
Operational level	Level 2; operational tasks related to technical issues

- ***Service support processes:***

change management	Level 2; improve planning, training, enforcement, measuring
configuration management	Level 2; improve measuring and other attributes at this level
help desk	Level 2; planning, practicing, training, enforcing, measuring
problem management	Level 2; emphasis on measuring problem parameters
software control & distr.	Level 2; emphasis on schedule, enforce, measure

- ***Service delivery processes:***

availability management	Level 2; emphasis on training, measuring, and improvement
capacity management	Level 2; imitate CAPM as a new process
contingency planning	Level 2; emphasis on training, measuring, and improvement
cost management	Level 2; emphasis on training, enforcing, and improvement
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

RS → ICT:	high exploitation of ICT in the faculty
ICT →RS:	high support of ICT for faculty activities
ICT →MCM:	medium to high ICT support for technical staff
MCM→ ICT:	medium to high training, experience and funds
RS→MCM:	medium to high faculty management attention to ICT management
MCM→RS:	medium to high responsiveness to user requests

Influences:

managerial	reduced impact of structural changes initiated by senate
donor	high level donor influence on ICT
technological	high positive impact of technological developments on ICT
economic	low level impact of economic influences on ICT
cultural	low level negative impact of cultural influences on ICT

4.7.1.5 Sub-Case 5: The Margaret Thatcher Library (MTL)

Using the model, M_6, the SOLL situation for MTL was defined as follows:

RS:

- ***User requirements:***

availability of ICT	HIGH; more available ICT for users in the library
flexibility of ICT	HIGH; more flexible ICT for users in the library
maintainability of ICT	HIGH; more maintainable ICT by technical staff in the library
performance of ICT	HIGH; high performance ICT to improve user productivity
reliability of ICT	HIGH; more reliable ICT for library users
security of ICT	HIGH; more secure ICT against vandalism, fire and weather

- ***Preconditions:***

information policy and planning	MED; formulated IPP on library should be highly disseminated to library users
centralization of activities	LOW; critical activities should be centralized
de-centralization of activities	MED; non-critical activities should be de-centralized for improved effectiveness
concentration of ICT	MED; critical ICT should be concentrated
de-concentration of ICT	MED; non-critical ICT be de-concentrated in departments
financial resources	HIGH; increased funding from income generation in addition to donors
personnel allocation	MED; qualified and experienced staff in sufficient numbers
safety of staff/equipment	HIGH; safety measures should be provided
standardization of ICT	HIGH; ICT should be standardized for effectiveness and efficiency
service level agreements	HIGH; enhanced SLA with vendors, new and enhanced SLAs with users

- ***Situational factors:***

age of library (est. 1984)	LOW; young library adaptation of adequate policies on ICT
size	LOW; increased ICT to provide for large number of users
location	MED; networked campuses to overcome geographical problems
technology environment	HIGH; computer literate user community, improved ICT management
library culture	LOW; reduced impact of negative culture and practices
communication infrastructure	HIGH; highly improved communication infrastructure
student unrest	LOW; reduced frequency and impact of student

unrest

ICT:

- *Hardware:* HIGH; hardware upgraded to state-of-the-art
- *Software :* HIGH; software to be upgraded to state-of-the-art
- *Network components:* HIGH; network components upgraded to state-of-the-art

- ***Extended State Model (ESM) states***
  - *utilization* HIGH; improved utilization of ICT by library users, well defined tasks
  - *exploitation* HIGH; improved exploitation of ICT by the library, well defined tasks
  - *maintenance* HIGH; improved maintenance of ICT, well defined tasks

- ***Complexity Factors (CFs):***
  - *quantity* LOW; increased ICT quantities, with improved ICT management
  - *distribution* MED; networked campuses to overcome problems of geography
  - *diversity* LOW; high industry standard ICT required to reduce complexity
  - *dynamics* LOW*;* high level changes to ICT, with improved change management
  - *utilization (usage)* LOW; high level utilization, improved functional management
  - *ownership* N/A; no dispute
  - *cohesion of ICT* LOW; maintain industry standard ICT
  - *functionality* LOW; high level computer literacy, high function application

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; decision making and policy formulation
  - *Tactical level* Level 2; implementation of policies on users
  - *Operational level* Level 2; operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on data sets
  - *Operational level* Level 2; operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on tech. issues
  - *Operational level* Level 2; operational tasks related to technical issues
- ***Service support processes:***
  - *change management* Level 2; improve planning, training, enforcement, measuring
  - *configuration management* Level 2; improve measuring and other attributes at this level
  - *help desk (HLP)* Level 2; planning, practicing, training, enforcing, measuring
  - *problem management* Level 2; emphasis on measuring problem parameters

software control & distr.	Level 2; emphasis on schedule, enforce, measure

- ***Service delivery processes:***

availability management	Level 2; emphasis on training, measuring, and improvement
capacity management	Level 2;initate CAPM as a new process
contingency planning	Level 2; emphasis on training, measuring, and improvement
cost management	Level 2; emphasis on training, enforcing, and improvement
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

*RS → ICT***:**	HIGH; realization and high exploitation of ICT
ICT →RS:	HIGH; support of ICT for library activities by university management
ICT →MCM:	HIGH; ICT support for technical staff
*MCM→ ICT***:**	HIGH; training, experience, funds required to improve ICT management
RS→MCM:	HIGH; library management should pay high attention to ICT management
MCM→RS:	HIGH; responsiveness to user requests by library management required

Influences:

managerial	LOW; reduced effects of structural changes initiated by government and senate
donor	HIGH; enhanced donors' role in influencing ICT
technological	HIGH; changes in technological developments should lead to improvements
economic	LOW; reduced impact of economic influences on ICT with adequate policies
cultural	LOW; reduced cultural influences on ICT

4.7.1.6 Sub-Case 6: The World Bank Computerization Project (WBC)

Using the model, M_6, the SOLL situation for WBC was defined as follows:

RS:

- ***User requirements***
  availability of ICT HIGH; more available ICT for users in the university
  flexibility of ICT HIGH; more flexible ICT for users in the university

  maintainability of ICT HIGH; more maintainable ICT by technical staff
  performance of ICT HIGH; high performance ICT to improve user productivity
  reliability of ICT HIGH; more reliable ICT for users
  security of ICT HIGH; more secure ICT against vandalism, fire and weather

- ***Preconditions:***
  information policy and planning MED; formulated IPP on WBC should be highly disseminated to users
  centralization of activities LOW; critical activities should be centralized
  de-centralization of activities MED; non-critical activities should be de-centralized for effectiveness
  concentration of ICT MED; critical ICT should be concentrated
  de-concentration of ICT MED; non-critical ICT should be de-concentrated in departments
  financial resources HIGH; increased funding from various sources
  personnel allocation MED; qualified and experienced staff in adequate numbers
  safety of staff/equipment MED; improved safety measures should be provided to users/ equipment
  standardization of ICT HIGH; highly standardized ICT for effectiveness and efficiency
  service level agreements HIGH; enhanced SLA with vendors, and new enhanced SLAs with users

- ***Situational factors:***

  age of university (est. 1984) LOW; adoption of appropriate ICT policies
  size MED; increased quantities of ICT for large number of users
  location MED; networked campuses to overcome problems of distances
  technology environment MED; high level of computer literacy among users
  university culture MED; reduce effects of negative culture and practices
  communication infrastructure MED; highly improved infrastructure
  student unrest LOW; reduced frequency of student unrest

ICT:

- *Hardware:* HIGH; hardware upgraded to state-of-the-art

- *Software :* HIGH; software upgraded to state-of-the-art
- *Network components:* HIGH; network components upgraded to state-of-the-art

- ***Extended State Model (ESM) states***

  utilization HIGH; enhanced utilization of ICT by university users, defined tasks

  exploitation HIGH; enhanced exploitation of ICT by the university, defined tasks

  maintenance MED; highly trained, competent university technical staff, defined tasks

- ***Complexity Factors (CFs):***

  quantity MED; increased ICT quantities, with improved ICT management

  distribution MED; networked campuses to overcome geographical problems

  diversity LOW; maintain high industry standard ICT

  dynamics LOW; minimize changes with improved management

  utilization (usage) LOW; improved ICT utilization with improved functional management

  ownership N/A; no dispute

  cohesion of ICT LOW; high industry standard ICT to be maintained

  functionality LOW; high level computer literacy among users

MCM:

- ***Functional management (FM):***

  Strategic level Level 2; decision making, policy formulation

  Tactical level Level 2; implementation of policies on users

  Operational level Level 2; operational tasks related to users
- ***Application management (AM):***

  Strategic level Level 2; decision making, policy formulation

  Tactical level Level 2; policy implementation on data sets

  Operational level Level 2; operational tasks related to data sets
- ***Technical management (TM) :***

  Strategic level Level 2; decision making, policy formulation

  Tactical level Level 2; policy implementation on tech. issues

  Operational level Level 2; operational tasks related to technical issues
- ***Service support processes:***

  change management Level 2; improve planning, training, enforcement, measuring

  configuration management Level 2; improve measuring and other attributes at this level

  help desk Level 2; planning, practicing, training, enforcing, measuring

  problem management Level 2; emphasis on measuring problem parameters

  software control & distr. Level 2; emphasis on schedule, enforce, measure
- ***Service delivery processes:***

  availability management Level 2; emphasis on training, measuring, and improvement

  capacity management Level 2;initate CAPM as a new process

  contingency planning Level 2; emphasis on training, measuring, and

	improvement
cost management	Level 2; emphasis on training, enforcing, and improvement
service level management	Level 2; initiate SLM as a new process

Relationships between entities:

RS → ICT:	MED; university exploitation of ICT to full realization
ICT →RS:	MED; improved support of ICT for university activities
ICT →MCM:	MED; high level support for technical staff by university management
MCM→ ICT:	MED; high level training in, and funds for ICT management
RS→MCM:	HIGH; more university management attention to ICT management
MCM→RS:	MED; improved responsiveness to user requests by university management

Influences:

managerial	LOW; reduced impact of structural changes initiated by university
donor	HIGH; enhanced donor influence on ICT should be maintained
technological	HIGH; high level changes in technological developments
economic	LOW; low impact of economic influences on ICT
cultural	LOW; low cultural influences on ICT

Conclusions:

We can conclude that the model has been used to define the future situation, briefly for the specific issues contained in each of the sub-case studies, which were examined individually. Recommendations made, though similar in structure, do apply to varying degrees to the sub-case studies themselves.

4.8 Function 4: Transformation from IST to SOLL situation

Change is necessary and critical if any improvement of the IST situation is to be realized, but with every change there is an accompaniment of and requirement for new concepts, new skills, new patterns, new commitments, new strategies and new resources in terms of training, financial resources and time needed to control and manage the realization of the new situation and to prevent it from getting out of hand. Skills and financial commitments are needed to stabilize and sustain the new situation once it has been realized so that it can last for as long as the users and the organization require; but the identification of changes that are needed to improve the situation is not sufficient. We must also examine the benefits that justify the costs associated with changing the situation. As studies have shown, economic gains alone may neither be necessary nor sufficient to judge institutional performance or to justify investment in changes aimed at improvement [Kaplan92, Brodman95].

A process improvement procedure is required to transform the IST situation to the SOLL situation. It is essential that the process improvement model be practical, feasible, cost-effective and within the financial and technical abilities of the institution to implement. While Function 3 specifies what needs to be done to transform the IST to SOLL, Function 4 dwells on *how* this should be done. In this function, the benefits, costs and consequences of transformation are also detailed. The process improvement model, presented in Figure 4.10, illustrates this concept.

Step 1: Establish the objectives for improvement and set up a team to oversee it. The team should be composed of a senior management official, ICT management staff, and a trained capability maturity assessor

Step 2: Analyze and reach a consensus regarding the gaps between the IST situation and the SOLL situation, that is, between where the university is today and where it wishes to be in future. Use the next higher capability maturity level as a reference land mark to identify what needs to be done to improve.

Step 3: Outline the specific activities required to make the transition between IST and SOLL situations. In particular, clearly defined remedial tasks must be assigned, these are:

- deliverables or expected results
- ownership of improvement processes
- timeframes for the accomplishment of tasks
- resources needed to perform the tasks
- risks involved in carrying out the tasks
- measurements of the achievements

Step 4: Select a criterion to evaluate success of attainment of maturity level. This step is necessary to review the goals/objectives set in Step 1, and serves as a means to determine how and why some objectives are not being achieved.

Step 5: Maintain the level of improvement process, maximizing the desirable activities (enablers) and minimizing inhibitors (disablers). This step is the most difficult to achieve and requires strict discipline, and commitment on the part of implementers.

FIGURE 4.10: ICT MANAGEMENT IMPROVEMENT PROCESS

Using this process for each of the sub-case studies, the transformation of the current situations to future situations can be attempted and realized.

Benefits, Costs, and Consequences of transformation

Before we proceed with the transformation function of the model, we will examine the benefits, costs and consequences or pitfalls of the transformations, which an institution that implements the model must be aware of. We will examine these issues for each entity.

RS:

In the entity RS, the issues discussed include users requirements, preconditions, and situational factors. After the transformation of the current situation to the future situation the issues can be summarized as:

Benefits:

- users and the university at large will be satisfied with the services they obtain from utilizing ICT. Service availability and utilization will be extended, impact on users and downtimes will be minimized, greater flexibility as more functions for user become accessible, ICT will become more maintainable and higher performance of ICT will lead to higher productivity levels. With greater reliability of ICT there will be higher user confidence and more security of ICT resources will lead to higher integrity of data and information.

With establishment of information and policy planning the university as an organization will establish a firm foundation on which to develop, utilize, exploit, and maintain ICT. Policies on centralization or de-centralization of activities and ICT, and concentration and de-concentration of ICT, will be considered and decided on the basis of their merits or demerits. These include reduction in operational costs, consolidation of management overviews, and enhanced usage of available resources. Guarantee of safety of people engaged in work related to ICT will boost user confidence. Standardization policy as a precondition will result in more uniform, equitable and sustainable ICT platform. Finally, service level agreements between users and ICT center (organization) will become a reality, which will ensure high levels of ICT services to users.

Costs:

- provision of more ICT hardware and software to ensure higher availability of ICT service for increasing numbers of users
- training in/or exposure of users to, various functions of ICT to ensure more flexibility in ICT utilization and exploitation.
- training technical staff in ICT management processes to ensure higher maintenance
- tuning ICT and minimizing downtimes/outage of ICT to enhance performance
- provide burglar-proof devices to prevent theft, ensure physical security and protection against fire, moisture, employ security tools to control intrusion of harmful programs (anti-virus), employ encryption to prevent unauthorized access to information in transit over networks, perform surveillance of ICT indicators to detect and warn of any violations or deviations from the norm as soon as they occur, administer password control and access, enhance security of data and information

- holding seminars, logistics, materials and paper, administrative costs, publishing, distribution and education, dissemination of contents of the documents, since this involves many parties from the same organizations
- centralization/de-centralization of activities and concentration/de-concentration of ICT must be considered including logistical costs, and loss of consolidated overview of activities and ICT operational costs reduction in usage of available ICT resources

- the costs of safety for people include purchase of equipment and materials to ensure people are safe from such conditions as repetitive strain injury (RSI) or occupational overuse syndrome (OOS). This implies purchase of suitable furniture, anti-radiation measures and provision of information on suitable body exercises for the benefit of staff. When injuries occur, an insurance cover should be considered and provided accordingly.

- the costs of standardization of ICT include the development of policy on standardization of ICT throughout the institution
- sale of existing non-conformant (non-standard) equipment
- purchase of standard equipment

The costs of *service level agreement* include development of service level agreement between users and the university, dissemination of service level agreements to users, and cost of violation of service level agreements.

The costs associated with s*ituational factors* are also considered:

Age: younger institutions lack prominence and an established name on the world stage. To publicize themselves they will need to adapt more aggressive strategies, which cost money to realize. With regard to *size*, large institutions have the tendency to lag behind in ICT. More users imply more ICT resources and higher ICT service provision cost. The cost of overcoming this should be taken into account. *Location* of a university or campus within a university can be an inhibiting factor. The farther away from the center of activity the more disadvantaged it is in terms of ICT development. Costing must also take this factor into account.
Technology environment: the less computer literate the users and customers the more difficult it is to take full advantage of available ICT services. To raise the level more training costs must be considered.
Organizational culture: the more culturally diverse the institution, in terms of attitude, values and beliefs, the more challenging it is to unify and orient towards a common goal. The cost of re-orientation towards a common goal can be high and demanding on those in positions of leadership.

With regard to c*ommunication infrastructure* the less developed the communication infrastructure of the university and the immediate environs the more difficult it is to communicate both within the university and with the outside world. The cost of putting into place a reliable communication infrastructure can be high in terms of money, equipment and materials, time, and professional and technical skills required. It may require the cooperation of many actors, government, donors, and university, jointly working together to implement it.

Consequences:
Consequences of initiating changes in ICT service can be visualized in terms of the effects the changes will bring. Some effects can be determined beforehand but most will be indeterminate. We focus on determinate consequences. In practical terms the consequences on the institutions will include diversion of funds from non-ICT areas to ICT areas leading to downgrading of quality of services in non-ICT areas. If funds are not forthcoming for capacity building (training of users and technical field) in utilization, exploitation and maintenance of ICT, then the institution may suffer lower utilization and poor management, which will lead to a cycle of more frustrations on the part of users and poor returns on investment for the university. Acquisition of ICT resources without accompanying user training will have the consequences of under-achievement since the full potential of ICT will not be exploited

ICT:

Benefits:

- user satisfaction derived from higher ICT utilization, exploitation and maintenance
- higher productivity levels derived from ICT utilization, exploitation and maintenance
- higher reliability levels derived from ICT maintenance
- higher levels of achievement of university objectives

Costs:

- cost of training users to utilize ICT, i.e. hardware, software, network components, fully
- cost of sensitizing university management to the need for and benefits of exploiting ICT(hardware, software, network components) in its activities
- cost of training technical personnel in ICT, i.e. hardware, software, network components maintenance
- cost of ICT (hardware, software, network components) maintenance
- cost of new ICT, i.e. hardware, software, network components
- cost of minimizing effects of complexity factors on utilization, exploitation and maintenance of ICT. These include better ways of dealing with increasing number of ICT resources, ensuring that ICT components work cohesively together; overcoming problems of distance between, and distribution of ICT over, campuses; ensuring different types of ICT resources can work together; changes in ICT are controlled and made to benefit users; as many of the functions of ICT are utilized and exploited; problems of ownership are resolved.

Consequences:

A lot depends on the willingness of university management to utilize, exploit and maintain ICT; but this may produce positive results with respect to ICT and may include:

- increased morale among users
- users will be motivated to work harder and produce more

However, the change may fail to materialize due to:

- lack of motivation on the part of users
- lack of top management commitment and support
- user resistance to change who are used to 'old' ways of doing things
- lack of , or insufficient training, for users
- implementing staff not given sufficient authority to decide
- lack of ability to implement the decisions made
- expectations are too ambitious to realize
- lack of suitable tools and expertise required to implement change

MCM:

Benefits:

Forms of management

- well defined ICT management forms
- better coordination of management tasks and task areas
- logical sequencing of tasks into processes
- reduction in volume of management work
- reduction in cost of ICT management
- better control of ICT services and resources

ITIL Service support processes

Change management

- better alignment of ICT services to university objectives

- increased visibility and communication of change to both university activities and ICT technical staff
- improved risk assessment and management
- reduction in adverse effects of change on quality of services
- better assessment of cost of planned change before they occur
- improved problem management and availability management through use of valuable management information relating to changes accumulated through change management process
- increased productivity of users through less disruption and higher quality services
- increased productivity of key personnel through less need for diversion from planned duties to implement urgent changes
- greater ability to absorb increasing number of changes
- enhanced university business perception of ICT through improved quality of service and a professional approach

Configuration management contributes to economic and effective ICT services by

- providing accurate and up-to-date information on configuration items (CIs) and their documentation
- controlling valuable CIs
- facilitating adherence to legal obligations such as SLAs
- helping with financial and expenditure planning
- helping to make visible any hardware and software changes made
- contributing to contingency planning through CMDB and backup system
- supporting and improving management of new releases
- improving security by controlling the versions of CIs in use at any given time
- enabling the university to reduce the use of unauthorized hardware and software
- allowing the university to perform impact analysis and reschedule changes
- providing trend data for problem management.

Helpdesk

- improved users service, perception and satisfaction
- increased accessibility through a single point of contact, communication, and information
- better quality and faster turnaround of customer requests
- improved team work and communication
- enhanced focus
- better managed infrastructure and control
- meaningful management information for decision making
- downtime and impact on users are minimized
- incidents are registered and monitored
- help desk attains a proactive position
- service availability and utilization are extended
- operational costs and resource costs are reduced

Problem management

- improved quality of ICT service
- reduction in volume of incidents
- permanent solution to problems
- improved organizational learning since it's based on learning from experience
- improved first time fix-rate at the help desk

Software control and distribution

- greater success rate of software release and therefore improved quality of service
- consistency in the release processes of the software environments
- minimal disruptions of the service to the university activities through synchronization
- assurance that the live software is of good quality
- better use of user resources

- better expectation setting within the organization
- error reduction through control of software release to the live environment
- proper control and safeguarding of the software assets
- ability to absorb high rates of change to the live systems
- ability to build and control software used at remote sites
- savings in support costs by maintaining consistent software over a large number of locations
- reduced likelihood of there being illegal copies of software in use
- easier detection of wrong versions or unauthorized copies and immediate redressing of the situation
- reduced risk of unnoticed introduction of viruses and other malicious software
- reduced time of software release and fewer delays
- reduced number of software releases to users all at once

ITIL Service delivery processes
Availability management
- improved ICT services and resources to users leading to improved productivity
- better control of ICT services and resources
- fewer complaints from users
- availability of management information, which is useful to other processes such as capacity management, problem management and configuration management
- optimization of ICT resources made possible

Capacity management
- provides management information on user requirements and utilization trends through raising of requests for change (RFC), which enables technical staff to plan for future needs
- enables management to evaluate change more effectively
- improves ICT services to users

Contingency planning
- minimizes inconvenience caused to users due to breakdown of ICT services
- guarantees provision of minimum pre-determined and agreed level of ICT service
- reduces risk through provision of resilient ICT and recovery procedure options

Cost management
- enables an organization (university) to charge users for ICT services and resources
- ensures maintenance of levels of pre-determined and agreed ICT services to users
- helps to prevent degradation of ICT services

Service level management
- minimizes impact of disruption to quality of ICT services to users
- enables staff to assess the impact of changes at both proposal stage for change and after changes have been effected
- being related to availability management SLM resolves incidents within agreed period

Costs:
Forms of ICT management
- convincing the management of the need for dividing ICT management into three forms of management which might call for funding of the separate forms of ICT management
- training staff in the separate forms of ICT management
- hiring more qualified and experienced staff

ITIL service support processes

Change management

- hiring change management team and staff
- implementing change management where none exists

Configuration management

- staff hiring costs to implement Configuration management
- costs to cover hardware and software configuration and level of control
- cost to cover configuration management database (CMDB) and definitive software library (DSL) – library in which the definitive authorized versions of all software CIs are stored and protected - hardware and software, including licences and maintenance costs
- specialized software configuration management tools, including associated hardware and software, for each hardware platform
- whether the configuration management is to be tailored to the needs of the university
- cost of integrating configuration management and other management
- cost of overcoming the diversity and raising the quality of existing information that may be loaded in CMBD
- staff training and education costs
- staff costs to develop and run the procedures
- costs of impact on existing commitments

Helpdesk

- cost of setting up helpdesk
- cost of training ICT staff in ICT service
- cost of attracting an retaining users of ICT services and resources
- cost of documentation of the processes

Problem management

- set-up of process problem management
- training and educating ICT staff in process problem management
- purchase of training materials required

Software control and distribution

- education and training of ICT staff in software control and distribution
- staff costs to develop and run required procedures and tools
- file storage costs to accommodate definition software library
- costs associated with building, testing, distributing and archiving environments
- accommodation, safe keeping and protection, for software
- cost of spare equipment needed
- cost of computer and network for moving software into and out of DSL
- cost of software support tools
- cost of automation of procedures
- initial operating costs
- software distribution cost

ITIL Service delivery processes

Availability management

- cost of new hardware and software to boost availability of ICT services and resources
- cost of seminars, training and education in availability management
- cost of implementing availability management

Capacity management

- cost of seminars, training and education in capacity management
- cost of new hardware, software, and network components required to meet the extra capacity

Contingency planning

- cost of seminars, training and education in contingency planning
- cost of implementing contingency planning
- cost of redundant hardware, software and network components
- cost of back-up facilities

Cost management
- cost of implementing cost management
- cost of seminars, training, and education in cost management
- cost of staff requirements

Service level management
- cost of implementing service level management
- cost of seminars, training, and education in service level management
- cost of staff requirements
- cost of improving service level management

Consequences:
- Over-stretching the university budget with the result that other university functions may suffer.
- If the capacity of the university to absorb the new technologies in ICT management is inadequate this may result in under-achievement.

To prevent this happening care should be taken to adapt the technology in phases. For each process, a separate project involving all stakeholders, i.e. top university officials, donors, should be set up with clear objectives, plans, adequate funding, timeframes and deliverables.

RELATIONSHIPS:

Benefits:
- stakeholders become aware of ICT issues
- more awareness leads to greater involvement, participation in, and support for ICT related activities from top management
- users will recognize the problems in the system of ICT services, which will lead to reasonable demands (user requirements) from them
- greater utilization and exploitation of ICT services and resources
- enhanced performance in the university accruing
- easier identification of problems and solutions sought

Costs:
- seminars, training, and education to enlighten stakeholders of the importance of these relationships
- cost of reviewing and maintaining the relationships on a regular basis

Consequences:
- weak relationships alienate entities and create problems
- weak relationships make the running of ICT processes difficult and costly
- failing to train, educate staff in importance of relationships, and to review relationships, can lead to deterioration of ICT services

INFLUENCES:

Benefits:
- understanding the effects of influences facilitates ways of finding solutions
- users, university management and other stakeholders recognize and understand the problems brought about by influences

Costs:

- cost of seminars, training and education to determine extent of effects of influences
- implementation and monitoring of strategies to overcome effects of influences

Consequences:
Care should be taken with respect to cultural influences, which are in most cases endemic in public universities and other organizations. To change the destructive cultural influences into a useful asset will require tact, persuasion, patience and determination on the part of the university management

Each issue in a sub-case study is examined taking into account the IST situation and the SOLL situation defined for it. It is then taken through Step 1 - Step 5 shown in Figure 4.11, bearing in mind the costs, benefits and consequences of any transformation activities taken.

4.8.1.1 Sub-Case 1: The Academic Register Information System (ARIS)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for ARIS can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequences, by:

RS:

- ***User requirements***:

availability of ARIS	acquiring more hardware and software to run ARIS program, training users to use the functions of ARIS, and allowing them (users) access ARIS services whenever they need them
flexibility of ARIS	training users to exploit the functions and capabilities of ARIS
maintainability of ARIS	extending, updating and modifying ARIS to include all the necessary functions
performance of ARIS	increasing speed, memory/storage capacity of ARIS
reliability of ARIS	increasing completeness, timeliness, and admissibility in processing data
security of ICT	providing protection ARIS against burglary, fire, and weather conditions

- ***Preconditions:***

information policy and planning	formulating IPP on ICT and publicizing it to users
centralization of activities	locating critical activities such as decision making in a central campus convenient and accessible to users
de-centralization of activities	locating non-critical activities in campuses where users are found
concentration of ICT	locating critical ICT for security/control at the main campus
de-concentration of ICT	re-locating non-critical ICT in other campuses where users are found
financial resources	through income generation, donor, and other sources
personnel allocation	through advertisement qualified/experienced staff in adequate numbers are hired, and through training/hiring staff acquire qualification
safety of staff/equipment	providing security and safety for staff and users
standardization of ICT	formulating policy on standardization of ICT
service level agreements	formulating SLAs with vendors and users and manage the SLAs.

- ***Situational factors:***

age of university (est. 1984)	adapting proactive policies on ICT
size	acquiring more ICT to provide for increasing numbers of users
location	developing the network to link up the 3 campuses
technology environment	rasing computer literacy among users through training, practice and usage
organizational culture	providing leadership, creating new culture, motivating users, and changing behavior
communication infrastructure	improving communication infrastructure across the campuses

student unrest	examining causes of student unrest, taking actions including dialogue with students to prevent unrest

ICT:

• *Hardware:*	upgrading existing hardware, or selling off old hardware and replacing it with new hardware
• *Software :*	upgrading software to the state-of-the-art regularly
• *Network components:*	upgrading existing network components to the state of-the-art or through acquisition

- ***Extended State Model (ESM) states***

utilization	training users to utilize ARIS functions effectively, define tasks
exploitation	exploiting ARIS on student academic activities, and defining tasks
maintenance	increasing quality of maintenance of ARIS through training, with adequate funding, and defining new tasks

- ***Complexity Factors (CFs):***

quantity	improving ICT management to reduce complexity of ICT quantity
distribution	improving infrastructure within and between campuses
diversity	maintaining industry standard ICT to minimize diversity
dynamics	initiating and improving change management to minimize changes
utilization (usage)	exposing users to ICT facilities, capabilities, and functions
ownership	N/A; no dispute
cohesion of ICT	maintaining industry standard ICT
functionality	training users in ICT functions,

MCM:

- ***Functional management (FM):***

Strategic level	recognizing, adapting, planning, and establishing the form of management
Tactical level	enforcing, measuring, and sequencing management tasks
Operational level	practicing, training, and performing tasks pragmatically

- ***Application management (AM):***

Strategic level	recognizing, planning, and establishing the form of management
Tactical level	enforcing, measuring, and sequencing management tasks
Operational level	practicing, training , and performing management tasks

- ***Technical management (TM) :***

Strategic level	recognizing, planning, and establishing the form of management
Tactical level	enforcing, measuring, and sequencing management

tasks

Operational level	practicing, training , and performing management tasks

- ***Service support processes:***

change management	improving and maintaining through training, practice and usage
configuration management	improving and maintaining through training, practice and usage
help desk	improving and maintaining through training, practice and usage
problem management	improving and maintaining through training, practice and usage
software control & distr.	improving and maintaining through training, practice and usage

- ***Service delivery processes:***

availability management	improving and maintaining through training, practice and usage
capacity management	initiating, improving and maintaining through training and practice
contingency planning	improving and maintaining through training, practice and usage
cost management	improving and maintaining through training, practice and usage
service level management	initiating, improving and maintaining through training and practice

Relationships between entities:

RS → ARIS	sensitizing the university and increasing access to ARIS
ARIS →RS	applying ARIS on academic and administrative activities
ARIS →MCM	using ARIS to support technical staff in their technical services
MCM→ ARIS	providing high training in ICT management processes to technical staff
RS→MCM	the university paying attention and support for IRM
MCM→RS	the university responding to user requests

Influences:

managerial	anticipating structural changes and taking proactive actions to counteract effects
donor	encouraging continued role of donors in influencing ICT
technological	making allowance between technological developments and new acquisitions
economic	anticipating changes in the economy, generating income, and taking steps
cultural	encouraging development of positive cultural practices and avoidance of negative influences

Remarks: The main point to note is that ARIS was still in the process of development and thus transformation aims at pointing at the factors that directly impact on the delivery of ARIS services, especially with regard to personnel allocation and funding. The focus should also be placed on the benefits, costs, and possible consequences that any transformation is likely to face.

4.8.1.2 Sub-Case 2: The Information Resource Management (IRM)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for IRM can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequences, by:

RS:

- ***User requirements:***

availability of ICT	allowing more access time to increased ICT
flexibility of ICT	exploiting all the functions and capabilities of ICT
maintainability of ICT	extending, updating and modifying ICT to include required functions
performance of ICT	acquiring ICT with higher processing speeds and capacities
reliability of ICT	increasing completeness, timeliness, admissibility in processing data
security of ICT	providing and protecting ICT from theft, environmental hazards, or fire

- ***Preconditions:***

information policy and planning	formulating and institute IPP on ICT and publicize it as widely as possible
centralization of activities	collecting critical activities, e.g. decision making, in one central location
de-centralization of activities	re-locating non-critical activities to faculties/departments
concentration of ICT	locating critical ICT for security/control in one central location
de-concentration of ICT	re-locating non-critical ICT to campuses, and faculties and/or departments
financial resources	diversifying sources of funding to include income generation, donors
personnel allocation	advertising jobs for qualified/experienced staff and through training
safety of staff/equipment	providing security and safety for staff and users
standardization of ICT	formulating policy, and standardizing ICT
service level agreements	formulating SLAs with vendors, initiating SLM process with users

- ***Situational factors:***

age of university (est. 1984)	developing polices on, and utilizing ICT on university activities
size	acquiring additional ICT, for increasing numbers of users
location	developing networks to link campuses and buildings
technology environment	promoting computer literacy among users through continuous training in ICT
organizational culture	providing leadership, creating new culture, motivating users, changing behavior
communication infrastructure	installing and commissioning new communication lines within and between campuses

student unrest	examining causes of student disturbances, taking necessary actions, including dialogue with students to prevent occurrence of unrest

ICT:

- ***Hardware:*** upgrading or acquiring new ICT regularly
- ***Software :*** upgrading or acquiring new software regularly
- ***Network components:*** upgrading or acquiring new network components

- ***Extended State Model states***

utilization	utilizing functions of ICT effectively, defining new tasks
exploitation	exploiting ICT to achieve university objectives, defining new tasks
maintenance	providing training, funding to increase level of maintenance of ICT

- ***Complexity Factors (CFs):***

quantity	providing training, funding to improve management of ICT resources
distribution	improving infrastructure within and between campuses
diversity	maintaining industry standard ICT to minimize diversity complexity
dynamics	initiating, improving and maintaining through training, practice and usage
utilization (usage)	exposing users to ICT capabilities and facilities
ownership	N/A; no dispute
cohesion of ICT	initiating and maintaining industry standard ICT
functionality	training users in ICT functions, improved functional management

MCM:

- ***Functional management (FM):***

Strategic level	recognizing, planning, and establishing form of management
Tactical level	enforcing, measuring, and sequencing management tasks
Operational level	through practice, training , and performing tasks

- ***Application management (AM):***

Strategic level	recognizing, planning, establishing form of management
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	practicing, training, performing management tasks

- ***Technical management (TM) :***

Strategic level	recognizing, planning, establishing form of management
Tactical level	enforcing, measuring, sequencing tasks
Operational level	practicing, training, performing management tasks

- ***Service support processes:***

change management	improving and maintaining through training, practice and usage

configuration management	improving and maintaining through training, practice and usage
help desk	improving and maintaining through training, practice and usage
problem management	improving and maintaining through training, practice and usage
software control & distr.	improving and maintaining through training, practice and usage

- ***Service delivery processes:***

availability management	improving and maintaining through training, practice and usage
capacity management	initiating, improving, maintaining through training and practice
contingency planning	improving and maintaining through training, practice and usage
cost management	improving and maintaining through training, practice and usage
service level management	initiating, improving, maintaining through training and practice

Relationships between entities:

RS→ network	improving exploitation of network and other infrastructure
network →RS	improving network support for university communication requirements
network →IRM	improving network data for IRM
IRM→ network	improving IRM management processes of the network
RS→ IRM	university officials paying attention to IRM requirements and meeting them
IRM →RS	university officials improving university responsiveness to user requirements through effective communication

Influences:

managerial	anticipate changes, take actions to counteract effects
donor	encourage participation of donor community in ICT projects
technological	anticipating technological developments and make changes
economic	instituting measures, e.g. income generation, to counteract impact of poor economy
cultural	encouraging the development of positive culture

Remarks: The main point to note is that IRM was still in the process of development and thus transformation must be aimed at pointing out the factors that may impact on the delivery of IRM services, especially with regard to personnel allocation and funding. The system should aim at sustaining itself in the difficult environment with policies and strategies, while focussing on the benefits, costs and consequences of the transformations made.

4.8.1.3 Sub-Case 3: The Faculty of Technology (FOT)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for FOT can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequnces, by:

RS:

- ***User requirements:***

availability of ICT	permitting and increasing access time to ICT resources
flexibility of ICT	exploit functions and capabilities of ICT resources
maintainability of ICT	extending, upgrading and modifying functions of ICT
performance of ICT	increasing memory, speed of ICT through upgrading
reliability of ICT	enhancing completeness, timeliness and admissibility in processing power
security of ICT	providing protection against theft, environmental hazards, or fire.

- ***Preconditions:***

information policy and planning	formulating IPP on ICT and disseminating to faculty users
centralization of activities	locating critical activities in the faculty
de-centralization of activities	distributing non-critical activities in departments
concentration of ICT	collecting critical ICT in a central location for security and control
de-concentration of ICT	distributing non-critical ICT in departments
financial resources	diversifying sources of funding to include income generation /donors
personnel allocation	advertising positions for qualified and experienced staff and training
safety of staff/equipment	providing improved safety for staff and equipment
standardization of ICT	developing a uniform policy on what ICT the faculty should acquire
service level agreements	providing enhanced SLA with vendors, new SLAs with users

- ***Situational factors:***

age of university (est. 1986)	developing polices on ICT, and utilizing ICT on faculty activities
size	acquiring additional ICT, for increasing numbers of users
location	developing networks to link departments, buildings and campuses
technology environment	boosting computer literacy through continuous training in ICT
organizational culture	providing leadership, creating new culture, motivating users, changing behavior
communication infrastructure	installing and commissioning new communication lines within and between departments

student unrest	examining causes of student unrest, taking necessary actions, instilling discipline

ICT:

• *Hardware:*	upgrading existing hardware or through new acquisitions
• *Software :*	upgrading existing software or through new acquisition
• *Network components:*	upgrading existing network components, or new acquisition

- ***Extended State Model states***

utilization	making use of ICT on academic and administrative activities in the faculty
exploitation,	exploiting ICT on faculty activities (teaching, research, extension service), and defining new management tasks
maintenance	through training, funding, and defining new maintenance tasks

- ***Complexity Factors (CFs):***

quantity	providing training, and funds to improve management of ICT
distribution	improving communication infrastructure in and between campuses
diversity	maintaining industry standard ICT to minimize diversity of ICT
dynamics	initiating, improving and maintaining ICT through training and practice
utilization (usage)	exposing users to ICT capabilities and facilities
ownership	N/A; no dispute
cohesion of ICT	initiating and maintaining industry standard ICT
functionality	training users in ICT functions, maintaining effective functional management

MCM:

- ***Functional management (FM):***

Strategic level	recognizing, planning, establishing form of management
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	practicing, training, performing management tasks

- ***Application management (AM):***

Strategic level	recognizing, planning, establishing management form
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	practicing, training, performing management tasks

- ***Technical management (TM) :***

Strategic level	recognizing, planning, establishing management form
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	practicing, training, performing management tasks

- ***Service support processes:***

change management	improving and maintaining through training, practice and usage
configuration management	improving and maintaining through training, practice and usage
help desk	improving and maintaining through training, practice and usage
problem management	improving and maintaining through training, practice and usage
software control & distr.	improving and maintaining through training, practice and usage

- ***Service delivery processes:***

availability management	improving and maintaining through training, practice and usage
capacity management	initiating, improving, maintaining through training, practice and usage
contingency planning	improving and maintaining through training, practice and usage
cost management	improving and maintaining through training, practice and usage
service level management	initiating, improving, maintaining through training, practice and usage

Relationships between entities:

$RS \rightarrow ICT$	exposing faculty management to ICT Utilization and/or exploitation on its activities
$ICT \rightarrow RS$	using ICT in faculty activities (teaching, research, extension service)
$ICT \rightarrow MCM$	using ICT to support technical staff in tier work
$MCM \rightarrow ICT$	improving ICT management through training, practice and usage and funding
$RS \rightarrow MCM$	faculty management paying more attention to ICT management
$MCM \rightarrow RS$	faculty management being more responsive to ICT users

Influences:

managerial	anticipating structural changes in the faculty, and taking actions
donor	encouraging participation of donor community in ICT projects in the faculty
technological	anticipating technological developments, making necessary changes
economic	instituting measures (income generation) to counteract economic influences
cultural	encouraging development of positive organizational culture in the faculty

Remarks: It should be noted that FOT as a faculty has departments that are varying level of development and thus to improve the level of ICT management and service delivery, the objectives should include paying attention to those departments that lag behind others in terms of ICT resources. New policies and strategies on ICT should be developed, paying attention to the benefits, costs and consequences of transformation made.

4.8.1.4 Sub-Case 4: Forestry Resources and Wildlife Management

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for FRWM can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequnces, by:

RS:

- ***User requirements:***

availability of ICT	increasing ICT resources and access time to ICT facilities
flexibility of ICT	exploiting functions and capabilities of ICT
maintainability of ICT	extending, upgrading and modifying the functions of ICT
performance of ICT	increase throughput through acquisition of high performance ICT
reliability of ICT	improving completeness, timeliness and admissibility of processing
security of ICT	providing protection of ICT against theft, environmental hazards, and fire

- ***Preconditions:***

information policy and planning	formulating IPP on ICT; publicizing its contents to faculty users
centralization of activities	locating critical activities in the faculty
de-centralization of activities	distributing non-critical activities in departments
concentration of ICT	locating critical ICT in faculty
de-concentration of ICT	distributing non-critical ICT in departments
financial resources	increasing funding from various sources
personnel allocation	hiring qualified and experienced or training staff in adequate numbers
safety of staff/equipment	providing improved safety for staff and equipment
standardization of ICT	developing uniform policies on ICT for effectiveness and efficiency
service level agreements	providing enhanced SLA with vendors, new SLAs with users

- ***Situational factors:***

age of university (est. 1984)	developing polices on ICT; utilizing ICT on faculty activities
size	acquiring new ICT, for increasing number of users
location	developing networks to link departments, buildings in the campus
technology environment	promoting computer literacy among users through training and practice in ICT
organizational culture	providing leadership; creating new culture; motivating users; changing behavior
communication infrastructure	improving communication infrastructure within/between departments
student unrest	examining causes, taking corrective actions

ICT:

- *Hardware:* upgrading hardware or new acquisitions

- *Software :* upgrading software or new acquisitions
- *Network components:* upgrading network components or new acquisitions

- ***Extended State Model (ESM) states***

utilization	utilizing ICT on activities (teaching, research, extension service), defining new management tasks
exploitation	exploiting ICT in the faculty, defining new objectives for ICT
maintenance	maintaining ICT through training, seminars, more funding for technical staff, defining new ICT maintenance tasks

- ***Complexity Factors (CFs):***

quantity	providing training, funds, experienced staff to manage ICT
distribution	improving infrastructure in and between campuses
diversity	maintaining industry standard ICT to minimize diversity of ICT
dynamics	initiating, improving and maintaining through continuous training and practice
utilization (usage)	exposing users to ICT capabilities and facilities
ownership	N/A; no dispute
cohesion of ICT	initiating and maintaining industry standard ICT
functionality	training users in ICT functions, maintaining effective functional management

MCM:

- ***Functional management (FM):***

Strategic level	recognizing, planning, establishing form of management
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	practicing, training, performing management tasks

- ***Application management (AM):***

Strategic level	recognizing, planning, establishing form of management
Tactical level	enforcing, measuring, sequencing tasks
Operational level	practicing, training, performing management tasks

- ***Technical management (TM) :***

Strategic level	recognizing, planning, establishing management forms
Tactical level	enforcing, measuring, sequencing management tasks
Operational level	through practice, training, performing management tasks

- ***Service support processes:***

change management	improving and maintaining through training, practice and usage
configuration management	improving and maintaining through training, practice and usage
help desk	improving and maintaining through training, practice and usage
problem management	improving and maintaining through training, practice and usage

software control & distr.	improving and maintaining through training, practice and usage

- ***Service delivery processes:***

availability management	improving and maintaining through training, practice and usage
capacity management	initiating, improving and maintaining through training, and practice
contingency planning	improving and maintaining through training, practice and usage
cost management	improving and maintaining through training, practice and usage
service level management	initiating, improving and maintaining through training, and practice

Relationships between entities:

RS → ICT	exploiting ICT in the faculty to achieve objectives
ICT →RS	utilizing ICT on faculty activities (teaching, research, extension service)
ICT →MCM	utilizing ICT to support technical services
MCM→ ICT	improving ICT management through training, experience and funding
RS→MCM	management considering recommendation from ICT management
MCM→RS	ICT management considering requests from and responding to users on time

Influences:

managerial	anticipating structural changes, and adapting proactive policies
donor	encouraging donor participation in ICT programmes
technological	anticipating technological changes in ICT, and adapting proactive policies
economic	anticipating economic changes, and adapting income-generating policies
cultural	encouraging development of positive organizational culture in the faculty

Remarks: In this sub-case study we note that as a faculty it lacks technical personnel in sufficient numbers to manage a growing number of ICT resources, and funding. Emphasis should be put on hiring, say, 10% additional technical staff from the current 20 or re-training those in position in new management skills to improve the level of ICT management and service delivery; similarly, the objectives should include paying attention to those departments that lag behind others in terms of ICT resources. New policies and strategies on ICT should be developed, bearing in mind the benefits, costs and consequences of transformation made.

4.8.1.5 Sub-Case 5: The Margaret Thatcher Library (MTL)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for MTL can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequnces, by:

RS:

- ***User requirements***

availability of ICT	allowing more access time to ICT
flexibility of ICT	exploiting the functions and capabilities of ICT resources
maintainability of ICT	extending, upgrading and modifying the functions of library ICT
performance of ICT	increase throughput acquisition of new high performance ICT
reliability of ICT	enhancing completeness, timeliness and admissibility of processing
security of ICT	providing protection of ICT against theft, environmental hazards, fire

- ***Preconditions***

information policy and planning	formulating IPP on ICT; publicizing its contents to library users
centralization of activities	locating critical activities (decision-making) in the main library
de-centralization of activities	de-centralize non-critical activities in the branch libraries
concentration of ICT	gathering critical ICT in the main library
de-concentration of ICT	distributing non-critical ICT in the branch libraries
financial resources	devising strategies for increasing financial base
personnel allocation	providing training and hire more staff
safety of staff/equipment	providing improved safety for staff and equipment
standardization of ICT	developing policies on uniform ICT for improved effectiveness and efficiency
service level agreements	providing enhanced SLAs with vendors, new SLAs with users

- ***Situational factors:***

age of university (est. 1984)	developing proactive polices on ICT; utilizing ICT on library activities
size	acquiring new ICT for increasing number of library users
location	developing online networks to link departments and buildings
technology environment	encouraging computer literacy, continuous exposure to ICT
organizational culture	providing leadership; creating new culture; motivating users; changing behavior
communication infrastructure	installing and commissioning communication lines within and between libraries
student unrest	examining causes of student disturbances, taking necessary actions, instilling order and discipline

ICT:

- *Hardware:* upgrading existing hardware or through new acquisitions
- *Software :* upgrading existing software or through new acquisitions
- *Network components:* upgrading existing network components or through new acquisitions
- ***Extended State Model (ESM) states***
  - *utilization* utilizing ICT on book lending, loaning, searching, defining new management tasks
  - *exploitation* exploiting ICT to achieve library objectives
  - *maintenance* maintaining ICT through training, workshops/seminars, funding
- ***Complexity Factors (CFs):***
  - *quantity* providing training, funds, experienced staff to manage ICT
  - *distribution* improving infrastructure in and between library branches
  - *diversity* maintaining industry standard ICT to minimize diversity of ICT
  - *dynamics* initiating, improving and maintaining through training, practice and usage
  - *utilization (usage)* exposing library users to ICT capabilities and facilities
  - *ownership* N/A; no dispute
  - *cohesion of ICT* initiating, maintaining industry standard ICT to minimize cohesion
  - *functionality* training library users in ICT functions, maintaining effective functional management

MCM:

- ***Functional management (FM):***
  - *Strategic level* recognizing, planning, establishing management
  - *Tactical level* enforcing, measuring, sequencing tasks
  - *Operational level* practicing, training, performing management tasks
- ***Application management (AM):***
  - *Strategic level* recognizing, planning, establishing management
  - *Tactical level* enforcing, measuring, sequencing tasks
  - *Operational level* practicing, training, performing management tasks
- ***Technical management (TM) :***
  - *Strategic level* recognizing, planning, management forms
  - *Tactical level* enforcing, measuring, sequencing tasks
  - *Operational level* through practice, training, performing tasks
- ***Service support processes:***
  - *change management* improving and maintaining through training
  - *configuration management* improving and maintaining through training
  - *help desk* improving and maintaining through training
  - *problem management* improving and maintaining through training
  - *software control & distr.* improving and maintaining through training,
- ***Service delivery processes:***
  - *availability management* improving and maintaining through training

capacity management	initiating, improving, through training, practice
contingency planning	improving and maintaining through training
cost management	improving and maintaining through training
service level management	initiating, improving maintaining through training

Relationships between entities:

RS → ICT	exploiting ICT to achieve overall objectives
ICT →RS	utilizing ICT to support day-to-day library activities
ICT →MCM	utilizing ICT to support technical services
MCM→ ICT	improving ICT management through training
RS→MCM	library management paying attention to ICT management activities
MCM→RS	ICT management responding to user requests

Influences:

managerial	anticipating changes, adapting proactive policies
donor	encouraging donor participation in ICT projects
technological	anticipating technological changes in ICT, and adapting proactive policies
economic	anticipating economic changes, and adapting income-generating policies
cultural	encouraging development of positive organizational culture in the library

Remarks: In this sub-case study we note that as a library it has some technical personnel in insufficient numbers to manage a number of ICT resources envisaged to cover the 3 campuses. Emphasis should be put on hiring, say, 10% additional technical staff from the current 4 and/or re-training those in position in new management skills to improve the level of ICT management and service delivery; similarly, the objectives should include paying attention to those library branches that lag behind others in terms of ICT resources, especially at Chepkoilel. New policies and strategies on ICT should be developed, bearing in mind the benefits, costs and consequences of transformation made.

4.8.1.6 Sub-Case 6: World Bank Computerization Project (WBC)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for ARIS can be transformed to SOLL situation, taking into account the Benefits, Costs and Consequnces, by:

RS:

- ***User requirements***:

availability of ICT	allowing access to ICT resources
flexibility of ICT	exploiting various ICT functions and capabilities
maintainability of ICT	extending, upgrading and modifying ICT functions
performance of ICT	increasing throughput through acquisition of new high performance ICT
reliability of ICT	enhancing completeness, timeliness and admissibility of processing
security of ICT	providing protection of ICT against theft, environmental hazards, fire

- ***Preconditions***:

information policy and planning	formulating IPP on ICT; publicizing IPP contents to ICT users
centralization of activities	locating critical activities in a central place
de-centralization of activities	distributing non-critical activities in the faculties and/or departments
concentration of ICT	gathering critical ICT in a central location
de-concentration of ICT	distributing non-critical ICT in the faculties
financial resources	devising long term strategy for funding, including income generation
personnel allocation	providing training and hiring qualified staff in adequate numbers
safety of staff/equipment	providing improved safety for staff and equipment
standardization of ICT	developing uniform policies on ICT for effectiveness and efficiency
service level agreements	providing enhanced SLA with vendors, and enter new SLAs with users

- ***Situational factors:***

age of university (est. 1984)	developing proactive polices on, and utilizing ICT on university activities
size	acquiring new ICT for increasing number of users
location	developing networks to link departments, buildings in the university
technology environment	promoting computer literacy among users through continuous exposure
organizational culture	providing leadership; creating new culture; motivating users; changing behavior
communication infrastructure	improving communication infrastructure within and between campuses
student unrest	examining causes of student unrest, taking necessary actions, instil ling order and discipline

ICT:

- *Hardware:* upgrading existing hardware or through acquisition of new acquisition
- *Software :* upgrading software or through acquisition of new acquisitions
- *Network components:* upgrading network components or through new acquisitions

- ***Extended State Model (ESM) states***
  - *utilization* utilizing ICT on university activities (teaching, research, extension service), and defining new management tasks
  - *exploitation* exploiting ICT to achieve overall strategic university objectives
  - *maintenance* maintaining ICT with more training, workshops and/or seminars, funding,

- ***Complexity Factors (CFs):***
  - *quantity* providing training, funds, and acquiring experience to manage increasing number of ICT
  - *distribution* improving communication infrastructure (lines) within and between campuses
  - *diversity* maintaining industry standard ICT to minimize diversity of ICT
  - *dynamics* initiating, improving and maintaining through training, practice and usage
  - *utilization (usage)* exposing users to ICT capabilities and facilities
  - *ownership* N/A; no dispute
  - *cohesion of ICT* initiating, maintaining industry standard ICT to minimize and cohesion, complexity
  - *functionality* training users in ICT functions, maintaining effective functional management

MCM:

- ***Functional management (FM) -*** this form of management can be achieved by:

  - *Strategic level* recognizing, planning, establishing the process
  - *Tactical level* enforcing, measuring , sequencing tasks
  - *Operational level* practicing, training, performing management tasks
- ***Application management (AM):***
  - *Strategic level* recognizing, planning, establishing the process
  - *Tactical level* enforcing, measuring, sequencing tasks
  - *Operational level* practicing, training , performing management tasks
- ***Technical management (TM) :***
  - *Strategic level* recognizing, planning, establishing the process
  - *Tactical level* enforcing, measuring, sequencing tasks
  - *Operational level* practicing, training , performing management tasks
- ***Service support processes:***
  - *change management* improving and maintaining standards through training and practice
  - *configuration management* planning, enforcing, measuring, training,
  - *help desk* improving and maintaining through training, practice and usage

problem management	improving and maintaining through training, practice and usage
software control & distr.	improving and maintaining through training, practice and usage

- ***Service delivery processes:***

availability management	improving and maintaining through training, practice and usage
capacity management	initiating, improving and maintaining through training and practice
contingency planning	improving and maintaining through training, practice and usage
cost management	improving and maintaining through training, practice and usage
service level management	initiating, improving and maintaining through training and usage and practice

Relationships between entities – these relationships between entities can be achieved by:

RS → ICT	exploiting ICT on activities to achieve overall strategic objectives
ICT →RS	utilizing ICT to support university activities (teaching, research, and extension services)
ICT →MCM	utilizing ICT to support technical services
MCM→ ICT	improving ICT management through training, experience, funds
RS→MCM	university management paying attention to ICT management activities
MCM→RS	ICT management considering and responding to user requests

Influences – impacts of these influences can be reduced by:

managerial	anticipating structural changes, and adapting proactive policies
donor	encouraging donor participation in ICT programmes
technological	anticipating technological changes in ICT, by adapting proactive policies
economic	anticipating changes, adapting appropriate income-generating policies
cultural	encouraging the development of positive organizational culture in the university while discouraging negative cultural practices such as lateness.

Remarks: In this sub-case study we note that it is a donor supported project; it has some technical personnel but in insufficient numbers to manage ICT resources (250 PCs) covering 3 campuses. Emphasis should, therefore, be put on hiring, say, 10% additional technical staff from the current staff drawn from academic departments and/or re-training those in position in new management skills to improve the level of ICT management and service delivery. New policies and strategies on ICT should be developed, bearing in mind the benefits, costs and consequences of transformation made.

Further, it is important to emphasize the following points:

1. the university or individual sub-case studies must commit themselves to transform the IST situation in terms of personnel allocation and funding needed.
2. some projects such as MHO under which ARIS and IRM are supported, and the World Bank (WBC) have limited life spans. On completion of their periods, arrangements must be in place to sustain and continue with the provision of ICT services at the same quality levels as before. This can be achieved by developing viable alternative sources of funding including income-generation and, where possible, external donor funding
3. the consequences of transformation must be borne in mind, especially with regard to its effect on other vital activities in the university
4. the management should be involved and users given a chance to participate in the process of transformation to give it the support it needs and ensure its success.

4.9 Translation of the model into an automated tool

The automation of depiction, qualification and definition functions of the model is a by-product of the model development process and employs one of the application software commonly found on the Kenyan market – text-based C++. The automated tool is essentially an interactive program that prompts the user to supply the required information.

Choice of software tools

The choice of the automated tool is dictated by the need to use software that is simple, easy-to-use, cost-effective and commonly available in Kenya.

Design features of software tool: Object-Link Technology (OLT), C++, and spreadsheet

The basic design features of the tool of choice must be such that it (the tool) can receive data, process the data and output the results. The tool does not attempt to base its qualifications on reasoning as in an expert system since it does not incorporate an inference engine which is a design feature of artificial intelligence; however it attempts to take the user through various aspects of ICT related issues and thus make him/her become aware of the issues that are of primary concern to the organization and ICT management.

Procedure pseudo code (Program Design)

A program design or pseudo code describes the features incorporated in the automated tool. Two functions specifications, depiction and qualification of the IST situation are coded. The pseudo code commences with the definitions of terms, parameters, variables and modules, which are used in the design of the tool. Separate modules that perform specific functions in the entities are included. Using the pseudo code executable program source code was written in C++, an object-oriented language [Brumbaugh94], [Carroll95], [Drozdek96], [Graba98], [Terribile94], [Winston94].

How to execute the program

Three senior persons are required to assess the issues. One person represents the management of the organization on strategic policy issues related to ICT. He/she gives informed opinion on the issues from the organizational viewpoint; the second person represents ICT management within the same organization. His/her role is to give perspectives on ICT management from the technical viewpoint. The third person acts as an expert assessor on ICT related issues. The assessor may be a person from inside or outside of the organization.

A unit is selected within the organization whose ICT related issues are to be assessed.

The assessment is performed through detailed and focussed discussion of the issues taken one at a time. The values entered are, therefore, based on consensus reached on all issues by the three persons.

The executable program is stored on file **ict_mgt.exe** on the diskette attached. It is opened by double clicking on the filename**.** The interactive program starts running in a window and prompts the person running it for responses. Responses are entered by typing in the values required (See Figures 4.11 and 4.12).

Function 1: Depiction of the IST situation

For this function issues in the framework are examined and compared with the issues in the test case study. Each entity is examined separately in turn. If the issue examined exists a value 1 is given, otherwise 0. Values that exist are stored in a separate file, while those that do not exist are stored in a separate file.

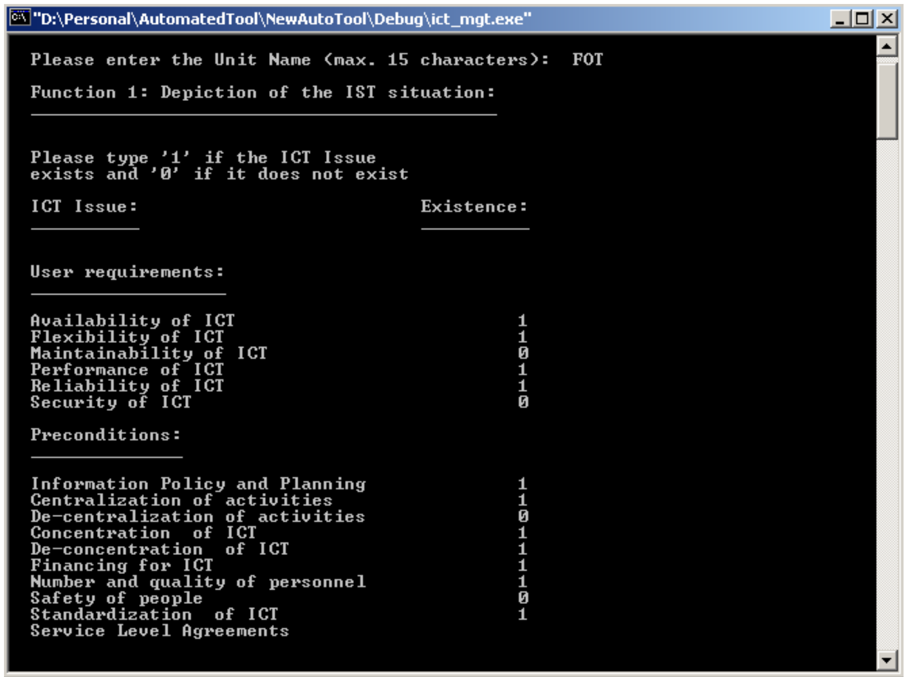


FIGURE 4.11: SAMPLE PROGRAM OUTPUT FOR DEPICTION OF THE IST SITUATION

Function 2: Qualification of the IST situation

During qualification of the IST situation, existing issues stored on a file, are retrieved. To qualify them, schemes shown in Figures 4.10 (a) – 4.10 (e) are used. Issues in the case study are compared with their qualifications in the schemes. Appropriate values are entered according to how close they fit the descriptions.

Both the depiction and qualification results are stored in a file called **View_results.dat** which can be opened at the end of the program by double clicking onto it.

Note that only those issues listed in depiction are retrieved for qualification. This is in keeping with the criterion used in depiction of the IST situation, that is existence. The program can be applied repeatedly to different units in the same organization as required.

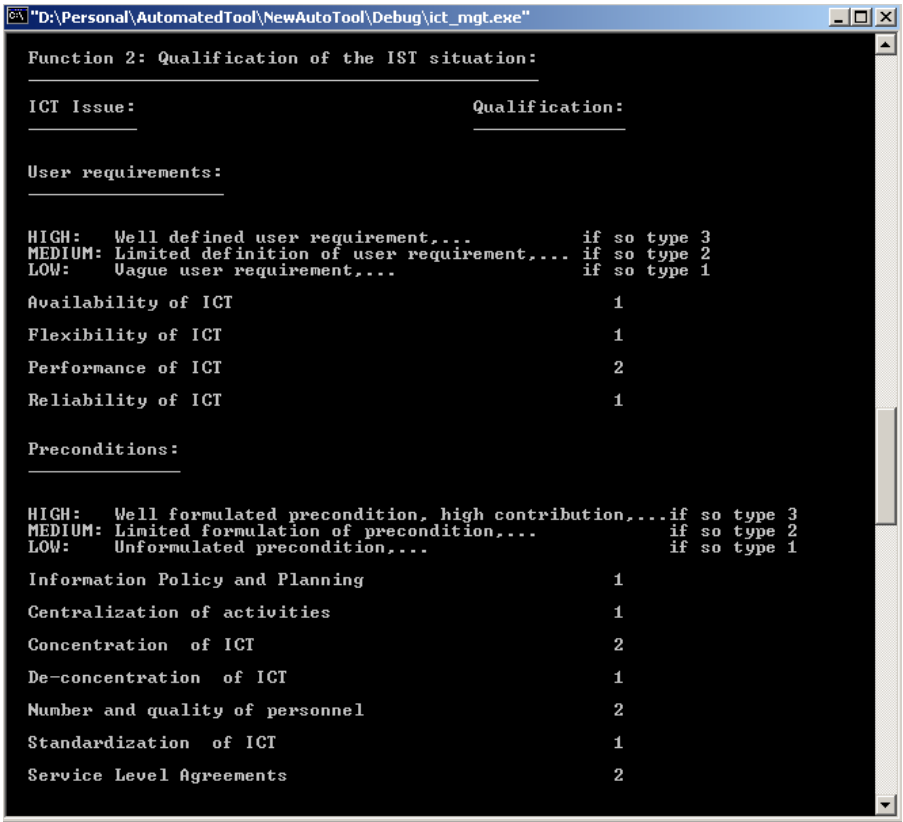


FIGURE 4.12: SAMPLE PROGRAM OUTPUT FOR QUALIFICATION OF THE IST SITUATION

4.10 Summary and conclusions

This chapter detailed the development of a model to improve the quality of ICT services in public universities in Kenya. The aim of the development process is partly to answer the following research question. – How can we develop a model of ICT support that can depict IST situation, qualify IST situation, define SOLL situation, and transform from IST to SOLL situations? The development process was based on the management paradigm, which forms the core of ICT management research at Delft University of Technology, Faculty of ITS, Department of ISSE. The model consists of four functional specifications – depiction and qualification of IST situation, definition of the SOLL situation, and the transformation from IST to SOLL situation. Within the management paradigm, the issues in the entities real system, ICT, MCM, and relationships between entities and (external) influences, were identified. The criteria for depiction and qualification of the IST situation were given, and the manner of qualification of the issues was also presented. Six relevant embedded sub-case studies from one of the Kenyan public universities (MU) were used in the depiction of the IST situation development phase. The next three chapters describe the application of the model to three case studies. One of the aims of the application of the model is to make the model relevant to the environments in which it will eventually be used. The other aim is to pursue the objectives of this research – application of the model to contemporary situations.

5 Model application: Case Study I – Kenyatta University

5.1 Introduction

Kenyatta University [www.ku.ac.ke], established in 1985, was the third public university to be created in Kenya, after Nairobi University, in 1970, and Moi University, in 1984. The university lies 16 km. to the north of the capital city Nairobi along the Nairobi - Thika Dual Highway on a 440-hectare campus. It has a student population of about 10,000. The university offers a wide range of degree and diploma programmes in six faculties – with education as its main specialization. Some of the faculties, boards and academic programmes (in asterisks *), are shown in Table 5.1.

The organizational structure of the institution is highly centralized, with much of the power vested in the head of the university, the vice chancellor. KU administration has three main divisions: (a) academic, (b) administration, and (c) finance, each headed by a deputy vice chancellor. The use of ICT in the university is growing rapidly. With strong personal support and encouragement from the vice chancellor and his deputy in charge of administration, the university has made great strides in this area. Consequently, the university has embarked on an ambitious project to exploit ICT in all its academic and administrative programmes.

One outstanding consequence of this endeavour has been the establishment of the African Virtual University, AVU-KU; however, disruptions in electricity supply from the national grid are frequent, making it necessary for the university to install a number of automatic diesel generators as standby backup power supply units in key areas including the AVU-KU and the computer laboratories. The university also faces regular closures due to the student demonstrations that take place from time to time.

Two units were selected for testing and application of the model, the IT Office and the AVU-KU, both of which fall directly under the office of the vice chancellor. The purpose of selecting two sub-case studies was to create an awareness of the issues related to ICT. The main objective of this chapter, however, is to validate, through application, the model developed in chapter 4 pursuant to the research question posed in chapter 1. In addition, we will examine the ways in which the model can be further modified to make it more relevant to improving ICT management in public universities in Kenya. The application assumes the same form and content as presented in chapter 4, that is, depiction of IST situation, qualification of the IST situation, and definition of the SOLL situation. The fourth function, transformation from IST to SOLL situation, could not be performed due to limitations of time as the period of the application of the model was close to Christmas in November/December 1999, and most people in authority were not present. The transformation function is presented in the form of recommendations that need to be taken to improve the IST situations described and assessed in the earlier sections. The procedure followed in the application of the model consisted of first obtaining official permission from the university management to conduct the research. The application of data collection instruments such as interviews with key players or actors, reviews of relevant documents/reports and inspection of ICT facilities in the two sub-case studies followed this step. The key players included the IT chairman, the director of AVU-KU, and their technical assistants.

Faculties/Boards	Academic programme level			
	Diploma	Bachelor	Masters	Doctorate
Faculties				
Arts		*	*	*
Commerce		*	*	*
Education	*	*	*	*
Environmental Studies		*	*	*
Home Economics		*	*	*
Science		*	*	*
Schools				
Music				
Continuing Education		*	*	*
Institutes				
Distance Education		*	*	*
Others				
African Virtual University				
Post Graduate Studies				
Student Affairs				
Board of Linkages				
Board of Undergraduate Studies				
Info. and Communication Technology Library Studies				
Catering and Accommodation				
Bureau of Training and Consultancy				
Board of Education Research				

TABLE 5.1: ACADEMIC PROGRAMMES AND BOARDS AT KENYATTA UNIVERSITY

This chapter is organized as follows:

Section 5.1 A general description of the Kenyatta University case study, in which two embedded sub-case studies were selected for the application of the model.

Section 5.2 Function 1: Depiction of the ICT related issues in the current (IST) situations for the two sub-case studies based on the model developed and presented in chapter 4, and on the criterion existence.

Section 5.3 Function 2: Qualification of ICT related issues in the existing (IST) situations for the sub-case studies based on the criteria effectiveness and efficiency.

Section 5.4 Function 3: Definition of the future (SOLL) situations of for the two sub-case studies based on the model developed and presented in chapter 4. The definition of the SOLL situation consists of a list of recommendations to be carried out to transform the current (IST) situation to the future (SOLL) situation.

Section 5.5 Function 4: Transformation of the IST to SOLL situations for the sub-case studies based on the model developed and presented in chapter 4. The benefits, costs and consequences of transformation are also presented.

Section 6.6 Summary and conclusions of the chapter are given.

5.2 Function 1: Depiction of the IST situation

In this section we present a description of the IST situations of the two sub-case studies. In each case we start with the general description of the sub-case studies. This is followed by the application of the first function of the model to the sub-case study. As in the case of Moi University, the criterion used in the depiction of the IST situation for the two sub-case studies presented in this section is *existence***.** The objective of the depiction is to gain an insight into the roles, needs and requirements of the key players regarding ICT, the available ICT facilities, the ICT management processes that are performed, the relationships between various entities and the impact of external influences on utilization, exploitation and maintenance of ICT.

Sub-Case 1: IT Office

Background information

The Information Technology, or IT, Office is charged with the responsibility of overseeing all aspects of IT at KU. As a unit in the office of the vice chancellor, the IT office is headed by the IT Chairman, a senior academic staff member whose position is comparable to that of the chief information officer, CIO, in a large organization. The structure of the IT Office is given in Figure 5.1.

The IT office, through the IT Chairman, formulates policies on ICT matters, negotiates the purchase, acquisition and distribution of IT resources; and manages the IT resources distributed in 13 computer laboratories for use by students in various faculties, and offices for both academic and administrative staff. It is also in charge of all IT projects in the university, with the exception of the AVU. The projects include a popular Cyber Café that provides e-mail, telephone and Internet services to the university user community, and the proposed Internet Service Provider, Codeless Telephone, and Lecture Transmission. The structure in many ways reflects a highly centralized form of management of ICT facilities within KU.

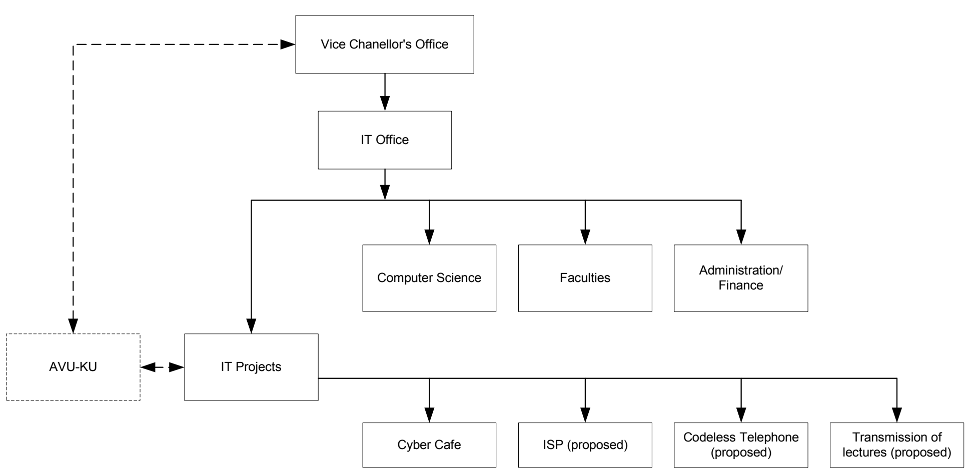


FIGURE 5.1: STRUCTURE OF IT OFFICE AT KENYATTA UNIVERSITY

[Source: KU IT Office, December 2000]

An IT Committee exists to assist the IT Chairman in coordinating the activities of IT Office with membership drawn from both the academic and ICT technical departments.

The user community includes regular students and staff, and users from outside the university, employed or unemployed, who register for lessons on a part time basis. A new supportive technology culture has taken root in the university, which is bound to grow in complexity and sophistication with time. The culture puts an emphasis on ICT know how and the use of terms that refer to hardware, software, network, internet and such like, are commonplace especially among the younger generation. Although in the past ICT was seen as a threat to employment in the third world [Mgaya99], the opposite now seems to be the case generally. No longer are people resistant to the use of ICT, rather each person wants to be identified with the new technology in one way or another. As a consequence of this development, new structures and relationships are emerging, new job descriptions have been created, and demand on the university for ICT has far outstripped the supply several-fold. People's perceptions of ICT have drastically changed from the days when the computer was viewed as a preserve of the commercial and specialized government and international agencies. Now it is viewed as an essential tool for success in one's life. The only group of users who feel excluded from the wave of enthusiasm are the older generations of academic and administrative staff. Computers, like heights, still inspire great fear in many people in Kenya, mostly among the older generation. The less one knows about how computers work the greater the fear and reluctance to use them. People in this group acquired their qualifications at a time when computers had yet to make their debut on the general market and the PC was still something out of science fiction. The learning curve for most of them is, therefore steeper than it is for the younger generation, and this inevitably causes resentment, which manifests in the form of critical remarks and comments about ICT. The older academics often lack the interest to learn new skills, though computer literacy classes are organized and made available in the university, instead they continue to use the old manual systems in preference to the new technology. This resistance among the senior staff represents a formidable hurdle for the university to overcome, but this group is small and declining due in part to natural wastage in contrast to the surge of interest that is growing among the younger generation. This demonstrates that ICT has had a major impact on the user community in the university. Against this background, we will now proceed with the application of the model at Kenyatta University.

The procedure adopted in the application of this model consisted of the following steps. First, the researcher initiated correspondence with the Kenyatta University authorities to secure their permission to conduct the research, which was granted. Upon acceptance of the offer, the researcher presented his model to the IT Chairman who was officially designated by the vice chancellor of Kenyatta University as the contact person. Through a detailed discussion in a number of scheduled meetings, the model, consisting of files on a set of diskettes, was installed on some stand-alone PCs in one of the laboratories and at the Cyber Cafe. Hard copies of the model were also made available for reference. An inspection of the ICT facilities, including the Cyber Café, ICT computer laboratories, was conducted and a number of documents in the relevant area reviewed. Finally, the work processes related to the management of ICT facilities were studied.

The depiction of the IST situation for the IT Office is given in **Appendix C, Sub-Appendix C1C1**.

Observation: As a unit in charge of ICT management in the university, the IST situation shows the existence and relevance of the many of the issues in the framework. With regard to MCM processes, they were found to be largely new concepts that need to be recognized, established and practiced according to the model.

Sub-Case 2: African Virtual University

Background information

The African Virtual University, or AVU [www.avu.org], is a non-profit organization that was initiated as a project under the World Bank in 1997, and it describes itself as a "university without walls". It uses modern information technology and communication technologies (ICT) to give the countries of sub-Saharan Africa (SSA) direct access to some of the highest quality faculty and learning resources throughout the world.

Vision: the vision of AVU is *to use the power of modern information technologies to dramatically increase access to global resources throughout Africa*
The main reasons why AVU was set up are:

- inadequate access to, and low quality, educational resources
- weak institutional capacity
- isolation from world academic community
- over-dependence on government financing

Objectives: The objectives of AVU are to:

- use ICT to:
  - increase enrolments in science, engineering, and business education
  - increase quality of university education
- build management and technical capacity at African universities
- integrate African academics into the worldwide community of learning

Strategies: AVU seeks to achieve these objectives by harnessing the power of the modern technology, interactive and computer –based technologies, to benefit from some of the highest quality academic faculty, library resources, and laboratory experiences found elsewhere in the world.

The rationales for establishing AVU in sub-Sahara Africa are that:

- university programmes in SSA, particularly in scientific and technological fields are dismally inadequate to meet the rapidly increasing demands for higher education
- the use of technology in the implementation of AVU enables institutions of higher education to supplement their existing programmes with the resources of a "Global Virtual University"
- through the AVU institutions of higher education can provide more cost-effective mass education disciplines that are critically needed in SSA by using technology to share quality academic facilities, library resources and laboratory experiences available around the world
- the AVU can tap the potential offered by technology to overcome existing barriers such as declining budgets, outdated equipment, and limited space and facilities that prevent increased access to higher education for a significant number of students in SSA

Financial donors: The financial donors for the AVU during its project phase are depicted in Table 5.2.

Donor Country	Amount, $
Belgium	62,000
Canada	1,000,000
European Union	1,000,000
Norway	1,280,000
Ireland	280,000
Sweden	82,000
United States	365,000

TABLE 5.2: AVU DONORS (SOURCE: WWW.AVU.ORG)

Among the 7 donors, Canada, EU, and Norway together accounted for more that 80% of the cost of the project.

Learning Sites: African Virtual University (AVU) has 26 learning sites (LSs) spread across sub-Saharan Africa in 8 English-speaking and 7 French-speaking countries shown in Figure 5.2.

FIGURE 5.2: AVU LEARNING SITES IN SUB-SAHARA AFRICA

The English-speaking countries (and the number of learning sites) are Ethiopia (1), Ghana (3), Kenya (2), Namibia (1), South Africa (2), Tanzania (2), Uganda (3), Zimbabwe (2); French-speaking countries include Benin (1), Burkina Faso (1), Burundi (2), Mauritania (1), Niger (1), Rwanda (2), Senegal (2).
In Kenya, the learning sites are at Kenyatta University, near Nairobi, and Egerton University, 150 km. to the west of Nairobi and near Nakuru in the Great Rift Valley.

Organization structure: The AVU, launched in 1997, was previously a World Bank funded project but it has since been transformed into a non-profit organization with headquarters in Nairobi, Kenya, with some support from the World Bank Office in Washington, DC. Staff officers in participating countries manage the affairs of the AVU in their respective countries. The AVU has plans to expand and to include up to 30 universities, 129 private and 114 corporate learning centers within the next 4 years.

How the AVU works: AVU is essentially a link between world-class academics and students in sub-Saharan Africa, who have little or no access to a world class education. The academic model of AVU is shown in Figure 5.3. The course content is provided by global course content academic providers based in universities in the US, Canada, and the Republic of Ireland. The lectures and data are transmitted via satellite link. Other modes of transmission such as full text online materials, and journals, are also used. The live broadcasts via satellite enable students in various participating Learning Sites across Africa to follow the lessons simultaneously with the assistance of local support staff, hence the term African Virtual University. Students respond by sending their questions to the instructor via telephone and/or e-mail.

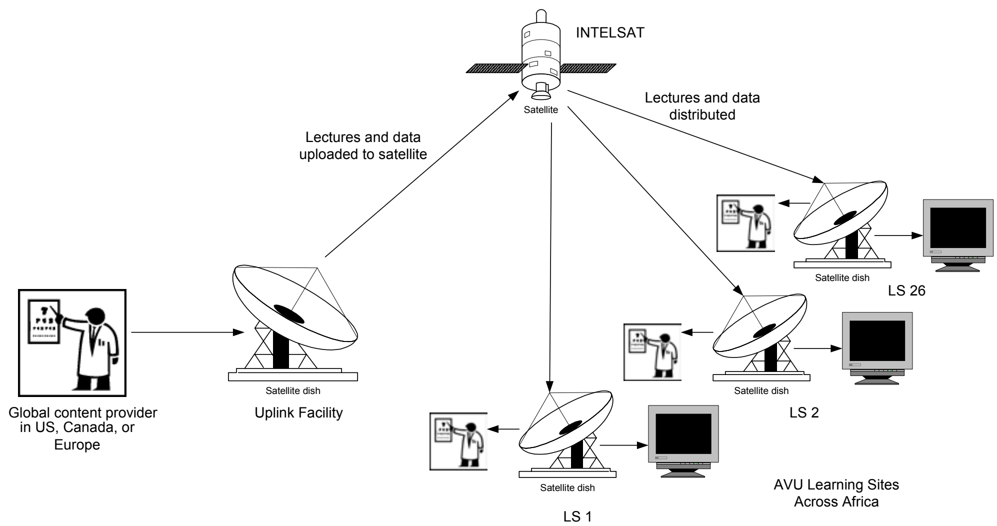


FIGURE 5.3: AVU DISTRIBUTION MODEL

AVU at Kenyatta University, AVU-KU, situated in Nairobi, Kenya, is one of the learning sites and serves as its international headquarters.

AVU Kenyatta University Learning Site

The procedure adopted for the application of the model at AVU – KU consisted of the following steps. First, the researcher requested an introductory meeting and interview with the director of the learning centre to secure her permission to conduct the research, which was granted. Upon acceptance of the offer, the researcher presented his model to the director's appointee who was officially designated the contact person. Through a number of scheduled meetings, the model, consisting of files on a set of diskettes, was installed on one of the stand-alone PCs at the centre. Hard copies of the model were also made available for reference. An inspection of the ICT facilities, including the ICT computer laboratories, was also conducted and a number of documents in the relevant area reviewed. Finally, the work processes related to the management of ICT facilities were studied.

The depiction of the IST situation for the AVU-KU is given in **Appendix C, Sub-Appendix C1C2**.

Observation: As a centre primarily in charge of providing ICT related student services in the university, the IST situation shows the existence and relevance of many of the issues contained in the model presented.

5.3 Function 2: Qualification of the IST Situation

Assessment of a current situation is an important step in understanding the roles of the key actors, the available ICT infrastructure, the ICT management processes, the relationships between entities and the impact of influences on the entities. To assess or qualify a situation we need to specify a criterion upon which the assessment is to be based upon. The qualification of the IST situation for the two sub-case studies is based on the two criteria, *effectiveness* i.e. doing the right things, and *efficiency* i.e. doing things right [Luftman00], both of which are associated with and address the problem of ICT improvement.

Sub-Case 1: IT Office

The IT Office is responsible for the management, control and maintenance of all ICT resources in the university, with the exception of the AVU-KU. Highly centralized, the management of ICT was found to depend much on the individual effort. There were no schedules of management activities. No notices were given to users before significant changes were made. Computer viruses were common. Drastic actions taken to contain the situation often affected many of user files. This picture gives a glimpse of the state and nature of management of ICT in the university.

Using the model developed in chapter 4, and based on the interviews, experience and observation by the researcher, ICT related issues under the IT Office were qualified as shown in **Appendix C, Sub-Appendix C2C1**.

Observation: level of user awareness for ICT services is considerably high, indicating high appreciation of ICT in day-to-day activities, i.e. academic, administrative, communication and research.

Lack of formulation of precondition IPP, affects much of the development of ICT in the university as in its absence little coordinated progress can be achieved.

Situational factors that impact on the management, control and maintenance of ICT in the faculty include the size of the university, long distances between campuses, and student unrest.

Hardware, software and network components are industry standard types (Intel 486, first, and second generation Pentium processors) donations. Network components comprise Ethernet based technology.

The level of utilization, mainly on academic and administrative activities, exploitation, and maintenance of ICT is medium, showing, as in other sub-cases the realization of benefits the computer technology.

The presence of qualified and experienced technical staff implies provision of services to users is better.

Significant complexity factors include diversity of ICT on account of the many types, origins and sizes of ICT, utilization by a large number of users (students and staff) and functionality.

Forms of management and processes have not been implemented according to this model as many were not appreciated at the time of the application of the model.

Relationships between entities indicate strong university exploitation of ICT on its activities, academic, administrative, communication and research, to achieve its overall objectives.

Donor influence is strong and positive. Managerial influence is also very significant as it impacts directly on the provision of ICT services.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

Sub-Case 2: African Virtual University

The AVU-KU has qualified technical personnel who manage, control and maintain ICT and communication installations. They include an engineer, middle level and operational level technicians. Hence, the level of management, control and maintenance of ICT was considerably high. However, the concepts of the model presented were new to the staff in various aspects.

Using the model developed in chapter 4 and based on the experience and observation by the researcher, ICT related issues in AVU-KU were qualified as shown in **Appendix C, Sub-Appendix C2C2**.

Observation: high user awareness for ICT services indicates appreciation of the importance of ICT to day-to-day work processes, including academic, administrative, communication and research.

Lack of formulation of precondition IPP, affects much of the development of ICT in the university. Its absence implies little of properly coordinated management, control, and maintenance of ICT can be achieved.
Situational factors that impact on ICT include the size of the university community and external users, location on account of its being close to the capital city, and student unrest.
Hardware, software and network components are of modern industry standard types (Intel 486, first, and second generation Pentium processors); network components comprise Ethernet based technology.
Significant complexity factors include quantity of ICT, diversity on account of the many types, origins and sizes of ICT, dynamics, utilization by a large number of users and functionality.
Forms of management and processes have not been implemented according to this model as many were unknown at the time of the application of the model.
Relationships between entities indicate strong AVU-KU exploitation of ICT on its activities, academic, administrative, and especially communication to achieve its overall objectives.

Donor influence is strong and positive. Managerial influence is also quite strong as it impacts directly on the provision of ICT services.
Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

5.4 Function 3: Definition of the SOLL Situation

Sub-Case 1: IT Office

It became apparent from the qualification of the IST situation, that ICT related issues under the IT Office were rated generally LOW. The introduction of the model accorded the university an opportunity for self-examination with regard to the management of ICT across the entire campus. With over 1,000 PCs to manage, control and maintain, the situation needed a lot of improvement to bring it to a higher level. In the words of the IT chairman, the model would "have an impact on the entire university and would create order in a situation where chaos reigned, and for this reason, its introduction is timely". He further remarked that according to the model, he saw himself operating at level 3 at times while the rest of the technical personnel were operating at level 1. This view was partly shared by the researcher. The problem with which the IT Office was confronted was how to bridge the gap between LOW (Level 1) and the MEDIUM (Level 2). In this sub-section, this problem is addressed by defining, for the IT Office, what needs to be done to bring the IST situation to Level 2.

The SOLL situation for IT Office for each entity in the model was defined using the model developed in chapter 4. The definition of the SOLL situation depended on the qualification of the current situation. The next level, serving as a road map, defined the SOLL situation for each issue. The process of defining the SOLL situation is presented in **Appendix C, Sub-Appendix C3C1.**

Sub-Case 2: African Virtual University

The qualification of the IST situation for AVU-KU indicates that compared to the IT Office, ICT related issues ranked slightly higher than in the rest of the university, although there was still much to be improved. Based on the qualification of the IST situation and using the model developed in chapter 4, the SOLL situation for AVU-KU was defined as shown in **Appendix C, Sub-Appendix C3C2**.

5.5 Function 4: Transformation from IST to SOLL situations

Transformation from IST to SOLL is not only the most critical function of this model, it is also the most difficult to achieve. The main objective of the function is to ensure that the current situation of an ICT related issue or process is changed to the next level of maturity. This implies that in transforming ICT related issues the organization also is transformed. Evidence exists which shows that ICT has the power to transform whole enterprises ([King95]; [Earl93]). Organizations need to change not only their real business scope but also their ICT infrastructure as a consequence of using of ICT ([Boynton96 et al], [Davidson96]). The approach used to achieve and maintain the SOLL situation focuses on the understanding of the SOLL situation, and on maximizing the enablers or positive aspects while minimizing the inhibitors or negative aspects at the current (IST) situation level. Once understood, the transformation process needs to take the actions necessary to improve the situation. The gaps between the IST situation and the SOLL situation as envisioned in the definition of the SOLL situation must be analyzed carefully, and prioritized. Then using the next level of maturity as a road map, the transformation process can be commenced and accomplished. Knowledge of the current situation drives the specific actions needed to get to the SOLL situation. In the process, the remedial tasks are defined as follows:

- deliverables or expected results
- ownership of improvement processes
- timeframes for the accomplishment of tasks
- resources needed to perform the tasks
- risks involved in carrying out the tasks
- measurements of the achievements

Benefits, Costs and Consequences of transformation

- Before we make recommendations on the actions and processes to be taken in the transformation process, there is need to draw the attention of implementers of the model to the common benefits, costs and consequences of the transformation covered in Section 4.8.

The list of benefits, costs, and consequences attempts to suggest to the authorities what critical aspects they need to be aware of when they embark on management and improvement of ICT in the organization. The recommended actions for the transformation from the current (IST) situations to the future (SOLL) situations for the two sub-case studies were suggested, with the list of benefits, costs and consequences acting as drivers.

Sub-Case 1: IT Office

The IST situation for the IT Office was generally very low as far as ICT management was concerned. This situation was largely attributed to the highly centralized nature and style of the management. Thus, using the model developed in chapter 4, recommendations for transforming each of the issues in the IST situation to SOLL situation for IT Office are as shown in **Appendix C, Sub-Appendix C4C1**.

Sub-Case 2: African Virtual University

Since AVU-KU is a single unit located on a single site, the process of transforming the IST situation to the SOLL situation proceeded in a more predictable manner than in the case of the IT Office, which oversees a large number of locations. Its location on one site and the strong support it receives from the university management makes it a favourable candidate for transformation. Its infrastructure is also much better developed and managed than the rest of the university infrastructure of which IT Office is in charge. Using the model developed in chapter 4, the IST situation for AVU-KU was transformed to SOLL as shown in **Appendix C, Sub-Appendix C4C2**.

5.6 Summary and conclusions

The application of the model at Kenyatta University brought to the fore a number of issues which are relevant to ICT management in public universities in Kenya. We can distinguish between two main driving factors: enablers and inhibitors (or disablers). The main driving factors, or enablers, behind ICT development at Kenyatta University, can be summarized as follows:

- the direct personal involvement of the university top management in ICT development and utilization
- the proximity of the university to the capital city, which is regarded as the information and communication technology hub for the East African region
- high exposure of the university to the technological developments and changes in the world or technology push
- the pressure exerted upon students by the university and the demand by prospective employers, most of whom are based in Nairobi, for computer literacy as a value-added requirement
- the eagerness on the part of students to want to learn the new technology, or technology pull, in its own right
- the availability of apparently ample ICT facilities in the university
- the emerging competition among the public universities and other universities in Kenya for the best staff and the best students using ICT as the 'carrot' to attract and retain them

On the other hand, very contrasting disablers (or inhibitors) existed between the same sub-case studies, these include:

- lack of suitable ICT management models for application
- lack of opportunities for training in ICT management
- lack of suitably qualified technical staff
- lack of funds needed for the maintenance of ICT in the university
- rapid turnover of technical staff
- highly centralized decision-making process.

The conclusion can be made that the situation at Kenyatta University explains partly why high returns on investment in ICT in public universities cannot be achieved without adopting new ways of managing ICT, with the objective of establishing ICT processes that can effectively contain the situation. It can also be concluded that more resources need to be made available for ICT and ICT management than are currently available. Such funds should be used for training the technical staff and users alike, purchase of new hardware and software, and hiring technical staff on more competitive terms than are offered currently.

6 Model Application: Case Study II – The University of Nairobi

6.1 Introduction

Established in 1970, the University of Nairobi, [www.uonbi.ac.ke], is the largest and oldest institution of higher learning in Kenya with a regular student population of about 15,000 and a full-time staff of 1,500. In addition, there are 7,000 students in the newly introduced Module II degree programme that runs side by side with the regular programmes, bringing the total number of students to about 22,000, according to a special report available at:
[www.nationaudio.com/13052001/Comment/SpecialReport2.htm].

Colleges and Campuses

Nairobi is composed of six colleges established by the University of Nairobi Act of 1985 and located on seven campuses in and around the capital city Nairobi. The colleges (the campuses shown in brackets) include the College of Agriculture and Veterinary Sciences (Upper Kabete), College of Architecture and Engineering (Main), College of Biological and Physical Sciences (Chiromo), College of Education and External Studies (Kikuyu), College of Health Sciences (Kenyatta National Hospital) and College of Humanities and Social Sciences (Main). The Parklands campus houses the Faculty of Law, which is part of the College of Humanities and Social Sciences. The university has a similar structure to that of Moi University with the Vice Chancellor as its academic and administrative head supported by two vice-chancellors and the principals of the colleges, the librarian, deans of faculties and chairpersons of academic departments. The campuses of the University of Nairobi are depicted in Figure 6.1.

In keeping with the recommendation of Yin [Yin94], three embedded sub-case studies were selected for the application of the model. The purpose of selecting three sub-case studies was to create a broad awareness of the issues related to ICT. These sub-case studies are (a) the campus-wide network backbone and access to the World Wide Web (WWW) and the Internet, (b) the University Library Information System, and (c) the Joint Admissions Board Information System. The Institute of Computer Science, part of the College of Biological and Physical Sciences, coordinates ICT development and management activities for the entire university, including the selected sub-cased studies.

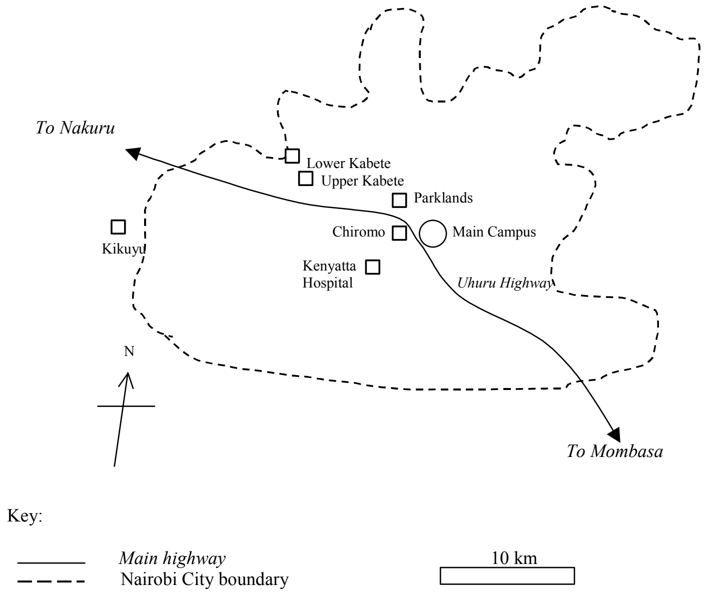


FIGURE 6.1: THE CAMPUSES OF UNIVERSITY OF NAIROBI

The location of the University of Nairobi in and around the capital city on seven widely separated campuses constitutes a serious communication and computing challenge to the university. In recognition of this challenge the university has set four objectives related ICT [Source: Nairobi University Information Systems Strategic Plan, paper presented at a planning seminar, known as Mbagathi II, Nairobi, 5-6 November 1999].

- To create and maintain an information and computing infrastructure in line with the university vision, mission and strategies.
- To acquire and maintain integrated management information system applications that are online and real-time; where data is captured, verified and validated at source; and which increase the efficiency and effectiveness of university academic and administrative processes.
- To attract, develop and retain competent technical staff and to build capacity at all levels of the university to develop, implement, use and sustain information systems that meet the university vision, mission and strategies.
- To implement other management measures that facilitate information systems to support the business of the university.

Specific strategies, activities and timeframes have been worked out and detailed in relevant documents, to achieve these objectives.

The application of the model consists of, in each sub-case study, four functions, namely, the *depiction* of the IST situation in which ICT related issues identified in the model described according to the criterion of existence. This is followed by *qualification* of the IST situation in which the existing issues were assigned values low, medium or high according to whether they are considered so, based on the dual criteria efficiency and effectiveness. The third function of the model is to *define* the new (SOLL) situation for the issues, one which is considered to be more efficient and effective than the current (IST) situation. The final step consists of statements of recommended actions to *transform* the IST situation to the SOLL situation by taking measures that will ensure a change in the current situation on the issues that are shown to require transformation.

The rest of this chapter is organized as follows

Section 6.2	Function 1: depiction of the ICT related issues in the current (IST) situations for the sub-case studies based on the model developed and presented in chapter 4, and on the criterion existence.
Section 6.3 the	Qualification of ICT related issues in the existing (IST) situations for sub-case studies based on the criteria effectiveness and efficiency.
Section 6.4 based	Definition of the future (SOLL) situations of for the sub-case studies on the model developed and presented in chapter 4.
Section 6.5 based	Transformation of the IST to SOLL situations for the sub-case studies on the model developed and presented in chapter 4. The benefits, costs and consequences of transformation are also presented.
Section 6.6	Summary and conclusion of the chapter.

The method and procedure followed in the application of the model included first obtaining permission to conduct the research. This was followed by a series of meetings held with technical and administrative staff, in which details of the model were presented and discussed, a review of available documents and reports, and observation of ICT management processes.

6.2 Function 1: Depiction of the IST situation

In this section three embedded sub-case studies are depicted to describe their current (IST) situation regarding ICT related issues based on the concepts contained in the model developed in chapter 4 and applied at Kenyatta University in chapter 5. In sub-section 6.2.1 we introduce the campus-wide network backbone; in sub-section 6.2.2 we present the university library information system and in sub-section 6.2.3 we depict an information system that supports the activities Joint Admissions Board. Joint Admissions Board is a body set up by the Kenyan public universities to coordinate the selection and placement of freshmen in their various degree programmes.

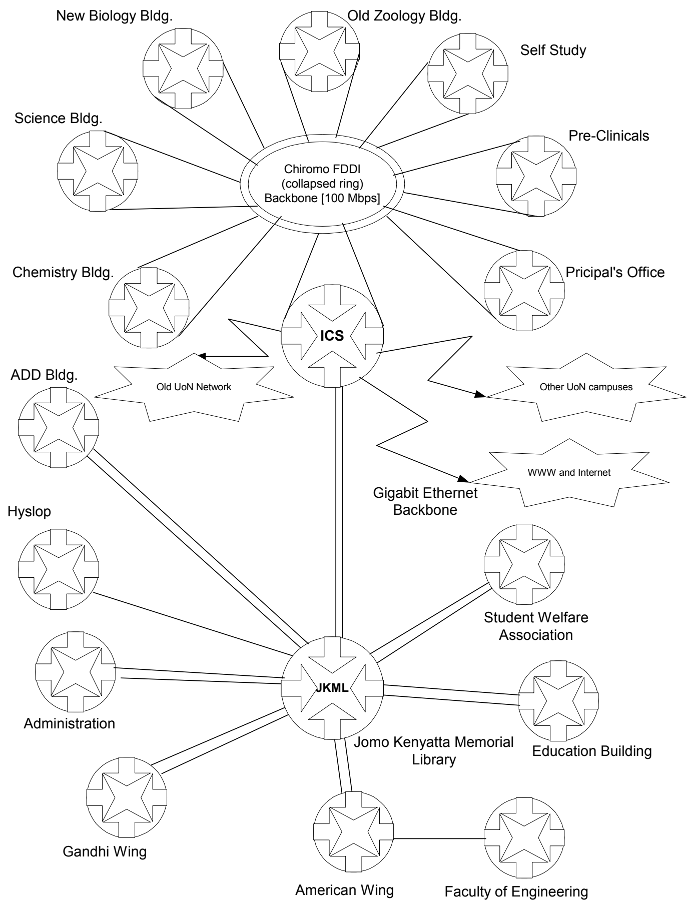
Sub-Case 1: The University Network Backbone

Background information

The communication needs of the University of Nairobi, UoN, are growing rapidly and the university is under pressure to meet the demand at a time of great economic difficulty. In addition, the current ICT and communication infrastructure can only be described as inadequate to meet the requirements. However, there are indications that some effort is being made to meet this need. To connect the seven campuses and to ease the problem of communication between them, parts of a campus-wide network backbone have been established while others are either in the proposal stage or under development. The Institute of Computer Science, ICS, at Chiromo campus is responsible for the development and management, control and maintenance of the campus-wide network backbone.

The current network infrastructure, shown in Figure 6.2, consists of a 100 Mbps ring topology Fibre Distributed Data Interface, FDDI, which is a backbone located at Chiromo campus. It is made up of a number of LANs in Chemistry Department, Science Faculty, New Biology building, Old Zoology building, Self-Study centre, Pre-clinical building, and the principal's office. At the main campus a similar arrangement exists except that, instead of a ring topology, there is a star configuration with the Jomo Kenyatta Memorial Library (JKML) serving as the hub. This links up LANs at the College of Architecture, Design and Development (ADD), Hyslop building, the main administration, the Gandhi Wing, the American Wing, the College of Engineering, the Education Building and the Student Welfare Association (SWA) centre. Both configurations are interconnected through the ICS from where there are connections to other UoN campuses, including Lower Kabete, Upper Kabete, Parklands, Kikuyu and Kenyatta Hospital, as well as the access to the World Wide Web (WWW) and the Internet. An old university network remains operational and it is also connected to the backbone; however, it is largely obsolete.

The university supports and aggressively promotes the use of computers. It has introduced computing facilities in key user departments such as academic, finance, administration, and planning divisions. It is supported in this effort by forging close links with external donor communities, which provide the required funds to purchase hardware, software, and technical training both locally and overseas. The major international donors include the World Bank and the Belgian government.



Key:

ADD Architecture, Design and Development

ICS Institute of Computer Science

FIGURE 6.2: CURRENT AND PROPOSED NETWORK BACKBONE AT NAIROBI UNIVERSITY (SOURCE: ICS)

The depiction of the IST situation is shown in **Appendix D, Sub-Appendix D1C1**.

Observation: As a network service unit responsible for providing network services to the entire university, UNB faces great challenges which present themselves in the form of situational factors, such as size, location, technology environment, and communication infrastructure, and complexity factors including quantity, dynamics and utilization. presented in the model. The model was useful and relevant in depicting the issues.

Sub-Case 2: University Library Information System

Background information

In depicting the University of Nairobi Library system, we include a review its mission and objectives to understand its operations and examine to what extent these objectives are being met with the utilization of ICT.

Mission: the mission is stated as to *provide students and staff with access to an extensive range of resource materials and information to support the academic work of the university.*

Objectives:

1. To work with the university community to provide access to information
2. To monitor and evaluate services to match changing needs of the university
3. To assist the users in understanding and utilizing the full range of information services available and to foster the acquisition of skills necessary for independent learning
4. To provide access to a wide range of information sources through *information and communication technology*, ICT, and to work with other services to ensure their effective use and development
5. To develop and maintain relationships with other library services and to facilitate library co-operation
6. To develop and maintain all service standards at the highest possible levels, with the emphasis on quality, customer care and cost-effectiveness, within the resources available to the service.

Objective No. 4 is of particular interest as it links ICT and the library activities. The University of Nairobi Library system, which consists of the main library (also known as Jomo Kenyatta Memorial Library) at the main campus and 12 specialized sub-libraries spread over 7 campuses, has the ICT resources indicated in Table 6.1, to meet this objective.

Campus	*Number of PCs*
Main Campus	18
College of Health Science	7
Chiromo	6
Lower Kabete	1
Upper Kabete	1
Institute of Development Studies	2
Parklands	1

TABLE 6.1: DISTRIBUTION OF LIBRARY ICT RESOURCES

The library serves a total of over 15,000 regular as well as part-time students and has a total of over 700,000 books, journals, periodicals and reports. No library service, including lending/loaning or charging, has been automated. Instead the system is still operated manually. The large number of users implies that there is a lot of pressure to automate the library system and provide for ICT services.

ICT related services
Library services that are associated with ICT include

- Internet based e-mail services including Yahoo, Hotmail and Pegasus. The university also provides free e-mail accounts to its users through the main library 'Internet café'.
- Internet access is open to students and staff and is also offered free of charge. Using this access users can conduct search and gain access to information available in remote databases
- in-house databases are held on electronic media (CD-ROMs) in various fields such as agriculture, education, engineering, humanities, medicine, science, technology, and zoology.

The management of ICT and the network within the main library is the specific responsibility of the technical staff of the Institute of Computer Science; however, the overall responsibility rests with the Officer in Charge of ICT in the library that coordinates the management activities. The ICT facilities are owned and used by the library. The typical ICT management activities consist of monitoring the operations of ICT used by students, staff and technical staff. If malfunctions are noticed by users, for example, very often the mail server goes down, the incident is reported to the officer in charge, who in turn calls, by phone, the technical staff stationed at the Institute of Computer Science about two kilometers away. If the incident can be contained, the matter is sorted out over telephone through advice given by the technical staff; however, if the problem persists or requires the attention of the technical staff then they arrange to travel to the library to sort it out. This may take time especially if the technical staff members have other tasks to deal with. In the meantime the users in the library must be prepared to be patient while the matter is sorted out. The cause of the problem may not be noticed until much later and the solution may require the replacement of a component through new purchase. Given the university's location within the city center the matter should be sorted within a short time but given the long procurement procedures put in place by administrative officials, the solution may take a day or two to sort out.

Given this background information about ICT management, we proceeded with the depiction of the IST situation in the university library information system, ULIS, shown in **Appendix D, Sub-Appendix D1C2.**

Observation: As a unit responsible for storing and disseminating information and knowledge, the library information system was relevant for the application of the function depiction of the IST situation as the issues were shown to apply in the sub-case study.

Sub-Case 3: Joint Admissions Board Information System

Background information

The Joint Admissions Board (JAB) is a body consisting of vice-chancellors, deputy vice chancellors, deans of faculties, directors of institutes of all the 6 public universities in Kenya, see Figure 6.3. Its main objective is to set the criteria for annual selection of candidates from schools into first degree programmes offered at the universities based on the performance of the candidates and the availability of places. The board meets regularly, about 6 times in a year, on a rotating basis once in each public university and is chaired by the hosting vice-chancellor. The data on applicants is supplied directly from the candidates' schools, and the Kenya National Examinations Council supplies examination results. The board then determines the cluster points and the cut-off points for each degree programme. The processing of the degree placement is performed by the Institute of Computer Science at the University of Nairobi. Out of about 160,000 candidates who sit the Kenya Certificate of Secondary Education – KCSE, every year, between 30,000 and 40,000 candidates apply for university places to JAB and out of these only about 10,000 are offered places at the public universities. The applicants pay a fee, which is used to meet the operating and maintenance costs of the JAB Information System - JABIS.

Key

Public universities

UoN University of Nairobi
MAU Maseno University
MU Moi University
KU Kenyatta University
EU Egerton University
JKUAT Jomo Kenyatta University of Agriculture and Technology

FIGURE 6.3: LOCATIONS OF PUBLIC UNIVERSITIES IN KENYA

JABIS consists of hardware, including powerful severs, connected on a LAN with a few PCs, and running on an Oracle platform having recently migrated from a Cobol platform. A senior member of the technical staff is in charge of the system assisted by two technical staff members who perform mostly data entry and processing duties.

Against this background, we proceeded to depict the IST situation for JABIS sub-case study as shown in **Appendix D, Sub-Appendix D1C3**.

Observation: The issues in the framework presented indicate they were relevant and appropriate to JABIS. The management of ICT for JAB is the responsibility of one senior technical staff of Nairobi University working under the general direction of the university's academic registrar. To assist the senior technical staff members are a few technical assistants with long working experience in data processing in Cobol; however, due to the migration from the Cobol platform to the Oracle platform, the staff has to undergo new training in the new software.

6.3 Function 2: Qualification of the IST situation

The main objective of the qualification was to validate further the model by applying it to the three embedded sub-case studies. In validating the model we needed to determine if the qualification function could be used accurately to assess the issues and provide a clear picture of the situation. This process was necessary to enable stakeholders to deepen their awareness with regard to the issues and the relationships between them, which must be taken into account when making decisions. The application of the qualification function, based on the criteria of **efficiency** and **effectiveness**, involved the participation of senior personnel in each sub-case study and the author. In all sub-case studies, reference was made to the qualification schemes presented in Figures 4.10 (a) – (e).

Sub-Case 1: The University Network Backbone

The model function qualification was applied to the sub-case study University Network Backbone, UNB using the schemes developed in Figures 4.10 (a)-(e). In the entity RS, it was found that users were moderately aware of their requirements and that the user requirements had a low formulation. Preconditions were in general moderate showing that the university had taken steps to provide an environment that is suitable for ICT utilization, exploitation and maintenance. The impact of situational factors ranged from medium to high, indicating some degree of difficulty for the university in meeting its commitments to ICT provision.

In the entity ICT, although hardware and software clearly lag behind the state-of-the-art standard, there was evidence that the university was making every effort to update its resources. Most of ICT scored high though the university as a whole was not fully exploiting it on academic and administrative activities. Due to changes and other factors some ICT remains low for maintenance due to shortage of funds. Complexity factors distribution and utilization appear to have a high impact on utilization, exploitation and maintenance. ICT management processes are in general at Level 1 according to the qualification scheme, implying that most of them are not clearly defined. Relationship between entities indicates some increasing degree of awareness on the parts of the university management, technical staff on ICT issues. Impact of economic changes appear to be comparatively more pronounced than other influences, indicating that this single factor plays a crucial role in ICT.

Details of the results of qualification function are presented in **Appendix D, Sub-Appendix D2C1**.

Observation: user awareness is between low and medium according to the information gathered, indicating appreciation of ICT in day-to-day activities.

Formulation of preconditions varies between low and medium level, also indicating that efforts have been made to create a framework in which ICT can be developed, managed, controlled and maintained.

Two significant preconditions, financial resources and personnel allocation show that staffing in sufficient numbers and quality remains significant problems.

Significant among these are size, and student unrest, as indicated by their high qualifications.

Hardware, software and network components used in UNB are graded medium or low to indicate that they still lag behind the present state of the art. Network components comprise Ethernet type technology.

Full exploitation, rated medium, is expected to be achieved when network development project is fully realized.

Significant complexity factors include quantity, distribution on account of the geographical locations of the campuses, utilization of ICT and functionality on account of the large number of users.

Forms of management and processes have not been implemented according to the model. Only rudimentary forms of these forms of management and processes can be recognized.

Relationships between entities indicate strong university exploitation of the network to improve intra- and inter-campus communication. However, the exploitation is limited since it is still under development.

Donor influence is fairly strong and positive but declining, while other influences are high or medium but negative, indicating a difficult environment in which to manage, control and maintain the network.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

Sub-Case 2: University Library Information System

With reference to qualification schemes presented in Figures 4.10 (a) – (e), users in ULIS were found to have an awareness of their requirements of between low and medium, indicating that there was a growing general awareness, but the level of formulation of the awareness was still very low. This implies that there is a need for the university to act on this aspect of user requirements. Most of the preconditions were rated medium with a few rated low on the qualification schemes. This showed that there has been some degree of achievement concerning the formulation of user requirements in a framework. Information policy and planning and service level agreements between the library and users need to be implemented as they were found to be limited in scope, or non-existent. Situational factors size, student unrest and location appear to have the greatest impact on utilization, exploitation and maintenance of ICT. These factors are followed by age/status of the university, organizational culture, technology environment and communication infrastructure.

In the entity ICT, hardware and software are of the standard types generally found elsewhere but clearly they still lag behind state-of-the-art technology by a few years. Most of the ICT is in high utilization and moderate exploitation states with a few under maintenance where the state though rated low due to low funding, appears to be improving.

With regard to complexity factors, as in other sub-case studies, distribution, and utilization of ICT were rated high. Frequent changes made to ICT were moderate but quantity, diversity and cohesion had little impact on utilization, exploitation and maintenance of ICT. Most of the MCM processes were undertaken by ICS staff but in general were at Level 1. Tasks carried out were fragmented and limited in scope and definition.
Most of the relationships were medium level, implying that there was a growing awareness on the part of those involved, however, ICT support for library activities and university exploitation of ICT appear to be at a low level. This indicates the need to apply ICT to the university and library activities such as automation.

Once again, impact of economic influence is rated high on ICT utilization in the library, leading to the stalling of the ICT project in the library. Managerial, technological and cultural influences also feature at a medium level. Donor influence and support were weakest among the influences investigated and were, therefore, rated low.

Details of qualification of the IST situation for ULIS are presented in **Appendix D, Sub-Appendix D2C2**.

Observation: awareness for ICT services is generally low; the library business processes have not been automated. However, the provision of Internet café within the same library has provided the users with the means of easier communication and processing.

Formulation of preconditions has been achieved to between low and medium levels, indicating that some positive steps have been taken towards this goal.

Key preconditions, financial resources and personnel allocation , are both rated low, indicating that they remain a significant problem.

Situational factors that impact on the management, control and maintenance of ICT in the faculty include the size of the library, location, technology environment (computer usage and applications), library culture, communication infrastructure and student unrest.

Hardware, software and network components used in the library are of modern industry standard types while network components comprise dial-up telephone connections.

ICT utilization is high, mainly for processing and communication; exploitation, and maintenance of ICT, indicating a realization of benefits that ICT brings to the library.

Significant complexity factors include distribution, dynamics arising from heavy and continuous use of ICT, and functionality, sophistication of which has grown with periodic maintenance and extensions.

Forms of management and processes have not been implemented according to requirements of this model; however, significant processes include configuration management, and cost management.

Relationships between entities indicate weak library exploitation of ICT on its activities to achieve its overall objectives, especially with regard to book circulation, searching and indexing activities.

Donor influence is weak and on decline, implying the need for self-reliance on its own financial and material resources.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

Sub-Case 3: Joint Admissions Board Information System

Users in JABIS were found to be highly aware of their requirements but as in the other sub-case studies, since requirement formulation in document form by the authorities was lacking, they were rated low. Among the preconditions formulated regarding ICT, centralization of activities and concentration of ICT were highly rated due to their impact on utilization, exploitation and maintenance of ICT. Information and policy planning and service level agreements between JBIS and users were either low or non-existent.

Situational factors for JABIS are similar to those in the other sub-case studies – impacts of age, size, location, and student unrest on ICT were rated medium to high, while those of technology environment, organizational culture and communication infrastructure were rated low.

In the entity ICT, hardware and software, as in other sub-case studies, lagged behind state-of-the-art ICT by up to 7 years, however, much effort is being spent on improving the technology through upgrading and direct purchase of new hardware and software. Much of the ICT is in medium to high utilization, and exploitation is often on a seasonal basis when candidates for university places are selected. Maintenance of ICT is also at medium level supported by qualified personnel.

Many of the complexity factors with high impacts in the other sub-case studies appear to be rated low in JABIS, due mainly to insignificant quantities of ICT, concentration of ICT in a central location, few changes made to ICT, and being of an industry standard type, impact on ICT utilization, exploitation and maintenance is low.

MCM processes have yet to be defined and carried out according to the model. Consequently, most of them are rated at Level 1, implying that there is need formally to establish them. In a few cases, i.e. application management, help desk, and capacity management, there seems to be some improvement but more needs to be done to define and implement the processes.

Relationships between entities range between low and medium implying a growing awareness of the importance of ICT, however, it also means there is still a need to strengthen the relationships so that users of JABIS can derive the benefits from ICT.

Due to the impact of external influences on ICT utilization, exploitation and maintenance falls between medium and high. Changes in administration often impact on the university operations and have an effect on ICT. Donors have in the past been active in and donated much of the current ICT although this influence is declining. Technologically, there has been an impact whenever there have been new development changes in computing technology and Nairobi University, being in the capital city, is especially susceptible to this influence. Economic changes in the country imply that universities find it difficult to acquire and maintain ICT on their own without external support. Finally, cultural influences play a significant part given the special status Nairobi University as a national institution.

Details of qualification of the IST situation for JABIS are presented in **Appendix D, Sub-Appendix D2C3**.

Observation: level of user awareness for ICT services is generally high. The reason for this lies in the fact that computers have for a long time been used to process large volumes of data

Formulation of preconditions represents a different view. In the case of IPP this has not been achieved, implication of which little coordinated development, management, control and maintenance of ICT can proceed. Other preconditions, financial and personnel allocations, are moderate.

Situational factors that impact on the management, control and maintenance of ICT in the unit include the location and student unrest.

Hardware, software and network components used in JABIS are of modern industry standard types; network components comprise Ethernet-based technology.

The level of utilization is high but seasonal meaning the JABIS peaks during high activity period when admissions are processed; exploitation, and maintenance of ICT were rated medium, indicating a realization of benefits that technology brings to the unit.

Forms of management and processes have not been implemented according to requirements presented in this model. Significant processes that have been implemented include application management, help desk, and capacity management.

Relationships between entities indicate low exploitation of the powerful ICT available to achieve objectives of JABIS.

Donor influence is on decline, implying the need for self-reliance on its own financial and material resources.

Overall efficiency issues scored generally higher than effectiveness issue, while technical issues were rated higher than managerial issues.

6.4 Function 3: Definition of the SOLL situation

Sub-Case 1: The University Network Backbone

The university network backbone is relied upon to provide both internal and external communication; however, due to situational factors depicted and qualified in sections 6.2 and 6.3, the communication requirements of the university are not fully met. Some campuses such as Kikuyu and Parklands are completely cut off from the rest of the university in terms of access to e-mail and Internet. A lack of qualified technical staff in adequate numbers, a lack of funds and the scale of the task to provide ICT services make it more difficult to meet the requirements of students and staff. On the basis of this observation, we attempt a definition of the SOLL situation that is possible within the financial means at the disposal of the university and technical and professional ability of the staff available to realize and sustain. Details of the results of definition of the SOLL situation for UNB are presented in **Appendix D, Sub-Appendix D3C1**.

Sub-Case 2: University Library Information System

The definition of the SOLL situation for the university library information system is made against the background of the level of impact of existing situational and complexity factors. Taking these categories of factors into account we are able to determine reasonably the SOLL situation that is practically possible to transform to, from the current situation.

It is clear that situational factors have an impact on ICT services in the university; however, the objective is not to eliminate the factors per se, but rather to analyze them with a view to understanding the level of their impact on ICT provision in the university so that appropriate strategies and actions can be put in place and taken steps to contain their effects.

Management of ICT depicted and qualified in sections 6.2 and 6.3, respectively, portrays a picture of ICT management processes as being at Level 1 according to the scheme given in Figures 4.11(a) – (f). Following this scheme, each of the existing library ICT management, control and maintenance processes bear little relationship with other ICT management, control and maintenance processes. However, a few of the processes, notably functional management, configuration management, software distribution and control, and cost management appear to be performed better than other processes. The general standard is still much lower than it should be according to the qualification scheme. To improve ICT management from the current levels, and considering the current levels of impact of situational and complexity factors, the SOLL situation is defined as shown in **Appendix D, Sub-Appendix D3C2**.

Sub-Case 3: Joint Admissions Board Information System

As in the first two sub-case studies, we apply the third function, definition of the SOLL situation, to the third sub-case study, JABIS, taking into account the situational factors and the complexity factors. We note the following for the entity MCM.

The management, control and maintenance of ICT is the responsibility of technical staff from the Institute of Computer Science, who are qualified and experienced in their respective fields; however, they are few in number compared to the large number of ICT resources for which they are responsible. This factor has an implication on the overall performance of ICT, including JABIS. In defining the SOLL situation for JABIS, we take this factor into consideration, that is, the limited number of staff available.

The definition of the SOLL situation for JABIS is shown in **Appendix D, Sub-Appendix D3C3**.

6.5 Function 4: Transformation From IST To SOLL Situations

The process required to transform the IST situation to SOLL situation for each of ICT related issues was presented in Figure 4.11 in chapter 4. To be able to transform the IST to SOLL, it is worthwhile to consider what benefits, costs, and consequences as these largely influence and provide the reasons why an organization should embark on improvement programmes.

Benefits, Costs and Consequences of transformation

Before we make recommendations on the actions and processes to be taken in the transformation process, there is need to draw the attention of implementers of the model to the common benefits, costs and consequences of the transformation covered in Section 4.8.

The list of benefits, costs, and consequences attempts to suggest to the authorities what critical aspects they need to be aware of when they embark on management and improvement of ICT in the organization. The recommended actions for the transformation from the current (IST) situations to the future (SOLL) situations for the two sub-case studies were suggested, with the list of benefits, costs and consequences acting as drivers.

For most ICT related issues resources must be available and capable of supporting the improvement of existing situations. Improvement can be achieved by making changes that meet both the university's needs and user requirements. The process may also require that the existing ICT situations be replaced by ICT situations that can enable users to become more effective and efficient. This implies that under certain circumstances, a situation can only be improved by replacement. Suitable examples of this category of situations include the replacement of batch-oriented systems by real-time interactive systems, replacement of an old analogue communication system by a digital communication system. Under other conditions, a situation can be improved by making only those changes that are considered necessary while the entire situation is left intact. Examples include training users to upgrade their knowledge, upgrading the hardware and software, and studying and understanding a complexity factor with a view to overcoming it. Following [Florac97 et al] the process of improving an ICT situation should include the following objectives:

- understanding the characteristics of the existing situation, as depicted in section 6.2, and the factors that affect the capability of an issue
- plan, justify and implement actions that can modify the situation to better meet the university needs and user requirements
- assess the impacts on the situation, and benefits gained, and compare them to the costs of changes made to the situation

The transformation function is applied on each of the ICT related issues in each sub-case study. The function involved the researcher making recommendations contained in function 3, the definition of the SOLL situation, to the university officials in charge of the sub-case study units, and discussing what resources would be needed to transform the IST situations to SOLL situations. The actions stated for each entity, therefore, represent the results of the discussions.

Sub-Case 1: University Network Backbone

The management of the network is the responsibility of the technical staff in the Institute of Computer Science based in Chiromo campus. Considering that there are 7 campuses that are in their care, the small number of technical staff involved and the impact of situational factors and the complexity factors associated ICT, all combine to contribute to exert considerable pressure on the ICT management. Against this background we examined how the transformation of the IST situations were achieved for the university network backbone in each entity. Modifications and simplifications in the transformation process were allowed where appropriate.

In all the entities, it was considered that as a first step in the transformation process, recognition and acceptance of the importance of the issues, should be secured from the authorities. The second step was to adapt of the issues and the processes of transforming the situations from their current states to the new states. As much of the improvement required resources, including finances coupled with limitation of time for implementation, only limited achievement was realized. As considerable work was already in progress on the initiative of the university to improve the quality of ICT, the model served as an additional aid to the process. Details of the transformation function for UNB are presented in **Appendix D, Sub-Appendix D4C1**.

Sub-Case 2: University Library Information System

Operations in the university library, which were still manual, need to be automated to bring them in line with the expectations of users and to speed up services; however, due to a lack of funds and other supporting resources such as personnel, the operations remained pending. The model when presented to the library staff served as a useful framework from which ICT management related issues could be focussed upon. In the entity RS, user requirements, including availability, flexibility, maintainability, performance, and reliability, were recognized and adopted. Preconditions information policy and planning was of particular interest to the library staff which agreed to develop it into a document to guide ICT not only in the library but in the university as a whole. The same held true for service level agreement between users and the university library.

With regard to ICT, fairly modern hardware, software and network components were being utilized and plans were in place to acquire more and to upgrade the existing equipment. Complexity factors distribution and utilization were of particular concern to the library staff and as a solution, networking was being pursued in conjunction with technical personnel from the Institute of Computer Science. The model presented the officials with a means to identify ICT related issues that need to be focussed upon. The rest of the details of the transformation function for ULIS are presented in **Appendix D, Sub-Appendix D4C2**.

Sub-Case 3: Joint Admissions Board Information System

JABIS presented a special sub-case study in that, although the system belonged to the University of Nairobi, its users were all the Kenya public universities. The transformation process in the sub-case study JABIS, was, therefore, along the same lines as the other two sub-case studies. That is, it took into account the existing situational and complexity factors. In most cases the processes took a similar approach to that of the other sub-case studies. Details of the transformation function for JABIS are also presented in **Appendix D, Sub-Appendix D2C3**.

6.6 Summary and conclusions

The University of Nairobi served as a further example of how public universities are trying to meet the challenges of managing the new computer technology. The model was applied at the University of Nairobi using three embedded sub-case studies: the university network backbone, UNB, university library information system, ULIS and the Joint Admissions Board Information System, JABIS. In each sub-case study four functions of the model were used to describe ICT related issues in terms of depiction and qualification of the IST situation, definition of the SOLL situation and the transformation necessary to realize the SOLL situation. The three units selected for the application of the model were chosen on the basis of their relevance and suitability for this study. The persons selected to provide the information required in the model occupied high positions in their respective fields within the university. Their participation in the application gave the model some added value and was necessary for the success of the model application. The participants possessed enough knowledge gained from experience and the authority to make the necessary decisions regarding the implementation of the model. Most of the issues discussed were found to be important though not practiced as specified in model; however, the persons appreciated the issues and indicated their willingness to recognize, accept and adapt the issues for implementation in their respective units. Most of the issues covered require funds and other resources to be implemented. Since the funds were not immediately available, the transformation of most of the situations could not be realized and instead recommended actions are presented.

The observation arising out of the application of this model is that the level management of information and communication technology at the University of Nairobi is LOW, i.e. at the initial level i.e. LEVEL 1. Most of the MCM processes are not categorized in the same manner as they are described in the model, and there is a high volume of work with which the technical staff attempt to cope. Lack of funds means that many of the processes are kept on hold with the consequence that users including staff and students, do not get the services that they require from the university. In many cases the users do not even expect to get high quality services due to lack of such information, hence they are not encouraged to ask for them.

The lack of service level agreement between users and the university was of particular interest to the respondents. They recognized that while the university enters some form of agreement with vendors regarding the level of service they expect from the vendors, they did not conclude and enter any sort of agreements between them and the users. They all accepted the need to implement the service level agreements in their respective units pending the availability of funds. The application of the model at the university of Nairobi gave a second opportunity to validate the model in a real life setting of a similar kind. The results validated the model as a useful reference framework and as a basis for further development of the management concepts in the field of ICT.

7 Epilogue

7.1 Introduction

The research presented in this thesis emerged from a personal interest in the study of ICT management that sought answers to the new problems that were emerging with the new computer technologies being introduced and used widely in Kenyan public universities in the 1980s and 1990s to support organizational activities. A review of the scant empirical literature on ICT management in Kenya led to the conclusion that there was a serious lack of expertise in the field in local universities in comparison with other well-established disciplines like basic sciences, engineering, agriculture, and economics. When the opportunity was presented to the researcher to study for a doctorate in ICT management at Delft University of Technology, The Netherlands, as part of a Dutch project at Moi University, Kenya, it was accepted both as a timely and appropriate research topic. As a first step in the research process, there was need to identify the research problem and to formulate the subsequent research question. Thus, eventually the study was conducted around the research question restated in Figure 7.1.

> How can we develop a model of ICT related issues that can enable a public university in Kenya to:
>
> (a) depict its current ICT related issues?
> (b) qualify its current ICT related issues?
> (c) define its new and improved ICT situation?
> (d) transform its current ICT situation to a new and improved situation?

FIGURE 7.1: THE RESEARCH QUESTION (REVISITED)

Research in ICT management at TU Delft, Netherlands, has traditionally been focused on problems in European organizations where situational factors differ significantly from those in Kenya. This led the researcher to shift away from conducting research in a Dutch company, as this would introduce a bias towards organizations in developed countries; also for reasons of relevance it was felt necessary that the research be carried out in the environment where the problems had been identified and were situated.

The identification of suitable organization was based largely on the fact that public universities are among the most significant recipients and users of the new computer technologies in Kenya, which, in addition, would benefit largely from such a research through improvement of their curriculum and actual direct utilization of such newly acquired technologies. As vehicles of technological change and development they (Kenyan public universities) in partnership with the donor community also act as agents of technology transfer in a wider sense, with a greater impact in a country than perhaps other types of organizations might. Based on these reasons, our search field and scope were narrowed down to ICT management in public universities in Kenya.

On examining the strengths and pitfalls of various methods used in ICT general and in ICT management in particular, we decided to use the *case study* technique in our research [Yin94], one which is commonly used by doctoral researchers ([Hemmen97], [Mersel95], [Wijs95], [Broek99]) at TU Delft, Faculty of Information Technology and Systems, Department of Information Systems and Software Engineering [www.its.tudelt.nl].

To start the research project we needed to identify a public university in which to conduct a pilot or feasibility study into the problems associated with ICT. There were three reasons for this approach. **The first reason was to gain a deeper insight into and get more acquainted with the existing problems; the second reason was to determine if the solutions to problems would be feasible and, therefore, warrant further research; and thirdly, by using multiple sub-case studies, to create a greater awareness among stakeholders of the issues related to ICT than was the case before.** This led us to select Moi University in Kenya as the pilot case study. In this case study the researcher faced one bias that needed to be avoided, that of being part of the organization in which the researcher needed to conduct the study. Using an embedded case study approach recommended in [Yin94], and avoiding researching the particular embedded sub-case study to which he belonged, overcame this bias.

Following this approach, various groups of ICT users were selected from the pilot case study based on type of unit and geographical location to obtain a representative mixture of responses. A variety of tools were used – questionnaires, interviews, and review of documents. The results confirmed the existence of problems related to the newly introduced computer technologies that needed urgent and lasting solutions if the situation was to be contained despite the fact the university selected was taking its own initiatives in this direction. The initiatives taken were not based on any particular scientific framework or model. The problems were identified as emerging issues and provided the basis and impetus for further research. Further, a framework of issues was proposed with its development based on existing proven models that would take into account the local situation in Kenya and the expressed requirements of the users contained in a pilot study case study (Moi University).

This phase was followed by the development of a model in which the views gathered from the initial group of users were fused together with issues from proven existing models to form the reference framework. The management paradigm ([Looijen98], [Looijen01]) provided the foundation upon which the research in its entirety rested. The model contained four functions. The first function entailed depicting the current situation based on the criterion of *existence* as far as ICT related issues are concerned. In depicting the current situation we sought to determine with some degree of certainty, which was reinforced by verification where possible, the ICT resources that we have, the processes that have been established and the situational factors and the external influences that impact on the Kenyan public universities at any give time. The second function, qualification of the current situation, entailed assigning values based on some specified assessment mechanism, to these issues and sought to make a critical comparison with others in the same categories and to provide the basis for improvement. The creation of levels of capability maturity based on similar issues observed in other organizations was a logical outcome of this process which led to the calibration of issues in the reference framework into three levels: LOW, MEDIUM, and HIGH based on the twin-criterion of *effectiveness* and *efficiency*.

Since the primary objective of the model was improvement, the formulation of the third function of the model with regard to ICT related issues, the definition of an affordable future situation within the constraints of the available resources that are so common in Kenyan public universities, became another logical step to take. Given the weakness and fragility of the economies of much of the third world, and of Kenya in particular, it was important to consider not only the benefits and costs of the envisioned future but also the possible consequences and repercussions which all stakeholders must be aware of before plans to realize an envisioned future situation are executed. The rationale for this viewpoint is that the situation in Kenyan public universities differs greatly from those in the developed world and due to this difference a lot of projects fail to grow into fruition because the authorities often fail to take this fact into account. Understanding local conditions is arguably key to successful implementation and utilization of ICT in Kenyan public universities.

The fourth function of the model, transformation from the current to the future situation, marked the final stage in the process of improvement of ICT related issues envisaged in the model. In many ways this is the most significant function of the process; however, the function requires tri-partite commitment and support of all stakeholders and the top management officials of the university, the users of computer technology systems, and the donors who provide much of the needed resources to translate concepts into reality. Saint [Saint92] has already underlined the role of external donors as supporters of long-term development strategies.

The process of model development used six embedded sub-case studies within the pilot case study purposely to create a broad awareness among stakeholders of issues related to ICT in Kenyan public universities. The results and conclusions of the process are presented above, with each sub-case study going through the four-function iterations of depiction, qualification, definition, and transformation defined in the model.

Following the development of the model, it became imperative that for validation purposes the model should be applied to similar situations in other public universities in Kenya. Two of the six public universities in Kenya were selected to participate in the application of the model, Kenyatta University and the University of Nairobi. In each case, embedded sub-case studies were identified and used. At Kenyatta University the sub-case studies include the IT Office and the African Virtual University while at the University of Nairobi three units were selected. The latter were the University Network Backbone, the University Library Information System and the Joint Admissions Board Information System. Similarly each of the sub-case study went through the same four-function iterations as were specified in the model. At the end of each application results were compared with those of the other sub-case studies. In the subsequent sections we present a summary of the research findings, conclusions pertaining to the research question, implications of the research findings for practitioners and for researchers, notes on the limitations of the research, and an agenda for further research.

7.2 Summary of research findings

The research findings can be summarized as follows:

- Using the first function of the model, depiction of the current situation, it was possible to describe the current situations in each of the sub-case studies with regard to real system issues, ICT issues, management, control and maintenance of ICT, relationships between entities and external influences. The criterion for depiction was existence.

- Using the second function of the model, qualification of the current situation, together with the capability maturity levels developed in each entity, it was possible to assign values, in each of the sub-case studies, to the current situations with regard to real system issues, ICT issues, management, control and maintenance of ICT, relationships between entities and external influences. The criteria for qualification were effectiveness and efficiency.

- Using the third function, definition of the future situation, and the capability levels defined for each ICT related issues in the entities as a road map, it was possible to assign values, in each of the sub-case studies, to the future situations with regard to real system issues, ICT issues, management, control and maintenance of ICT, relationships between entities and external influences.

- Using the fourth function, transformation from current to the future situation, it was possible to either carry out or recommend the required improvement/transformation activities depending on the resources available, to realize, in each of the sub-case studies, the future situations with regard to real system issues, ICT issues, management, control and maintenance of ICT, relationships between entities and external influences. Further, this step recognizes the role of resources in transformation and thus partly serves as platform from which to argue for increased financial support for ICT management. As it has been reported in ([DN00], [STD01]), Kenya registered an inflation rate of 6.5% and a negative growth in economy of 0.3% in 2000. These figures imply that despite the efforts made by the public universities to generate income by initiating various projects, the economic climate is not supportive, hence the need for continued and sustained external financial support.

The key attributes regarding the model are the relevance, clarity, ease of use, perceived usefulness, and suitability.

Relevance

It became apparent that the issues contained in the model were relevant to the sub-cases used in the research.

Clarity

From the manner in which the users went about applying the model to the respective issues it become apparent that the model was not only relevant but also clear. Each issue in each entity has clearly been defined.

Ease of use and traceability

The automated tool developed at the end of chapter 4 as an extension of the model demonstrated the ease of use of the model in a practical situation. Its traceability, i.e. ability to trace how an issue goes through the 4 functions, is an added feature.

Perceived usefulness

The strength of the model lies in its perceived utility value as an essential tool in the management of ICT and especially with regard to users.

Suitability

The model was judged suitable for the tasks related to ICT management and other related issues.

Considering that the model presented was of a pioneering nature being the first of its kind in the field of ICT management in Kenyan public universities, the research findings indicate a vital contribution to knowledge in an area where this kind of research had not been performed before.

The ability of the model to create awareness and serve as a basis of communication among the stakeholders in public universities was amply demonstrated in the two case studies. As a vehicle for improving ICT management processes the model also provided a means for practitioners to use as a tool in situations where none existed before.

One notable conclusion that can be drawn from the summary in Table 7.2 is that, consistent with what has been observed in [Luftman00], there are many variables involved in the reference framework and at the same time the computer technology and organizational environments are too dynamic. This multiplicity of issues and dynamism lead us to conclude that no single activity can enable a public university attain and sustain higher capability maturity levels since the technology and organizational environments change so rapidly; however, careful assessment of a university's maturity level is an important milestone in identifying the specific actions needed to ensure appropriate utilization, exploitation and maintenance of ICT in achieving the organizational objectives.

7.3 *Implications of the research findings*

The research findings presented in the last sections have direct implications for senior management officials and practitioners in public universities in Kenya.

Implications for senior management in public universities

For management officials in public universities in Kenya, the application of the four functions of the model made it possible for them to become aware of and conversant with the relevant issues related to ICT in their institutions.

- The first function depicted what issues existed and how they were related to one another. It made the officials to become aware of the situations in which they were and external influences under which they were operating. Consequently, by using the model as a means of communication, users and other stakeholders as interested parties, can now more reliably understand the issues better than in the absence of the model. This is one of the key benefits of using the model approach to dealing with problem areas in which not all parties are experts but in which everyone can contribute more meaningfully as a result of being better informed.
- The second function brought to fore the quality of the issues depicted. As a consequence of becoming aware of the qualities of the issues depicted the officials can now more reliably gauge how the current situations compare with the 'ideal' situations and thus much needs to be done with respect to setting the goals and objectives, devise strategies and plans to achieve than without a model. By 'ideal' is meant the higher levels of qualification towards which the organizations should strive.
- The third function, definition of the SOLL situation for each of the issues, provided a specific roadmap, containing clear milestones, towards achieving the goals. There are specific requirements to be considered under this function. The goals set must take into account the financial resources, technical expertise, and administrative means required to achieve them. The goals set must be achievable within the means and abilities of the institutions concerned and must be achieved on schedule to avoid budget over-runs. As a consequence, administrative officials, donors and other interested parties can now become aware of the extent of the work required and thus can commit their resources within a better informed framework.
- The fourth function, transformation from IST to SOLL situation, implies for the university officials making concerted efforts to improve the current situation. An organization-wide approach to dealing with issues of this kind is highly recommended. The specified steps in the function, though routine in nature, do indicate that implementers of the model must be aware of what must be done and in what order so that the goals set can be achieved optimally. The need for concerted efforts imply cooperation among all the stakeholders, administrative officials, donors and other stakeholders, and users, each playing a role to ensure success of the transformation.

In addition to the above, the research suggests two major pairs of implications that ICT managers and those in similar positions must take into account. The pairs of implications are effectiveness versus efficiency issues, and technical versus managerial issues.

- Effectiveness versus Efficiency Issues

Traditionally less emphasis has often been placed on effectiveness, which is, doing the right things, than on efficiency, that is, doing things the right way, when it comes to application of computing technologies. The model used in this research attempted to create a balance between effectiveness and efficiency by qualifying the issues based on the two criteria. It can be concluded from this observation that stakeholders will be de-motivated if they realized that less attention has been paid to ICT effectiveness than expected.

One can argue that there is a significant contingency factor related to effectiveness, which requires public universities to put additional emphasis on changing organizational characteristics, and approaches that appear to militate against ICT effectiveness. In practical terms, among these characteristics are the organizational culture, as observed from the visions/mission statements, goals, strategies, rewards and penalties; information policy and planning; centralization/de-centralization issues; and complexity and situational factors. Top management support and personal involvement, and user participation, in ICT related issues must not be only symbolic but must be actively and continuously promoted, sustained and forthcoming. ICT must no longer be viewed as a cost center but as a vital and even strategic part of the university, which must be given the full support it deserves.

- Technical vs. Managerial Issues

Based on fact-findings, higher premiums are placed on technical issues than on managerial issues. This trend is the same in other technically oriented fields such as engineering and agriculture. The consequence of this bias towards the technical and less to the managerial on the implementation and utilization of ICT in particular has been that managerial matters have suffered and led to poor utilization, exploitation and maintenance of ICT. This view needs to change so that both the technical and managerial issues are considered as complimentary and should, therefore, be given equal attention and emphasis. As ICT becomes more widely available to a growing number of users, ICT as a tool gains some social values. To obtain optimal benefits from such a value added system, understanding how to manage, control and maintain it is not only essential but also absolutely necessary and must not be compromised. A healthy and balanced combination of the two, technical and managerial expertise, is bound to become vital as the levels of complexity of ICT increase and become significant for the stakeholders of the public universities.

The view expressed above points to the need for further and continuous training in managerial aspects of ICT in addition to training in technical matters. Given the lack of training facilities in ICT in Kenya and a rapidly declining economy, the argument leads us back to the crucial role of the external donors. The deficiency in managerial expertise can be filled through regular attendance at organized training workshops/seminars/conferences and visits to exemplary organizations, with specific themes and topics to address the issues. Further, local participation of non-ICT experts and should be encouraged to bring to the fore the social issues that may have escaped the attention of the technical experts.

7.4 Agenda for further research

Instead of enumerating all the areas for possible further research based on this research, we present for more focused investigation four specific areas.

The first area is the refinement and extension of the concept of the capability maturity model (CMM) in relation to ICT management. In this research rather nominal values were used to define the capability maturity levels and only the first three levels were used. The proposed topic should seek to include levels four and five in tandem with the established trend in the field of software development and related disciplines.

The second area is to 'dramatize', as it were, the ICT management processes through simulation for the benefit of users and other stakeholders, to visually reflect the real situations and processes. In this case, the simulation should target processes that are key to successful utilization, exploitation and maintenance of ICT.

The third area is the need to bridge the technological and the social issues related to ICT. The growing importance of ICT as it permeates into various research areas and disciplines, especially those related to humanities, provide an ample opportunity and justification for further research into this area within the context of the Kenyan society. Cross-cultural issues related to ICT should also be part of the new agenda as there is need to gauge the reactions of various user communities to the deployment of ICT in their areas. Assumptions that what is good for the developed nations is also equally good for the developing world should be re-examined afresh with a view to contextualizing any emerging issues.

The fourth area is the extension of the model to cover other sets of ITIL processes since only two of the nine sets cited in section 4.3 were used in this research. The approach followed in this research is, thus, similar to the implementation of ITIL processes by organizations in The Netherlands. As the universities increasingly apply ICT on virtually all academic and administrative activities, the research into the relevance and efficacy of the model with regard to the remaining sets will be appropriate. The remaining sets include the manager's set, software support, networks, computer operations, environmental strategy, environmental management, and office environment.

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APPENDIX A: PILOT STUDY QUESTIONNAIRE ON MOI UNIVERSITY ICT REQUREMENTS

Section A: Background information

1. Name of respondent: ______________________________

2. Name of institution: ______________________________

3. Department: ____________ Section: ____________ Campus: ________

4. Current position: ____________________ Grade: ____________

5. Number of years served in the university: ____________________

6. Number of years using a computer in the university, if any: ____________

7. Number of years using a computer network, if any: ______________

8. Please state institution, period and level of training in computers, if any:

   Institution: ______________________________
   (if self taught, please say so)
   Period of training: ________months/years (please delete as appropriate)

   Level of training: (please indicate with a tick where appropriate)

   Elementary (E): __________ (certificate level and below)
   Intermediate (I): __________ (college diploma level)
   Advanced (A): __________ (university degree and above)

9. Number of official hours spent on a computer per week, if any: __________

10. Of these please indicate the number spent on the following application software and their competence levels:

S/W Application Package	Name of package	Version	No. of hours per week	Competence Level (E,I,A)
Word-processing	_______	_______	_________	_________
Spreadsheets	_______	_______	_________	_________
Databases	_______	_______	_________	_________
Statistical	_______	_______	_________	_________
E-Mail	_______	_______	_________	_________
Other(s)	_______	_______	_________	_________

11. In your view, are computers worthwhile tools to use in a work place such as the university? Please tick in one of the boxes as appropriate.

    Yes….. ☐ No ….. ☐ Not sure …. ☐

Section B: Information Requirements

12. Please list up to 5 items of information (ranked in order of importance from top), *e.g. total number of students registered in a year,* that are required most frequently (a) by your department/section, and (b) from your department/section, for:

(i) General internal operational purposes for staff and students in the university:

BY YOUR SECTION	FROM YOUR SECTION
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

(ii) Internal Management purposes for top university officials:

BY YOUR SECTION	FROM YOUR SECTION
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

(iii) External purposes with university clients, customers and other organizations:

BY YOUR SECTION	FROM YOUR SECTION
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

(A separate sheet of paper may be attached if necessary)

13. For which of the above items of information in the university would computers be most appropriate and have the greatest positive impact if use?

REQUIRED BY YOUR SECTION FOR

(i) Operational purposes	Management purposes	External purposes
____________________	____________________	____________________
____________________	____________________	____________________
____________________	____________________	____________________
____________________	____________________	____________________
____________________	____________________	____________________

REQUIRED FROM YOUR SECTION FOR

(ii) Operational purposes	Management purposes	External purposes
____________________	____________________	____________________
____________________	____________________	____________________
____________________	____________________	____________________

Section C: Development, Desired features and benefits of ICT in the university

14. Information Policy and Planning

(i) To what extent do you agree that a university in modern Kenya should have an Information Policy and Plan?

Strongly Disagree Neither Strongly Agree

1	2	3	4	5
☐	☐	☐	☐	☐

What purpose(s) should such a policy and plan serve in the university?

(iii) Are you aware of the existence of such policy and plan in the university?

Yes ☐
No ☐

(iv) To what extent do you then agree that the issues listed below concerning personal information are currently viewed as important and should, therefore, be incorporated in the desired university information and communication technology?

Use the 5-point Likert scale *1 (strongly disagree)* to *5 (strongly agree)* to indicate your choice with an X in both the CURRENT and DESIRED situations.

Privacy and confidentiality of personal data:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

Integrity of personal records:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

Right of access to personal data for purposes of verifying their accuracy and completeness:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

Restriction of access to personal data:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

Use of personal data for specified purposes:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

Non-revelation of the identities of individuals whose data is used for statistical purposes:

	1	2	3	4	5
CURRENT SITUATION	☐	☐	☐	☐	☐
DESIRED SITUATION	☐	☐	☐	☐	☐

(v) What specific and practical proposals and strategies would you give to ensure that present and future IT projects are sustained and time and cost overruns are avoided?

____
____
____

15. Development and constraints

(i) Please give your assessment of the present level of ICT development in the university compared to other public universities in Kenya?

- Much higher ☐
- Higher ☐
- Average (same as others) ☐
- Lower ☐
- Much lower ☐

(ii) Do you think that, as a potential (or actual user) of ICT, your participation in the university could significantly contribute towards the success of a new information and communication technology?

- Yes ☐
- No ☐
- No idea ☐

(iii) If your answer to (ii) above is either 'Yes' or 'No idea', state the extent to which you would like to be involved in its development. Use the scale 0 (No involvement) to 5 (High involvement) by marking X in the appropriate box.

	0	1	2	3	4	5
Level of user involvement	☐	☐	☐	☐	☐	☐

(iv) To what extent do you think that the following are major constraints that presently face ICT development in the university? Use the 5-point Likert scale 1 (Least likely) to 5 (Most likely) to indicate in the boxes provided the likelihood of the constraint.

	1	2	3	4	5
High cost of hardware & software	☐	☐	☐	☐	☐
	1	2	3	4	5

	1	2	3	4	5
Poor communication and ICT infrastructure	☐	☐	☐	☐	☐
High cost of training	☐	☐	☐	☐	☐
Lack of funds for ICT and training	☐	☐	☐	☐	☐
Little priority given to ICT by management	☐	☐	☐	☐	☐
Lack of physical security for computers	☐	☐	☐	☐	☐
Lack of support and commitment by mgt.	☐	☐	☐	☐	☐
Lack of interest by potential users	☐	☐	☐	☐	☐
Lack of confidence of mgt. in users	☐	☐	☐	☐	☐
Uncaring and poor attitude	☐	☐	☐	☐	☐
Poor management of computers	☐	☐	☐	☐	☐
Institutional inertia (reluctance)	☐	☐	☐	☐	☐
Lack of clear information policy and plan	☐	☐	☐	☐	☐
Poor remuneration for ICT staff	☐	☐	☐	☐	☐
Wide geographical locations of campuses	☐	☐	☐	☐	☐

(v) List up to 5 significant steps that the university has taken to tackle problems facing ICT development in the recent past.

____
____
____

(vi) Indicate in the spaces below how the situation can be improved from the users' side as well as from the university management's side:

From users' side:

____
____

Form university management's side:

____
____

Section D: Current and Required Information and Communication Technology

In Questions 16 to 19, indicate the features or benefits you think are associated with the current ICT, and those you would like to obtain from the development of a new information and communication technology involving computers in the university. For each category, use the 5-point Likert scale 1 (Low) to 5(High) ratings.

For example, if you highly rate *ease of learning* as a desirable feature in future ICT but is hardly available in the present ICT, then mark 'X' in, or shade, the corresponding boxes as follows:

16. Acceptance and Implementation:

	1	2	3	4	5
Ease of access to computer facilities					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Availability of ICT					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Flexibility of functions					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Job satisfaction					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Control over my work					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐

17. Utilization:

	1	2	3	4	5
Efficiency					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Effectiveness					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Accuracy in data processing					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Internal communication					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
External communication					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐

18. Maintenance:

	1	2	3	4	5
Adaptability to changes in ICT					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
Training opportunity					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐
University image					
CURRENT ICT	☐	☐	☐	☐	☐
REQUIRED ICT	☐	☐	☐	☐	☐

		1	2	3	4	5
Reliability of ICT						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐
Durability of ICT						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐

19. Exploitation:

		1	2	3	4	5
Reduced reliance on paper work						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐
Reduced operational costs						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐
Advantage of new IT						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐
Service to staff & students						
	CURRENT ICT	☐	☐	☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐
Competitive advantage						
	CURRENT ICT	☐	☐	☐ ☐	☐	☐
	REQUIRED ICT	☐	☐	☐	☐	☐

20. Briefly state how you think the above features and benefits can best be realized in your university. (You may attach a separate sheet of paper if necessary).

____

____

____

21. In your view, can the university do without computers in the present times and in the future? (Please mark check in one of the boxes).

Yes ………………………………………………….☐
No ………………………………………………….☐
Not sure ……………………………………………..☐

22. If your answer to Question 21 above is 'No', what are the strategies that the university should adapt in order to ensure sustained future IT growth?

Use the scale from 1 (Least agreed) to 5 (Strongly agreed), to make your choice by checking in the appropriate box.

	1	2	3	4	5
(i) Devise a comprehensive IPP	☐	☐	☐	☐	☐
(ii) Invest significantly in ICT	☐	☐	☐	☐	☐
(iii) Invest in staff training	☐	☐	☐	☐	☐

(iv) Manage ICT more effectively ☐ ☐ ☐ ☐ ☐

(v) Re-orient staff in proper use of ICT ☐ ☐ ☐ ☐ ☐

(vi) Other (please specify) ☐ ☐ ☐ ☐ ☐

23. What specific and practical proposals would you give which will ensure that the present and future level of ICT service is maintained?

____

____

____

Section E: (Optional)

24. If you think that a further discussion on one or more of the issues raised in this questionnaire, or indeed any other relevant issues, would be helpful then please tick in the box below and indicate the topic:

Yes, a further discussion will be necessary ……………………..

If 'Yes', please suggest a topic for discussion:

____

END

APPENDIX B: QUALIFICATION OF MCM PROCESSES –Six MU Sub-Case Studies

Table B1: ACADEMIC REGISTER INFORMATION SYSTEM (ARIS)

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0
has structured actions	**3**	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	0	1	1	0
has predictable services	**3**	1	1	1	1	1	1	2	2	1	1	1	0	1	0	0	0	1	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0
process is peer reviewed	**2**	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0
processes are standardized	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
processes documented	**1**	1	1	1	2	2	1	2	2	2	0	0	0	0	0	0	0	0	0	0
have preparedness criteria	**1**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0
Level 2																				
repeats earlier success	**3**	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	0	1	1	0
is performed pragmatically	**3**	1	1	1	1	1	1	1	2	2	1	1	0	1	0	1	0	1	1	0
process is recognized	**3**	1	1	1	2	2	1	2	2	2	1	1	1	1	1	1	0	1	1	0
activities are processes-like	**3**	1	1	1	1	2	1	2	1	1	1	1	1	1	0	1	0	0	1	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is enforced	**2**	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0
process is trained	**2**	1	1	1	1	1	1	1	2	1	0	1	0	1	0	0	0	1	1	0
process is practiced	**2**	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	0	1	1	0
process is planned	**2**	1	1	1	1	1	1	2	2	1	1	1	0	0	0	1	0	1	1	0
processes is cost-effective	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated work																				
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide																				
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes																				
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.1**	**1.2**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.0**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table B2: **INFORMATION RESOURCE MANAGEMENT (IRM)**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0
has structured actions	**3**	1	1	1	1	1	1	2	2	2	1	1	1	1	0	1	0	1	1	0
has predictable services	**3**	1	1	1	1	1	1	2	2	2	0	1	1	1	0	0	0	1	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0
process is peer reviewed	**2**	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0
processes are standardized	**2**	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0
processes documented	**1**	1	1	1	1	1	1	2	2	2	1	1	0	1	0	0	0	1	1	0
have preparedness criteria	**1**	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0
Level 2																				
repeats earlier success	**3**	1	1	1	1	1	1	2	2	2	1	1	1	1	1	0	0	0	1	0
is performed pragmatically	**3**	1	1	1	1	1	1	2	2	2	0	1	1	0	0	0	0	0	1	0
process is recognized	**3**	1	1	1	1	1	1	2	2	2	1	1	1	1	1	0	0	1	1	0
activities are processes-like	**3**	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	0	0	1	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is enforced	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is trained	**2**	1	1	1	1	1	1	2	2	2	0	1	0	1	0	0	0	0	1	0
process is practiced	**2**	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	0	1	1	0
process is planned	**2**	1	1	1	1	1	1	2	2	2	1	1	1	1	0	0	0	1	1	0
processes is cost-effective	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated work																				
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide																				
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.3**	**1.3**	**1.3**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		**Management Level**		**Service Support Processes**		**Service Delivery Processes**	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table B3:	FACULTY OF TECHNOLOGY (FOT)																			
	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	2	1	1	0	1	0	1	1	1	0	2	2	0
has structured actions	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
has predictable services	**3**	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	2	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	0	0	0	1	1	1	1	1	0	0	0	0	1	0	1	0	1	2	0
process is peer reviewed	**2**	0	0	0	1	1	1	1	1	0	1	1	0	1	1	1	0	1	2	0
processes are standardized	**2**	0	0	0	1	1	1	1	1	0	0	1	0	1	1	1	0	1	2	0
processes documented	**1**	0	0	0	1	1	1	2	2	1	1	1	0	1	1	1	0	2	2	0
have preparedness criteria	**1**	0	0	0	1	1	1	1	1	0	0	0	0	1	0	1	0	1	2	0
Level 2																				
repeats earlier success	**3**	0	0	0	1	1	1	2	2	1	1	1	0	1	0	1	0	1	2	0
is performed pragmatically	**3**	0	0	0	1	1	1	2	2	1	1	1	0	1	0	1	0	2	2	0
process is recognized	**3**	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	0	2	2	0
activities are processes-like	**3**	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	2	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is enforced	**2**	0	0	0	1	1	1	0	0	0	0	1	0	1	0	1	0	1	1	0
process is trained	**2**	0	0	0	1	1	1	2	2	1	0	1	0	1	1	0	0	1	1	0
process is practiced	**2**	1	1	1	1	1	1	2	2	1	1	1	0	1	1	1	0	1	2	0
process is planned	**2**	1	1	1	1	1	1	2	2	0	0	1	0	1	1	1	0	1	2	0
processes is cost-effective	**1**	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	0
processes is on schedule	**1**	0	0	0	1	1	1	1	1	0	1	1	1	1	0	1	0	1	2	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated work																				
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide																				
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
	MCM Pr	SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.3**	**1.2**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.2**	**1.7**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.2**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table B4:	FOREST RESOURCES AND WILDLIFE MANAGEMENT (FRWM)																			
	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	0
has structured actions	**3**	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	1	1	0
has predictable services	**3**	0	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is peer review ed	**2**	0	0	0	1	1	1	1	1	1	0	0	0	1	0	1	0	0	1	0
processes are standardized	**2**	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0
processes documented	**1**	0	0	0	1	2	1	1	1	1	0	1	0	1	1	1	0	1	1	0
have preparedness criteria	**1**	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Level 2																				
repeats earlier success	**3**	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1	0	0	1	0
is performed pragmatically	**3**	0	0	0	1	1	1	1	1	1	0	0	0	0	0	1	0	0	1	0
process is recognized	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
activities are processes-like	**3**	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	**2**	0	0	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0
process is trained	**2**	0	0	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0	1	0
process is practiced	**2**	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
process is planned	**2**	1	1	0	1	1	0	1	1	1	0	1	0	0	1	1	0	1	0	0
processes is cost-effective	**1**	0	1	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0
processes is on schedule	**1**	0	1	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated w ork		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
High w orkloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.0**																		
s.d.		**0.0**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Softw are Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table B5: **MARGARET THATCHER LIBRARY (MTL)**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
has structured actions	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
has predictable services	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	2	2	0
process is peer review ed	**2**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
processes are standardized	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
processes documented	**1**	2	2	2	2	2	1	2	2	2	2	2	1	2	1	1	0	2	2	0
have preparedness criteria	**1**	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	2	2	0
Level 2																				
repeats earlier success	**3**	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	0	2	2	0
is performed pragmatically	**3**	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	0	2	3	0
process is recognized	**3**	2	2	2	2	2	2	2	2	2	1	2	2	2	1	2	0	3	3	0
activities are processes-like	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
process is enforced	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
process is trained	**2**	1	1	1	1	1	1	2	2	2	1	1	1	2	1	1	0	2	2	0
process is practiced	**2**	1	1	1	1	1	1	2	2	2	1	2	1	2	2	1	0	2	2	0
process is planned	**2**	1	1	1	1	1	1	2	2	2	1	2	1	1	2	1	0	2	2	0
processes is cost-effective	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated w ork																				
High w orkloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**	**1.6**	**1.9**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.2**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Softw are Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table B6: **WORLD BANK COMPUTERIZATION PROJECT (WBC)**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	3	0	0	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
has structured actions	3	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
has predictable services	3	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0
process is related to SLA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	2	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	0	1	1	0
process is peer reviewed	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
processes are standardized	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
processes documented	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	0	0	2	1	0
have preparedness criteria	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
Level 2																				
repeats earlier success	3	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	0	1	1	0
is performed pragmatically	3	0	0	0	1	1	1	1	1	1	2	2	1	1	1	1	0	1	1	0
process is recognized	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	1	0
activities are processes-like	3	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
process is measured	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	2	0	0	0	1	1	1	1	1	1	0	1	0	1	1	0	0	1	0	0
process is trained	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	2	1	0
process is practiced	2	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
process is planned	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
processes is cost-effective	1	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0
processes is on schedule	1	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated work		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
MEAN OVERALL LEVEL		1.0																		
s.d.		0.0																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

APPENDIX C: MODEL APPLICATION - CASE STUDY I: KENYATTA UNIVERSITY

Note: In this case study, we examine issues from the perspective of the entire university, since IT Office and African Virtual University serve the entire university community, including the faculties and administrative departments.

Sub-Appendix C1C1

Function 1: Depiction of the IST situation

Sub-Case 1: IT Office

RS:

- ***User requirements:***
  availability of ICT - availability of ICT to enable them perform their academic, administrative and learning activities
  flexibility of ICT - flexibility of ICT to enable them perform a variety of functions with ICT
  maintainability of ICT - maintainability of ICT to enable them change or modify ICT functions
  performance of ICT - performance of ICT to enable them obtain accurate, complete and fast results
  reliability of ICT - reliability of ICT is required to enable user to perform their activities despite problems
  security of ICT - safety of ICT to protect them from theft, environmental hazards, or fire

- ***Preconditions:***
  information policy and planning - no IPP precondition has been formulated, plans were underway
  centralization of activities - centralization of activities, exists
  de-centralization of activities - de-centralization of activities, also exists
  concentration of ICT - concentration of ICT for control and security, exists
  de-concentration of ICT - de-concentration of ICT, also exists
  financial resources – the university provides much of the funding
  personnel allocation – technical staff are available
  safety of staff/equipment - safety of staff/equipment for protection, exists
  standardization of ICT - no standardization of ICT to improve services across the university
  service level agreements - SLAs between vendors and university exist, no SLAs between users and university

- ***Situational factors:***
  age - university was started in 1985
  size- university has about 10,000 students, 1000 academic staff, and 1,500 administrative staff
  location - university has one campus only 16 km. North of Nairobi City
  technology environment - the university quickly adopting technology
  organizational culture - staff, students, and environment contribute to culture
  communication infrastructure - its location favors growth of communication infrastructure
  student unrest - this is a regular occurrence at Kenyatta University

ICT:

- ***Hardware:*** PCs**,** printers, constitute the main hardware
- ***Software :*** Microsoft productsconsisting of basic and application software, including
  Windows 95, 98, 2000. Microsoft Office 97; also available is special

software (Delphi 4.00) for developing ICT

- ***Network components:*** LAN and Internet components are provided for local communication And access to WWW and Internet, using dial-up access
- ***Extended State Model (ESM) states:***
  utilization: ICT is in the state *Utilization,* on the ESM
  exploitation: ICT is in the state *Exploitation,* on the ESM
  maintenance: ICT is in the state *Maintenance* on the ESM

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources
  distribution - locations of several faculties and departments over a wide campus contribute
  diversity - diversity of ICT resources exists gathered over period of time
  dynamics - many changes take place to ICT hardware and software
  utilization - utilization takes place made necessary by pressure from students and staff
  ownership - ownership of ICT is not in contest
  cohesion of ICT - parts differ in make, age and origin, no coherence with each other
  functionality - a variety of functions exist and present a complex problem

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by IT office and top university management
  Tactical level - tactical FM is provided by middle level technical staff
  Operational level - operational FM is provided by lower level technical staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by IT office and top university management
  Tactical level - tactical AM is provided by middle level technical staff
  Operational level - operational AM is provided by lower level technical staff
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided IT staff and top university management
  Tactical level - tactical TM is provided by middle level technical staff
  Operational level - operational TM is provided by lower level technical staff

- ***Service support processes:***
  change management (CHG) - CHG exists, for hardware, software, and network components
  configuration management(CONF) - CONF exists, for hardware, software, and network components
  help desk (HLP) - HLP exists, to attend to incident reports from users
  problem management (PRB) - some form of PRB exists, to deal with ICT problems
  software control & distribution(SCD) - some form of SCD exists, in the form of inventory control

- ***Service delivery processes:***
  availability management(AVLM) - AVLM for ICT resources exists
  capacity management (CAPM) - CAPM does exist to the extent that it forecasts future needs
  contingency planning (CONT) - CONT in form of backups, UPS, standby

generators

cost management (CSTM) - CSTM for e-mail, photocopying, telephone services, does exist

service level management (SLM) - SLM exists between university and vendors, none with users

Relationships between entities:

RS→ ICT - exists: the KU *exploits* ICT for its own benefit[Luftman95 et al; Luftman99 et al];

ICT →RS - ICT *supports* KU activities related to students and administration

ICT →MCM - ICT *supports* the technical staff by supplying data/ info

MCM→ ICT - technical staff *manages* ICT on behalf of KU

RS→MCM - the KU *employs* technical staff to manage ICT

MCM→RS - technical staff *respond* to user requests in the university

Influences:

managerial - structural decisions made by university and govt. influence ICT

donor - decisions made by donors (World Bank), on funding influence ICT

technological - technological developments and changes influence ICT at KU

economic - economic changes in Kenya and the world influence ICT

cultural - organizational culture within the university influences ICT management

Sub-Appendix C1C2

Function 1: Depiction of the IST situation

Sub-Case 2: African Virtual University

RS:

- ***User requirements***
  availability of ICT - availability of ICT to enable them participate in AVU courses
  flexibility of ICT - flexibility of ICT to enable them use a variety of functions of ICT
  maintainability of ICT - maintainability enables them modify and extend ICT
  performance of ICT - performance of ICT to enable them to obtain accurate, complete results
  reliability of ICT - reliability of ICT to enable them continue using ICT in the face of difficulty
  security of ICT – security of H/W and S/W, data to avoid adverse consequences

- ***Preconditions:***
  Information policy and planning - no IPP has been formulated on ICT
  centralization of activities - centralization of activities, exists, all centered at AVU
  de-centralization of activities - de-centralization of activities, does not exist
  concentration of ICT - concentration of ICT for control and security, exists at AVU
  de-concentration of ICT - de-concentration of ICT, does not exist
  financial resources - learning site generates own funds to supplement donor funds
  personnel allocation - technical staff are allocated
  safety of staff/equipment – staff and equipment are provided with protection
  standardization of ICT - no standardization of ICT to improve services across AVU
  service level agreements - SLAs between vendors and AVU-KU exist; no SLAs between users and AVU-KU
- ***Situational factors:***
  age - AVU-KU was started in 1997
  size - AVU-KU caters for about 10,000 students, 1000 academic staff, and 1,500 administrative staff
  location - AVU-KU is located in one campus 16 km. North of Nairobi City
  technology environment - AVU is technology-intensive center
  organizational culture - staff, students, environment all contribute to AVU culture
  communication infrastructure - location favors growth of communication infrastructure
  student unrest - a regular occurrence at Kenyatta University as a whole

ICT:

- ***Hardware:*** PCs**,** printers, constitute the main hardware
- ***Software :*** Microsoft products basic and application software constitute the main software, including Windows 95, 98, 2000. Microsoft Office 97; also available is special software (Delphi 4.00)
- ***Network components:*** LAN and Internet components, satellite receiver dish are provided for local communication, satellite communication and access to WWW and Internet, using dial-up

- ***Extended State Model (ESM) states***
  utilization: ICT at AVU-KU is in the state *Utilization,* on the ESM
  exploitation: ICT at AVU-KU is in the state *Exploitation,* on the ESM

maintenance: ICT at AVU-KU is in the state *Maintenance* on the ESM

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT resources
  distribution - location of LSs in SSA and global content providers situated in US, Canada, and Europe
  diversity - diversity of ICT resources exists
  dynamics - many changes take place to hardware and software and network components
  utilization - ICT utilization takes place made necessary by demands from students and staff
  ownership - not significant, ownership is not in contest
  cohesion of ICT - not significant, parts are coherent with each other
  functionality - many ICT functions exist, presenting a problem to users

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by AVU director and top KU management
  Tactical level - tactical FM is provided by middle level technical staff (engineer)
  Operational level - operational FM is provided by lower level technical staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by AVU director and top KU management
  Tactical level - tactical AM is provided by middle level technical staff
  Operational level - operational AM is provided by lower level technical staff
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided AVU director and top KU management
  Tactical level - tactical TM is provided by middle level technical staff
  Operational level - operational TM is provided by lower level technical staff
- ***Service support processes:***
  change management (CHG) - exists, for hardware, software/network components
  configuration management - exists, for hardware, software/network components
  help desk (HLP) - HLP exists, to attend to incident reports from users
  problem management (PRB) - exists, to deal with hardware, network/software problems
  software control & distribution(SCD) - SCD exists, in the form of inventory control

- ***Service delivery processes:***
  availability management(AVLM) - AVLM for ICT resources exists
  capacity management (CAPM) - CAPM provides upgrades for hardware, software, network components
  contingency planning (CONT) - CONT exists in form of backups, UPS, standby generators
  cost management (CSTM) - CSTM for e-mail, computer literacy course delivery, exists
  service level management (SLM) - SLM between AVU-KU / vendors, no SLM between
  AVU and users

Relationships between entities:

RS→ ICT - the AVU-KU *exploits* ICT for students and staff [Luftman95 et al; Luftman99 et al]

ICT →RS - ICT *supports* AVU-KU activities related to course delivery
ICT →MCM - ICT *supports* the technical staff with relevant data/ info
MCM→ ICT - technical staff *manages* ICT on behalf of AVU-KU
RS→MCM - the AVU-KU *employs* technical staff to manage ICT
MCM→RS - technical staff *respond* to user requests in AVU-KU

Influences:

managerial - structural decisions made by university, Washington Office influence ICT at AVU
donor - decisions made by donors (e.g. World Bank, US, Canada, Ireland), on funding influence ICT
technological - technological developments and changes influence ICT
economic - economic changes in Kenya and the world influence ICT at AVU
cultural - organizational culture within the university influences ICT management at AVU

Sub-Appendix C2C1

Function 2: Qualification of the IST situation: Sub-Case 1: IT Office

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions:***

information policy and planning	N/A (NOT APPLICABLE)
centralization of activities	HIGH
de-centralization of activities	LOW
concentration of ICT	HIGH
de-concentration of ICT	MED
financial resources	MED
personnel allocation	LOW
safety of staff/equipment	MED
standardization of ICT	N/A (NOT APPLICABLE)
service level agreements	LOW

- ***Situational factors:***

age of university (est. 1985)	LOW
size	HIGH
location	HIGH
technology environment	LOW
organizational culture	LOW
communication infrastructure	LOW
student unrest	HIGH

ICT:

• ***Hardware:***	MED
• ***Software :***	MED
• ***Network components:***	MED
• ***Extended State Model (ESM) states***	
utilization	MED
exploitation	MED
maintenance	MED
• ***Complexity Factors (CFs):***	
quantity	HIGH
distribution	LOW
diversity	MED
dynamics	HIGH
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:

(Refer to **Table C1 in Appendix C** for details of qualification of MCM processes.)
How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

• *Functional management (FM):*	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Application management (AM):***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Technical management (TM) :***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Service support processes:***	
change management (CHG)	Level 1
configuration management	Level 1
help desk (HLP)	Level 1
problem management (PRB)	Level 1
software control & dist.	Level 1
• ***Service delivery processes:***	
Availability management	Level 1
Capacity management	Level 1
Contingency planning	Level 1
Cost management	Level 1
Service level management	Level 1

Relationships between entities:

RS → ICT:	MED
ICT →RS:	LOW
ICT →MCM:	LOW
MCM→ ICT:	LOW
RS→MCM:	LOW
MCM→RS:	LOW

Influences:

managerial	HIGH
donor	HIGH
technological	MED
economic	HIGH
cultural	MED

Sub-Appendix C2C2

Function 2: Qualification of the IST situation: *Sub-Case 2: African Virtual University*

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions***

information policy and planning	N/A (NOT APPLICABLE)
centralization of activities	HIGH
de-centralization of activities	N/A (NOT APPLICABLE)
concentration of ICT	HIGH
de-concentration of ICT	N/A (NOT APPLICABLE)
financial resources	MED
personnel allocation	MED
safety of staff/equipment	HIGH
standardization of ICT	N/A (NOT APPLICABLE)
service level agreements	N/A (NOT AVAILABLE)

- ***Situational factors:***

age of university (est. 1985)	LOW
size	HIGH
location	HIGH
technology environment	MED
organizational culture	MED
communication infrastructure	MED
student unrest	HIGH

ICT:

• ***Hardware:***	MED
• ***Software :***	MED
• ***Network components:***	MED
• ***Extended State Model (ESM) states***	
utilization	MED
exploitation	MED
maintenance	MED
• ***Complexity Factors (CFs):***	
quantity	LOW
distribution	LOW
diversity	MED
dynamics	LOW
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:

(Refer to **Table C2 in Appendix C** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.

- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- ***Functional management (FM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Application management (AM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Technical management (TM) :***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Service support processes:***

change management (CHG)	Level 1+
configuration management(CONF)	Level 1+
help desk (HLP)	Level 1+
problem management (PRB)	Level 1
software control & distribution(SCD)	Level 1+

- ***Service delivery processes:***

availability management(AVLM)	Level 1+
capacity management (CAPM)	Level 1+
contingency planning (CONT)	Level 1+
cost management (CSTM)	Level 1+
service level management (SLM)	N/A (NOT AVAILABLE)

Relationships between entities:

RS → ICT:	MED
ICT →RS:	MED
ICT →MCM:	LOW
MCM→ ICT:	MED
RS→MCM:	HIGH
MCM→RS:	LOW

Influences:

managerial	MED
donor	HIGH
technological	MED
economic	HIGH
cultural	MED

Sub-Appendix C3C1

Function 3: Definition of the SOLL situation: *Sub-Case 1: IT Office*

RS:

- ***User requirements:***

availability of ARIS	HIGH*;* ICT should be be made more widely available to users
flexibility of ARIS	HIGH*;* more flexible ICT to enable user to use a variety of functions
maintainability of ARIS	HIGH*;* more maintainable ICT to enable users to continue working
performance of ARIS	HIGH*;* high performance ICT to improve throughput and productivity
reliability of ARIS	HIGH*;* more reliable ICT to minimize stoppages
security of ARIS	HIGH*;* more secure ICT from theft, fire or weather conditions

- ***Preconditions:***

information policy and planning	MED; seek opportunity to formulate IPP on ICT management
centralization of activities	MED; centralization of critical activities at a lower level
de-centralization of activities	MED; de-centralization non-critical activities at a medium level
concentration of ICT	MED; concentration of critical ICT at a low level for security/control
de-concentration of ICT	HIGH; de-concentration of non-critical ICT in faculties and departments
financial resources	HIGH; increased funding to meet training and hiring of staff
personnel allocation	MED; hire more qualified and expepreinced staff
safety of staff/equipment	HIGH; safety measures should be instituted and guaranteed
standardization of ICT	MED; ICT should be standardized for greater effectiveness and efficiency
service level agreements	MED; improved SLAs with vendors, and new SLAs with users

- ***Situational factors:***

age of university (est. 1985)	LOW; authorities to take advantage of the young institution and adapt proactive policies on ICT for competitive use of IT [Boynton96 et al; Davidson96]
size	MED; more ICT to satisfy demand from increasing numbers of users
location	MED; reduced adverse effects due to proximity to the city
technology environment	MED; improved computer literacy to take full advantage of available technology and demand from potential users
organizational culture	LOW; better organization, coordination and improved work ethics
communication infrastructure	MED; improved communication infrastructure

across the campus

student unrest MED; as an inhibitor student unrest must be contained and kept to a minimum to prevent disruptions to learning

ICT:

- ***Hardware:*** HIGH; upgraded hardware to the state-of-the-art level
- ***Software :*** HIGH; upgraded software to the state-of-the-art level
- ***Network components:*** HIGH; upgraded network components to the state-of-the-art level

- ***Extended State Model (ESM) states***
  - *utilization:* HIGH; increased utilization of ICT by users
  - *exploitation:,* HIGH; increased exploitation of ICT by the university
  - *maintenance:* HIGH; increased quality maintenance of ICT by IRM

- ***Complexity Factors (CFs):***
  - *quantity* MED; increased quantities of ICT to meet user demand
  - *distribution* LOW; improved communication in the campus
  - *diversity* LOW; maintained industry standard ICT to keep diversity low
  - *dynamics* MED; fewer and necessary changes to be made to ICT
  - *utilization (usage)* LOW; better trained users in ICT to make full use of ICT
  - *ownership* N/A; no dispute
  - *cohesion of ICT* LOW; industry standard ICT to be maintained to keep complexity low
  - *functionality* LOW; better trained user base to make use of most of ICT functions

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; implementation of policies on users
  - *Operational level* Level 2; operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on data sets
  - *Operational level* Level 2; operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on tech. issues
  - *Operational level* Level 2; operational tasks related to technical issues
- ***Service support processes:***
  - *change management* Level 2; cost-effectiveness, efficiency, training, enforcement
  - *configuration managemen* Level 2; cost-effectiveness, efficiency, enforcement, measurement

help desk (HLP)	Level 2; measure helpdesk data, number and nature of requests
problem management	Level 2; nature and frequency of problems, effectiveness/efficiency
software control & distribution	Level 2; training, enforcement, measurement, performance needed

- ***Service delivery processes:***

availability management	Level 2; concetrate on attributes for AVLM process
capacity management	Level 2;create and establish CAPM as a new process
contingency planning	Level 2; enforce and measure CONT process
cost management	Level 2; concetrate on attributes for CSTM process
service level management (SLM)	Level 2; create and establish SLM as a new process

Relationships between entities:

RS → ICT:	HIGH; high realization of ICT exploitation
ICT →RS:	MED; support of ICT for activities at a high level
ICT →MCM:	MED; use of ICT to support technical staff
MCM→ ICT:	MED; better trained and experienced staff
RS→MCM:	MED; more attention by university to ICT management
MCM→RS:	MED; university management to be more responsive to users

Influences:

managerial	MED; minimize effects of administrative changes by the government and/or the university
donor	HIGH; continued donor support in ICT be maintained at a high level
technological	HIGH; technological changes should be beneficial to the university
conomic	MED; minimize economic effects with adequate policies strategies
cultural	LOW; negative effects of cultural influences should be minimized

Sub-Appendix C3C2

Function 3: Definition of the SOLL situation: *Sub-Case 2: African Virtual University*

RS:

- ***User requirements:***

availability of ARIS	HIGH*;* ICT should be be made more widely available to users
flexibility of ARIS	HIGH: more flexible ICT to enable user to use a variety of functions
maintainability of ARIS	HIGH*;*more maintainable ICT to enable users to continue working
performance of ARIS	HIGH*;* high performance ICT to improve throughput and productivity
reliability of ARIS	HIGH*;* more reliable ICT to minimize stoppages
security of ARIS	HIGH*;* more secure ICT from theft, fire or weather conditions

- ***Preconditions:***

information policy and planning	MED; opportunities for realization and formulation of IPP on ICT
centralization of activities	MED; centralization of critical activities at AVU Center at a lower level
de-centralization of activities	N/A (NOT APPLICABLE)– all activities are located on one site
concentration of ICT	MED; concentration of critical ICT at a low level for security/control
de-concentration of ICT	N/A (NOT APPLICABLE)– all ICT is located on one site
financial resources	HIGH; enhanced funding from university and income generation
personnel allocation	HIGH; qualified / experienced staff in adequate numbers
safety of staff/equipment	HIGH; institutionalized safety measures and guarantees
standardization of ICT	MED; standardization of ICT for effectiveness & efficiency
service level agreements	HIGH; improved SLAs with vendors, and new SLAs with users

- ***Situational factors:***

age of university (est. 1985)	LOW; adapt proactive policies on ICT for future competitive advantage
size	MED; new ICT to satisfy demand from increasing numbers of users
location	MED; exploit proximity to capital city for competitive advantage
technology environment	HIGH; advanced computer literacy
organizational culture	LOW; better organization, coordination, improved work ethics
communication infrastructure	HIGH; improved communication infrastructure to the outside world
student unrest	MED; student unrest to be contained and kept to a minimum to prevent disruptions to learning and other activities

ICT:

- ***Hardware:*** HIGH; upgrade hardware to state-of-the-art
- ***Software :*** HIGH; upgrade software to state-of-the-art
- ***Network components:*** HIGH; upgrade network to state-of-the-art
- ***Extended State Model (ESM) states***
  - *utilization* HIGH; increase utilization of ICT by ordinary & specialized users
  - *exploitation* HIGH; increase exploitation of ICT by the university
  - *maintenance* HIGH; increase quality maintenance of ICT by IRM
- ***Complexity Factors (CFs):***
  - *quantity* LOW; increased quantities of ICT to meet user demand
  - *distribution* LOW; improved communication between sites in Sub-Sahara African region
  - *diversity* LOW; maintained industry standard ICT to minimize complexity
  - *dynamics* LOW; fewer and only necessary ICT changes
  - *utilization (usage)* LOW; better trained users in ICT to make full use of ICT
  - *ownership* N/A; there is no dispute
  - *cohesion of ICT* LOW; maintained industry standard ICT to keep complexity low
  - *functionality* LOW; better trained user base to make full use of functions of ICT

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; implementation of policies on users
  - *Operational level* Level 2; operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on data sets
  - *Operational level* Level 2; operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* Level 2; decision making, policy formulation
  - *Tactical level* Level 2; policy implementation on tech. issues
  - *Operational level* Level 2; operational tasks related to technical issues
- ***Service support processes:***
  - *change management* Level 2; enhance cost-effectiveness, efficiency, training, enforcement
  - *configuration management* Level 2; enhance / enforce cost-effectiveness, efficiency, measurement
  - *help desk (HLP)* Level 2; enhance / measure helpdesk data, number / nature of requests
  - *problem management* Level 2; measure nature / frequency of problems, effectiveness/efficiency
  - *software control & distribution* Level 2; training, enforcement, measurement, and performance are needed
- ***Service delivery processes:***
  - *availability management* Level 2; concetrate on attributes for AVLM process
  - *capacity management* Level 2; enhance / enforce and measure CAPM process

contingency planning	Level 2; enforce and measure CONT process
cost management	Level 2; concetrate on attributes for CSTM process
service level management	Level 2; create and establish SLM as a new process

Relationships between entities:

RS → ICT:	HIGH; high realization of exploitation of ICT at AVU-KU
ICT →RS:	HIGH; ICT supports AVU-KU activities at a high level
ICT →MCM:	MED; ICT supports technical staff at a high level
MCM→ ICT:	HIGH; better trained and experienced staff to manage ICT
RS→MCM:	HIGH; more attention by AVU-KU management to ICT management
MCM→RS:	MED; AVU-KU management to be highly responsive to users

Influences:

managerial	LOW; minimize effects of administrative changes by donor or AVU-KU
donor	HIGH; continued donor support in ICT be maintained at a high level
technological	HIGH; technological developments should influence ICT in AVU-KU
economic	MED; minimize effects of economy with ICT policies and strategies
cultural	LOW; improved cultural influences

Sub-Appendix C4C1

Function 4: Transformation from IST to SOLL situation: *Sub-Case 1: IT Office*

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for IT Office can be transformed to SOLL situation as follows, taking into account the Benefits, Costs, and Consequences:

RS:

- ***User requirements:***

availability of ICT	increase access to ICT resources, increase access time to ICT facilities, increase quantity of ICT
flexibility of ICT	training and re-training needed to exploit the functions and capabilities of ICT resources
maintainability of ICT	extend, upgrade and modify the functions of ICT
performance of ICT	increase throughput of ICT by proper ICT maintenance
reliability of ICT	improve the completeness, timeliness and admissibility of processing power through proper maintenance
security of ICT	provide adequate physical protection, and insurance cover for users of ICT

- ***Preconditions:***

information policy and planning	formulate IPP on ICT; publicize its contents to users
centralization of activities	centralize critical activities in the faculty
de-centralization of activities	de-centralize non-critical activities in the departments
concentration of ICT	concentrate critical ICT
de-concentration of ICT	de-concentrate non-critical ICT in departments
financial resources	device a long term self-sustating strategy on funding for ICT
personnel allocation	provide training and hire more experienced staff in adequate numbers
safety of staff/equipment	provide improved safety for staff and equipment
standardization of ICT	formulate and implement policy on ICT standardization
service level agreements	provide enhanced SLA with vendors, and enter new SLAs with users

- ***Situational factors:***

age of university (est. 1985)	develop appropriate polices on ICT; utilize ICT in university activities
size	by acquiring more ICT resources, for increasing number of users
location	develop networks to link up departments and buildings within campus
technology environment	boost computer literacy among old and new users through continuous ICT training and re-training programs
organizational culture	provide leadership; create new culture; motivate users; change behavior
communication infrastructure	improve communication infrastructure within and between departments
student unrest	examine causes of student unrest, take necessary

actions, instill discipline through open dialogue with students

ICT:

- ***Hardware:*** upgrade hardware to state-of-the-art
- ***Software :*** upgrade software to state-of-the-art
- ***Network components:*** upgrade network components to state-of-the-art
- ***Extended State Model (ESM)***
  - *utilization:* utilize ICT in faculty activities (teaching, research, publishing
  - *exploitation:* exploit ICT in the university
  - *maintenance*: more funding for re-training of technical staff and for maintenance tools

- ***Complexity Factors (CFs):***
  - *quantity* provide training, funds, experienced staff to manage increasing number of ICT resources
  - *distribution* improve infrastructure within the campus and externally
  - *diversity* maintain industry standard ICT to minimize ICT diversity
  - *dynamics* initiate, improve and maintain through training, practice and usage
  - *utilization (usage)* train users in ICT capabilities, functions and facilities available; initiate effective problem management to deal with user problems
  - *ownership* N/A; no dispute
  - *cohesion of ICT* initiate policy to maintain open and industry standard ICT
  - *functionality* train users in ICT functions, maintain effective functional management

MCM:

- ***Functional management (FM):***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implementation of policies on users
  - *Operational level* carry out operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implement policy on data sets
  - *Operational level* carry out operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implement policy on technical matters
  - *Operational level* carry out operational tasks related to technical issues
- ***Service support processes:***
  - *change management* cost-effectiveness, efficiency, training, enforcement
  - *configuration management* cost-effectiveness, efficiency, enforcement, measurement
  - *help desk (HLP)* measure helpdesk data, number and nature of requests
  - *problem management* nature and frequency of problems, effectiveness/efficiency
  - *software control & distribution* training, enforcement, measurement,

performance needed

- ***Service delivery processes:***
  availability management concetrate on attributes for AVLM process
  capacity management - create and establish CAPM as a new process
  contingency planning - enforce and measure CONT process
  cost management - concetrate on attributes for CSTM process
  service level management - create and establish SLM as a new process

Relationships between entities:

RS → ICT:	exploit ICT in the university to achieve strategic objectives
ICT →RS:	utilize ICT on Univ. activities (teaching, research, and extension service)
ICT →MCM:	utilize ICT to support technical services in the university
MCM→ ICT:	improve ICT management through training/re-training, experience and funding
RS→MCM:	university should hire qualified ICT management
MCM→RS:	university management should respond to user requests

Influences:

managerial	anticipate managerial changes, by adapting proactive strategies
donor	secure and maintain donor support for ICT projects
technological	anticipate technological changes in ICT, by adapting proactive strategies
economic	anticipate economic changes; by adapting income-generating strategies
cultural	encourage development of positive organizational culture in the university

Sub-Appendix C4C2

Function 4: Transformation from IST to SOLL situation: *Sub-Case 2: African Virtual University*

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for AVU-KU can be transformed to SOLL situation as follows, taking into account the Benefits, Costs, and Consequences:

RS:

- ***User requirements:***

availability of ICT	increase access to ICT facilities, access time, and quantity of ICT resources
flexibility of ICT	exploit functions and capabilities of ICT resources through training
maintainability of ICT	extend, upgrade and modify the functions of ICT
performance of ICT	improve throughput with high performance ICT
reliability of ICT	improve completeness, timeliness and admissibility of ICT processing power
security of ICT	provide adequate protection, and insurance cover for users of ICT

- ***Preconditions:***

information policy and planning	formulate IPP on ICT; publicize its contents to users
centralization of activities	N/A, all activities are located on one site
de-centralization of activities	N/A (NOT APPLICABLE), all activities are located on one site
concentration of ICT	all ICT is concentrated on one site
de-concentration of ICT	N/A (NOT APPLICABLE)– all ICT is located on one site
financial resources	devise long term strategy on funding for ICT and training of staff
personnel allocation	provide training/re-training and hire more staff
safety of staff/equipment	provide improved safety for staff and equipment
standardization of ICT	standardize ICT for effectiveness and efficiency
service level agreements	provide improved SLAs with vendors, and enter new SLAs with users

- ***Situational factors:***

age of university (est. 1985)	develop strategic polices on ICT; utilize ICT in AVU-KU activities
size	acquire new ICT, to meet demand from increasing number of users
location	improve ICT facilities and management to meet demand from users
technology environment	boost computer literacy among users through training, practice and usage
organizational culture	provide leadership; create new culture; motivate users; change behavior
communication infrastructure	improve communication infrastructure to the outside world
student unrest	address causes of student disturbances, take action

ICT:

- ***Hardware:*** improve hardware to state-of-the-art

- ***Software :*** improve software to state-of-the-art
- ***Network components:*** improve network components to state-of-the-art
- ***Extended State Model (ESM):***
  - *utilization* utilize ICT in AVU-KU activities (distance education and communication)
  - *exploitation* exploit ICT in the AVU-KU
  - *maintenance* maintain ICT thro' training, seminars, more funding for technical staff
- ***Complexity Factors (CFs):***
  - *quantity* provide training and funds for management of increasing ICT resources
  - *distribution* improve infrastructure between sites in Sub-Saharan Africa
  - *diversity* keep diversity low by maintaining industry standard ICT
  - *dynamics* initiate, improve and maintain through training, practice and usage
  - *utilization (usage)* improve training to enable users to utilize ICT capabilities and facilities
  - *ownership* N/A; no dispute
  - *cohesion of ICT* maintain industry standard ICT
  - *functionality* train users in ICT functions, maintain effective functional management

MCM:

- ***Functional management (FM):***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implement policies on users
  - *Operational level* carry out operational tasks related to users
- ***Application management (AM):***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implement policy on data sets
  - *Operational level* carry out operational tasks related to data sets
- ***Technical management (TM) :***
  - *Strategic level* plan decision making, policy formulation
  - *Tactical level* implement policy on technical issues
  - *Operational level* carry out operational tasks related to technical issues
- ***Service support processes:***
  - *change management* enhance cost-effectiveness, efficiency, training, enforcement
  - *configuration management* enhance / enforce cost-effectiveness, efficiency, and measurement
  - *help desk* enhance / measure helpdesk data, number / nature of requests
  - *problem management* measure nature / frequency of problems, effectiveness/efficiency
  - *software control & distr.* training, enforcement, measurement, performance needed
- ***Service delivery processes:***
  - *availability management* concetrate on attributes for AVLM process
  - *capacity management* enhance / enforce and measure CAPM process
  - *contingency planning* enforce and measure CONT process
  - *cost management* concetrate on attributes for CSTM process
  - *service level management* create and establish SLM as a new process

Relationships between entities:

RS → ICT:	ICT to support achievement of AVU-KU objectives
ICT →RS:	utilize ICT on AVU-KU activities (distance education and communication)
ICT →MCM:	utilize ICT to support technical services in AVU-KU
MCM→ ICT:	improve ICT management through training, experience and funding
RS→MCM:	AVU-KU management should pay attention to ICT management
MCM→RS:	AVU-KU management should respond to user requests

Influences:

managerial	anticipate structural changes, by adapting proactive policies
donor	encourage continued donor participation in ICT programmes
technological	anticipate technological changes in ICT, by adapting proactive policies
economic	anticipate economic changes; adapt income-generating policies
cultural	encourage development of positive organizational culture in AVU-KU

Table C1: **IT Office Kenyatta University**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0
has structured actions	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0
has predictable services	**3**	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	1	1	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0
process is peer reviewed	**2**	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	0
processes are standardized	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
processes documented	**1**	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	0
have preparedness criteria	**1**	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	1	2	0
Level 2																				
repeats earlier success	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	2	0
is performed pragmatically	**3**	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	2	0
process is recognized	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	2	2	0
activities are processes-like	**3**	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	1	2	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
process is enforced	**2**	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	2	0
process is trained	**2**	0	0	0	0	0	1	1	1	1	0	1	1	1	0	0	0	1	2	0
process is practiced	**2**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	2	0
process is planned	**2**	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	1	2	0
processes is cost-effective	**1**	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	2	0
processes is on schedule	**1**	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	1	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Uncoordinated work		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.6**	**1.0**
MEAN OVERALL LEVEL		**1.0**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level	Service Support Processes		Service Delivery Processes	
0	Missing	SM Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH		prb	Problem Management	cstm	Cost Management
			scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3					x	Non-improvement parameter

Table C2: **AVU Kenyatta University**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	3	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	2	2	2	0
has structured actions	3	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	2	2	2	0
has predictable services	3	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	2	2	2	0
process is related to SLA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	0
process is peer reviewed	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	0
processes are standardized	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
processes documented	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	2	2	2	0
have preparedness criteria	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Level 2																				
repeats earlier success	3	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	0
is performed pragmatically	3	1	1	1	1	1	1	1	1	1	2	2	2	1	1	2	2	2	2	0
process is recognized	3	1	1	1	1	1	1	1	1	1	2	2	2	1	2	2	2	2	2	0
activities are processes-like	3	1	1	1	1	1	1	1	1	1	2	2	2	1	2	1	1	1	1	0
process is measured	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
process is trained	2	1	1	1	1	1	1	1	1	1	2	2	2	1	2	1	2	2	2	0
process is practiced	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	0
process is planned	2	1	1	1	1	1	1	1	1	1	2	1	2	1	2	2	2	2	2	0
processes is cost-effective	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	1	2	2	0
processes is on schedule	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	2	1	2	2	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Uncoordinated work																				
High workloads																				
Authorities decide																				
ad hoc reactions																				
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.4**	**1.5**	**1.4**	**1.0**	**1.4**	**1.4**	**1.3**	**1.5**	**1.4**	**1.0**
MEAN OVERALL LEVEL		**1.2**																		
s.d.		**0.2**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrit	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

APPENDIX D: MODEL APPLICATION - CASE STUDY II - UNIVERSITY OF NAIROBI

Note: In this case study, for the university backbone and the university library, we examine issues from the perspective of the entire university, since they serve all the faculties and administrative departments. For the Joint Admissions Board, we examine the issues from the perspective of the six public universities.

Sub-Appendix D1C1

Function 1: Depiction of the IST situation: *Sub-Case 1: University Network Backbone*

RS:

- ***User requirements:***
  availability of ICT - to enable users to perform their learning, academic, and administrative activities
  flexibility of ICT- flexible ICT to enable users to switch from one ICT function to another
  maintainability of ICT - to enable users to change, extend or modify ICT functions
  performance of ICT - high performance ICT to achieve accurate, complete results
  reliability of ICT - reliable ICT to enable users to continue performing their activities in the face of problems
  security of ICT - protection of ICT and data from theft, environmental hazards, fire, loss or damage
- ***Preconditions:***
  information policy and planning - IPP on ICT has been formulated
  centralization of activities - centralization of critical ICT related activities exists
  de-centralization of activities - de-centralization of non-critical ICT related activities exists
  concentration of ICT - concentration of critical ICT for control and security, exists
  de-concentration of ICT - de-concentration of ICT, also exists
  financial resources - mostly internally generated with some support from external donors
  personnel allocation - staff are allocated by the university
  safety of staff/equipment - safety of staff/equipment for protection, exists
  standardization of ICT - standardization of ICT to improve services across the university, does exists
  service level agreements - formal SLAs between vendors and university exist, not with users
- ***Situational factors:***
  age - university was started in 1970 as a full fledged institution of higher learning
  size - university has about 15,000 students, over 1,000 academic staff, and over 1,500
  administrative staff. Retrenchment of some administrative staff has commenced to trim down the workforce
  location - university has seven campuses spread in and around the city of Nairobi
  technology environment - the university has been adopting and utilizing ICT from its inception in early 1970s.
  organizational culture - its strategic location and reputation make it a focal meeting point for various cultures from all parts of Kenya. The management styles of its heads, traditions and philosophy also contribute to its corporate culture.
  communication infrastructure - location puts the university within easy reach of communication infrastructure
  student unrest - this is a regular occurrence often with serious consequences on local business community and motorists in and around the University

of Nairobi premises

ICT: The Network

- ***Hardware:*** 3 Unix servers, 2 Windows NT server, 250 PCs, printers and accessories constitute the main hardware
- ***Software :*** basic and application software constitute the main Software, including Windows 95, 98, 2000, Microsoft Office 97, Visual Basic, and Unix also available is Oracle on Unix for developing backend ICT applications. A web server is provided for web development. Other specific software applications are provided and include student admissions (different from JABIS), payroll system, accounting system, staff records, nominal rolls for students, examinations and fees management system.
- ***Network components:*** LAN and Internet components are provided for local and external communication and a dedicated digital link at 64 KBPS which provides access to WWW and Internet, using dial-up access and dedicated links to other campuses
- ***Extended State Model (ESM) states***
  utilization: ICT and network backbone are utilized
  exploitation: ICT and network backbone are exploited
  maintenance: ICT and network backbone are maintained

- ***Complexity Factors (CFs):***
  quantity - growing with increasing numbers of ICT and network components
  distribution - due to locations of seven campuses over a wide area
  diversity - diversity of ICT resources exists gathered over a long time
  dynamics - many changes take place to ICT hardware, software and network
  utilization - utilization takes place made necessary by pressure from users
  ownership - ownership of ICT and network components are not in dispute
  cohesion of ICT - differ in make, age and origin; coherence exists since they are of industry standard.
  functionality - existence a large number of new ICT functions on PCs and network components constitute a measure of complexity to staff and users

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by University Network Backbone senior technical management officials
  Tactical level - tactical FM is provided by middle level technical staff
  Operational level - operational FM is provided by lower level technical staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by University Network Backbone senior database administrators
  Tactical level - tactical AM is provided by middle level database administrators
  Operational level - operational AM is provided by lower level database administrators
- ***Technical management (TM):***
  Strategic level - strategic TM is provided by senior ICT staff
  Tactical level - tactical TM is provided by middle level ICT staff
  Operational level - operational TM is provided by lower level ICT staff
- ***Service support processes:***
  change management (CHG) - CHG exists, for hardware, software, and network components
  configuration management(CONF) - CONF exists, for control of hardware, software, and network

help desk (HLP) - HLP exists informally, to attend to incident reports from users in need of assistance
problem management (PRB) - PRB exists to deal with hardware, network and software problems
software control & distribution(SCD) - informal SCD exists, in the form of inventory control

- ***Service delivery processes:***
  availability management(AVLM) - AVLM is performed to regulate use of ICT facilities
  capacity management (CAPM) - CAPM does not exist
  contingency planning (CONT) - CONT exists in form of backups, UPS, standby generators
  cost management (CSTM) - CSTM does not exist
  service level management (SLM) - SLM exists between university and vendors, but no SLM between the University and ICT and network users

Relationships between entities:

RS→ ICT - UoN *exploits* ICT on its own operational and communication activities
ICT →RS - ICT *supports* UoN activities related to students and administration
ICT →MCM - ICT *supports* the technical staff by supplying accurate and reliable technical data
MCM→ ICT - technical staff *manages* ICT and network on behalf of UoN
RS→MCM - UoN *employs* network staff to manage ICT and university network backbone
MCM→RS - network staff *respond* to network user requests in the university

Influences:

managerial - structural decisions made by university, and govt. influence ICT
donor - decisions made by donors (Belgian gov.) on funding influence ICT and network
technological - technological developments and changes influence ICT and network
economic - economic changes in Kenya and in the world influence ICT and network
cultural - organizational culture within the university influences ICT and network management

Sub-Appendix D1C2

Function 1: Depiction of the IST situation: *Sub-Case 2: University Library Information System (ULIS)*

RS:

- ***User requirements:***
  availability of ICT - to enable users to communicate, perform searches for information, and learning
  flexibility of ICT - flexible ICT to enable users to switch from one ICT function to another
  maintainability of ICT - maintainable ICT to enable tech. staff to change, extend or modify ICT functions
  performance of ICT - high performance ICT to enable them obtain accurate, complete and immediate results
  reliability of ICT - reliable ICT to enable users to continue performing their activities in spite of problems
  security of ICT - security of ICT facilities and data to protect them from loss, damage or unauthorized access

- ***Preconditions:***
  information policy and planning - IPP on ICT has been formulated in a document on university strategy
  centralization of activities - centralization of critical library activities exists
  de-centralization of activities - de-centralization of non-critical library activities exists
  concentration of ICT - concentration of ICT for control and security, exists
  de-concentration of ICT - de-concentration of ICT, also exists
  financial resources - much of the unding is internally generated
  personnel allocation - staff are allocated
  safety of staff/equipment - safety of staff/equipment for protection, exists
  standardization of ICT - standardization of ICT to improve services across the university, does exists
  service level agreements (users, vendors) - formal SLAs between vendors and university, none for users and

- ***Situational factors:***
  age - university was started in 1970 as the first public university in Kenya
  size - university has about 15,000 students, over 1,000 academic staff, and over 1,500 administrative staff.
  location - university library system is spread over seven campuses in and around the city of Nairobi
  technology environment - the library system has not adopted to utilizing ICT in its core services of book circulation.
  organizational culture - as an intellectual center of learning and a focal meeting point for various cultures from all parts of Kenya, UoN has evolved a reputation for itself. Its traditions and philosophy also contribute to its corporate culture that is viewed as aloof and elitist. This is reflected in library operations.
  communication infrastructure - the university has easy access to communication infrastructure
  student unrest - this is a regular occurrence often with serious consequences on local business community, motorists and students themselves in and around the university premises

ICT:

- ***Hardware:*** PCs**,** printers and accessories constitute the main hardware
- ***Software:*** Microsoft products including basic and application software constitute the main Software - Windows 95, Windows 98, Windows 2000, Microsoft Office 97 and
- ***Network components:*** LAN and Internet components are provided for local and external communication and access to WWW and Internet, using dial-up access and dedicated links to some campuses
- ***Extended State Model (ESM) states***
  utilization: ICT and network backbone are in the state *Utilization,*
  exploitation : ICT and network backbone are in the state *Exploitation,*
  maintenance: ICT and network backbone are in the state *Maintenance*
- ***Complexity Factors (CFs):***
  quantity - number of ICT and network components is not significant
  distribution - due to locations of library branches in seven campuses over a wide area
  diversity - diversity of ICT does not exist
  dynamics - no significant changes take place on ICT hardware, software and network components
  utilization - ICT utilization takes place due to pressure from users
  ownership - ownership of ICT and network components are not in dispute
  cohesion of ICT –industry standard ICT vary in make and origin, but coherence is not compromised
  functionality - large number of new ICT functions on PCs and network components for users to master and these constitute a measure of complexity

MCM:

- ***Functional management (FM):***
  Strategic level - provided by senior library official in charge and senior technical staff from ICS
  Tactical level - provided by middle level technical staff in conjunction with library official in charge
  Operational level - is provided by lower level computer laboratory staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by senior library official and senior database administrators
  Tactical level - tactical AM is provided by middle level technical staff
  Operational level - operational AM is provided by lower level technical staff
- ***Technical management TM :***
  Strategic level - provided by senior technical staff in conjunction with senior library official in charge
  Tactical level - provided by middle level technical staff
  Operational level - provided by lower level technical staff
- ***Service support processes:***
  change management (CHG) - CHG has not been introduced
  configuration management(CONF) - CONF for inventory control of hardware, software, and network components
  help desk (HLP) -HLP exists informally, to attend to incident reports from users in need of assistance
  problem management (PRB) - PRB exists, performed by technical staff from ICS
  software control & distribution(SCD) - informal SCD exists, as an extension of inventory control
- ***Service delivery processes:***
  availability management(AVLM) - AVLM exists to regulate use of ICT facilities
  capacity management (CAPM) - CAPM exists informally to forecast future needs

contingency planning (CONT) - CONT has not been introduced
cost management (CSTM) - CSTM does exist
service level management (SLM) - SLM exists between university and vendors, but no SLM between the library and users

Relationships between entities:

RS→ ICT - University Library *exploits* ICT on its own operational and communication activities
ICT →RS - ICT *supports* university library activities related to information access and communication
ICT →MCM - ICT *supports* the technical staff by furnishing accurate and reliable tech. data
MCM→ ICT - technical staff *manages* ICT and network on behalf of university library
RS→MCM - University Library *employs* technical staff to manage ICT and network
MCM→RS - technical staff *responds* to network user requests in the library

Influences:

managerial - structural changes made by university, e.g. retrenchment, influence ICT management
donor - decisions made by donors (Belgian gov.) on funding influence ICT and network
technological - technological developments and changes in the world influence ICT and network
economic - economic changes in Kenya and in the world influence ICT and network in the library
cultural - organizational culture influences ICT and network management in the library

Sub-Appendix D1C3

Function 1: Depiction of the IST situation*: Sub-Case 3: Joint Admissions Board Information System (JABIS)*

RS:

- ***User requirements:***
  availability of ICT - availability of ICT to process admission of students
  flexibility of ICT - flexible ICT to enable technical staff to use various ICT function with ease and convenience
  maintainability of ICT - maintainable ICT to enable tech. staff to change, extend or modify ICT functions
  performance of ICT - to enable them process accurately, completely and fast the large amounts of data
  reliability of ICT - reliable ICT to enable tech. staff to continue processing data in the face of problems
  security of ICT - security of ICT facilities to protect them from loss, unauthorized access or damage
- ***Preconditions***
  information policy and planning - no precondition on IPP on ICT for JABIS has been formulated
  centralization of activities - activities related to JAB data processing have been centralized at Nairobi University
  de-centralization of activities - no activities related to JAB data processing have been de-centralized
  concentration of ICT - critical ICT for control and security is concentrated at Nairobi University
  de-concentration of ICT - no ICT has been de-concentrated
  financial resources - much of the funding is generated through application fees
  personnel allocation – technical staff are allocated
  safety of staff/equipment - safety of staff/equipment for protection, has been provided
  standardization of ICT - all ICT is IBM compatible and industry standard
  service level agreements - SLAs between the university and ICT vendors; no SLAs with other users (other public universities).
- ***Situational factors:***
  age - JAB was started in 1986 as a committee to select students for admission into degree programs
  size - public universities process between 30,000 – 40,000 applications per year
  location - JABIS is located at Chiromo campus, Nairobi University
  technology environment - JAB has adopted the use of ICT in the data processing
  organizational culture - the strategic location and reputation of JAB host (Nairobi University) make it a focal meeting point for various cultures from all parts of Kenya.
  communication infrastructure - the location puts JABIS within easy reach of communication infrastructure
  Student unrest - this is a regular occurrence at Nairobi University often with serious consequences on local business community and motorists in and around the university premises

ICT:

- ***Hardware:*** powerful computers**,** printers and accessories constitute the main hardware
- ***Software :*** Oracle running on Unix constitute basic and application software constitute the main software

- ***Network components:*** LAN and Internet components for local and external communication and access to the WWW and Internet, using dial-up access to other public universities (users) are provided
- ***Extended State Model (ESM) states***
  utilization: ICT and network are utilized on student data processing
  exploitation : ICT and network are exploited on admissions activities
  maintenance: ICT and network are maintained by ICS technical staff
- ***Complexity Factors (CFs):***
  quantity - this complexity does not exist as there are few ICT resources in JABIS
  distribution - due to the central locations of JABIS, this complexity factor does not exist
  diversity - diversity of ICT does not exist
  dynamics - no significant changes take place to ICT hardware, software and network components
  utilization - utilization takes place made necessary by pressure from users (public universities)
  ownership - University of Nairobi owns ICT and network components
  cohesion of ICT – although ICT components differ in make, age and origin, coherence is not compromised.
  functionality of ICT - new ICT and software functions constitute a measure of complexity to technical staff

MCM:

- ***Functional management (FM):***
  Strategic level - strategic FM is provided by senior technical staff under the academic registrar
  Tactical level - tactical FM is provided by middle level technical staff
  Operational level - operational FM is provided by lower level technical staff
- ***Application management (AM):***
  Strategic level - strategic AM is provided by senior database administrator/senior technical staff
  Tactical level - tactical AM is provided by middle level database administrators
  Operational level - operational AM is provided by lower level operators
- ***Technical management (TM) :***
  Strategic level - strategic TM is provided by senior technical staff
  Tactical level - tactical TM is provided by middle level technical staff
  Operational level - operational TM is provided by lower level technical staff

- ***Service support processes:***
  change management (CHG) - CHG has not been formally introduced as a process
  configuration management(CONF) - CONF exists, mainly for control of hardware, software, and network
  help desk (HLP) - HLP exists informally, to attend to incident reports from lower level
  technical staff
  problem management (PRB) - PRB exists, to deal with hardware, network and software problems
  software control & distribution(SCD) - informal SCD exists, in the form of inventory control
- ***Service delivery processes:***
  availability management(AVLM) - AVLM is performed to regulate use of JAB ICT facilities
  capacity management (CAPM) - CAPM does exist to prepare for future expansions in admissions

contingency planning (CONT) - CONT has not been introduced formally
cost management (CSTM) - CSTM does exist indirectly in the form of fees charged to students for processing data
service level management (SLM) - SLM exists between university and vendors, but no formal SLM for Nairobi University and JABIS and users (public universities)

Relationships between entities:

RS→ ICT - public universities *exploit* JABIS in processing admission data
ICT →RS - JABIS *supports* activities related to admission of students in public universities
ICT →MCM - ICT *supports* the technical staff by supplying accurate and reliable technical data
MCM→ ICT - technical staff *manages* JABIS on behalf of public universities
RS→MCM - Nairobi University *employs* technical staff to manage JABIS
MCM→RS - technical staff *respond* to user requests (from public universities) to process data

Influences:

managerial - managerial decisions made by the university influence JABIS
donor - influence due to donors plays no significant role in JABIS
technological - technological developments / changes have influence on JABIS
economic - economic changes in Kenya and in the world influence JABIS as shown by the migration from Cobol to Oracle platforms
cultural - organizational culture within Nairobi University influences JABIS management

Sub-Appendix D2C1

Function 2: Qualification of the IST situation: *Sub-Case 1: University Network Backbone (UNB)*

RS:

- ***User requirements:***

availability of ICT	LOW
flexibility of ICT	MED
maintainability of ICT	LOW
performance of ICT	MED
reliability of ICT	MED
security of ICT	MED

- ***Preconditions***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	MED
concentration of ICT	MED
de-concentration of ICT	MED
financial resources	MED
personnel allocation	MED
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	LOW

- ***Situational factors:***

age of university (est. 1970)	MED
size	HIGH
location	MED
technology environment	MED
organizational culture	MED
communication infrastructure	LOW
student unrest	HIGH

ICT:

- ***Hardware:*** MED
- ***Software :*** MED
- ***Network components:*** LOW
- ***Extended State Model (ESM) states***

utilization:	HIGH
exploitation	MED
maintenance	LOW

- ***Complexity Factors (CFs):***

quantity	MED
distribution	HIGH
diversity	LOW
dynamics	MED
utilization (usage)	HIGH
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:

(Refer to **Table D1 in Appendix D** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

- Functional management (FM):

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Application management (AM):***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Technical management (TM) :***

Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1

- ***Service support processes:***

change management (CHG)	Level 1
configuration management(CONF)	Level 1+
help desk (HLP)	Level 1+
problem management (PRB)	Level 1+
software control & distribution(SCD)	Level 1

- ***Service delivery processes:***

availability management(AVLM)	Level 1
capacity management (CAPM)	Level 1
contingency planning (CONT)	Level 1+
cost management (CSTM)	Not Available
service level management (SLM)	Not Available

Relationships between entities:

RS $\rightarrow$ ICT:	MED
ICT $\rightarrow$RS:	MED
ICT $\rightarrow$MCM:	MED
MCM$\rightarrow$ ICT:	MED
RS$\rightarrow$MCM:	MED
MCM$\rightarrow$RS:	MED

Influences:

managerial	MED
donor	MED
technological	MED
economic	HIGH
cultural	LOW

Sub-Appendix D2C2

Function 2: Qualification of the IST situation: *Sub-Case 2: University Library Information System (ULIS)*

RS:

- ***User requirements:***

availability of ICT	LOW
flexibility of ICT	LOW
maintainability of ICT	LOW
performance of ICT	MED
reliability of ICT	MED
security of ICT	MED

- ***Preconditions:***

information policy and planning	LOW
centralization of activities	MED
de-centralization of activities	MED
concentration of ICT	MED
de-concentration of ICT	MED
financial resources	LOW
personnel allocation	LOW
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	LOW

- ***Situational factors:***

age of university (est. 1970)	MED
size	HIGH
location	HIGH
technology environment	MED
organizational culture	MED
communication infrastructure	MED
student unrest	HIGH

ICT:

• ***Hardware:***	MED
• ***Software :***	MED
• ***Network components:***	LOW

- ***Extended State Model (ESM) states:***

utilization	HIGH
exploitation	MED
maintenance	LOW

- ***Complexity Factors (CFs):***

quantity	LOW
distribution	HIGH
diversity	LOW
dynamics	MED
utilization (usage)	HIGH
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:

(Refer to **Table D2 in Appendix D** for details of qualification of MCM processes.)

How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

• ***Functional management (FM):***	
Strategic level	Level 1+
Tactical level	Level 1+
Operational level	Level 1+
• ***Application management (AM):***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Technical management (TM) :***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Service support processes:***	
change management (CHG)	Level 1
configuration management(CONF)	Level 1+
help desk (HLP)	Level 1
problem management (PRB)	Level 1
software control & distribution(SCD)	Level 1+
• ***Service delivery processes:***	
availability management(AVLM)	Level 1
capacity management (CAPM)	Level 1
contingency planning (CONT)	Not Available
cost management (CSTM)	Level 1+
service level management (SLM)	Not Available

Relationships between entities:

RS → ICT:	LOW
ICT →RS:	LOW
ICT →MCM:	MED
MCM→ ICT:	MED
RS→MCM:	MED
MCM→RS:	MED

Influences:

managerial	MED
donor	LOW
technological	MED
economic	HIGH
cultural	MED

Sub-Appendix D2C3

Function 2: Qualification of the IST situation: *Sub-Case 3: Joint Admissions Board Information System (JABIS)*

RS:

- ***User requirements:***

availability of ICT	HIGH
flexibility of ICT	HIGH
maintainability of ICT	HIGH
performance of ICT	HIGH
reliability of ICT	HIGH
security of ICT	HIGH

- ***Preconditions:***

information policy and planning	LOW
centralization of activities	HIGH
de-centralization of activities	LOW
concentration of ICT	HIGH
de-concentration of ICT	N/A (NOT APPLICABLE)
financial resources	MED
personnel allocation	MED
safety of staff/equipment	MED
standardization of ICT	MED
service level agreements	LOW

- ***Situational factors:***

age of university (est. 1970)	MED
size	MED
location	HIGH
technology environment	LOW
organizational culture	LOW
communication infrastructure	LOW
student unrest	HIGH

ICT:

• ***Hardware:***	MED
• ***Software :***	MED
• ***Network components:***	LOW

- ***Extended State Model (ESM) states:***

utilization:	HIGH
exploitation:	MED
maintenance:	MED

- ***Complexity Factors (CFs):***

quantity	LOW
distribution	LOW
diversity	LOW
dynamics	LOW
utilization (usage)	MED
ownership	N/A (NOT APPLICABLE)
cohesion of ICT	LOW
functionality	MED

MCM:
(Refer to **Table D3 in Appendix D** for details of qualification of MCM processes.)
How to use the table:

- enter raw attribute values for each process in the spreadsheet according to the method described in Section 4.6. The mean capability maturity level values for each form of management or process are automatically calculated in the row **Mean Process Level**.
- transfer the mean capability maturity level values from the spreadsheet to the corresponding forms and processes indicated below.
- Level 1+, where applicable, means the qualification lies between CMM values 1.0 – 2.0

• *Functional management (FM):*	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Application management (AM):***	
Strategic level	Level 1+
Tactical level	Level 1+
Operational level	Level 1+
• ***Technical management (TM) :***	
Strategic level	Level 1
Tactical level	Level 1
Operational level	Level 1
• ***Service support processes:***	
change management (CHG	Not Available
configuration management(CONF)	Level 1
help desk (HLP)	Level 1+
problem management (PRB)	Level 1
software control & distribution(SCD)	Level 1
• ***Service delivery processes:***	
availability management(AVLM)	Level 1
capacity management (CAPM)	Level 1+
contingency planning (CONT)	Level 1
cost management (CSTM)	Not Available
service level management (SLM)	Level 1

Relationships between entities:

RS → ICT:	LOW
ICT →RS:	MED
ICT →MCM:	MED
MCM→ ICT:	MED
RS→MCM:	LOW
*MCM→**RS:***	LOW

Influences:

managerial	MED
donor	MED
technological	MED
economic	HIGH
cultural	MED

Sub-Appendix D3C1

Function 3: Definition of the SOLL situation: *Sub-Case 1: University Network Backbone*

RS:

- ***User requirements:***
  availability of ICT MED; availability requirement for increased ICT resources
  flexibility of ICT HIGH; flexibility requirement to enable users to switch between ICT functions
  maintainability of ICT MED; maintainability requirement to allow users more time for and use of ICT
  performance of ICT HIGH; performance requirement to increased demand for accuracy, speed
  reliability of ICT HIGH; reliability requirement for ICT that is dependable for services and results
  security of ICT HIGH; to meet demand from users for ICT protection and security
- ***Preconditions:***
  information policy and planning MED; IPP on ICT should be formulated
  centralization of activities LOW; critical network activities need to be centralized
  de-centralization of activities HIGH; non-critical activities are de-centralized
  concentration of ICT LOW; critical ICT, e.g. servers, are concentrated for security and control
  de-concentration of ICT HIGH; non-critical ICT are de-concentrated in departments and faculties
  financial resources HIGH; increased funding
  personnel allocation HIGH; qualified/expepreinced technical staff in adequate numbers
  safety of staff/equipment HIGH; measures need to be taken to provide safety and staff protection
  standardization of ICT HIGH; standardize ICT and upgraded for effectiveness and efficiency
  service level agreements MED; SLAs with vendors are improved, new SLAs with users
- ***Situational factors:***
  age of university (est. 1970) LOW; develop strategies/policies to cater for future ICT requirements
  size MED; enhanced quality and quantity of ICT resources and services
  location LOW; exploit the university's proximity to the city markets
  technology environment HIGH; increased computer literacy among users
  organizational culture LOW; higher degree of work ethics among university users required
  communication infrastructure MED; fairly effective, well managed communication infrastructure
  student unrest MED; student unrest is minimized through dialogue

ICT:

- ***Hardware:*** HIGH; new or upgraded hardware, to current state-of-the-art level
- ***Software :*** HIGH; new or upgraded software, to state-of-the-art
- ***Network components:*** MED; new or upgraded network components

- ***Extended State Model (ESM):***
  - *utilization:* HIGH; maintain ICT utilization by university users at current level
  - *exploitation:* HIGH; enhanced ICT exploitation by university users
  - *maintenance:* MED; enhanced maintenance of ICT by network technical staff
- ***Complexity Factors (CFs):***
  - *quantity* LOW; appreciated, analyzed, understood and managed complexity
  - *distribution* MED; adequate and well managed networks (LANs)
  - *diversity* LOW; industry standard ICT to miminze diversity
  - *dynamics* LOW; changes to ICT are anticipated with better change management
  - *utilization (usage)* MED; maintain level of computer literacy among users
  - *ownership* N/A; no dispute, and in case of any, dispute resolutions are provided
  - *cohesion of ICT* LOW industry standard ICT is maintained as matter of policy
  - *functionality* LOW; higher computer literacy, higher level of functional management

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; appreciated/recognized, adopted, and practiced.
  - *Tactical level* Level 2; appreciated/recognized, adopted, and practiced
  - *Operational level* Level 2; appreciated/recognized, adopted, and practiced
- ***Application management (AM):***
  - *Strategic level* Level 2; appreciated/recognized, adopted, and practiced
  - *Tactical level* Level 2; appreciated/recognized, adopted, and practiced
  - *Operational level* Level 2; appreciated/recognized, adopted, and practiced
- ***Technical management (TM) :***
  - *Strategic level* Level 2; recognition, training and funding, and elevated
  - *Tactical level* Level 2; training, funding, and conditions of service
  - *Operational level* Level 2; training in network management, better conditions
- ***Service support processes:***
  - *change management* Level 2; recognized, institutionalized, and practiced
  - *configuration mgt.* Level 2; recognized, accepted, planned, racticed, enforced, measured
  - *help desk* Level 2; recognized, planned, practiced, enforced, and measured
  - *problem management* Level 2; recognized, practiced, enforced, and measured
  - *software control & distribution* Level 2; recognized, planned, practiced, and enforced
- ***Service delivery processes:***
  - *availability management(AVLM)* Level 2; planning, enforcement required
  - *capacity management* Level 2; recognized, institutionalized, planned, and enforced
  - *contingency planning* Level 2; planing, practice, enforcement, training, and measurement
  - *cost management* Level 2; recognized, planned, and enforced
  - *service level management* Level 2; SLM is recognizedand and improved

Relationships between entities:

RS → ICT:	HIGH; enhanced exploitation of ICT to improve communication
ICT →RS:	HIGH; high support of ICT for university communication
ICT →MCM:	HIGH; ICT to support technical staff (e.g. decision support system)
MCM→ ICT:	HIGH; high level training and funding of staff to improve ICT
RS→MCM:	HIGH; management attention to ICT management is more focussed
MCM→RS:	HIGH; high university responsiveness is assured and timely

Influences:

managerial	LOW; minimal negative impact on account of structural changes
donor	HIGH; continued donors support for ICT is encouraged
technological	HIGH; impact of changes in technology has maximum positive effects
economic	MED; ICT based income generating activities are initiated
cultural	LOW; initiate and encourage positive work ethics and attitudes

Sub-Appendix D3C2

Function 3: Definition of the SOLL situation: *Sub-Case 2: University Library Information System (ULIS)*

RS:

- ***User requirements:***
  availability of ICT MED; ICT resources and services are made available to users
  flexibility of ICT MED; flexibility of ICT is explained to users during utilization / training
  maintainability of ICT MED; ICT resources and services are improved through training, and practice
  performance of ICT HIGH; performance of ICT with regard to accuracy, speed, and throughput
  reliability of ICT HIGH; depended upon for services and results; is explained to users and realized
  security of ICT HIGH; security of ICT facilities and data are provided

- ***Preconditions:***
  information policy and planning MED; IPP on ICT is well formulated with the participation of users
  centralization of activities LOW; critical library activities are centralized for better control
  de-centralization of activities HIGH; non-critical library activities are de-centralized
  concentration of ICT LOW; critical ICT, such as servers, are concentrated in a central location
  de-concentration of ICT HIGH; non-critical ICT resources are de-concentrated in departments
  financial resources MED; increased funding from university/income generation activities
  personnel allocation MED; better qualified staff in sufficnet numbers are hired
  safety of staff/equipment HIGH; greater safety measures are taken to provide protection / safety
  standardization of ICT HIGH; ICT is standardized and upgraded to the state-of-the-art level
  service level agreements MED; SLA with vendors are improved, and new SLAs with users

- ***Situational factors:***
  age of university (est. 1970) LOW; plan and develop ICT strategies for current and future needs
  size MED; ICT resources and quality services are acquired or introduced
  location MED; library authorities take advantage of the university's location
  technology environment HIGH; increased computer literacy among library users to utilize ICT
  organizational culture LOW; improved work ethics among library users
  communication infrastructure HIGH; effective and well-managed communication infrastructure
  student unrest MED; student unrest is contained through continuous dialogue

ICT:

- ***Hardware:*** HIGH; new hardware, or upgraded hardware is provided
- ***Software :*** HIGH; new software, or upgraded software is provided
- ***Network components:*** MED; new network components, or upgraded network
- ***Extended State Model (ESM) states***
  - *utilization* HIGH; utilization of ICT is maintained at current level
  - *exploitation* HIGH; enhanced exploitation of ICT by university users
  - *maintenance* MED; enhanced maintenance of ICT by technical staff through training
- ***Complexity Factors (CFs):***
  - *quantity* LOW; better managemnent of increased ICT through training
  - *distribution* MED; well managed networks (and LANs) required
  - *diversity* LOW; industry standard ICT is provided as part of university policy
  - *dynamics* LOW; change management is used whenever changes to ICT are made
  - *utilization (usage)* MED; high level computer literacy among library users required
  - *ownership* N/A; no dispute
  - *cohesion of ICT* LOW; industry standard ICT is maintained as matter of university policy
  - *functionality* LOW; higher computer literacy, higher level of functional management

MCM:

- ***Functional management (FM):***
  - *Strategic level* Level 2; formalized, planned, practiced, enforced, and measured
  - *Tactical level* Level 2; appreciated/recognized, adopted, and practiced
  - *Operational level* Level 2; appreciated/recognized, adopted, and practiced
- ***Application management (AM):***
  - *Strategic level* Level 2; appreciated/recognized, adopted, and practiced
  - *Tactical level* Level 2 appreciated/recognized, adopted, and practiced
  - *Operational level* Level 2; appreciated/recognized, adopted, and practiced
- ***Technical management (TM) :***
  - *Strategic level* Level 2; recognition, training and funding, and decision-making
  - *Tactical level* Level 2; training, funding, and conditions of service and remuneration
  - *Operational level* Level 2; training in network management and better work conditions
- ***Service support processes:***
  - *change management* Level 2; recognized, institutionalized, practiced, and measured, enforced
  - *configuration management* Level 2; recognized, adopted, planned, practiced, and enforced
  - *help desk (HLP)* Level 2; recognized, planned, practiced, enforced, and measured
  - *problem management* Level 2; recognized, planned, practiced, enforced,

and measured

software control & distr. Level 2; recognized, planned, practiced, and enforced

- ***Service delivery processes:***

availability management Level 2; planned, enforced, and measured

capacity management Level 2; recognized, institutionalized, planned, and enforced

contingency planning Level 2; planned, practiced, enforced, trained, and measured

cost management Level 2; recognized, planned, and enforced

service level management Level 2; between university and vendors must be improved, new SLM with users required

Relationships between entities:

RS → ICT:	MED; training, practice and usage of ICT
ICT →RS:	MED; high support of ICT for university communication
ICT →MCM:	HIGH; ICT support for technical staff (decision support)
MCM→ ICT:	HIGH; training and funding to improve ICT management
RS→MCM:	HIGH; deliberate and focussed attention to ICT management
MCM→RS:	HIGH; timely responsiveness to user requirements assured

Influences:

managerial	HIGH; structural changes have minimal negative impact on ICT
donor	MED; continued donors support for ICT is encouraged
technological	HIGH; impact of changes in technology has maximum effect
economic	MED; ICT based income generating activities are initiated
cultural	LOW; initiate, inculcate and encourage positive work ethics

Sub-Appendix D3C3

Function 3: Definition of the SOLL situation: *Sub-Case 3: Joint Admissions Board Information System (JABIS)*

RS:

- ***User requirements:***

availability of ICT	MED; increased demand for ICT expected
flexibility of ICT	HIGH; enable users to switch betwen ICT functions
maintainability of ICT	HIGH; improved with better staff training
performance of ICT	HIGH; increased accuracy, speed, and throughput
reliability of ICT	HIGH; dependable for services and results
security of ICT	HIGH; provision of data protection and security

- ***Preconditions:***

information policy and planning	MED; IPP on ICT is formulated and disseminated
centralization of activities	MED; critical student admissions activities remain highly centralized
de-centralization of activities	MED; non-critical admissions activities are de-centralized and handled
concentration of ICT	MED; critical ICT, such as servers, are concentrated at Nairobi University
de-concentration of ICT	N/A; There is no need for de-concentration of ICT
financial resources	HIGH; increased funding for improved service
personnel allocation	HIGH; qualified staff in sufficicent numbers required
safety of staff/equipment	HIGH; greater safety measures are provided
standardization of ICT	HIGH; ICT is standardized and upgraded to the state-of-the-art level
service level agreements	MED; SLA with vendors are improved, and new SLAs with users initiated

- ***Situational factors:***

age of university (est. 1970)	LOW*;* aim at developing new ICT strategies and policies
size	LOW; consider increasing ICT resources and improving services
location	MED; take advantage of the university's location
technology environment	MED; increased computer literacy among users
organizational culture	LOW; higher degree of work ethics among university users is needed
communication infrastructure	MED; effective infrastructure in campuses
student unrest	MED; student unrest is contained through dialogue

ICT:

• ***Hardware:***	HIGH; new hardware, or upgraded hardware to the state-of-the-art level
• ***Software:***	HIGH; new software, or upgraded software to the state-of-the-art level
• ***Network components:***	MED; new network components, or upgraded network components

- ***Extended State Model (ESM):***

utilization	HIGH; high utilization of ICT by JAB users (i.e. all public universities)

exploitation,	HIGH; enhanced exploitation of ICT by public universities
maintenance	HIGH; improved maintenance of ICT by qualified and experienced staff

- ***Complexity Factors (CFs):***

quantity	LOW; due to insignificant quantities of ICT
distribution	LOW; due to high centralization of JAB data processing activities
diversity	LOW; industry standard ICT and network components are provided
dynamics	LOW; since no significant changes to ICT are made on frequent basis
utilization (usage)	HIGH; enhanced ICT utilization of ICT is realized
ownership	N/A; no dispute
cohesion of ICT	LOW; industry standard ICT is maintained as matter of policy
functionality	LOW; high computer literacy supported by functional management

MCM:

- ***Functional management (FM):***

Strategic level	Level 2; formally recognized, adopted, and practiced
Tactical level	Level 2; formally recognized, adopted, and practiced
Operational level	Level 2; formally recognized, adopted, and practiced

- ***Application management (AM):***

Strategic level	Level 2; formally recognized, adopted, and practiced
Tactical level	Level 2 formally recognized, adopted, and practiced
Operational level	Level 2; formally recognized, adopted, and practiced

- ***Technical management (TM) :***

Strategic level	Level 2; recognition, training, funding, and elevated positions needed
Tactical level	Level 2; training, funding, and improved conditions of service
Operational level	Level 2; training in ICT management and enhanced terms

- ***Service support processes:***

change management	Level 2; formally recognized, practiced, measured, and enforced
configuration management	Level 2; planning, practicing, enforcing, and measuring needed
help desk (HLP)	Level 2; planning, practicing, enforcing, and measuring needed
problem management	Level 2; planning, practicing, enforcing,and measuring needed
software control & distr.	Level 2; planning, practicing, enforcing, and measuring are needed

- ***Service delivery processes:***

availability management	Level 2; planning, practicing, enforcing, and measuring needed
capacity management	Level 2; planning, practicing, enforcing, and measuring needed
contingency planning	Level 2; recognized, practiced, measured, and enforced
cost management	Level 2; planning, practicing, enforcing, and measuring needed

service level management	Level 2; SLM between Univ./vendors improved, new SLM with users

Relationships between entities:

*RS → ICT**:***	MED; enhanced exploitation of ICT through training, practice and usage
*ICT →RS**:***	HIGH; high support of ICT for JAB activities is maintained
*CT →MCM**:***	HIGH; ICT supports technical staff (e.g. decision support system)
*MCM→ ICT**:***	HIGH; high level training and funding to improve ICT management
*RS→MCM**:***	MED; university attention to ICT management is focussed
*MCM→RS**:***	MED; high university responsiveness to user requirements is assured

Influences:

managerial	LOW***;*** structural changes have minimal negative impact on ICT
donor	HIGH; continued donors support for ICT is sought and encouraged
technological	HIGH; technological developments have positive impact
economic	MED; secure sources of funds are initiated to support ICT
cultural	LOW; initiate and encourage positive work ethics and attitudes staff

Sub-Appendix D4C1

Function 4: Transformation from IST to SOLL situation: *Sub-Case 1: University Network Backbone (UNB)*

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for UNB can be transformed to SOLL situation as follows, taking into account the Benefits, Costs, and Consequences:

RS:

- ***User requirements:***

availability of ICT	the need for more access time for ICT was recognized, and adopted
flexibility of ICT	knowledge of ICT functions is recognized, adopted.
maintainability of ICT	recognized, and adopted; ICT extension, upgrading and modifications.
performance of ICT	upgrading ICT was made to increase performance.
reliability of ICT	completeness, timeliness, and admissibility were improved
security of ICT	ICT security was stepped up by providing electronic/digital locks

- ***Preconditions:***

information policy and planning	formulation of IPP on ICT was readily accepted ready to be implemented.
centralization of activities	vital activities related to network, including decision-making and policy formulation, were centralized to allow technical staff control of resources.
de-centralization of activities	non-vital activities related to network, including computer and network operations, storage and provision of security, were de-centralized.
concentration of ICT	vital network components and related ICT, were concentrated at the Institute of Computer Science
de-concentration of ICT	non-vital network components and related ICT such as PCs, printers and application software, were de-concentrated in campuses
financial resources	new long term trategies for income-generation were being implemented.
personnel allocation	recruitment of new staff and training were being implemented
safety of staff/equipment	safety of staff and equipment was considered, accepted and provided.
standardization of ICT	old and obsolete ICThad been phased out and replaced with modern ICT
service level agreements	formalization of contracts regularly carried out by university authorities.

- ***Situational factors:***

age of university (est. 1970)	policies and strategies related to ICT were were being implemented
size	more ICT to meet growing demand were being acquired
location	university takes advantage of its location in the city with regard to ICT

technology environment	ICS is actively engaged in providing computer literacy lessons to users
organizational culture	the university is engaged in creating a social atmosphere
communication infrastructure	the old analog network has been replaced by a high-speed digital network
student unrest	student unrest has been studied by a national committee and report made.

ICT:

- ***Hardware:*** up-to-date hardware components were being purchased and upgraded
- ***Software :*** new software had recently been acquired through the World Bank
- ***Network components:*** new network components had recently been acquired
- ***Extended State Model (ESM):***

utilization	network utilization was enhanced through increased availability, and usage
exploitation	necessary network facilities had been provided to ensure increased exploitation
maintenance	well maintained network facilities had been provided.

- ***Complexity Factors (CFs):***

quantity	re-organization of ICT management will enhance ICT resource management
distribution	new communication infrastructure was being installed
diversity	new ICT replacement policy was being pursued
dynamics	a new change management process was proposed, accepted and planned.
utilization (usage)	users were exposed to ICT through training and varied work experiences.
ownership	N/A; no dispute.
cohesion of ICT	industry standard network components were used as a matter of policy
functionality	users are exposed to various ICT functions through training

MCM:

- ***Functional management (FM):***

Strategic level	policy formulation on ICT was already in place
Tactical level	policy implementation was already part of existing functional management
Operational level	ICT management related to users was already part of the established form

- ***Application management (AM):***

Strategic level	the model introduced new dimension in the management of databases
Tactical level	policy implementation was part of an existing process
Operational level	management of databases was already part of the existing process.

- ***Technical management (TM) :***

Strategic level	formulation of policies related to university network was being pursued
Tactical level	implementation of policies formulated was part of tactical management

Operational level	there were formal recognition and awareness of the need for this form

- ***Service support processes:***

change management	process was formally recognized, accepted and adopted
configuration management	formally recognized, accepted and adopted
help desk	plans were made to establish, practice, enforce, measure this process
problem management	plans were made to establish, practice, enforce, measure this process
software control & distr.	formally recognized, and adopted; plans were made to establish it

- ***Service delivery processes:***

availability management	plans were made to formally establish, practice, enforce, and measure it
capacity management	formally recognized, and adopted; plans were made to establish it
contingency planning	authorities accepted to establish the process
cost management	authorities formally recognized, accepted and adopted the process
service level management	plans were immediately put in place to establish the process

Relationships between entities:

RS → ICT:	relationship would be improved through continued use of ICT
ICT →RS:	university acknowledges the benefits of ICT and continues to utilizing ICT
ICT →MCM:	staff gain knowledge and expertise of ICT through experience and training
MCM→ ICT:	staff are involved in daily management of ICT and networks
RS→MCM:	authorities recognize the importance of technical staff in ICT management
MCM→RS:	staff respond to users (students and staff) whenever needed

Influences:

managerial	changes are often anticipated, through appointments
donor	close ties with external donors always encouraged
technological	university developes strategies, geared towards ICT
economic	income generating activities have been established
cultural	university is committed to contributing to the dynamic cultural development

Sub-Appendix D4C2

Function 4: Transformation from IST to SOLL situation: *Sub-Case 2: University Library Information System (ULIS)*

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for ULIS can be transformed to SOLL situation as follows, taking into account the Benefits, Costs, and Consequences:

RS:

- ***User requirements:***

availability of ICT	availability of ICT resources and services is publicized
flexibility of ICT	users are periodically exposed to new ICT concepts
maintainability of ICT	modifications needed on ICT are periodically made
performance of ICT	ICT is occasionally upgraded and / or replaced with new components
reliability of ICT	completeness, timeliness, and admissibility due for further improvement
security of ICT	security guards, burglar-proof, access controls and authorization provided

- ***Preconditions:***

information policy and planning	plans put in place to formalize IPP on a priority basis
centralization of activities	decision-making, policy formulation on ICT were centralized
de-centralization of activities	computer/network operations, storage, were de-centralized
concentration of ICT	file servers/application software were concentrated at the head library
de-concentration of ICT	non-vital ICT were de-concentrated in campuses
financial resources	new strategies for financing were developed and implemented
personnel allocation	need for more staff was accepted and plan made to hire them
safety of staff/equipment	this was provided and further improvements planned
standardization of ICT	old and obsolete ICT were phased out and replaced with more modern ICT
srvice level agreements	concept of service level agreements with local ICT vendors were accepted

- ***Situational factors:***

age of university (est. 1970)	policies and strategies related to ICT were developed for implemention
size	the library has made plans to computerize basic activities (e.g. indexing)
location	university has taken advantage to improve ICT
technology environment	Internet Café is used to provide computer literacy
organizational culture	library provides leadership in creating a social culture
communication infrastructure	plans were being implemented by the university to provide networking
student unrest	a national committee had given its findings and recommendations

ICT:

- ***Hardware:*** modern hardware had lately been acquired

- ***Software :*** modern software had lately been acquired
- ***Network components:*** modern network components include ring and star topogies, and Ethernet
- ***Extended State Model (ESM):***

utilization:	utilization was enhanced through continuous training and usage of ICT
exploitation:	library ensures exploitation of its ICT through an arrangement with ICS
maintenance:	library provides ICT facilities, which are maintained by staff from ICS

- ***Complexity Factors (CFs):***

quantity	training technical staff, ICT standardization and funding needed
distribution	communication infrastructure is continuously improved
diversity	old non-industry standard ICT is replaced by industry standard ICT
dynamics	a new ICT process, change management, was suggested and accepted
utilization (usage)	high level computer literacy among users staff is provided
ownership	N/A, as there are no ownership disputes
cohesion of ICT	industry standard ICT is used as a matter of policy in the university
functionality	users are introduced to ICT functions through training, work experience

MCM:

- ***Functional management (FM):***

Strategic level	policy formulation on ICT, is part of the existing functional management
Tactical level	policy implementation is already part of existing functional management.
Operational level	operational ICT management is part of the functional management

- ***Application management (AM):***

Strategic level	policy formulation on ICT is part of the existing AM
Tactical level	policy implementation is part of the existing AM
Operational level	operational management of data and databases is part of existing form

- ***Technical management (TM) :***

Strategic level	formulation of policies related to ICT is part of existing process
Tactical level	implementation of policies is part of management
Operational level	operational management of the network was part of the daily activities

- ***Service support processes:***

change management	change management was formally recognized, accepted and adopted
configuration management	process was formally recognized, accepted and adopted.
help desk	plans were made to formally establish, practice, enforce, and measure it

problem management	process was formally recognized, and adopted.
software control & distr.	training staff in its principles, procedures, and practice needed

- ***Service delivery processes:***

availability management	procedures set up with support tools, including database
capacity management	plans were put in place to establish, practice, and enforce the process
contingency planning	plans were made to improve its quality through enforcement and practice
cost management	authorities formally recognized, accepted and adopted the process
service level management	plans were put in place to establish the process and practice it

Relationships between entities:

RS → ICT:	library has embarked on a policy of training staff and users in ICT
ICT →RS:	more effective communication network with wider bandwidth and
ICT →MCM:	university plans to avail senior staff with automated tools (e.g. DSS)
MCM→ ICT:	university management has plans to hire staff and offer
RS→MCM:	library supports the development of technical staff through training
MCM→RS:	staff responds to users by examining the problems and providing solutions

Influences:

managerial	structural changes are minimized through job advertisements
donor	the university seeks to enlist the support of external donors
technological	university has developed foreward-looking ICT related policies/strategies
economic	university has put in place several income generating activities
cultural	university strives to contribute to the dynamic socio-economic and cultural development

Sub-Appendix D4C3

Function 4: Transformation from IST to SOLL situation

Sub-Case 3: Joint Admissions Board Information System (JABIS)

Using the model, M_6, and following Steps 1 to 5 of Figure 4.11, the IST situation for JABIS can be transformed to SOLL situation as follows, taking into account the Benefits, Costs, and Consequences:

RS:

- ***User requirements:***

availability of ICT	improved manteance ensures availability of ICT servcies
flexibility of ICT	extending functions of ICT through adaptive maintenance of ICT
maintainability of ICT	adaptive maintenance, and additive maintenance recommended
performance of ICT	recommended replacement of old ICT with new state-of-the-art ICT
reliability of ICT	upgrading the existing ICT or new ICT acquisitions to increase reliability
security of ICT	increased security is provided by electronic/digital locks on door entrance

- ***Preconditions:***

information policy and planning	formulation of IPP on ICT was accepted for implementation on a priority basis
centralization of activities	vital activities, e.g. decision-makingwere centralized at Nairobi University.
de-centralization of activities	non-vital activities are de-centralized in various user public universities
concentration of ICT	vital ICT are concentrated at the Institute of Computer Science
de-concentration of ICT	non-critical ICT are de-concentrated in respective public universities
financial resources	implementation of income generation activities are maintained
personnel allocation	accepted and plans made to hire qualified technical personnel.
safety of staff/equipment	safety of staff and equipment are constantly provided and improved
standardization of ICT	university had recently phased out old and obsolete ICT
service level agreements	SLAs between public universities not considered necessary

Situational factors:

age of university (est. 1970)	policies and strategies were continuously being developed and reviewed
size	*u*niversity has recently implemented new ICT to meet increased demand
location	university in an easy reach of vital commercial places of interest
technology environment	ICS is actively engaged in providing computer literacy to staff, students

organizational culture	the university encourages the development of positive attitudes to work
communication infrastructure	constantly under review, improved and updated.
student unrest	national committee has submitted its findings and recommendations

ICT:

- ***Hardware:*** university makes direct H/W purchases using own funds
- ***Software :*** university makes direct S/W purchases using own funds
- ***Network components:*** modern network components had been donated
- ***Extended State Model (ESM):***

utilization	enhanced through continuous training and on-the-job work experience
exploitation	ICT and network facilities provided for exploitation on data processing
maintenance	ICT and provided network facilities are maintained by ICS staff

- ***Complexity Factors (CFs):***

quantity	number of ICT resources is relatively small
distribution	distribution complexity did not constitute a problem for the technical staff
diversity	diversity complexity did not constitute a problem for the technical staff
dynamics	not applicable in JAB since few or no frequent changes are made to ICT.
utilization (usage)	formal and informal training of users to enable them to make use of ICT.
ownership	There were no disputes regarding the ownership of ICT.
cohesion of ICT	recommended policy of maintaining industry standard ICT and network
functionality	recommemnded exposing users to the various ICT functions

MCM:

- ***Functional management (FM):***

Strategic level	policy formulation are part of the existing informal functional management
Tactical level	policy implementation are already part of existing functional management
Operational level	operational ICT management was part of the functional management

- ***Application management (AM):***

Strategic level	policy formulation is part of informal AM
Tactical level	policy implementation of AM is part of existing process
Operational level	operational management in databases is part of existing process

- ***Technical management (TM) :***

Strategic level	formulation of policies is part of the existing tasks
Tactical level	implementation of policies is part of tactical management.
Operational level	operational management tasks are part of daily activities

- ***Service support processes:***

change management	plans were made to enforce and practice the process

configuration management	plans were made to enforce, and practice
help desk	process was formally recognized, and adopted
problem management	process was formally recognized, and adopted
software control & distribution	process was formally recognized, and adopted

- ***Service delivery processes:***

availability management	process was formally recognized, and adopted
capacity management	plans were made to practice, train, and enforce the process
contingency planning	plans were made to improve quality through enforcement, and practice
cost management	plans were made to practice, train, enforce, and measure the process
service level mgt.	plans were made to improve the process through practice

Relationships between entities:

RS → ICT:	university has embarked on a policy of highly training staff in ICT.
ICT →RS:	JABIS supports student admission activities, including processing of data
ICT →MCM:	technical staff knowledge and skills continuously updated
MCM→ ICT:	staff receive high level training to manage ICT effectively and efficiently
RS→MCM:	university recognizes and employs technical staff to manage ICT resources
MCM→RS:	technical staffs often respond to user requests and problems

Influences:

managerial	structural changes are anticipated thus minimizing effects
donor	university seeks to forge close links with external donors
technological	university constantly developes and reviews ICT strategies and policies
economic	university has put in place income generating activities
cultural	university is committed to contributing to the dynamic socio-economic and cultural development of Kenya

Table D1:	UNIVERSITY NETWORK BACKBONE																			
	NA	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0
has structured actions	**3**	2	2	2	1	1	1	2	2	2	2	2	2	1	1	1	0	2	0	0
has predictable services	**3**	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	0	2	0	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0
process is peer reviewed	**2**	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	0	2	0	0
processes are standardized	**2**	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	2	0	0
processes documented	**1**	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	0	2	0	0
have preparedness criteria	**1**	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	0	1	0	0
Level 2																				
repeats earlier success	**3**	1	1	1	1	1	1	1	1	1	1	2	2	1	2	1	0	2	0	0
is performed pragmatically	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	1	0	0
process is recognized	**3**	2	2	2	2	2	2	2	2	2	1	1	2	2	1	1	0	2	0	0
activities are processes-like	**3**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	0
process is enforced	**2**	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0
process is trained	**2**	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	0	2	0	0
process is practiced	**2**	1	1	1	1	1	1	2	2	2	1	1	1	2	1	1	0	1	0	0
process is planned	**2**	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	0	2	0	0
processes is cost-effective	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0
processes is on schedule	**1**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
Uncoordinated work		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		
	MCM Pr	SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.3**	**1.2**	**1.1**	**1.0**	**1.0**	**1.0**	**1.4**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table D2: **UNIVERSITY LIBRARY INFORMATION SYSTEM**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delivery				
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
seen as service organization	**3**	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	1	0	3	0
has structured actions	**3**	2	2	2	1	1	1	1	1	1	0	1	2	1	2	1	1	0	3	0
has predictable services	**3**	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	0	2	0
process is related to SLA	**3**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	**2**	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	2	0
process is peer reviewed	**2**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	2	0
processes are standardized	**2**	1	1	1	1	1	1	1	1	1	0	1	1	1	2	1	1	0	2	0
processes documented	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	2	1	1	0	2	0
have preparedness criteria	**1**	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0
Level 2																				
repeats earlier success	**3**	2	2	2	1	1	1	1	1	1	0	1	1	3	2	2	1	0	2	0
is performed pragmatically	**3**	2	2	2	1	1	1	1	1	1	1	1	1	2	2	1	2	0	1	0
process is recognized	**3**	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	0	2	0
activities are processes-like	**3**	2	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1	0	0	0
process is measured	**2**	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
process is enforced	**2**	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0
process is trained	**2**	1	1	1	1	1	1	1	1	1	0	2	1	1	2	1	1	0	0	0
process is practiced	**2**	2	2	2	1	1	1	1	1	1	0	2	1	1	2	1	1	0	1	0
process is planned	**2**	1	1	1	1	1	1	1	1	1	0	2	1	1	2	1	1	0	1	0
processes is cost-effective	**1**	0	0	0	0	0	0	1	1	1	0	1	1	1	2	1	0	0	0	0
processes is on schedule	**1**	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0
Level 1																				
Efficiency not measured		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
Uncoordinated work		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
High workloads		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
Authorities decide		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
ad hoc reactions		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
No MCM processes		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm	slm
MEAN PROCESS LEVEL		**1.1**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.5**	**1.0**	**1.0**	**1.0**	**1.3**	**1.0**
MEAN OVERALL LEVEL		**1.1**																		
s.d.		**0.1**																		

KEY:

Qualification of attributes		Management Level		Service Support Processes		Service Delivery Processes	
0	Missing	SM	Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM	Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM	Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH			prb	Problem Management	cstm	Cost Management
				scd	Software Control and Distrib	slm	Service Level Management
Weighting, WT.: W1… Wn, 1<= Wi<=3						x	Non-improvement parameter

Table D3: **JOINT ADMISSIONS BOARD INFORMATION SYSTEM**

	WT.	Funct. Mgt.			Appl. Mgt.			Tech. Mgt.			Service Support					Service Delive			
Level 3		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm
seen as service organization	3	1	1	1	1	1	1	1	1	1	0	1	2	1	1	1	1	0	1
has structured actions	3	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	1	0	1
has predictable services	3	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	1
process is related to SLA	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
has completion criteria	2	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1
process is peer review ed	2	1	1	1	2	2	2	1	1	1	0	1	2	2	1	1	1	0	2
processes are standardized	2	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1
processes documented	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1
have preparedness criteria	1	1	1	1	1	1	1	2	2	2	0	1	1	1	1	1	2	0	1
Level 2																			
repeats earlier success	3	1	1	1	2	2	2	1	1	1	0	1	2	1	1	2	2	0	1
is performed pragmatically	3	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1
process is recognized	3	1	1	1	2	2	2	2	2	2	0	1	2	1	1	1	2	0	1
activities are processes-like	3	1	1	1	2	2	2	1	1	1	0	1	1	1	1	1	1	0	1
process is measured	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
process is enforced	2	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	1	0	0
process is trained	2	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1
process is practiced	2	1	1	1	2	2	2	2	2	2	0	1	1	1	1	1	1	0	1
process is planned	2	1	1	1	2	2	2	2	2	2	0	1	1	1	1	2	2	0	2
processes is cost-effective	1	1	1	1	2	2	2	1	1	1	0	1	1	1	1	2	1	0	1
processes is on schedule	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	2
Level 1																			
Efficiency not measured		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
Uncoordinated w ork		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
High w orkloads		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
Authorities decide		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
ad hoc reactions		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
No MCM processes		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x		x
MCM Pr		SM	TM	OM	SM	TM	OM	SM	TM	OM	chg	conf	hlp	prb	scd	avlm	capm	cont	cstm
MEAN PROCESS LEVEL		**1.0**	**1.0**	**1.0**	**1.4**	**1.0**	**1.4**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.2**	**1.0**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**
MEAN OVERALL LEVEL		**1.1**																	
s.d.		**0.1**																	

KEY:

Qualification of attributes		**Management Level**	**Service Support Processes**		**Service Delivery Processes**
0	Missing	SM Strategic Mgt.	chg	Change Management	avlm	Availability Management
1	LOW	TM Tactical Mgt.	conf	Configuration Management	capm	Capacity Management
2	MEDIUM	OM Operational Mgt.	hlp	Helpdesk	cont	Contingency Planning
3	HIGH		prb	Problem Management	cstm	Cost Management
			scd	Softw are Control and Distrib	slm	Service Level Managem
Weighting, WT.: W1… Wn, 1<= Wi<=3					x	Non-improvement paran

List of authors

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Summary (In Dutch)

Samenvatting

Introductie

Gedurende de laatste 10-15 jaar is Kenia, net als een groot deel van de andere ontwikkelingslanden, getuige geweest van een snelle toename in de verspreiding van computertechnologie die is gericht op het vergroten van organisatieprestaties. Tot nu toe werd in veel organisaties de meeste nadruk gelegd op technische zaken die met computers te maken hebben en werd erg weinig aandacht besteed aan managementvraagstukken en dit heeft noodzakelijkerwijs geleid tot een aantal nieuwe problemen - hoe men de nieuwe technologie het meest effectief en efficiënt kan beheren, beheersen en onderhouden. Deze nieuwe problemen hebben veel organisaties, bestuursfunctionarissen en academici gedwongen om met een hernieuwde blik nauwkeurig naar de vraagstukken rond deze nieuwe technologie te kijken, met als doel nieuwe manieren en benaderingen te vinden om deze het hoofd te bieden. Dit onderzoek komt voort uit een academische belangstelling naar, en de noodzaak om zowel algemene als specifieke oplossingen te vinden voor, de speciale problemen die ontstonden toen de technologie was verworven in openbare universiteiten in Kenia.

In deze samenvatting worden de belangrijkste onderdelen van het proefschrift gepresenteerd in de volgorde waarin ze werden geschreven. We beginnen met het onderzoeksgebied en de methodologie die werd gevolgd, waaronder het onderzoeksprobleem, de onderzoeksvraag en de doelen van het onderzoek. De ontwikkeling van een model ter ondersteuning van de probleemoplossing en de toepassing en verificatie ervan in een aantal casestudy's.

Onderzoeksgebied en -vraagstuk

Dit onderzoek richt zich op het beheer van ICT in openbare universiteiten in Kenia. Openbare universiteiten spelen een zeer belangrijke rol in de overdracht van technologie van de ontwikkelde landen naar de ontwikkelingslanden en de conclusies van dit onderzoek moeten wel een grote invloed hebben op velerlei organisaties waar de producten van deze openbare universiteiten, namelijk de afgestudeerden, uiteindelijk zullen worden ingezet. Daarnaast heeft het grote publiek en andere belanghebbenden inherent belang bij wat zich afspeelt op de universiteiten en verwachten zij van de universiteiten dat ze voorop lopen bij vernieuwing zoals bij de introductie en het wijdverbreide gebruik van computertechnologie, die een verregaand effect hebben op de levens van veel mensen in ontwikkelingslanden. Met dit doel bestudeert dit onderzoek de problemen die gerelateerd zijn aan ICT. De probleemruimte van het onderzoek wordt daarom als volgt omschreven:

> *Het gebruik van informatie- en communicatietechnologie in openbare universiteiten in Kenia neemt snel toe. De modellen gebruikt in, de leeftijd en andere eigenschappen van diverse ICT middelen verworven over de periode gedurende het begin van de jaren tachtig tot nu verschillen en dit vergroot de complexiteit van het beheren van middelen in de dynamische ICT-wereld en de mondiale economie. Het gebrek aan een nauw verband tussen de processen, ICT, en het ICT beheer maakt de uitdaging over het algemeen groter.*

Uit de probleemruimte komt een specifieke onderzoeksvraag voort, waar men zich in moet verdiepen om de oplossing voor het probleem te vinden. Daarom werd de volgende onderzoeksvraag geformuleerd om het probleem aan te pakken:

Hoe een model van ICT-gerelateerde vraagstukken te ontwikkelen dat een openbare universiteit in Kenia in staat kan stellen om:

(a) haar huidige ICT-gerelateerde vraagstukken weer te geven?
(b) haar huidige ICT-gerelateerde vraagstukken te kwalificeren?
(c) haar nieuwe en verbeterde ICT situatie te definiëren?
(d) haar huidige ICT situatie in een nieuwe en verbeterde situatie te doen veranderen?

Doel van het onderzoek

Expliciet en ook impliciet verschaft de onderzoeksvraag de basis waarop de specifieke onderzoeksdoelen kunnen worden geformuleerd, dus

- het model *ontwikkelen*, en
- het *toepassen* teneinde de geïdentificeerde problemen op te lossen.

Het eerste onderzoeksdoel, het ontwikkelen van een model, verschaft het middel dat nodig is voor het oplossen van het gestelde probleem. Het tweede onderzoeksdoel, het model toepassen op hedendaagse situaties, is nodig om het model te valideren, zodat het algemene toepassing van het model in zulke situaties aanvaardbaar is. Om de toepassing van het model te vergemakkelijken is er een automatische *tool* ontwikkeld en toegepast.

Naast de specifieke doelstellingen is het ook nodig om enkele meer algemene doelen van het model vast te leggen. Deze algemene doelen zijn:

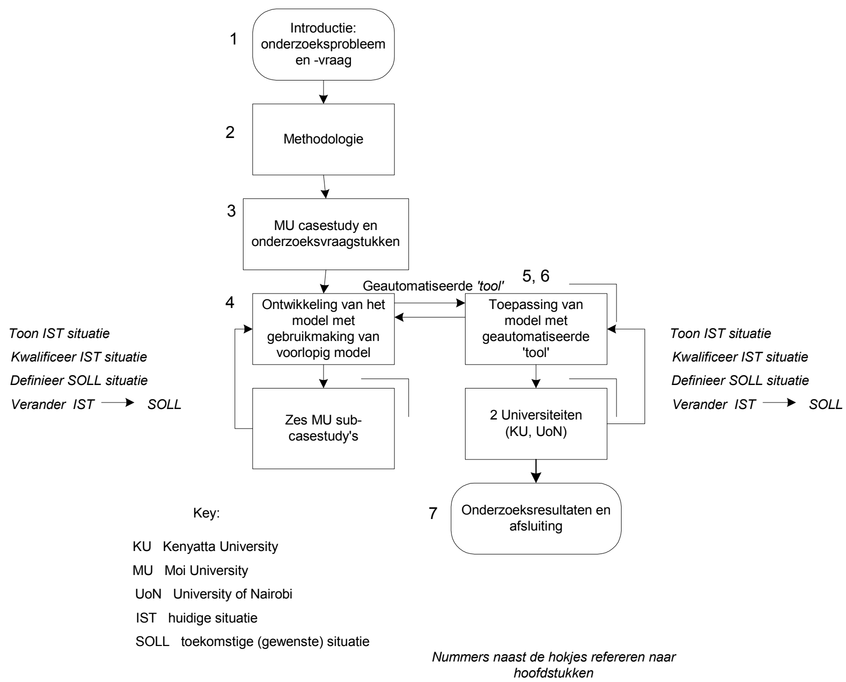
- De vele belanghebbenden van de openbare universiteiten, waaronder de staf, studenten, personen van buiten zoals donors en klanten bewust maken van ICT-gerelateerde vraagstukken;
- Een praktisch middel verschaffen dat openbare universiteiten kunnen gebruiken voor het beoordelen en beheren van ICT en aanverwante zaken;
- Als communicatiemiddel dienen tussen de belanghebbenden en een uitgangspunt vormen voor verder onderzoek naar ICT in de Afrikaanse landen onder de Sahara.

Onderzoeksmethodologie en - strategie

De methodologie die werd gebruikt voor dit onderzoek is het casestudyonderzoek. Drie casestudy's werden gekozen: de eerste vond plaats op de plaats waar het vooronderzoek werd uitgevoerd en het model werd ontwikkeld, aan de Moi University, en de tweede en derde casestudy waar het model werd toegepast, dat wil zeggen, aan de Kenyatta University en de University of Nairobi. In overeenstemming met de casestudymethode werd een aantal instrumenten gebruikt om tijdens de casestudy's data te verzamelen, waaronder vragenlijsten, interviews, observatie, en het bestuderen van documentatie. De onderzoeksstrategie, getoond in figuur S-1, werd ontwikkeld en verschafte de route gevolgd bij de uitvoering van het onderzoek.

In het vooronderzoek uitgevoerd aan de Moi University werden data die onder andere nodig waren voor de ontwikkeling van het model verzameld uit een aantal bronnen met gebruikmaking van een aantal verschillende technieken. Er werden onder andere verschillende technieken gebruikt om de verzamelde data door middel van triangulatie te controleren, d.w.z., de data werden via andere kanalen gecontroleerd, en daardoor werd de nauwkeurigheid en betrouwbaarheid bepaald. Dit is in overeenstemming met de gekozen casestudymethode.

Omdat er in Kenia weinig of geen onderzoek op dit gebied was verricht, was het nodig om gebruikers te vragen wat voor informatiesystemen ze hadden en wat voor informatiesystemen ze nodig hadden. Vragenlijsten werden ontworpen en voorgelegd aan speciaal uitgekozen gebruikers in het bestuur van de universiteit die waren verdeeld over drie campussen. De belangrijkste bestuursfunctionarissen van de universiteit werden ook ondervraagd om zo hun mening over ICT te bepalen en om vast te stellen hoeveel steun zij zouden geven. Documenten gerelateerd aan de ontwikkeling van ICT werden bestudeerd. Tijdens de ontwikkeling van het model werden zes sub-casestudy's gekozen en met gebruikmaking van de taken die in het model zijn gedefinieerd, werden de ICT-gerelateerde vraagstukken beschreven.



FIGUUR S-1: DE METHODOLOGIE

Moi Universiteit

Eén van de openbare universiteiten in Kenia, Moi University, werd bestudeerd om inzicht te krijgen in de aard van de vraagstukken gerelateerd aan het beheer van ICT in openbare universiteiten. In aanmerking nemend dat het soort beheer altijd afhangt van de omstandigheden bestudeerden we een aantal specifieke factoren die te maken hebben met de omstandigheden binnen en rond de universiteit, waaronder historische perspectieven, geografische locatie, omvang en soort organisatie, cultuur, macht en besluitvorming. Een methode die omstandigheidfactoren in verband brengt met de complexiteit en onzekerheid in beheer dat tot risico's leidt, werd overgenomen. Daarnaast werden ook algemene omstandigheidfactoren onderzocht.

Een vooronderzoek werd ontworpen en uitgevoerd, waarbij voornamelijk de bestuursfunctionarissen van de universiteit werden ondervraagd. De data afkomstig van de ondervraagden, zowel kwalitatieve als kwantitatieve data, werden in categorieën ondergebracht en geanalyseerd, en de resultaten gaven gedeeltelijk aan dat gebruikers zich steeds meer bewust werden van hun behoeften op het gebied van ICT, ondanks de nieuwheid van de technologie. Het werd duidelijk dat op basis van de richtlijnen voor het soort informatie dat werd gevraagd die werden gegeven in de vragenlijsten en de interview vragen, de gebruikers een duidelijk beeld hadden van het soort ICT dat ze gebruikten in vergelijking tot het soort ICT dat ze dachten nodig te hebben. In alle gevallen beoordeelden de gebruikers de informatiesystemen als slecht volgens het kwalificatieschema dat ontworpen was voor dit doel. Genoemd bij de redenen die volgens de gebruikers ten grondslag lagen aan deze lage beoordelingen waren:

- slechte acceptatie van ICT
- geen toegang tot ICT faciliteiten
- ICT niet beschikbaar
- ICT niet flexibel
- gebruikers ontevreden over de nieuwe technologie
- gebruikers hebben geen controle over hun werk
- slecht gebruik voornamelijk door een gebrek aan effectieve en efficiënte ICT middelen
- gebrek aan effectief ICT onderhoud
- slechte faciliteiten om zowel in de interne als externe communicatiebehoeften te voorzien
- slecht onderhoud omdat ICT niet aangepast kan worden of slecht aangepast wordt
- gebrek aan mogelijkheden om te worden opgeleid voor de ICT
- gebrek aan betrouwbare en duurzame ICT
- slechte exploitatie van ICT

De resultaten van dit onderzoek impliceren dat de betrokken overheden moeite zouden moeten doen om de vraagstukken gerelateerd aan ICT beheer te identificeren, zodat een basis kan worden gelegd voor het oplossen van de problemen waarmee de gebruikers zich geconfronteerd zien. Het vooronderzoek leidde tot twee belangrijke conclusies:

- Er was behoefte aan een model met behulp waarvan de geïdentificeerde problemen konden worden aangepakt
- Het model zou moeten worden toegepast op openbare universiteiten in Kenia.

Ontwikkeling van het model

Het vooronderzoek uitgevoerd aan de Moi University bracht een aantal onderzoeksvraagstukken aan de oppervlakte en gaf voldoende reden voor verder onderzoek. Deze vraagstukken vormden een onderdeel van het schema van vraagstukken dat later werd opgenomen in de ontwikkeling van het model. Om een model te maken dat geschikt was voor het soort omstandigheden aangetroffen in Keniaanse openbare universiteiten was het nodig om de taken die het model zou uitvoeren te benoemen, met in gedachten dat het algemene doel van het model was het ondersteunen en verbeteren van het beheer van de informatie- en communicatietechnologie. Voor dit doel werden vier taken gespecificeerd:

- de huidige situatie (IST) *weergeven*
- de huidige situatie (IST) *kwalificeren*

- de toekomstige situatie (SOLL) *definiëren*
- de huidige situatie (IST) *veranderen in* de toekomstige situatie (SOLL).

Voor de verdere ontwikkeling van het model werd gebruik gemaakt van zes sub-casestudy's, die werden gekozen uit de Moi University om de gevarieerde aard en de uiteenlopende onderdelen van een openbare universiteit weer te geven. De sub-casestudy's werden gekozen om het voorlopige model stap voor stap toe te passen en te testen. Tijdens dit proces werden extra kwesties in overweging genomen en wanneer van toepassing toegevoegd aan het model. Als extra middel voor het beschrijven en kwalificeren van de vraagstukken in het schema werd een geautomatiseerde *tool* ontworpen en ontwikkeld in de object-georiënteerde taal C++.

Toepassing van het model

Om het model buiten Moi University ook te valideren werden twee casestudy's gekozen. De eerste casestudy was van de Kenyatta University en de tweede van de University of Nairobi. Beide bevinden zich in, of in de buurt van, de hoofdstad Nairobi. De eerste casestudy, die van de Kenyatta University, bevatte twee sub-casestudy's terwijl de tweede casestudy, die van de University of Nairobi, drie sub-casestudy's bevatte.

Kenyatta University

De sub-casestudy's betroffen de IT Office en de African Virtual University.

IT Office

Het IT Office is verantwoordelijk voor het beheer en onderhoud van ICT in de gehele universiteit; dit dekt zowel de wetenschappelijke als de administratieve tak. Bij de wetenschappelijke tak heeft het IT Office de verantwoordelijkheid voor het beheer van 13 computerruimtes die zowel door de studenten als de staf worden gebruikt, terwijl bij de administratieve tak het IT Office verantwoordelijk is voor alle universiteitscomputers die in de verschillende kantoren op de campus staan. De manier waarop het model werd toegepast bij het IT Office bracht het gebruik van dataverzamelingsinstrumenten met zich mee zoals interviews, observatie en het bestuderen van de beschikbare documenten.

African Virtual University

De tweede sub-casestudy uitgevoerd aan de Kenyatta University was van de African Virtual University, AVU. De AVU werd opgestart door de Wereldbank als onderdeel van een project waarin de kracht van de moderne informatie- en communicatie technologie zou worden gebruikt om in heel Afrika de toegang tot de middelen beschikbaar over de hele wereld drastisch te verbeteren.

Voor dit doel werden 26 leerplaatsen opgericht in Afrika waarvan de AVU bij de Kenyatta University er één is; het heeft een moderne directe satellietverbinding en andere faciliteiten die het in staat te stellen lessen te organiseren van wetenschappelijk medewerkers in de ontwikkelde landen voor studenten in Afrika via deze verbindingen.

Deze huidige situatie van de sub-casestudy werd beschreven en gekwalificeerd, haar toekomstige situatie omschreven en activiteiten om de huidige situatie in de toekomstige situatie te veranderen aanbevolen. Het model liet zien dat de faciliteiten redelijk modern waren en redelijk goed beheerd werden. Gebruikers van verschillende achtergronden werden aangetrokken die belangstelling hadden om met computers te leren omgaan, waaronder studenten, staf en mensen van buiten de universiteit. In het algemeen kwam AVU naar voren als één van de plaatsen waar het model erg relevant bleek te zijn omdat het liet zien dat het gebruik ervan het management in staat stelde om de relevante ICT-gerelateerde vraagstukken te identificeren.

The University of Nairobi

De sub-casestudy's betroffen de ruggengraat van het universiteitsnetwerk, de universiteitsbibliotheek, en het 'Joint Admissions Board Information System'.

De Ruggengraat van het Universiteitsnetwerk

De Ruggengraat van het Universiteitsnetwerk is een eenheid in het Instituut van Computerwetenschap dat zich richt op het verzorgen van netwerkservices aan de gehele universiteit. Voor dit doel heeft het instituut op twee van haar campussen, de Hoofdcampus en de Chiromo-campus, met succes een netwerk opgezet dat toegang biedt tot Internetservices. Door de eerste taak van het model toe te passen was het mogelijk ICT- en netwerk-gerelateerde data te verzamelen. Bij het onderdeel 'het echte systeem' gaat het onder andere om data over de gebruikerseisen ten aanzien van netwerkdiensten en middelen, de eerste vereisten en de mate waarin deze beschreven zijn, en de omgevingsomstandigheden waaronder de universiteit opereerde. Bij het onderdeel 'ICT en netwerk' vonden we data over verschillende soorten hardware en software om voor de communicatiediensten te zorgen. Voor elke categorie bleek dat de vraagstukken relevant en toepasselijk waren, zoals bij de eerdere casestudy's. De data gaf aan dat er moderne technologie werd gebruikt voor verschillende activiteiten, waaronder onderwijsactiviteiten, wetenschappelijke en administratieve activiteiten.

Informatiesysteem van de Universiteitsbibliotheek

Het informatiesysteem van de universiteitsbibliotheek werd gekozen vanwege de cruciale rol die de bibliotheek speelt bij het verstrekken van informatie benodigd door zowel lezers als onderwijzers. Eén van haar doelen heeft te maken met het bereikbaar maken van een uitgebreide keus aan informatiebronnen d.m.v. informatie- en communicatietechnologie, en het samenwerken met andere diensten om een effectieve ontwikkeling en gebruik van hun bronnen veilig te stellen.

In de hoofdbibliotheek is een internetcafé opgezet om de gebruikers toegang te geven tot het Internet en het WWW. De bibliotheekdiensten zijn niet geautomatiseerd en dit is een nadeel bij het gebruik van ICT. De vergelijking tussen de automatisering van de bibliotheek van de MOI University en het handmatige systeem dat nog steeds door de Universiteit van Nairobi wordt gebruikt was er een goed voorbeeld van dat iedere openbare universiteit verschillende prioriteiten heeft en een verschillende aanpak voor het gebruik van ICT.

Joint Admissions Board Informationsystem

Het systeem van de Joint Admissions Board is een informatiesysteem dat door openbare universiteiten wordt gebruikt om eerstejaarsstudenten voor verschillende opleidingen te kiezen. Het systeem is in eigendom van en wordt onderhouden door de University of Nairobi. Het ontvangt data van scholen, de landelijke examenraad van Kenia en de joint Admissions Board die regelmatig bijeenkomt om ieder jaar het aantal studenten te bepalen dat in aanmerking komt om aan openbare universiteiten te studeren. De gegevens worden verwerkt en de uitkomsten worden gegeven aan de vakgroepen van openbare universiteiten waar plaatsen worden aangeboden, de scholen waar de kandidaten van afkomstig zijn en de aanvragers.

Conclusies

De ontwikkeling en toepassing van het model bij drie Keniaanse openbare universiteiten is een onderdeel van een nieuw onderzoeksinitiatief op het nieuwe onderzoeksgebied van ICT management in Kenia.

Op basis van dit onderzoek kan een aantal observaties worden gedaan en conclusies worden getrokken betreffende de ontwikkeling, het gebruik, en het beheer van ICT in Keniaanse openbare universiteiten, waarbij een rol spelen:

- *informatie- en beleidsplanningsinstrumenten en de toepassing ervan;*
- *de toewijzing van personeel en scholing;*
- *de noodzaak voor financiële steun en steun van het bestuur;*
- *de rol van externe donors.*

About the author

Gregory Wanyembi was born on 22nd June, 1946 in Bungoma, Kenya and attended Teldet School, Chewoyet Secondary, Kenyatta College and University of Nairobi where he obtained B.Sc. degree in mathematics and physics in 1974. He also trained as a teacher at Nairobi University where he obtained a postgraduate diploma in education in 1981 and postgraduate diploma in computer science at the University of Dundee, Scotland in 1989.

He taught mathematics and physics at Friends' School, Kamusinga, Moi Girls' High School, and The Mombasa Polytechnic prior to joining the faculty at Moi University in 1992 to teach computer science. His research interests include impact of ICT in developing countries and management of ICT in organizations with particular reference to institutions of higher learning.

He commenced this research project in February 1997 as part of MHO (Dutch) government sponsored project and cooperation between Moi University Central Services and TU Delft.

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